

Domestic Data Entry Operator

(Job Role)

Qualification Pack: Ref. Id. SSC/Q2212

Sector: Information Technology and Information
Technology enabled Services (IT-ITeS)

Textbook for Class IX



17925

विद्यया ऽ मृतमश्नुते



एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
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FOREWORD

The National Curriculum Framework–2005 (NCF–2005) recommends bringing work and education into the domain of the curricular, infusing it in all areas of learning while giving it an identity of its own at relevant stages. It explains that work transforms knowledge into experience and generates important personal and social values such as self-reliance, creativity and cooperation. Through work one learns to find one's place in the society. It is an educational activity with an inherent potential for inclusion. Therefore, an experience of involvement in productive work in an educational setting will make one appreciate the worth of social life and what is valued and appreciated in society. Work involves interaction with material or other people (mostly both), thus creating a deeper comprehension and increased practical knowledge of natural substances and social relationships.

Through work and education, school knowledge can be easily linked to learners' life outside the school. This also makes a departure from the legacy of bookish learning and bridges the gap between the school, home, community and the workplace. The NCF–2005 also emphasises on Vocational Education and Training (VET) for all those children who wish to acquire additional skills and/or seek livelihood through vocational education after either discontinuing or completing their school education. VET is expected to provide a 'preferred and dignified' choice rather than a terminal or 'last-resort' option.

As a follow-up of this, NCERT has attempted to infuse work across the subject areas and also contributed in the development of the National Skill Qualification Framework (NSQF) for the country, which was notified on 27 December 2013. It is a quality assurance framework that organises all qualifications according to levels of knowledge, skills and attitude. These levels, graded from one to ten, are defined in terms of learning outcomes, which

the learner must possess regardless of whether they are obtained through formal, non-formal or informal learning. The NSQF sets common principles and guidelines for a nationally recognised qualification system covering Schools, Vocational Education and Training Institutions, Technical Education Institutions, Colleges and Universities.

It is under this backdrop that Pandit Sunderlal Sharma Central Institute of Vocational Education (PSSCIVE), Bhopal, a constituent of NCERT has developed learning outcomes based modular curricula for the vocational subjects from Classes IX to XII. This has been developed under the Centrally Sponsored Scheme of Vocationalisation of Secondary and Higher Secondary Education of the Ministry of Human Resource Development.

This textbook has been developed as per the learning outcomes based curriculum, keeping in view the National Occupational Standards (NOS) for the job role and to promote experiential learning related to the vocation. This will enable the students to acquire necessary skills, knowledge and attitude.

I acknowledge the contribution of the development team, reviewers and all the institutions and organisations, which have supported in the development of this textbook.

NCERT would welcome suggestions from students, teachers and parents, which would help us to further improve the quality of the material in subsequent editions.

New Delhi
June 2018

HRUSHIKESH SENAPATY
Director
National Council of Educational
Research and Training

ABOUT THE TEXTBOOK

The IT-ITeS sector is growing at a fast pace and is a very important industry in India and abroad. In the growing business opportunities in various domains around the globe, there is a huge transfer of information from one place to another. Large amount of data are churned thus creating a need for proper management of the data that are collected. The companies also have to concentrate on their core activities and resort to outsourcing the data entry process. The rapid growth in the IT industry along with the entry of many small and large outsourcing companies in this area, has led to a huge demand for trained personnel for various job roles, such as Data Entry Operator.

Domestic Data Entry Operators in the IT-ITeS Industry are also known as a Data Entry Operators. These individuals are responsible for providing daily work reports and work on hourly basis. They are also responsible for electronic entry of data from the client site on to the office site or vice-versa. Individual tasks vary depending on the size and structure of the organisation. This job requires the individual to have thorough knowledge of various technology trends and processes as well as have updated knowledge about database management systems and IT initiatives. The individual should know fast and accurate typing or data encoding. This job involves working on a computer, and appropriate software to enter accurate data regarding different issues like retrieving data from a computer or to a computer.

The textbook for the job role of “Domestic Data Entry Operator” has been developed to impart knowledge and skills through hands-on learning experience, which forms a part of the experiential learning. Experiential learning focuses on the learning process for the individual. Therefore, the learning activities are student-centered rather than teacher-centered.

The textbook has been developed with the contribution of the expertise from the subject and industry experts and academicians

for making it a useful and inspiring teaching-learning resource material for the vocational students. Adequate care has been taken to align the content of the textbook with the National Occupational Standards (NOSs) for the job role so that the students acquire necessary knowledge and skills as per the performance criteria mentioned in the respective NOSs of the Qualification Pack (QP). The textbook has been reviewed by experts so as to make sure that the content is not only aligned with the NOSs, but is also of high quality. The NOSs for the job role of Domestic Data Entry Operator covered through this textbook are as follows:

1. SSC/N3022 – Undertaking data entry services
2. SSC/N9001 – Managing work to meet requirements
3. SSC/N9003 – Maintaining a healthy, safe and secure working environment

Unit 1 of the textbook explains the various career opportunities within the IT-ITeS sector. It then details the various IT enabled services. Maintaining the work area as well as the health and safety aspects within the IT service sector are also covered in the first unit. Unit 2 will help students to learn typing skills using a typing tutor. It also covers the ergonomics and sitting posture, to put the student on a firm footing in terms of health aspects associated with computer systems. Unit 3 deals with basic Word Processing skills so that students can learn to enter and edit the text to prepare the document. Unit 4 deals with basic spreadsheet skills to prepare a worksheet so that students can learn to create and manipulate the data in the spreadsheet. Unit 5 covers the basic presentation skills to prepare a slide presentation so that students can learn to create presentations.

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The Council expresses its gratitude towards Rajesh Khambayat, *Joint Director*, PSS Central Institute of Vocational Education (PSSCIVE), Bhopal, for providing support and guidance in the development of this textbook. We are thankful to the course coordinator Dipak D. Shudhalwar, *Associate Professor* (CSE) and *Head*, Department of Engineering and Technology, PSSCIVE, NCERT, Bhopal, for his untiring efforts towards solely developing the content for this textbook and also providing software related photographs used in the textbook. The images used other than these are under Creative Commons License. Ganesh Kumar Dixit and Jayant Mishra, *Consultants* in IT-ITeS, Department of Engineering and Technology, PSSCIVE, Bhopal, are also duly acknowledged for their untiring efforts and contribution in the development of this textbook for vocational skills.

The Council is grateful to Saroj Yadav, *Professor and Dean (A)*, NCERT, and Ranjana Arora, *Professor and Head*, Department of Curriculum Studies, and Mamur Ali, *Assistant Professor*, CIET, NCERT, New Delhi, for carefully evaluating and giving suggestions for the improvement of this book and its finalisation. The Council acknowledges the copy editing and valuable contribution of Shilpa Mohan, *Assistant Editor* (Contractual) and Sanjeev Kumar, *Copy Holder* in shaping this book. The efforts of Pawan Kumar Barriar, *DTP Operator*, and Haridarshan Lodhi, *DTP Operator* (Contractual), Publication Division, NCERT, for flawless layout design are also acknowledged.

The Council is grateful to the Ministry of Human Resource Development for the financial support and cooperation in realising the objective of providing a quality textbook for the Indian vocational students.



Nirmalya Chakraborty, College of Art, New Delhi

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Do You Know

According to the 86th Constitutional Amendment Act, 2002, free and compulsory education for all children in 6-14 year age group is now a Fundamental Right under Article 21-A of the Constitution.

**EDUCATION IS NEITHER A
PRIVILEGE NOR FAVOUR BUT A
BASIC HUMAN RIGHT TO
WHICH ALL GIRLS AND WOMEN
ARE ENTITLED**

*Give Girls
Their Chance !*





Introduction to IT-ITeS Industry

INTRODUCTION

Information and Communication Technology (ICT) has become one of the basic requirements of the modern society. In today's digital era, we use mobile devices to perform the tasks of our daily life. It is difficult to think of any event without the use of digital devices. Information Technology (IT) is one of the world's fastest growing economic activities, which envisages easier flow of information at various levels in the desired pattern. The Information Technology enabled Services (ITeS) sector has not only changed the way the world looks at our country but has also made significant contributions to the Indian economy. This session will introduce the basic concepts and ideas related to Information Technology (IT) and IT enabled Services (ITeS).



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Information Technology

Information Technology (IT) means creating, managing, storing and exchanging information. IT includes all types of technology used to deal with information, such as computer hardware and software technology

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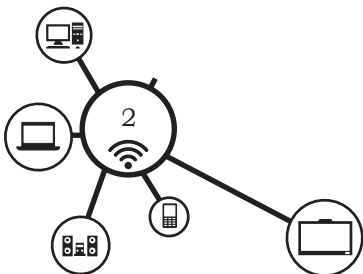
used for creating, storing, and transferring information. Computer takes data as input, processes it and produces the results as output. The information is the result of data processing. Data refers to the facts or raw material, which are processed to get the information. Number of boys and girls in a class is a factual data of the classroom. This is an example of data related to the students in the class. Some conclusion can be drawn based on the data. This conclusion is information. The decisions are taken on the basis of data and information.

IT is a tightly integrated part of business. Computers and information systems are an essential part of every business today. Like accounting and legal, every business needs to invest in technology to compete. IT has several benefits for a business, such as it helps in reaching more potential customers, developing a business relationship with potential customers, streamlining operations, reducing costs, improving efficiency, maximising profit, minimising waste, providing better service to customers, supporting better relationships with key partners, and allowing customers to better guide the business.

Information Technology enabled Services (ITeS)

Information Technology that enables the business by improving the quality of service is Information Technology enabled Services (ITeS). ITeS is also called web-enabled services or remote services that cover the entire operations which exploit Information Technology for improving the efficiency of an organisation. These services provide a wide range of career options that include opportunities in all offices like call centres, payrolls, logistics management, revenue claims processing, medical billing, coding, medical transcription, legal databases, back office operations, content development, GIS (geographical information system), web services and Human Resource (HR) services, etc.

ITeS is defined as outsourcing of processes that can be enabled with information technology and covers diverse areas like finance, HR, administration, health care, telecommunication, manufacturing, etc.



E-enabled services radically reduce costs and improve service standards. In short, Internet service provider aims to provide B2B e-commerce solutions. ITeS offers different services integrated in a single delivery mechanism to end users. The services may include: Medical Transcription, Customer Relationship Management, Data Entry and Data Processing, Software development, Data Warehousing, IT Help Desk Services, Enterprise Resource Planning and Telecommunication Services.

BPO services

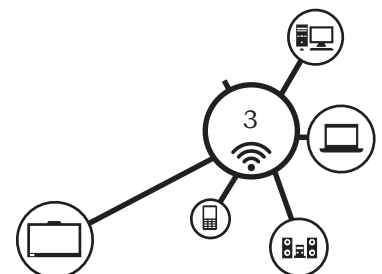
Business Process Outsourcing (BPO) services means performing business operations through an outside service provider. BPO also comes under IT services as IT plays a very useful role in optimising the business performance. The BPO industry is highly organised and hence various kinds of jobs are outsourced in India. India has the expertise in reducing costs with firm control on the quality of the service.

Some of the BPO services are as follows:

- (a) Financial and Accounting Services
- (b) Taxation and Insurance Services
- (c) E-Publishing and Web Promotion
- (d) Legal Services and Content Writing
- (e) Multimedia and Design Services
- (f) Document Management Services
- (g) Software Testing Services
- (h) Health Care Services

BPM industry in India

The IT BPM (Business Process Management) industry has been fueling India's growth. In addition to contributing towards the country's Gross Domestic Product (GDP) and exports, the growth of the IT BPM industry has provided India with a wide range of economic and social benefits which includes creating employment, raising income levels, and promoting exports. It has placed India on the world map with an image of a technologically advanced and knowledge-based economy. This sector attracts amongst the largest investments by venture



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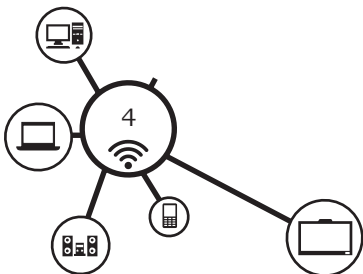
capitalist and has been credited with enabling the entrepreneurial ventures of many in the country. The IT-BPM industry has almost doubled in terms of revenue and contribution to India's GDP over the last decade (2008–18). BPO Service Industry is doing exceptionally well in India because of the following advantages:

- (a) BPO service providers in India invest in hi-tech hardware and software to deliver the best of services. They follow quality checks to ensure error free and exceptional service.
- (b) Government of India is encouraging the BPO Industry in India by providing necessary infrastructure and logistical support.
- (c) BPO Industry in India is highly developed and capable of delivering numerous types of BPO services in exceptional quality.

Structure of the IT-BPM industry

The organisations within the IT-BPM industry are categorised along the following parameters:

- Sector the organisation is serving
 - Type as well as range of offering the organisation provides
 - Geographic spread of operations
 - Revenues and size of operations
- (a) **Multinational Companies (MNCs):** MNCs have their headquarters outside India but operate in multiple locations worldwide including those in India. They cater to external clients (both domestic and/or global).
 - (b) **Indian Service Providers (ISPs):** ISPs started with their operations in India. Most of these organisations have their headquarters in India while having offices in many international locations. While most have a client base, which is global as well as domestic, there are some that have focussed on serving only the Indian clients.
 - (c) **Global In-house Centers (GIC):** GIC organisations cater to the needs of their parent company only and do not serve external clients.



This model allows the organisation the option to keep IT Operations in-house and at the same time take advantage of expanding their global footprint and offering opportunities for innovation in a cost-effective manner.

IT applications

In technologically developed nations, Information Technology has become a part of everyday life. For a user, computer is a tool that provides the desired information, whenever needed. The use of computer and Information Technology can be observed at home, workplace, in the modern service industry and in all aspects of our life. It includes listening to music, watching movies, playing games, doing office work, chatting and sending messages, managing daily planner, reading books, paying utility bills, booking ticket to travel, bank operations, etc. Computers and ICT is used in industries, in offices, and in house also. The various application areas are business, banking, insurance, education, marketing, health care, engineering design, military, communication, animation, research, agriculture and government.



Fig. 1.1: IT applications

IT in home computing

A personal computer (PC) is used to work at home, to do household accounts, play games, surf the web, use

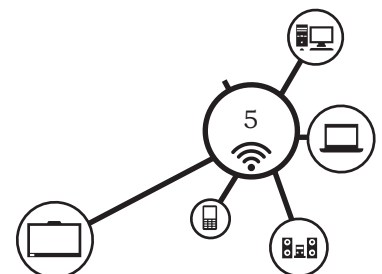




Fig. 1.2: IT in home computing



Fig. 1.3: IT in everyday life



Fig. 1.4: IT in library

e-mail, create music, and pursue a range of other hobbies. PC is also used to play games. It includes action games, role playing games, puzzles and many more. A PC with a CD-ROM drive, sound card, and speakers can play audio CD. A computer can be used from home to study a wide range of online training courses. Computers and digital devices are now used for online shopping and e-commerce.

IT in everyday life

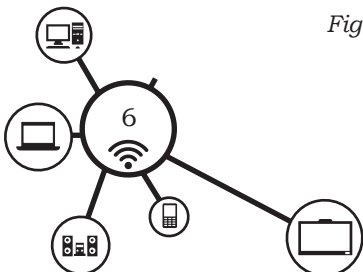
In our daily life, we use washing machines, microwave oven and many other products using which have embedded software. We can store all the information about our important work, appointments schedules and list of contacts in a computer. Computer is, therefore, playing a very important role in our lives and now we cannot imagine the world without computers.

IT in library

Nowadays many libraries are computerised. Each book has a barcode associated with it. This makes it easier for the library to keep track of books and the availability of a specific book. Computer software is used to issue and return the book. Each book in the library has a magnetic strip attached to it that is deactivated before the book can be borrowed.

IT at workplace

In the office environment, computers and computer applications are used to perform office work more effectively.



In assembly-line industries, where attention to detail, speed and efficiency are important, automation is becoming more and more common. Internet and Office applications form the basis of modern business.

IT in education

Computers and Information Technology are extensively used in education for teaching-learning and assessment.

The software and hardware technology is used for creation and transmission of information in various forms including still pictures, audio, video and animation to the learners. The learning becomes easy and accessible through IT. A lot of teaching resources are available for teachers to teach in a better way. Online assessment helps to assess the students without any biasness. The students, teachers and educational administrators and every stakeholder in the education sector has benefitted with the integration of IT in education.

(a) ICT in the classroom

There are many ways in which the ICT is used for education in the classroom, such as

- e-learning classrooms;
- smart-board presentations;
- videos on experiments;
- creation of images and video;
- desktop publishing of magazines, letters and documents;
- educational games;
- learning using the CD-ROM media; and
- gathering educational information on the Internet.

(b) Education — anywhere anytime

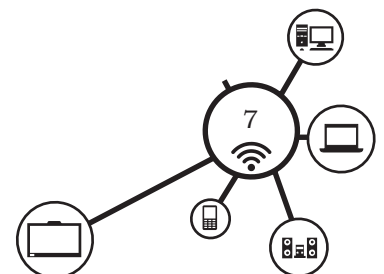
Any student in India can access the NCERT book online through the website www.epathshala.nic.in or mobile app.



Fig. 1.5: IT at workplace



Fig. 1.6: IT in education



Apart from this there are a variety of websites and mobile apps to access educational resources on any topic.

You can also contact a teacher or a trainer via Internet to use WBT (Web-based Training). In this way education has reached the far flung areas by reaching the unreached.

(c) Teaching aids and media

ICT is used mostly as a teaching aid in schools to

- use pictures, animations and audio-visuals to explain subjects that are difficult to explain.
- make the lessons interesting using presentations.
- organise lessons using the computer.
- obtain the information relevant to the subjects.

(d) Learning Management System (LMS)

A Learning Management System (LMS) is being used by many countries to manage school systems. A student or teacher can register himself/herself on the official website to access LMS and can get many services from LMS. The student can be benefited by using LMS, as it can be used to

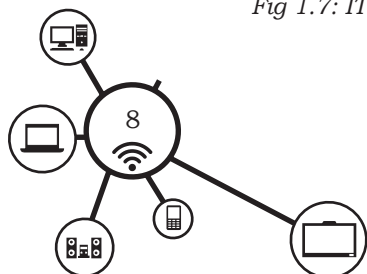
- learn lessons anytime and anywhere.
- submit queries, getting replies and submit comments through forums.
- participate in the co-curricular activities via video.
- monitor the progress of their children (by parents).



Fig 1.7: IT in entertainment

IT in entertainment

Information Technology has had a major impact on the entertainment industry. Internet is a major source of entertainment. One can download and view movies, play games, chat, use multimedia, incorporate visual and sound effects using computers, etc. Digital broadcasting has changed the way we experience television, with more interactive programming and participation.



IT in communication

Communication is used to convey messages and ideas, pictures, or speeches. A person who receives this must understand clearly and correctly. Modern communication makes use of the computer system. We use computers for email, chatting, FTP, telnet and video conferencing.



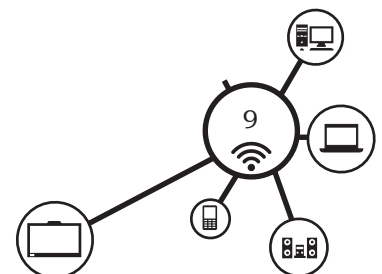
Fig. 1.8: IT in Communication

IT in business

Computers are used in business organisations for payroll calculation, budgeting, sales analysis, financial forecasting, managing and maintaining stocks. A lot of business transactions happen through Internet called e-commerce. IT facilitates marketing, customer visit, product browsing, shopping basket checkout, tax and shopping, receipt and process order. E-commerce offers services pertaining to processing inventory management, transactions, documentation, presentations, and gathering product information. Smart cards, such as credit cards and debit cards are used in shops. These cards have a metallic strip on which the user's Personal Identification Number (PIN), and account number is stored and can be read when it is passed through a special reader. Airlines use large-scale computer applications for their reservations system, both in the airports and in central reservations call-centers. Other businesses that have large-scale computing requirements are insurance claims systems and online banking, which both have large numbers of users and operators interacting across one system.

IT in science and engineering

Scientists and engineers use computers for performing complex scientific calculations, Computer Aided Design (CAD) or Computer Aided Manufacturing (CAM) applications are used for drawing, designing and for simulating and testing the designs. Computers are used for storing large amount of data, performing complex calculations and for visualising



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3-dimensional objects. Complex scientific applications like rocket launching, space exploration, etc., are not possible without the computers.

IT in banking

Computer is an essential part of the modern banking system. Every activity of a bank is now online. The customer's data and transactions are recorded by computers. Recurring deposits (e-RD), Fixed deposits (e-FD), money transfer from one account to another (NEFT, RTGS), online transactions are done using Internet. Capital market transactions, financial analysis and related services are available in online platforms. Bank customers use Automated Teller Machines (ATM) for cash deposits and withdrawal, or to view current balance.

IT in insurance

Insurance companies keep all records up to date with the help of computer database. Procedures for continuation of policies, starting date, date of next installment, maturity date, interest dues, survival benefits, and bonus are declared by using computers in insurance companies. Many online policies are also available which can be purchased by using the website of insurance companies.

IT in marketing

In marketing, computers are used for advertising of products, by using arts and graphics facility it is possible to create interesting advertisements of various products so that the goal of selling can be achieved. Using e-commerce websites, people can purchase items even sitting at home.

IT in health care

ICT is used in the health sector in numerous ways. Hospital Management System is used to maintain and manage patients' records as well as various activities pertaining to hospital administration. The computerised

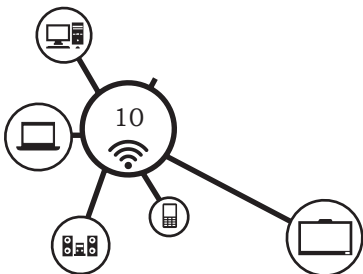




Fig. 1.9 (a) MRI machine

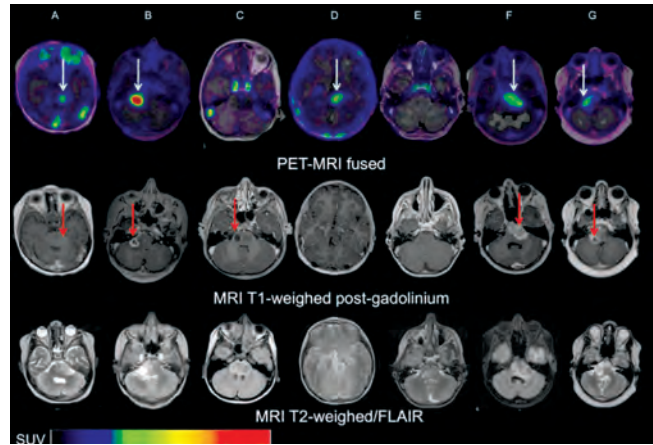


Fig. 1.9 (b) Detailed images

machines are used for ECG, EEG, Ultrasound and CT Scan. The variety of measuring instruments and surgical equipment are used to monitor patients' conditions during complex surgery. Expert system is used for diagnosis. Health care manufacturing companies use computers to aid the production of diagnostic tools and instruments. Computers are an integral part of laboratories and dispensaries. They are used in scanning and diagnosing different diseases.

(a) Use of ICT in diagnosis

With the advancements in computer hardware and software technology, various high-tech machines are used in the diagnosis and treatment of critical diseases. Using expert system, diseases can be diagnosed at the early stages and the patients can be given treatment accordingly. Some of these machines are:

- (i) **Computerised Axial Tomography Machine (CAT):** Using this machine three-dimensional (3D) images of different parts of the body can be made. These images are helpful in the diagnosis of diseases.
- (ii) **MRI (Magnetic Resonance Imaging Machine):** MRI machines are used to give the digital impression of internal organs of the body by using strong magnetic fields and radio waves. The digital images are very helpful in the detection and in deciding the treatment of diseases.

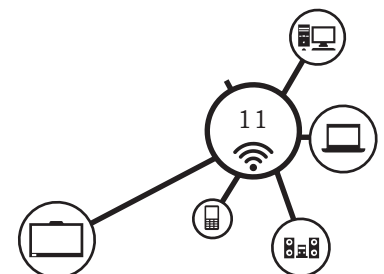




Fig. 1.10 (a) ECG Machine

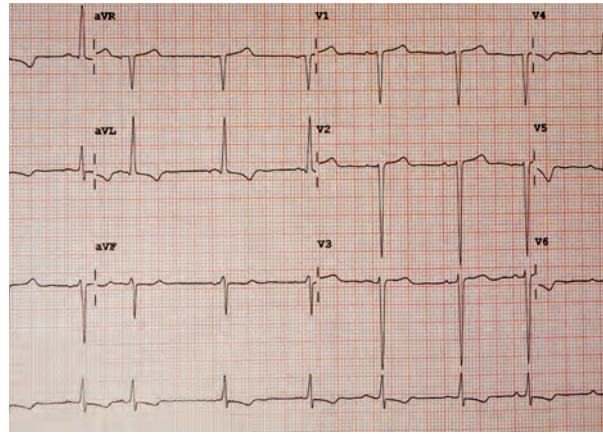


Fig. 1.10 (b) ECG Graph



Fig. 1.11: Cardiac Screening Machine and Display



Fig. 1.12: EEG Machine and Display



Fig. 1.13: Sugar Testing Machine

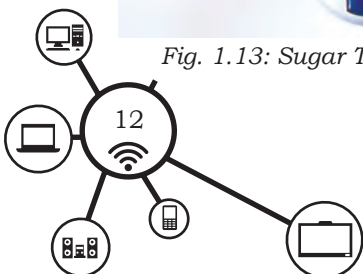
(iii) **Electrocardiogram (ECG) Machine:** The ECG machine is used to monitor the heartbeat. When the heart pumps blood to different parts of the body some electrical impulses are produced. This machine records the electrical impulses and shows it in the form of a graph.

(iv) **Cardiac Screening Machine:** This machine displays the physiology of the heart and it displays the movements inside the heart. Through this machine it is possible to diagnose problems of the heart, such as thinning of veins and then recommend treatment.

(v) **EEG (Electro-encephalography) Machine:** This machine is used to record the activities of the brain. The small electrical probes attached to the head receive the electrical impulses of the brain and display them on a computer screen. This device can retrieve the data in both states where a patient is awake or asleep.

(vi) **Blood Sugar Testing Machine:** This device analyses a sample of blood and determines the blood glucose level.

(vii) **Blood Pressure Measuring Machine:** This device which is worn as a wrist band can measure the blood pressure of a person at



rest or when he/she is involved in some physical activity.

IT in the government and public service

The government uses large-scale computer applications in its daily operations and is actively encouraging e-governance practices. Digital India and e-governance initiative of Government of India are best examples of this. Government and Non-Governmental Organisations (NGOs) as well as International Government Agencies use ICT applications to communicate and provide various services to the people and is called as e-governance. There are various official web portals of the Government of India for e-governance. There are various advantages of e-governance.

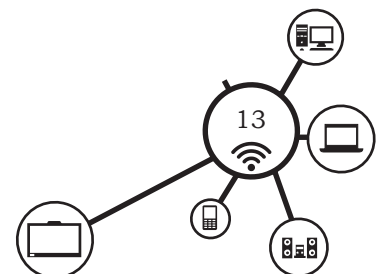
The Income tax department, sales tax department, preparations of voters list, preparation of PAN card makes use of the computer system. Many government services are available online. Electricity bills can now be paid online. The government uses electronic voting for elections, by replacing the traditional voting slip and ballot box. People can enroll themselves in the electoral roll through the State Election Commission portal. Computers are common-place in modern society, and tend to make previously laborious manual tasks of data entry much simpler and quicker.



Fig. 1.14: Measuring Blood Pressure

Practical Exercise

1. Explore the impact of IT and ITeS in various areas in day-to-day life.
2. Visit Indian government websites, such as the official web portal of Department of School Education, MHRD, Government of India. Make a list of all the valuable information and the services you could obtain yourself.
3. Make a list of e-government services that are provided by other countries.
4. Visit the various websites and list the areas where ICT is used.
5. Identify the advantages of using ICT over conventional methods in various areas.
6. Observe other instances where ICT is used in business and manufacturing and compile a list.

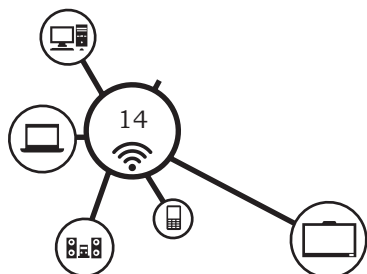


A. Give an example of the use of IT in the following areas. Avoid already discussed examples.

Teacher Practice	Example
Classroom content transaction	
Assessment of students	
Library management	
Student record management	

B. Short answer questions (50 words)

1. What do you understand by the term IT and ITeS?
2. What are the pros and cons of using ICT?
3. What precautions are required to ensure that ICT use is safe?
4. What are the four main sub-sectors in the IT-BPM industry?
5. Give examples of use of IT in everyday life.
6. How is IT used in libraries?
7. What are the various processes of education where IT is used?
8. Which software are used in digital communication?
9. For what purpose is IT used in business?
10. Which are the prominent areas where IT is used in science and engineering?
11. List the various uses of IT in a banking system.
12. Which are the different areas of healthcare where IT is used? And how?
13. List any 5 websites of the Indian government which provide IT enabled services to the people.





Data Entry and Keyboarding Skills



INTRODUCTION

In order to enhance operational skills in the use of computers, knowledge of efficient and effective keyboarding skills and typing ergonomics has become inevitable today. With consistent, sincere efforts and controlled environment, we can master keyboarding skills and acquire high speed. Keying data into the computer quickly and accurately, thus, becomes easy.

There are various methods of typewriting. In this unit, we will study about various types of keys, typing ergonomics and positioning of fingers on the keyboard according to touch method of typewriting and use of typing software for learning keyboarding skills.

Keyboarding Skills

Keyboard is the most common text-based input device. Computer keyboards are similar to electronic typewriter keyboards with additional keys. A keyboard generally has more than 100 keys. Each key of a keyboard corresponds to a single symbol. Some symbols require pressing and holding several keys simultaneously or in sequence. It allows entering alphabets, digits and

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symbols into the computer. Simultaneous key press can produce actions or computer commands. The touch method of typewriting is a method of typing without using the sense of sight to find the keys. There is no need to search the key while typing and one has to move only the finger which is needed to strike a key.

A touch typist knows the location on the keyboard through muscle memory. Touch typing typically involves placing the eight fingers in a horizontal row along the middle of the keyboard (the home row). Touch typing can be done with two hands or by using a single hand also.

A touch typist starts by placing his or her fingers on the “start position” in the middle row and knows which finger to move and how much to move it for reaching any required key. It is important to learn placing fingers into the start position blindly as the hands are frequently raised from the keyboard to operate the line feed lever (in the past) or (more recently) the computer mouse.

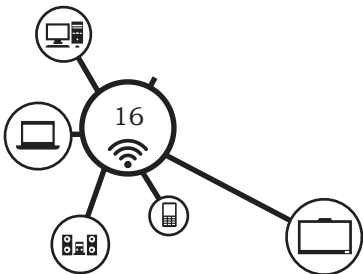
Typing speed generally improves with practice. The typing speed can be increased gradually and speeds of 60 WPM (words per minute) or higher can be achieved. The rate of speed increase varies between individuals. Many websites and software products (e.g., Rapid Typing Tutor) are available to learn touch typing and many of these are free. There are many such software available which are free of cost and are customised to learn typing efficiently and effectively.

Keyboards are also used for computer gaming, either with regular keyboards or by using keyboards with special gaming features.

Types of keys

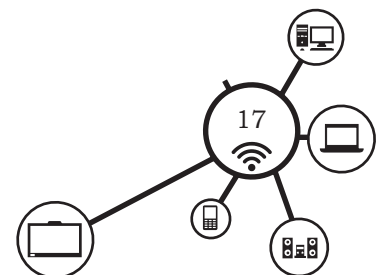
Though there are several input devices viz. mouse, touchscreen, character or voice recognition, etc., used for giving input to the computer, yet the use of keyboard is the most common method adopted for input of data into a computer. A computer keyboard contains the following types of keys:

- **Alphanumeric keys:** All of the alphabet (A-Z) and numbers (0-9) on the keyboard.



- **Punctuation keys:** All of the keys associated with punctuation, such as the comma (,), period (.), semicolon (;), brackets ([]), and parenthesis ({ }) and so on. Also, all of the mathematical operators such as the plus sign (+), minus sign (-), and equal sign (=).
- **Alt key:** Short for Alternate, this key is like a second control key.
- **Arrow keys:** There are four arrow keys to move the cursor (or insertion point) up (↑), down (↓), right (→), or left (←). Arrow keys can be used in conjunction with the
- **Shift or Alt keys:** To move the cursor in more than one position at a time.
- **Backspace key:** Deletes the character just to the left of the cursor (or insertion point) and moves the cursor to that position.
- **Caps Lock key:** It is a toggle key, which when activated, causes all alphabetic characters to be uppercase.
- **Ctrl key:** The control key is used in conjunction with other keys to produce control characters. The meaning of each control character depends on which program is running.
- **Delete key:** The Del key deletes the character at the current cursor position, or the selected object, but does not move the cursor. For graphics-based applications, the delete key deletes the character to the right of the insertion point.
- **Enter key or Return key:** It is used to enter commands or to move the cursor to the beginning of the next line.
- **Esc key:** The Escape key is used to send special codes to devices and to exit (or escape) from programs and tasks.
- **Function keys:** Special keys labelled F1 to F12. These keys have different meaning depending on which program is running.

When a key is pressed, an electrical contact is formed. These electric signals are transmitted to a



micro-controller in a coded form to the computer describing the character which corresponds to that key. Keyboards are used for text-based programs and software. In the modern GUI based operating systems and applications, more sophisticated pointing devices were evolved, such as mouse, joystick, scanner, etc.



Fig. 2.1: Numeric keys

Numeric keypad

Numeric keypad (Figure. 2.1) is used when enormous numeric data is to be entered. This keypad is just like a simple calculator. It is normally located on the right-hand side of computer keyboard. It contains numbers 0 to 9, addition (+), subtraction (-), multiplication (*) and division (/) symbols, a decimal point (.) and Num Lock and Enter keys. Numeric keypad may also work on dual mode. On one mode, it represents numbers and on the other mode, it contains various keys like arrow keys, page up, page down, etc. NumLock is provided to switch between the two modes. Usually, some of the keyboards of laptops do not have a numeric keypad.

Home keys

Alphabets ASDF are home keys for the left hand and; (semi-colon) LKJ for the right hand. The fingers are trained to make the correct movement to other keys and each finger returns immediately to its respective home key after it has depressed the corresponding key in any other row.

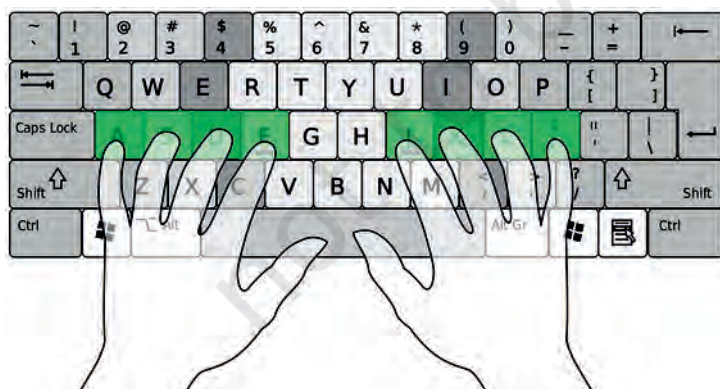
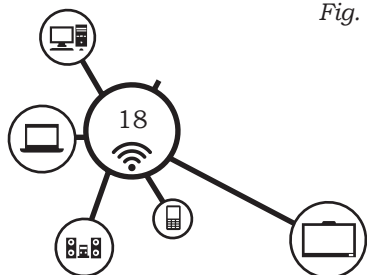


Fig. 2.2: Position on Home Row

Guide keys

On a computer keyboard, keys 'F' and 'J' are called guide keys for left and right hand, respectively. Both contain a small raised tangible mark with the help of which the touch typist can place the fingers correctly on the home keys. Figure 2.2 shows the position of fingers of both hands on the Home Row.



Typing and deleting text

For typing text in a document you should

- click on the letters on the keyboard.

For deleting text in a document you should

- use the backspace key or the delete key. The backspace key will remove text from behind (to the left of) your cursor position.

For typing numbers in a document you should

- use the numbers lock or the numbers on the second row of keys on the keyboard.

Typing capital letters

To type capital letters, switch ON the Caps Lock by pressing the key before typing. A light will shine on the top right side corner of the keyboard that shows Caps lock is on. To switch it off, tap on the Caps lock key before typing.

Typing symbols

Press and hold the key and then press the key with the required symbol. There are two Shift keys on the keyboard — to the bottom left and right of the letters. The Shift key is used to access the top symbols that are one of the keys with two characters.

Typing sentences

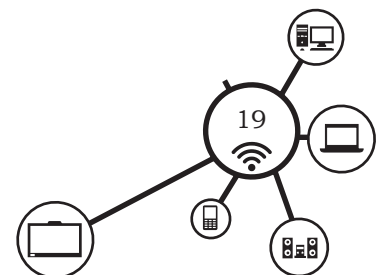
To get space between typed words, press the space bar once and then type the next word.

Creating new lines and spaces between paragraphs

The Enter or return key is used to create new lines and spaces between paragraphs. Make sure that the cursor is flashing from a new line. It is also used to authorise instructions asked for the computer to perform.

Guide for typing

The cursor keys serve as a guide for typing. They can be used to move the position of the cursor. The cursor is the small downward line that flickers in a sentence while typing. Move the position of the cursor by clicking the position with a mouse.



Pointing devices

Instead of typing, directly some items can be selected from computer screen, for example "print" or "close" button. This can be done using point and draw devices, such as mouse. Not only to select, but drawing of line, curve and shapes is also possible with such devices. Other examples of point and draw devices are joystick, light pea, touch pad or track ball and touch screen.

Mouse

Mouse is a pointing device used to point a particular place on the screen and select to perform one or more actions (Figure 2.3). It can be used to select menu commands, resize windows, selecting actions from screen icons, etc. A mouse primarily comprises of three parts: the buttons, the handling area, and the rolling object. By default, the mouse is configured to work for the right hand. The left-handed persons can change the settings as per the needs.

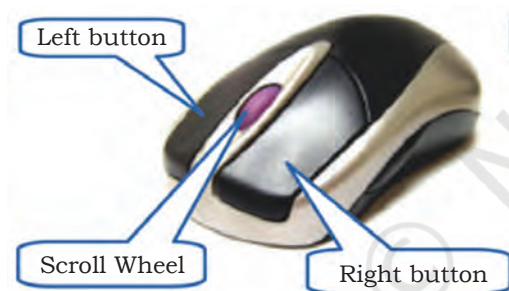


Fig. 2.3: Mouse buttons

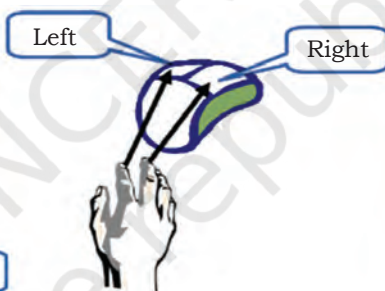


Fig. 2.4 (a) How to hold the mouse



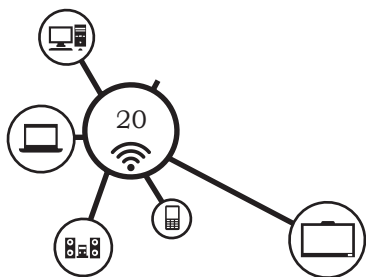
Fig. 2.4 (b) Position of fingers while holding the mouse

Put the right hand on the mouse, the index finger goes on the left button, and the middle finger goes on the right button (Figure 2.4 [a&b]). Hold the mouse with thumb and ring finger. To click, press a mouse button lightly and release it immediately.

Mouse pointer

The mouse pointer allows to point on the screen. The pointer changes as shown below.

☞ This mouse pointer will appear as you move it around the screen (it can also be used to move things).



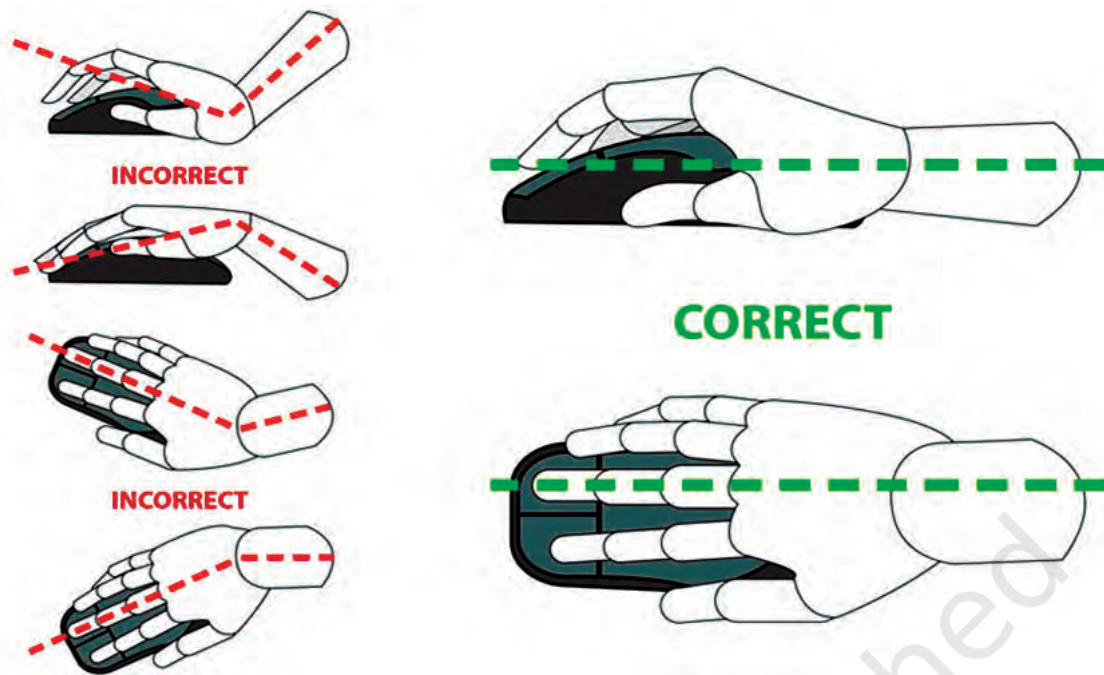


Fig. 2.4: Correct and incorrect positioning of fingers on the mouse

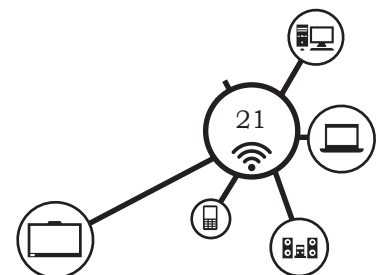
It will appear as you move it around the screen.

¶ This mouse pointer will also appear as you move it around the screen, particularly if it is over text. (This shape can be seen when you are about to type text.).

☞ While working on a web browser, the pointer change to a pointing finger symbol as moved it over the page. This identifies a hyperlink. Click the left mouse button once to follow the hyperlink to another page.

Mouse operations

All mouse do not use the same mechanical operation but all of them accomplish the same task. Some of them use a tracking ball at the bottom and some of them use a type of light beam to detect the motion of mouse. Laptops are equipped with a small flat surface or sometimes with a very short stick for performing same job as mouse. The most conventional kind of mouse has two or three buttons on its top. These buttons are used for different actions. Using left button of mouse different operations like selection, dragging, moving and pasting can be done. With the right button we can open a context menu for an item, if it is applicable.



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The common mouse actions are as follows:

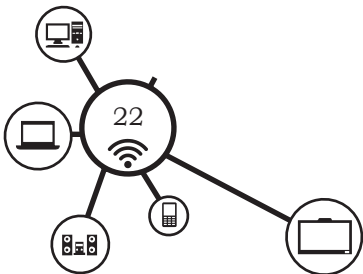
- (a) **Click or left click:** It is used to select an item. Press down once on the left button with your index finger.
- (b) **Double click:** It is used to start a program or open a file or trigger an action.
- (c) **Right click:** It is used to display a set of commands and available options. Move the mouse pointer to the desired position, position your middle finger on the right mouse button, keeping the mouse still, click lightly with the middle finger on the right button.
- (d) **Drag and drop:** It allows to select and move an item from one location to another. Position the mouse on an object, hold down the left side of the mouse, and drag the object.
- (e) **Scroll:** Many applications provide scrollbars on right side of screen if the page length is more than the monitor/screen length. Instead of using page down key or arrow keys, one can use scroll key of a mouse to scroll up or down. If the scroll key is not available, one can click on the scroll bar on the application screen with the left button of the mouse. Use the scroll wheel on the mouse to move the page on the screen up or down.
- (f) **Blocking:** Blocking is another way of selecting text. It is used to select text that needs to be edited or formatted. Click at the beginning of the word or sentence and hold down the left button, then drag along the text and see it being highlighted in black. At the end of the text or sentence release the left button.

Typing ergonomics

Typing ergonomics provides the logistic support for efficient and effective typewriting. They are important to attain and maintain accuracy and speed. Some of these factors included are as given as below.

Sitting posture

While operating the computer keyboard, sit straight, slightly bending your neck forward. Check your comfort



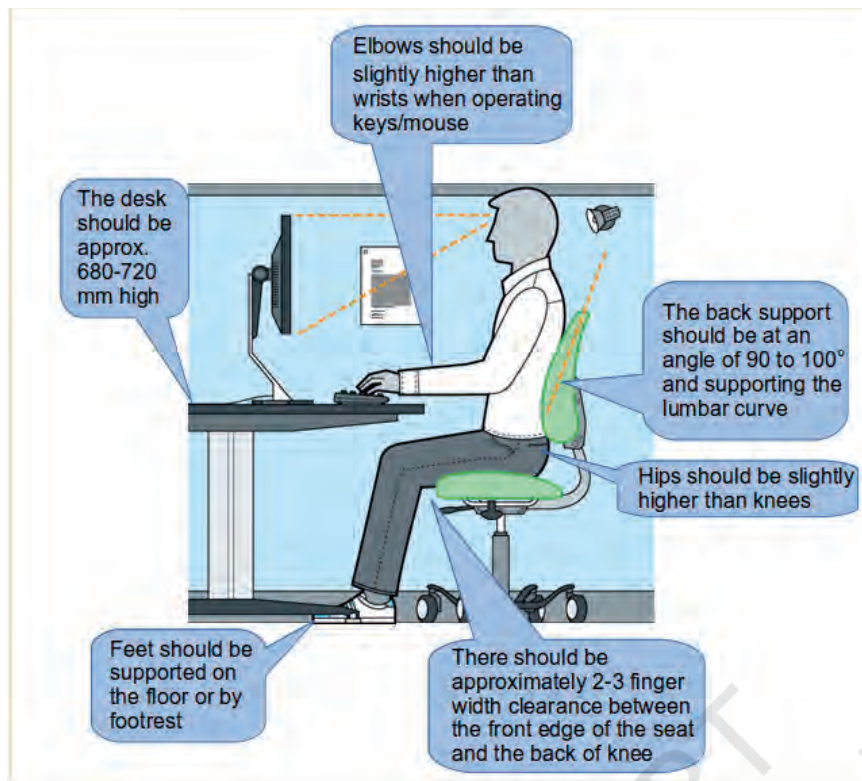


Fig. 2.5: Sitting posture while working on computer

and sitting position of body. Touch the lower portion of your back to the lower portion of the back rest of the chair. Touch both the feet to the floor (Figure 2.5).

Position of hands

Put your forearms at level with the keyboard and palms down (Figure 2.6). Keep your wrists straight and hang



Fig. 2.6 Correct screen angle view



Fig. 2.7 Wrong way of sitting

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your elbows naturally. Don't touch the elbows to the body nor be too far away from the body (Figure 2.7). Bend at about a 90 degree angle.

Monitor placement

Do not bend your neck while working on the monitor and keep the upper border of screen at eye level. The distance of screen from the user depends on the size of the screen. Keep an approximate distance of about 60–65 cms for 17 inches screen.

Mouse and keyboard placement

Keep the keyboard and mouse together at an approximate distance of 20 cms, which will help in smooth and effortless operation of keyboard. Same height of keyboard, mouse and elbows helps the users to work comfortably.

Chair and table placement

Adjust computer chair and table to an optimal height. The chair of the computer user must be supportive to his/her lower back. Keyboard and vibrating devices, such as printers, should be on separate tables. The computer table should also have sufficient space for your legs. With the correct ergonomics, typewriting becomes a natural phenomenon without causing unnecessary fatigue.

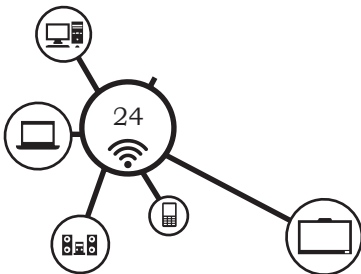
Placement of matter to be typed

Place the matter for typing to the left or right side of the keyboard preferably on a Copy Holder which has a sloping surface.

Positioning of fingers on the keyboard

As typing is equivalent to pen or pencil now-a-days, mastery of computer keyboard has become obvious. Mastery typewriting skills means to attain necessary knowledge and skill of keyboard operation by correct positioning of fingers.

In the Home Row Approach, also called Horizontal Approach, all the eight fingers of both the hands rest on



Home Keys during the keyboard operation. The fingers are trained to make the correct movement to the other keys in such a way that each finger returns immediately to its home key after it has depressed the corresponding key in any other row. The thumb of the right hand is used to operate the Space Bar.

Allocation of keys to fingers

The keyboard learning process starts from the second row (Home Row) followed by the Third Row (Upper Row), First Row (Bottom Row) and the Fourth Row (Number Row). The fingers of both the hands have to operate the keys allotted to them on each row (Figure 2.8). It must be remembered that each finger has to operate only the key allotted to it.



Fig. 2.8: Allocation of keys to fingers

Allocation of keys to fingers on the second row (home row)

Place four fingers of each hand on Home Keys as shown in Figure 2.9. The remaining two keys 'g' and 'h' on the second row are operated by the forefingers (Index Finger) of left and right hand, respectively.

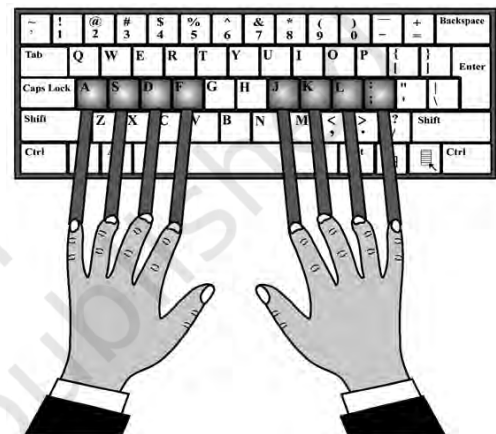


Fig. 2.9: Positioning of fingers on the Home row

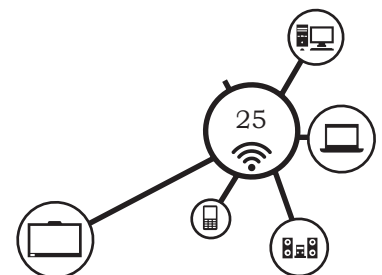
Let's Practice 1

A. Type the following in double line spacing to get perfection over the Home Row.

asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh
asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh
asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh

Instructions:

- Do not look at the keyboard
- Each letter should come beneath the other
- Concentrate your mind on the text
- Typing should be done quite accurately with constant rhythm
- Repeat this process until mastery over this exercise



Let's Practice 2

B. Type the following in double line spacing to get perfection over the Home Row.

asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh
 asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh
 asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh
 asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh
 asdfg;lkjh asdfg;lkjh asdfg;lkjh asdfg;lkjh fads lall
 dask sad slak flask fads lall dask sad slak flask
 fads lall dask sad slak flask fads lall dask sad slak
 flask fads lall dask sad slak flask fads lall dask sad
 slak flask fads lall dask sad slak flask fads lall dask
 sad slak flask

Instructions

- Do not look at the keyboard
- Each letter should come beneath the other
- Concentrate your mind on the text
- Typing should be done quite accurately with constant rhythm
- Repeat this process until mastery over this exercise

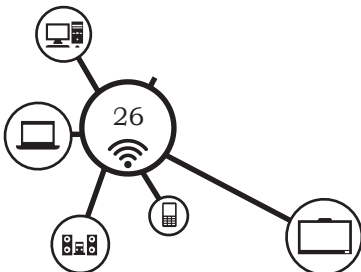
Undertake repeated practices of typewriting the character on the Home Row without looking at the keyboard.

Allocation of keys to fingers on the third row (upper row)

The next step is learning the key-reaches from the Home Row to the row above it. The learning begins with the reaches from 'a' to 'q' by left hand little finger and from ';' to 'p' by right hand little finger. This is followed by the placement of the third fingers (Ring fingers) to the adjoining keys 'w' and 'o' and so on (Figure 2.10). In the third row, the allotment of fingers is explained below.

LF	RF	MF	IF	IF	IF	IF	MF	RF	LF
Q	W	E	R	T	Y	U	I	O	P

Fig. 2.10: Allocation of fingers on the third row



While typing on the upper row, keep fingers on home row. Lift fingers of left hand and strike upper row key one by one and type

q w e r t (r and t are typed by the same finger)

Now, again lift the fingers of right hand and strike upper row keys one after another and type

p o i u y (u and y are typed by the same finger)

You should ensure that one finger should move at a time, while other fingers should remain on the home row.

Allocation of keys to fingers on the first row (bottom row)

After learning how to operate keys on Home Row and Third Row, the next step is to learn how to operate keys on the First Row. Keys Z, X, C, V, B, N, M, Comma, Full Stop and '/' sign are located on this row.

Let's Practice 3

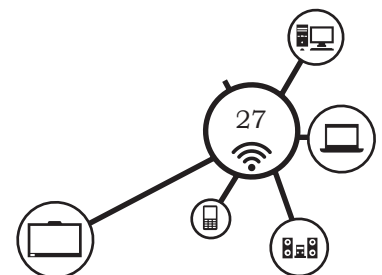
A. Type the following words and sentences in double line spacing to practice the Upper Row of the keyboard.

*qwertyuiopqwertyuiopqwertyuiopqwertyuiopqwertyuiop
qwertyuiopqwertyuiop post quite type quaypoleripehope
wait role what show flow goal wool post quite type quay
pole ripe hope wait role what show flow goal wool self help
is the order of the day. Self helps the order of the day the
writer was happy, the writer was happy.*

In the earlier two rows, all the eight fingers of both the hands were used to operate the keys. But while typewriting on the First Row, little finger of left hand is not used, i.e., no key is assigned to it. So, from the Home Row, turn downwards the Ring Finger of left hand and strike key 'z'. Similarly, type keys 'x' and 'c' with middle and forefinger, respectively. Type full stop, comma, m, n with little, Ring, Middle and forefinger of right hand, respectively, which will appear as given below.

z x c . , m n

Alphabets 'v' and 'b' are to be typed with forefinger of left and right hand, respectively.



Allocation of keys on bottom row is depicted below:

LF	RF	MF	IF	IF
-	Z	X	C	V

IF	IF	MF	RF	LF
B	N	M	,(Comma)	.(Fullstop)

Let's Practice 4

A. Type the following words in double line spacing to practice the Bottom Row of the keyboard.

gameroxytimetaximindcampjumplazy,size;zeal,haze,zone;zinc.
 Gameroxytimetaximindcampjumplazy,size;zeal,haze,zone;zinc.
 on,no,man,can,child,chalk,number,member,remember,general
 on,no,man,can,child,chalk,number,member,remember,general

Allocation of keys to fingers on the Fourth Row (Number Row)

In this row, type 1, 2, 3 with little, ring and middle fingers of the left hand, respectively, and 4 and 5 with the index finger (forefinger). Similarly type 0, 9, 8 with little, ring and middle fingers of right hand, respectively, 7 and 6 with index finger (forefingers).

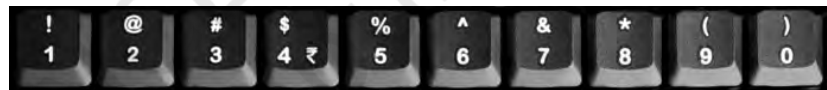
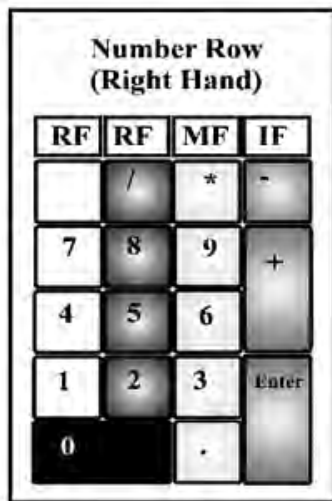


Fig. 2.11 Numeric Keypad on keyboard

LF	RF	MF	IF	IF
1	2	3	4	5
IF	IF	MF	RF	LF
6	7	8	9	0

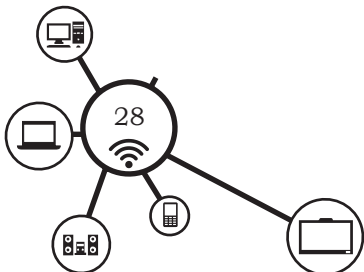


Fig. 2.12: Positioning of fingers on the number row

Using numeric keypad

Efficient and effective use of numeric keypad is important in numeric data entry. The numeric keypad has four columns and five rows. The row which has 4, 5, 6 and + is called Home Row. This is the row which is initially practiced by a touch typist. The allocation of keys on this row is as shown in Figure 2.12.

On a numeric keypad, the number 5 is the guide key. It has a small raised tangible mark which serves as a guide for the touch typist in the placement of fingers on other keys.



Allocation of rest of the keys on numeric keypad '0' is to be pressed by the right-hand thumb. One can also make use of calculator keyboard for numeric keypad practice.

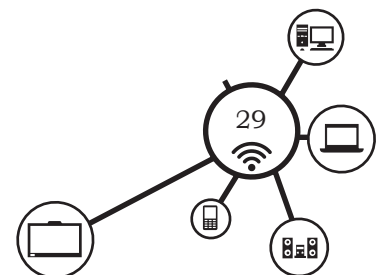
Successful keyboarding tips

The following points may be kept in mind for successful keyboarding techniques.

- Press the keys with feather touch and do not put undue pressure.
- Rest your fingers on Home row while typing.
- Allow your fingers to fall naturally on the keys so that each rests on top of the next key along the same horizontal row.
- While typing, release the key immediately as soon as you press it. Holding the key for long time, will repeatedly type the same character.
- Do not look at the keyboard while practicing.
- Press the keys with equal intervals of time in rhythm.
- Press the keys only with the fingers allotted for them.
- While pressing a key, say slowly pronounce the character on the key.
- Do not take any mental stress while typing.
- Secure typing ergonomics.
- Maintain patience if committed mistake at initial stage.
- Maintain a balance between speed and accuracy, as both are equally important. Do not sacrifice accuracy for speed.
- To gain mastery of computer keyboard, undertake repeated practice of typewriting words, sentences, passages and figures without looking at the keyboard.

Check your typing ergonomics

- Do you sit in the correct posture while working on computers? Yes/No
- Is your desk and chair ergonomic, and if not, have you adjusted them? Yes/No



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- Are your computer table, mouse, keyboard placed in correct position? Yes/No
- Is your computer/laptop correctly placed on your desk? Yes/ No
- Have you arranged your tools on your desk to prevent twisting and reaching? Yes/No

Using typing software

There are many software available which are free of cost and are customised to learn typing efficiently and effectively.

Introduction to Rapid Typing Tutor

Rapid Typing Tutor is a Free and Open Source Software (FOSS) designed to learn typing skills on the computer. It is free to use and share with others for free, but only by using the original distribution package. Learning to type is fun with the typing game included with Rapid Typing Tutor.

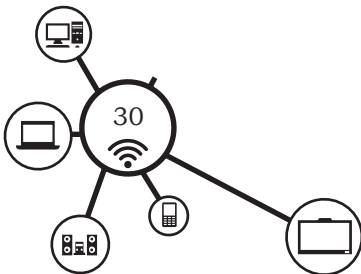
Touch typing technique

Touch typing improves typing speed and accuracy. A touch typist never looks at the keyboard. The fingers hit the right keys by habit. The typist is entirely focused on the text being typed, reading the words and phrases as the fingers type the text reflexively. Touch typing can be learned by performing special exercises.

Stage one of the process begins with learning the Home Row of the keyboard (the row beginning with the Caps Lock key). Looking at the keyboard is strictly forbidden. This is followed by learning the lower and upper rows, the numbers row, uppercase letters and special symbols.

Stage two involves memorising frequently used syllables and typing words containing these syllables.

Stage three involves typing actual text to perfect the skills acquired.



Touch typing rules



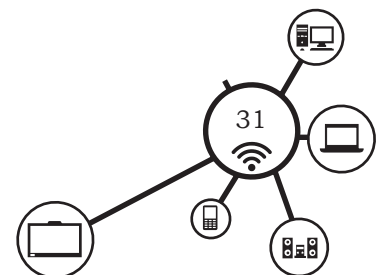
Fig 2.13: Keyboard layout for learning typing

- The F, D, S, A, and J, K, L, ; keys (on a QWERTY keyboard) represent the base position. Keyboards usually have small protrusions on the F and J keys. They help your fingers locate the base position without looking at the keyboard. Try to return your fingers to the base position after each keystroke.
- Colour coding shows which finger should press each key (see the picture above). The left index finger is reserved for all the red keys. The right index finger is reserved for green keys, and so forth. Use the thumb of whichever hand is more convenient for you to press the Space key.
- The base position on the numeric pad is the number 5 key for the middle finger, 4 for the index finger, and 6 for the ring finger. The numeric pad simplifies and speeds up numerical data input.
- Uppercase letters and symbols appearing on keys in the numbers row are typed by one hand with the little finger of the other hand holding down the SHIFT key.
- Do not look at the keyboard. Try to locate the right key with your fingers.

After configuring settings in Wizard, Rapid Typing's main window will appear as shown in Figure 2.14.

Let us familiarise with the **Typing Tutor** interface. The window is composed of the following controls:

Taskbar allows to set or change some basic options to start a lesson (keyboard layout, level, lesson, and background).



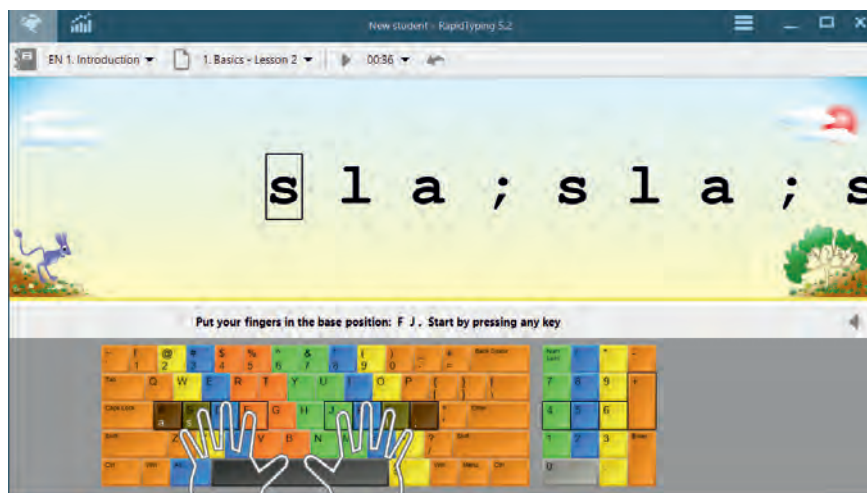


Fig 2.14: Rapid Typing's main window

Three horizontal buttons in the top-right corner (Options, About and Help) can display the corresponding dialogs.

Three vertical buttons in the top-left corner (Lesson, Statistics and Lesson Editor) are used for switching between current lesson, User Statistics and Lesson Editor.

Text panel is the area where the text to be typed is displayed. You can easily edit it in Lesson Editor, if necessary.

Lesson control panel includes several controls to pause/resume the current lesson, enable/disable sounds, and adjust the sound volume.

Keyboard is the virtual keyboard that will help you to learn touch typing with all 10 fingers. You can customise its appearance in the 'Lesson' section.

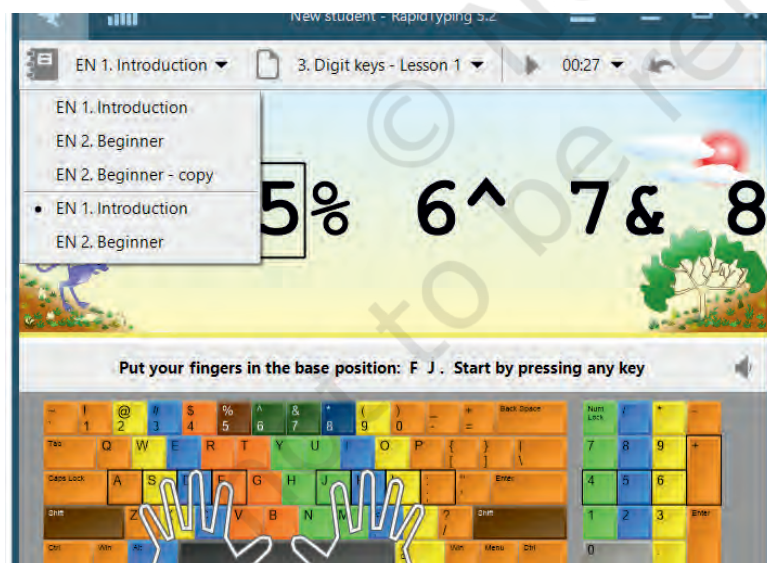


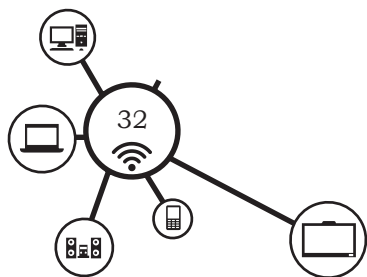
Fig 2.15: Beginning or Introduction to Rapid Typing tutor

Begin lessons

To start your first lesson in **Typing Tutor**, select the keyboard layout, level and lesson category on the Taskbar shown below.

There are four drop-down lists in the top-left corner of the screen. Therefore, moving from left to right, the procedure will be as follows:

- Choose the layout (i.e., the language of keyboard); it's "EN" on the picture above.
- Then, select a level (there are three levels available— Introduction, Beginner); it's "Beginner" on the picture above.



- Specify lesson category (depending on the level chosen, the available categories may vary).
- Finally, choose the lesson that you would like to study.
- When everything is ready, press any key, then put your fingers in the initial position shown on the keyboard and start typing the text.

There is also the Lesson Control Panel just above the Keyboard from where you can suspend/resume the current lesson or adjust the sound effects:

- To start/resume a lesson, click the ► button just above the top-left corner of the keyboard.
- To pause a lesson, click the || button that is displayed instead of the ► button.
- To restart the current lesson, click the ↺ button, which is the far right button on the Taskbar.
- To enable/disable sounds in the current lesson, click the 🔊 button located above the top-right corner of the keyboard and set the sounds volume using the vertical slider.

Notes

- You can also set the background image for the Text Panel by choosing an option (**Animation**, **Wallpaper** or **Plain**) from the dropdown list on the Taskbar in top-right corner of the window.

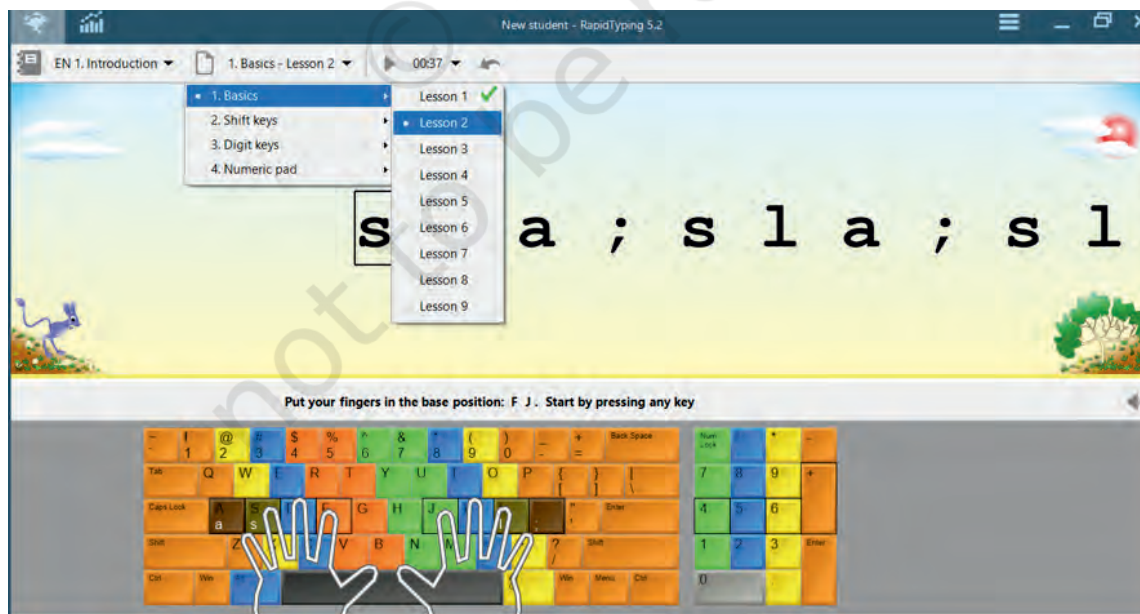
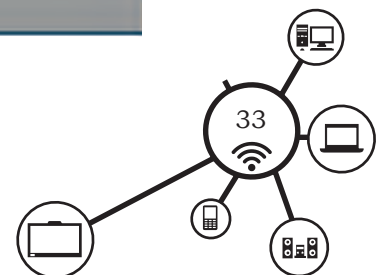


Fig 2.16: Selecting a Lesson



- While making your way through the lessons, you will probably mention two progress bars (one in green and another in yellow) on the Lesson Control Panel.
- The green progress bar (upper) shows the percentage of completion for the current lesson, and the yellow progress bar (lower) reflects the acceptable time period for typing a single character.
- When the yellow progress bar runs out at least once, **Typing Tutor** records that you have broken the rhythm at this character.

How to interpret your results

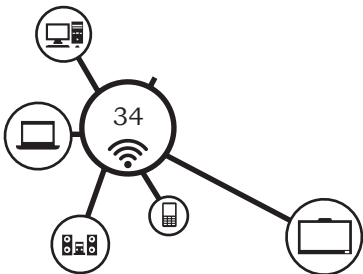
Each time you complete a lesson, the Results dialog window displays your achievements in this lesson.

The Results dialog window consists of two tabs called Rating and Errors. The first one looks like shown in figure 2.17

You can review your metrics: overall skill level between *Beginner* and *Champion* (upper slider indicator) as well as words per minute, characters per minute and accuracy in per cent (three remaining sliders below). In the text area, you can check your mistakes that occurred during the lesson.



Fig 2.17: Results dialog window for your achievements



The colour indication is as follows:

- **Green** letters denote right inputs.
- **Yellow** letters stand for right inputs exceeding the acceptable timeframe.
- **Red** letters denote wrong inputs within the acceptable timeframe.
- **Orange** letters indicate wrong inputs that also exceed the acceptable timeframe (it's the worst result).

Error window

On the Error tab you can view your detailed statistics for the current lesson. This tab shows your errors and delays percentage both in the graphical and table view. This will help you to better understand which letters are still hard for you to type. You can switch between the Errors in percent chart (by clicking the button just below the tabs) and Delay in percent chart (by clicking the button).

On the bar chart, the X-axis corresponds to the letters used in the lesson, while the Y-axis shows the errors or delays related to each letter. If there aren't any errors and delays for a certain character, it won't show up on the chart.

Note

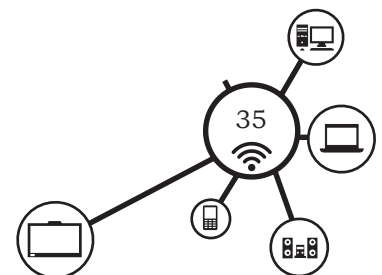
When you select a row in the table, the corresponding bar on the chart will be highlighted. When you select a column in the table, the chart will show either errors or delays.

Then, you can click the Next button below to proceed to the next lesson, Repeat to go through this lesson once again, or Records to check whether your results are great enough for **Typing Tutor's** Hall of Fame.

To view the results of all the lessons that you've already completed (not only the current one), go to the Statistics section.

View and analyse statistics

To view the results of all the lessons that you have already completed: (i) Open the Statistics section, and (ii) choose the button in the top-left corner of the main window. The Statistics screen will open as shown in Figure 2.18.



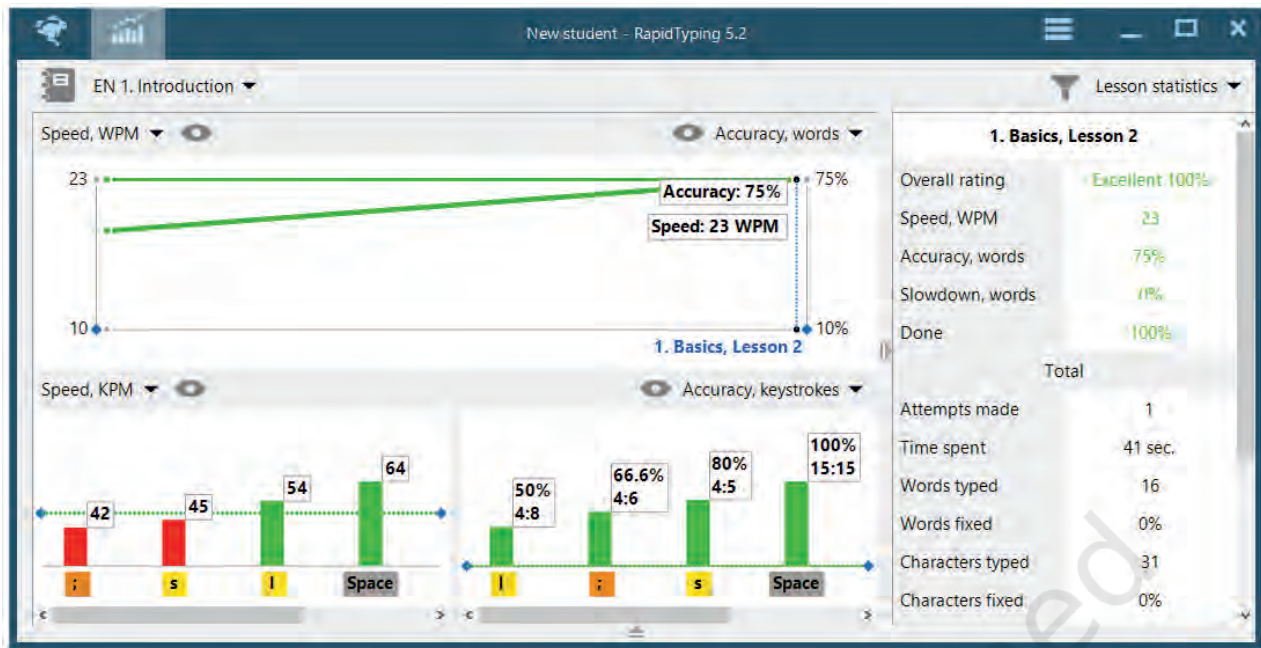


Fig 2.18: Overall statistics and progress of your typing

Here, you can review your overall statistics and progress both in graphical and table view. The following options are available:

- Click the button in the top-left corner of the window (or press Ctrl+1 on your keyboard) to see your CPM speed (characters per minute) progress.
- Click the button (or press Ctrl+2 on your keyboard) to see your WPM speed (words per minute) progress.
- Click the button (or press Ctrl+3 on your keyboard) to see how your typing accuracy changes in the different lessons.

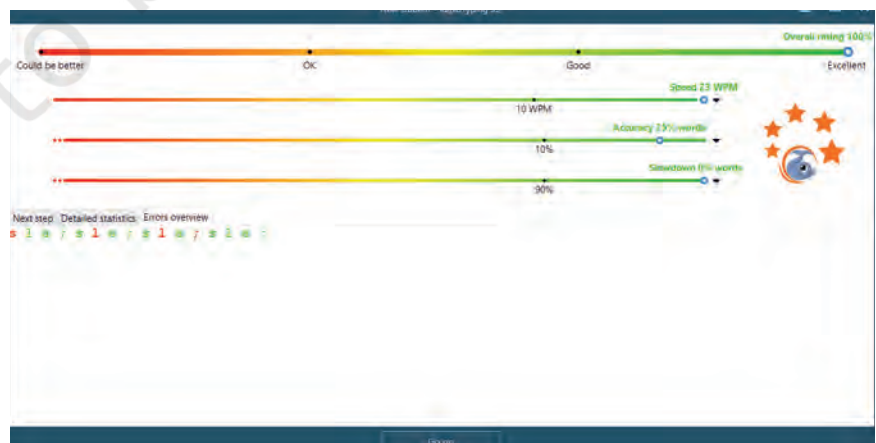


Fig 2.19: Statistics for a particular lesson

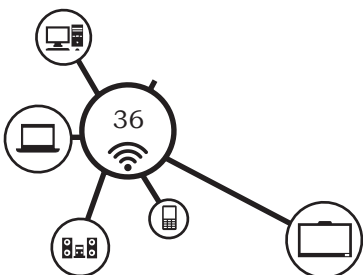




Fig 2.20: Overall rating

- To remove a metric from your statistics, select a lesson in the right table and click the button (or press Delete on your keyboard).
- On the Taskbar in the upper part of the window, you can choose keyboard layout, level and course for which you'd like to see statistics.
- You can also switch between the Lesson Group (that is, statistics by lessons) and Day Group (statistics by days) options in the far right drop-down on the Taskbar.

Detailed lesson statistics

To review the statistics for a particular lesson, choose this lesson in the right table and click the Lesson tab in the top-right corner. The Lesson tab contains the same data that are displayed upon completion of every lesson. For details, see How to Interpret Your Results section.

Working with lesson editor

To open Lesson Editor, click the button in the top-left corner of the Rapid Typing window.

Lesson Editor window is composed of the following controls:

- Taskbar which allows to select the keyboard layout and level of the lesson to edit.
- Toolbar which includes Basic_lesson1 or lesson 2...., for inserting text.

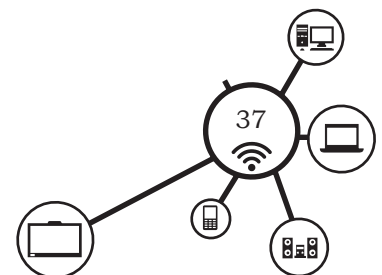




Fig 2.21: Typing using the basic keys



Fig 2.22: Type using Shift key

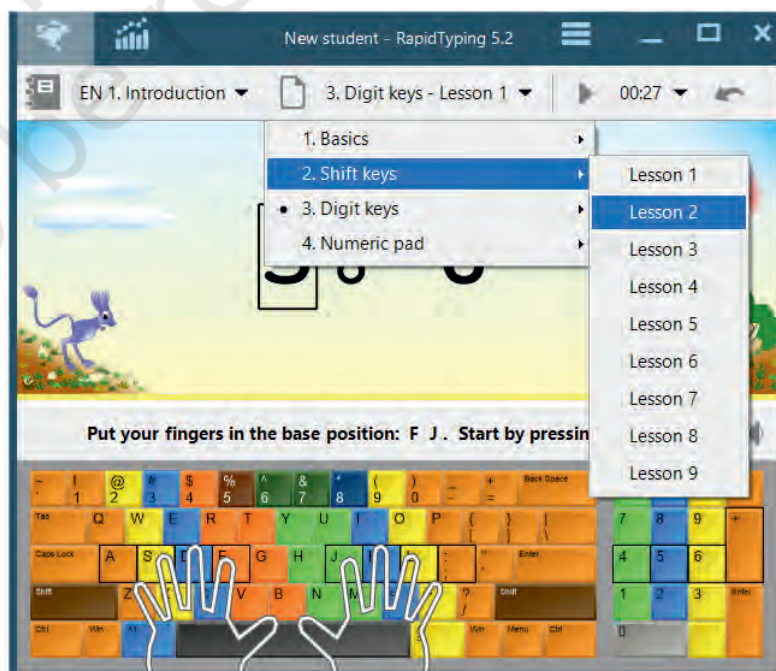
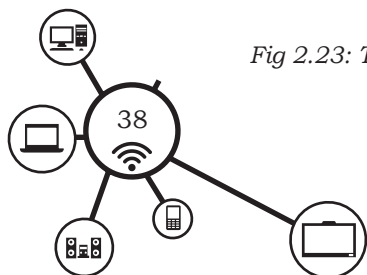


Fig 2.23: Type using Digit key

- Navigation Tree which shows the existing courses and lesson hierarchy.
- Text Panel, an area where you can edit the text of the lesson currently selected in the Navigation Tree.
- Lesson Metrics which displays the number and percentage of words, characters, spaces and specific characters in the lesson.
- Keyboard, which is the virtual keyboard that highlights the characters used in the currently selected lesson. You can customise its appearance in the 'Lesson' section.



Lesson Editor makes all the lessons fully customisable. You can add, insert, change, and delete lessons, group them in courses, and review the corresponding metrics. You can type using the basic keys, such as Shift keys, Digit keys and Numerical pad.

Calculating the typing speed

The typing speed can be measured with different accuracies, such as

- How many words are typed for a certain time period (the least accurate)?
- How many characters are typed for a certain time period?
- How many keystrokes are made for a certain time period (the most accurate)?

Also there are

- Simple speed (Gross speed)
- Net speed (takes into account the errors)

The following table lists the detailed descriptions of typing speed types.

Types	Description	Formula
WPM	the number of words typed in a one minute period of time	$WPM = (\text{Words without errors} + \text{Words with errors}) / \text{Time spent in minutes}$
Net WPM	the WPM without words with errors	$\text{Net WPM} = WPM - (\text{Words with errors} / \text{Time spent in minutes})$
CPM	the number of characters typed in a one minute period of time	$CPM = (\text{Characters without errors} + \text{Characters with errors}) / \text{Time spent in minutes}$
Net CPM	the CPM without characters with errors	$\text{Net CPM} = CPM - (\text{Characters with errors} / \text{Time spent in minutes})$
KPM	the number of keystrokes in a one minute period of time	$KPM = (\text{Keystrokes without errors} + \text{Keystrokes with errors}) / \text{Time spent in minutes}$
Net KPM	the KPM without keystrokes with errors	$\text{Net KPM} = KPM - (\text{Keystrokes with errors} / \text{Time spent in minutes})$



Fig 2.24: Type using the Numeric Keypad

A student typed 240 characters per 2 min with errors in 20 characters.

Simple speed = 240 characters / 2 min = 120 cpm

Net speed = 120 cpm - (20 errors / 2 min) = 100 net cpm

Typing accuracy

Typing accuracy is defined as the percentage of correct entries out of the total entries typed. The following table lists the different formulas for the typing accuracy calculation.

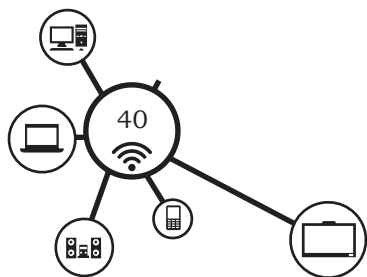
Description	Formula
Accuracy in the words, percent	Accuracy = (100% - Words with errors * 100%) / Total number of words
Accuracy in the characters, percent	Accuracy = (100% - Characters with errors * 100%) / Total number of characters
Accuracy in the keystrokes, percent	Accuracy = (100% - Incorrect keystrokes * 100%) / Total number of words

Sometimes it's convenient to evaluate the typing accuracy in the Errors (percentage errors). See table below—

Typing rhythm

Description	Formula
Errors in the words, percent	Errors % = Words with errors * 100% / Total number of words
Errors in the characters, percent	Errors % = Errors = Characters with errors * 100% / Total number of characters
Errors in the keystrokes, percent	Errors % = Incorrect keystrokes * 100% / Total number of keystrokes

In the touch typing techniques the typing rhythm is very important. Typing rhythm means the keystrokes



should come at equal intervals. To control the constant typing speed, the Slowdown indicator is used. The following table shows the different formula for the Slowdown (percentage slowdowns) calculation:

Description	Formula
Slowdown in the words, percent	Slowdown % = Words with delay * 100% / Total number of words
Slowdown in the characters, percent	Slowdown % = Characters with delay * 100% / Total number of characters
Slowdown % in the keystrokes, percent	Slowdown % = Keystroke delay * 100% / Total number of keystrokes

Overall rating calculation

Overall rating (%) = (Net speed / Course goal: Speed) *100% where:

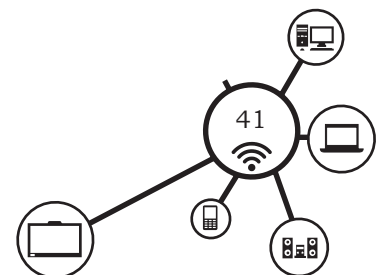
- Net speed is Net WPM, Net CPM or Net KPM, the value depends on the current options
- Course goal: Speed is customised in the options for each course

(a) Good typing speed

An average professional typist types usually in speeds of 50 to 80 wpm, while some positions can require 80 to 95 and some advanced typists work at speeds above 120 wpm.

The fastest typing speed on an alphanumeric keyboard, 216 words in one minute, was achieved by Stella Pajunas in 1946.

As of 2005, writer Barbara Blackburn was the fastest alphanumerical English language typist in the world, according to *The Guinness Book of World Records*. Using the Dvorak Simplified Keyboard, she maintained 150 wpm for 50 minutes, and 170 wpm for shorter periods. Her top speed was 212 wpm.



Practical Exercise

A. Using your left-hand type

asdfsdfasdfsdfasdfsdfasdfsdfasdfsdfasdfsdfasdfsdf
fdfsdfasdfsdfasdfsdfasdfsdfasdfsdfasdfsdfasdfsdfasdfsdf

B. Using your right-hand type

[illegible]

Using your both handstype

ghghghghghghghghghghghghghghghgh

C. Stretch your left index finger up/out to T (look on the keyboard) and type

th

D. Using your left-hand type

deed frf deer reed red deed frf deed reed red deed frf deer
reed red

E. Using your right-hand type

ujkiikjujkikjuujkiikjujkikjuujkiikjujkikjuujkiikjujkikjuuj
kiikjujkik

F. Using both your hands type

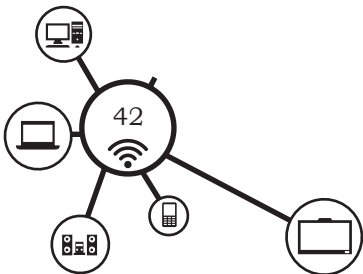
juut jut jute kiit kit kite juut jut jute kiit kit kite juut jut
jute kiit kit kite jud judder jug jugger judge judged juud
judder jug jugger judge judged igh high thigh ight fight
right fright igh high thigh ight fright right fright

A common reference would be
<http://www.typing-lessons.org>

<http://www.typing-lessons.org>

A. Multiple choice questions

1. Which of the following is not a key for punctuation marks?
 - (a) comma (,)
 - (b) period (.)
 - (c) semicolon (;)
 - (d) equal sign (=)
2. Which of the following is not an arrow key?
 - (a) top (^)
 - (b) down (↓)
 - (c) right (→)
 - (d) left (←)



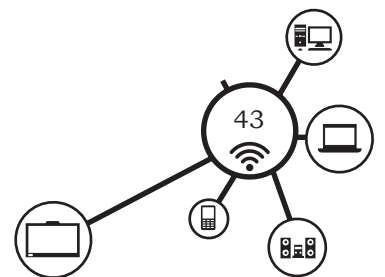
3. Which of the following operation is not performed by a mouse?
 - (a) Left Click
 - (b) Right Click
 - (c) Middle Click
 - (d) Double Click
4. In the Rapid typing tutor, which of the following is not true?
 - (a) Green letters denote right inputs.
 - (b) Yellow letters stand for right inputs in extra time.
 - (c) Red letters denote wrong inputs within time.
 - (d) Orange letters indicate wrong inputs with in time.
5. The lesson control panel can be used for_____.
 - (a) animation
 - (b) enable or disable sounds
 - (c) plain
 - (d) background

B. Fill in the blanks

1. A touch typist knows the location on the keyboard through _____memory.
2. The typing speed is measured in _____.
3. Alphabets (A-Z) and numbers (0-9) are known as _____keys.
4. Del key deletes the character at the _____ cursor position.
5. A standard keyboard has_____Function keys.
6. Numeric keypad is used to enter _____ data.
7. Page Up key is used to shift the _____ one page up.
8. Pressing the End key moves the cursor to the _____character of the line.
9. On numeric keypad '0' is to be pressed by the _____thumb.
10. The numeric keypad has _____ columns and _____ rows.

C. State whether the statements given below are True or False.

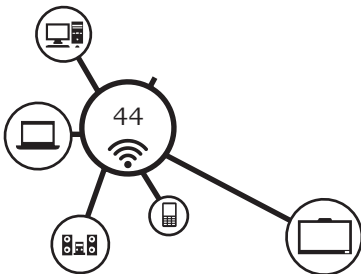
1. The Alt key is always used with the other key.
2. There are 5 arrow keys on the keyboard.

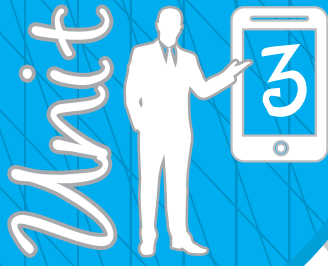


3. The Backspace key is used to delete the character on the right to the cursor.
4. Caps lock key is a toggle key.
5. The control key is used in conjunction with other keys.
6. Enter key is also known as Return key.
7. The function keys have different meaning in different software.
8. The keys 'F' and 'J' are known as guide keys.
9. There are two Caps Lock keys on the keyboard.
10. The mouse has two scroll buttons.
11. PageDown key is used to move the cursor on next page.
12. Pressing the Home Key, moves the cursor to the first character in the document.
13. On a numeric keypad, the number 8 is the guide key.
14. In Rapid typing tutor, the right input entered is denoted by yellow color.
15. In Rapid typing tutor, the right input entered in exceeding time frame is denoted by Red colour.

D. Short answer questions (50 words)

1. Discuss the various types of keys available on a computer keyboard.
2. Differentiate between Home Keys and Guide Keys.
3. What do you understand by Guide Keys? Name the Guide keys of a
 - (a) computer keyboard
 - (b) typewriter
4. Explain the role of typing ergonomics.
5. Why the use of various typing software is common now-a-days?
6. Mention the finger allocation of keys of the Bottom Row of computer keyboard.





Digital Documentation



17925CH03

INTRODUCTION

In earlier days, manual typewriters were used for typing a document, which was replaced by electronic typewriter and now a computer is used for this purpose. Word processing, data processing, communication and presentation are the most common activities performed in an office. Office productivity software is used to perform these activities effectively.

A document is a paper with written contents and the process of preparing a document is called documentation. Documentation is required to preserve the contents for a longer period or to be used as evidence. The documents can be letters, reports, thesis, manuscripts, legal documents, books, etc. A handwritten document can have certain disadvantages like understanding the specific handwriting. With the advancement in computer hardware and software technology, the process of handwritten documentation consequently automated to computer word processing.

A data entry operator should possess the skills to use the office productivity tools with a good typing speed. Although typing skill is the essential criteria for

Word processing

The term word processing was invented by IBM in the late 1960s. By 1971 it was recognised by the *New York Times* as a "buzz word". (source: <http://www.computernostalgia.net/articles/istoryofWordProcessors.htm>)

data entry operator, a little care has to be taken while using the word processing software. A typist used to hit the space bar a number of times to arrange the text. This is not required in the computer, as the automated features for editing and formatting are available.

Word processing is the use of computer software to enter, edit, format, store, retrieve and print the document. The document can be a letter, notice, report, business correspondence, etc.

A word processor is a computer application used for the production of printable material. In the beginning WordStar was the most widely used word processing software. There are several limitations to using a typewriter, which are as given below.



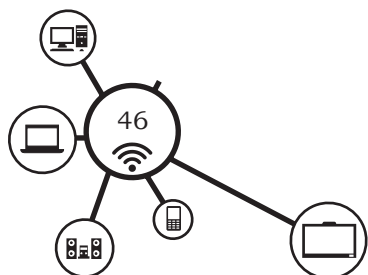
Fig. 3.1: Typewriter

1. In case of any typing error, the whole sheet is required to be typed again.
2. To send same letter to two or more persons with different addresses requires multiple typing efforts.
3. Typewriter does not have all the required characters or symbols. It is not possible to type all the characters using the typewriter.

4. It is not possible to produce a document in the desired format using a typewriter.

In the year 1974 **Xerox** company had introduced an electronic typewriter, as an attempt to solve the problems of the manual typewriter to some extent (<http://www.computernostalgia.net/articlesHistoryofWordProcessors.htm>).

In electronic typewriter, it is possible to make changes in the content, make multiple copies with minor changes. But it has a limitation of very small size screen to display the contents. Its screen can view only one or two lines. In late 1970s, with the development of



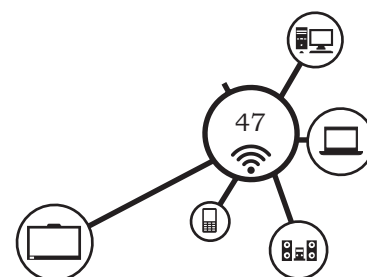
computer software technology, word processing software was introduced. In this software the document can be navigated, edited, formatted and printed. The modern word processors take advantage of a GUI (graphical user interface) providing some form of what-you-see-is-what-you-get (WYSIWYG) editing. This means, the special effects on text are also visible on the screen.

Word processing software not only provides basic ability to enter and modify the text but also provides efficient text manipulation functions that can be used for documentation. Modern word processors provide attractive features. Some of the features provided by popular word processors are as listed below.

- Create, edit, save, retrieve and print the document
- Select and move the text from one place to another in the document
- Copy the text to other places within the document
- Move or copy a selected text from one document to any other document
- Change the font size, font style of the text in the document
- Format paragraphs as well as pages
- Check spelling and grammar
- Create table, modify the size of the selected rows, columns or cells
- Combine one or more documents
- Insert pictures or graphs within the document
- Print the selected text or selected pages of the document

Word processors are being used in the business, home, and education, i.e., in schools and colleges for preparing letters, reports, and many other different types of documents. Students use it for preparing project reports and assignments. Teachers use word processors for preparing question papers and notes.

Office suite is a collection of programs, which are useful for word processing, spreadsheet preparation, presentation, and database management. There are several office suits. We will be using LibreOffice, because of its several advantages.



LibreOffice is a free and open source software (FOSS), fully-featured office productivity suite. Currently the versions of LibreOffice is 6.0 and above are available. It is available free for downloading from the website www.libreoffice.org. This suite is available in many languages and runs on many platforms (Windows, Mac and Linux). It uses Open Document Format (ODF) file format, for publishing documents. LibreOffice components are integrated with each other and have a similar 'look and feel', which makes it easy to use and train. The components of LibreOffice are Writer for word processing, Calc for spreadsheet preparation, Impress for presentation, Base for database management, Draw for drawing and others. LibreOffice includes support for opening and saving files in many common formats including Microsoft Office, HTML, XML, WordPerfect, and PDF.

Getting started with word processor – Writer

LibreOffice writer word processor

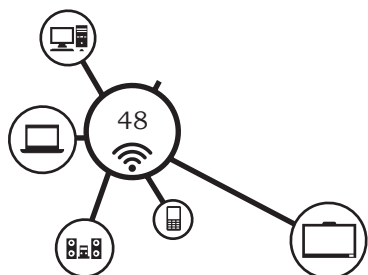
Several word processing software are available to prepare the report. But we will prefer to use LibreOffice Writer, because it is free and an open source software (FOSS) with rich features of word processing. Some word processors are also available freely on the web.

Web-based word processor

- Google Docs
- Office 365 Word
- Microsoft OneDrive Word

A school teacher arranged a field visit of Class IX students to a National level IT job fair. The purpose was to know the scope and opportunity in IT-ITeS sector.

After the visit the students were given an assignment to submit a report which should include details about the IT-ITeS industry in India with pictures, responsibilities of a Data Entry Operator and the education and experience required to be one. The students had to prepare a draft report on a paper. It had to be typed and printed. Initially the students thought to use a typewriter to type the report, but the typewriter cannot provide the facility to type with various fonts and colours and also they would not be able to add pictures using a typewriter. Therefore, they prepared the report by using the word processing software on the computer. This provides various features



to make the report more attractive. It was printable and changes could be made in the file anytime. There are a variety of computer software applications used to prepare such reports, letter in offices, schools and colleges. Let us study how to use the word processing application to prepare a report.

Let us prepare the report in LibreOffice Writer. The presentation of the final report should be as shown in the following **REPORT** page.

Report

Field Visit to IT Job Fair

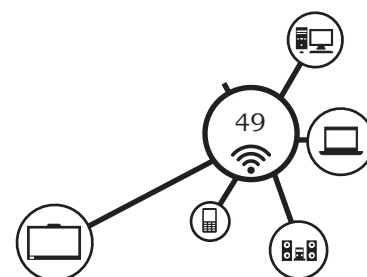
We visited the IT Job Fair, 2018 held at **Kasturchand Park, Nagpur** on 5th July. It was quite a knowledgeable experience for us. We got to know about the IT Sector in depth.

The **Information Technology & Information Technology Enabled Services (IT/ITeS)** sector is a field which is undergoing rapid evolution and is changing the shape of Indian business standards. This sector includes software development, consultancies, software management, online services and **Business Process Outsourcing (BPO)**.

India's IT industry is expected to grow at a rate of 12–14% during 2016–17 as per a report by India's software industry body National Association of Software and Services Companies (NASSCOM.)

Data entry employment is a wide field. Sometimes referred to as a key entry operator, data entry specialist, data entry clerk or an information processing worker. These are also the common core functions and data entry skills of the job.

Job Tasks and Responsibilities	Education and Experience
1. Prepare, compile and sort documents for data entry 2. Check source documents for accuracy 3. Verify and correct data where necessary 4. Update and delete unnecessary files 5. Combine and rearrange data from source documents where required	1. High school certificate 2. Formal computer training an advantage 3. Proficient in relevant computer office applications 4. Accurate keyboard skills and proven ability to enter data at the required speed



- | | |
|---|---|
| 5. Enter data from source documents into computer database, and forms | 7. Knowledge of correct spelling, grammar and punctuation |
| 6. Scan documents into document management systems or databases | |

Double click means to move the mouse pointer over the desired item and click the left mouse button twice, quickly, click-click.

To prepare the above report, we will first learn how to open LibreOffice Writer and then type the text of the above report.

Starting LibreOffice Writer

In general, you will find a shortcut of LibreOffice on the desktop or on the *Quick Launch Taskbar*. The process may slightly differ according to the operating system you are using (*Windows or Linux*).

- (i) To start LibreOffice Writer in **Windows**, double click LibreOffice Writer shortcut, which is usually found on the computer desktop (Figure 3.2).

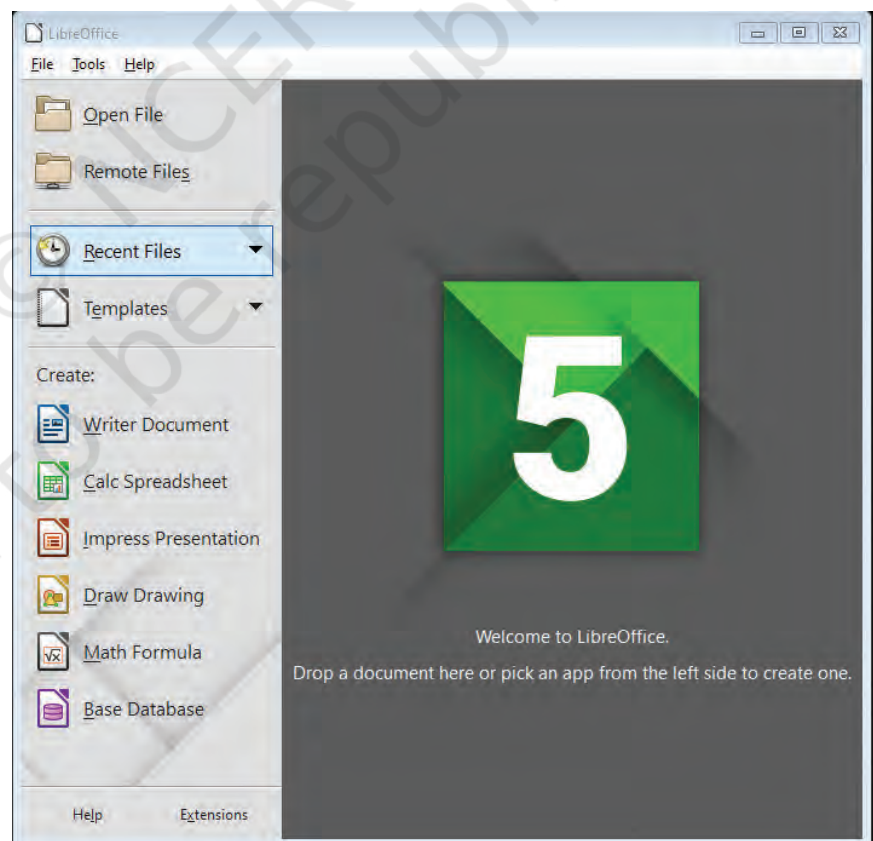
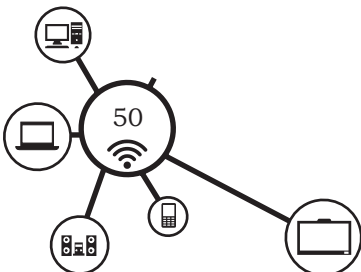


Fig. 3.2: Starting LibreOffice in Windows



- (ii) Alternatively, click on the **Start** or **Windows button**, select **LibreOffice** → **LibreOffice Writer** from application window.
- (iii) Using the Search command, type the word 'writer' in the search field, and select *LibreOffice* Writer from the offered results.
- (iv) **In Ubuntu Linux**, find the LibreOffice Writer icon on the application launcher, or search it by clicking on 'Show Applications', as shown in Figure. 3.3.



Fig. 3.3: Starting LibreOffice in Linux

Creating a document

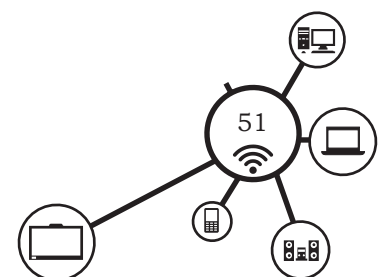
Step 1 Create a new text document by using *File Menu* → *New* → *Text Document*.

Step 2 Now save the file by clicking on the **File Menu** → **Save**. Give the name of the file (for example: report). By default, the file is saved in **.odt** format. Different file formats are as under

Step 3 Saving the file by another name

It is possible to make another copy of the file by saving it with another name using the *Save As* option. Once the user saves the document by giving a name, it is called a '**File**'. The user can save the file with another name

To create a new document:
 Keyboard shortcut: **Ctrl+N**;
 Mouse options: **File** → **New** → **Text Document**



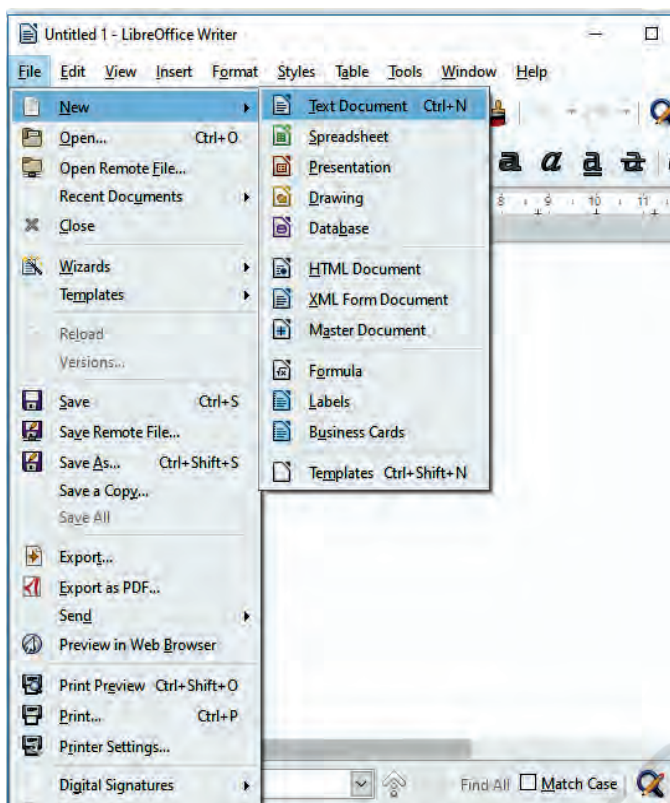


Fig. 3.4: Opening a New Text Document in Writer

in other location using the *Save As* option. The user will get two files the previous one and the one with new name.

Step 4 Closing the document—

After finishing the work, close the file, as too many opened files will cause a disturbance in working. To close the file, select

File → Close

Step 5 Opening the document—It may further require to open a file for editing. Select **File → Open (Ctrl+O)** and the document will be open for editing (Figure 3.4).

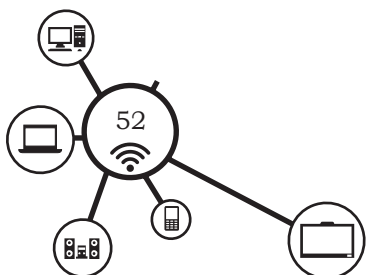
(a) To Save a document using password

1. Select **File → Save**
2. Select the location on disk to save the file
3. Type a suitable name for the document
4. Click on **Save** button
5. To save the document with password, put a tick on the checkbox **Save with a password**
6. Type the password to open the file in **Set password** dialog box
7. Type the same password in the second box and click **OK** button

Parts of the Writer window

The various parts of the Writer window have been briefly explained below.

- (a) Title bar:** Title bar is located on the top of Writer window. It shows the title of the currently opened document. The name of the document means the file name of the document saved on the disk. For a new document, it shows the title of the



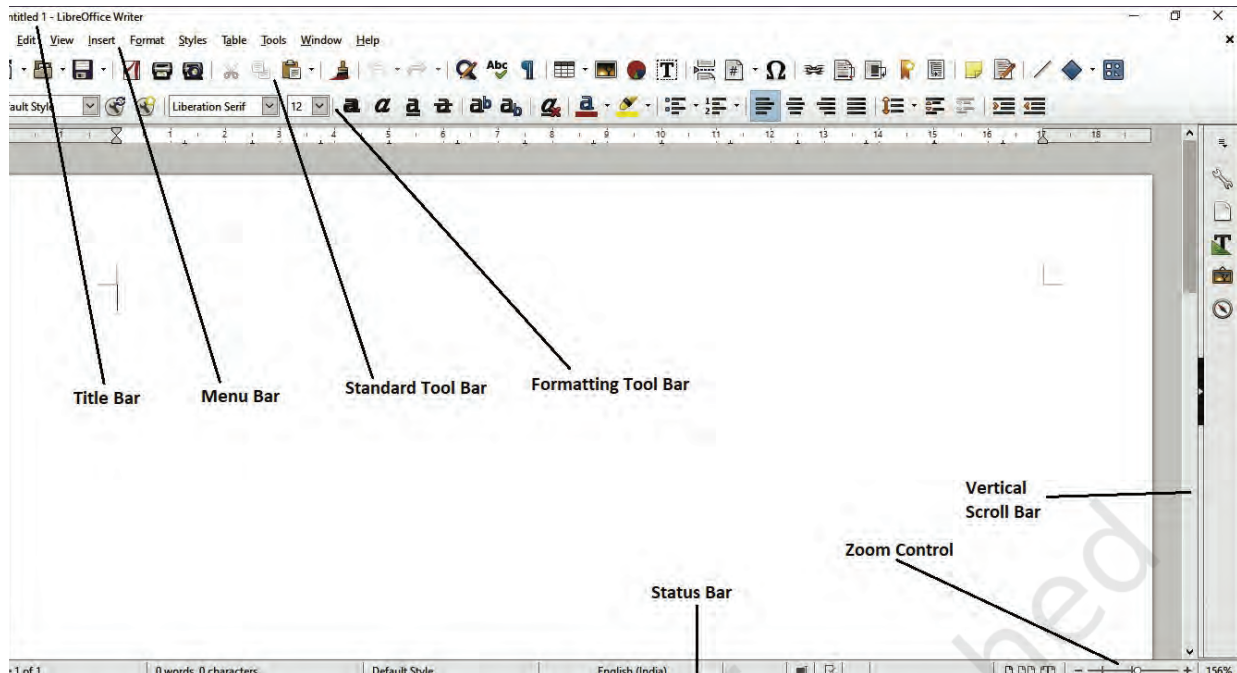


Fig. 3.5: Parts of the main Writer window

document as Untitled X, where 'X' is the document number Untitled 1, Untitled 2, Untitled 3... etc., as we go on opening the new document (Figure 3.5).

(b) Menu bar: It appears below the Title Bar. It shows the menu items File, Edit, View, Insert, Format, Tables, Tools, Window and Help. On selecting a menu item, its submenu will open below the menu item. We can select any item in the submenu as per the requirement. As an example Figure 3.6 shows the submenu for File menu.

- Selecting the File menu, shows the submenu as shown in Figure 3.6.
- The submenu item which shows three dots '...' just after the submenu name, means, clicking on it will open the dialog box.
- The submenu item which shows right hand side arrows '►' just after the submenu name, means, clicking on it will open another submenu.

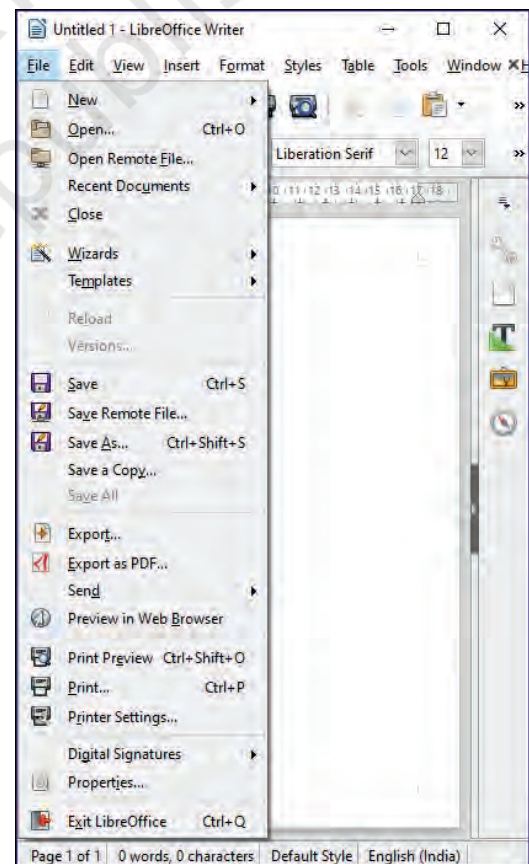


Fig.3.6: Submenu for File menu

- (c) **Toolbars:** The tool bar appears below Menu Bar. By default, the Standard Tool Bar and Formatting Tool Bar will appear. The other tool bars can be activated by clicking on '**View**' menu, and selecting the 'Toolbars' of submenu. The user can choose the required toolbars by clicking on it. The selected toolbar will show the $\sqrt{}$ sign before the toolbar. Suppose we select the Find toolbar then the Find word in the toolbar will appear as $\sqrt{\text{Find}}$.
- (d) **Standard toolbar:** It contains commands in the form of icons.
- (e) **Formatting toolbar:** It contains the various options for formatting a document. A graphical representation of commands is shown in the form of icons.
- (f) **Status bar:** This is positioned at the left bottom of the Writer window and displays the number of pages, words, the language used, zooming, etc. It is located at the bottom of the workspace.
- (g) **Scroll button and scroll bar:** It is used to scroll the document.

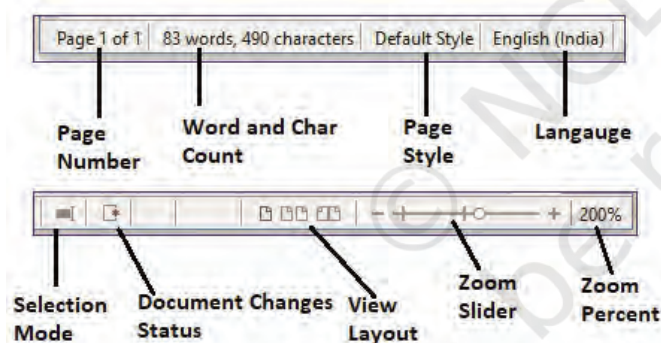


Fig. 3.7: Status bar

- (h) **Zoom:** It allows to change the scale of the text and pictures in the document only for view. It does not affect the physical document. It is used to check the finishing quality of the document.

To know the meaning of other tools, position the mouse pointer on the tool and see the Tool Tip.

Cursor movement

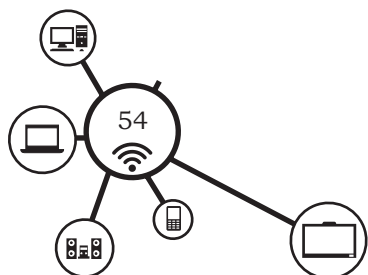
Text Cursor: The Text Cursor is a flashing vertical line in the body of the text. The 4 arrow keys ($\leftarrow$ $\uparrow$ $\downarrow$ $\rightarrow$) on the keyboard are called as cursor control keys.

(a) Text Cursor Movement

- Observe the location of the Text Cursor.
- Press the different cursor control keys on the keyboard and watch how the Text Cursor moves around.

Let's Revise

Practice using the cursor control keys until you are able to position the text cursor exactly where you want it.



There are two keys above the cursor control keys marked as **Home** and **End**. Pressing the Home key jump to the beginning of the line and pressing End key jump to the end of a line.

- Position the Text Cursor on a line of the document.
- Press the Home key and observe that the Text Cursor jumps to the beginning of the line.
- Press the End key and observe that the Text Cursor jumps to the end of the line.

When these keys are pressed in combination with *Ctrl* key, the cursor jumps to the beginning and end of the document.

- To jump to the beginning of a document, press the Ctrl key, hold it down, then press the End key (**Ctrl+Home**).
- To jump to the end of a document, press the Ctrl key, hold it down, then press the End key (**Ctrl+End**).

Mouse pointer

☞ This is the mouse pointer. It takes the pointer shape while moving it around the screen.

I The mouse pointer changes to I shape, when moved over the text in a document.

Moving the 'I' shaped mouse pointer over the text and clicking on the desired text, helps to get the text cursor while editing the document. Thus, the mouse is used to control the **Text Cursor** location.

Let's Revise

Practice positioning the Text Cursor using the mouse.

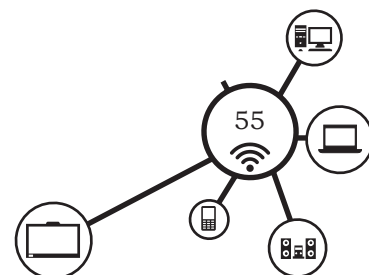
Let's Practice 1

Open the LibreOffice Writer and enter the text as in the following paragraph. Save the document as "Activity 1" in your folder. Close the document.

Report

Field Visit to an IT Job Fair

We visited the IT Job Fair, 2018 held at Kasturchand Park, Nagpur on 5th July. It was quite knowledgeable



experience for us. We came to know about the various information of the IT Sector.

The **Information Technology & Information Technology Enabled Services (IT-ITeS)** sector is a field which is undergoing rapid evolution and is changing the shape of Indian business standards. This sector includes software development, consultancies, software management, online services and **Business Process Outsourcing (BPO)**.

To open existing file

Keyboard

shortcut: **Ctrl+O**

Mouse options: **File**
→ **Open**

To undo the changes

Keyboard shortcut:

Ctrl+Z

Mouse options: **Edit** →
Undo

Copy option (**CTRL+C**) is used to make one or more copies of the selected text whereas Cut option (**CTRL+X**) is used to move the selected text from one place to another.

Editing the document

(a) Undo and Redo

- Open the existing file (For example, report.odt) and then start editing in it.
- If, by mistake, you have made some changes and now you want to erase the last change done, then use the Undo option.
- After undo command, again if you want to go back then use the Redo option.

(b) Moving and copying text

Cut and Paste: It is used to move a selected text from one place to another.

- Select the text and click on **Edit** → **Cut** option or press **CTRL+X**
- Place the cursor where the text has to be moved. Click on **Edit** → **Paste** option or press **CTRL+V**

(c) Copy and Paste

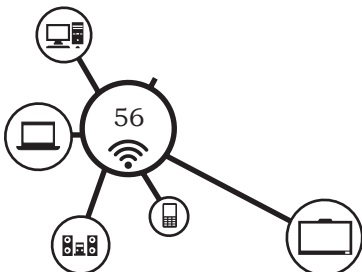
It is used to make a duplicate copy of selected text.

Step 1: Select the text and click on **Edit** → **Copy** option or press **CTRL+C**

Step 2: Place the cursor where the text has to be duplicated. Click on **Edit** → **Paste** option or press **CTRL+V**

(d) Selecting text

It is necessary to select the text to perform copy and paste operation. The selected text will be **highlighted**. For editing the text you must first select the required text. The editing can be done on the selected text.



(e) Selection criteria

To select the text in Writer, swipe the mouse cursor over text. There are several selection tricks to speed up the selection process as below.

To select a letter or letters	Drag the Mouse across the letter(s)
To select a single word at a time	Position the mouse pointer anywhere on that word and double click.
To select a complete sentence at a time	Position the mouse pointer anywhere in the sentence and triple click. (Triple click means to quickly click the left mouse button three times.)
To select a complete paragraph at a time	Position the mouse pointer anywhere in the paragraph and quadruple click (Quadruple click means to quickly click the left mouse button four times.)
A document	Press Ctrl + A on the key board. Drag the mouse pointer till you see a right arrow which is white. Then click it thrice.

Let's Revise

Practice selecting words, sentences, paragraphs and shift click option until you can do it accurately and easily.

A portion of the text can be selected by clicking and dragging. To do this, position the mouse pointer at the beginning point of the selection, click and hold the left mouse button down, and move the mouse pointer to the end of the desired selection.

To de-select the text, move the mouse pointer to an unselected location and click the left mouse button once.

To select all of the text in a document, press **Ctrl+A**.

Ctrl+A means to hold the **Ctrl** key down and press the **A** key.

Let's Revise

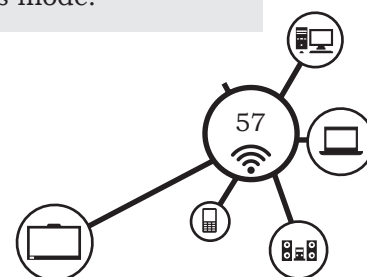
Practice selecting all text till you can do it accurately.

(f) Selecting non-consecutive text items

The above process shows the selection of continuous text. But suppose if the text is not continuous and you have been asked to select a part of the text from a paragraph, then perhaps you may say that it is not

By using the keyboard

- select the first piece of text.
- press Shift+F8. This puts Writer in 'Adding selection' mode.
- use the arrow keys to move to the start of the next piece of text to be selected. Hold down the Shift key and select the next piece of text.
- repeat as often as required.
- press Esc to exit from this mode.



By using the mouse

- select the first piece of text.
- hold down the Ctrl key and use the mouse to select the next piece of text.
- repeat as often as needed.

To select the vertical block of text select from menu:

Edit → Selection Mode → Block Area,
or press **Ctrl+F8**
(Keyboard shortcut).

possible to select the non-consecutive text. But Writer provides a way to select the non-continuous text using the keyboard and mouse. Figure 3.8 shows the selection of non-consecutive items.

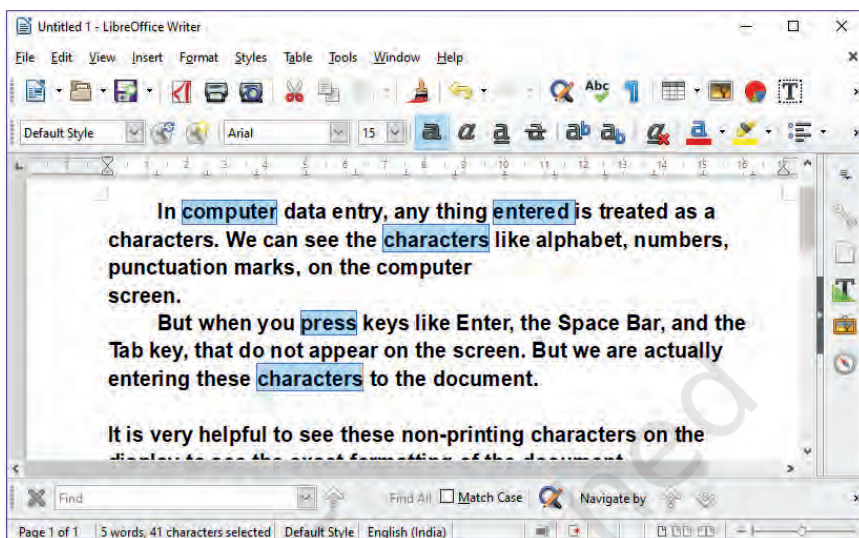


Fig. 3.8: Selecting non-consecutive text items

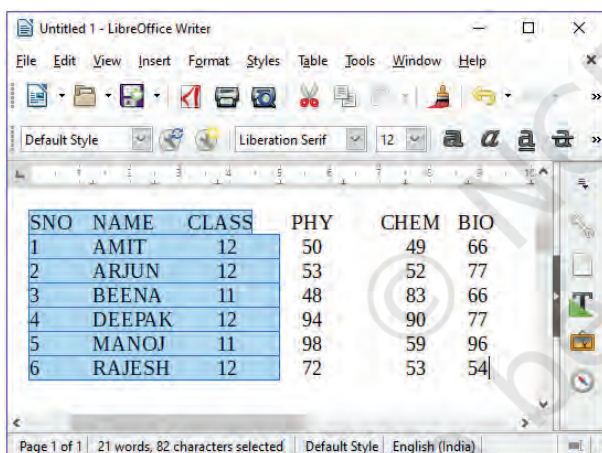


Fig. 3.9: Selecting vertical block of text

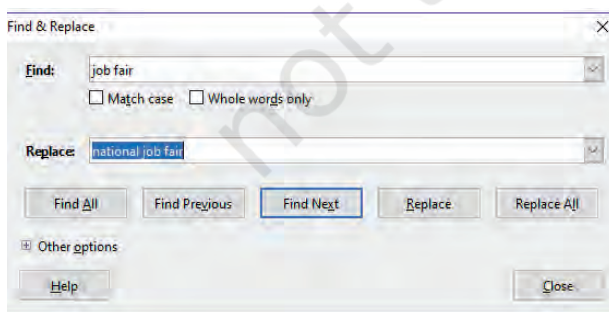


Fig. 3.10 : Find and Replace the word

(g) Selecting a vertical block of text

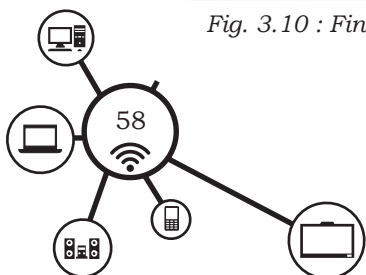
It is also possible to select a vertical block or 'column' of text that is separated by spaces or tabs (Figure 3.9).

(h) Find and Replace

This feature is used to search for a text and replace it with other text.

- Select **Edit → Find & Replace**, the dialog box will open.
- Type the text to find in the **Find** box.
- To change the text with different text, enter the new text in the **Replace** box. For example, while writing the paragraph the word 'IT Job Fair' was typed but it should be 'NationalITJobFair'. So let's replace it (Figure 3.10)

Step 1: Click on **Edit Menu → Find & Replace** option or press **CTRL+F**



Step 2: Write text under Search For option and click on Find button to locate the entered word. This will select the word which you want to search for. Also, you can click on Find All to select and display all occurrences of the entered text.

Step 3: Write the text under Replace with option. Now click on Replace if you want to change only first occurrence of it and use Replace All to replace all the matching occurrences.

Find only locates the text given in Search for whereas Replace changes the text into the Replace with text.

Find will search one instance at a time whereas Find All will search all instances in one go.

(i) Jumping to the page number

Sometimes we may require to jump to a particular page number. It becomes difficult to scroll down if it is a large document with several pages. In such a situation, 'Go to Page' feature of Writer is useful. To do this, select the **Edit Menu** → **Go to Page (Keyboard shortcut: Ctrl+G)**. Specify the page number in the dialog box. The cursor will move to the first character of the specified page number directly (Figure 3.11).

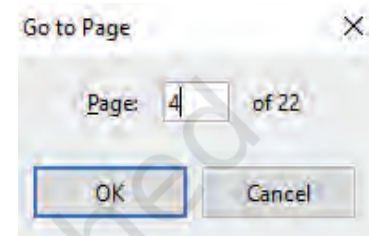


Fig. 3.11 : Go to Page

(j) Non-printing characters

In computer data entry, anything entered is treated as a character. We can see the characters like alphabet, numbers, punctuation marks, on the computer screen.

But when you press keys like Enter, the Space Bar, and the Tab key, that do not appear on the screen, we are actually entering these characters in the document.

It is very helpful to see these non-printing characters on the display to see the exact formatting of the document.

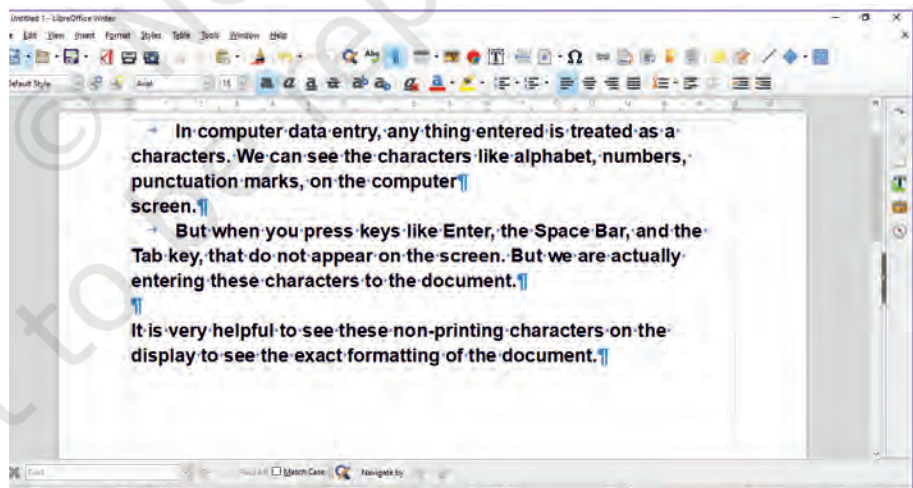
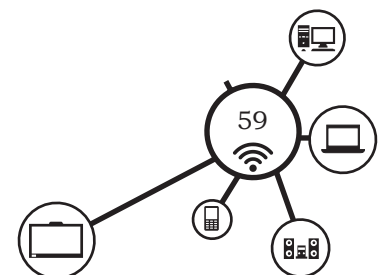


Fig. 3.12: Non-printing characters

To display the non-printing character, press the toggle formatting mark (¶) or use keyboard shortcut **Ctrl+F10**. The tab space is shown by → sign and spacebar is shown by dot (.) as shown in Figure 3.12.



(k) Checking spelling and grammar

While writing a report on paper, sometimes we may not remember the spelling of some words. In this situation we refer to the books or confirm the spelling from

teachers or parents. Also while word processing a document, we may commit spelling mistake. In such cases, the Writer helps us to correct the spelling. It also provides a grammar checker to check the grammar of the sentence. It can be used separately or in combination with the spelling checker. This is one of the important features of any word processing application.

If any grammatical errors are detected, they are underlined by a wavy blue line. Right-clicking on this line brings up a context menu as shown in Figure 3.13. The first entry in the menu describes the suspected broken grammatical rule. We can do the correction as suggested.

So after typing a paragraph of a report, one can check the spelling and grammar. A spelling checker checks to see if each word in the document is in the installed dictionary. The grammar checker, can be used separately or in combination with the spelling checker.

To check the spelling and grammar of the document (or selected text), select **Tools** → **Spelling and Grammar**, or click the **Spelling and Grammar** button on the Standard toolbar, or press the keyboard key F7.

The Spelling and Grammar dialog (Figure 3.14) opens.

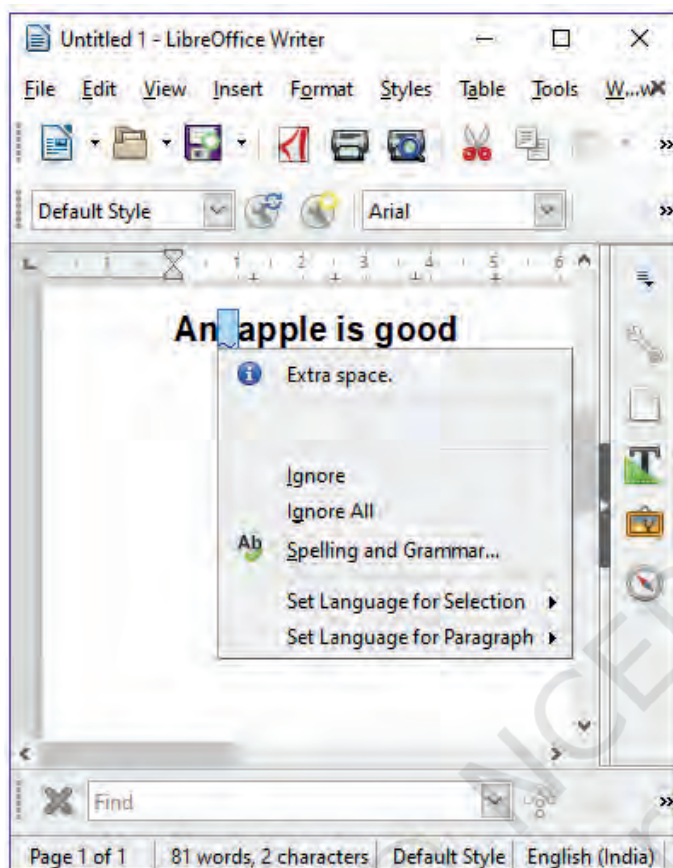


Fig 3.13: Context menus for suspected grammar errors

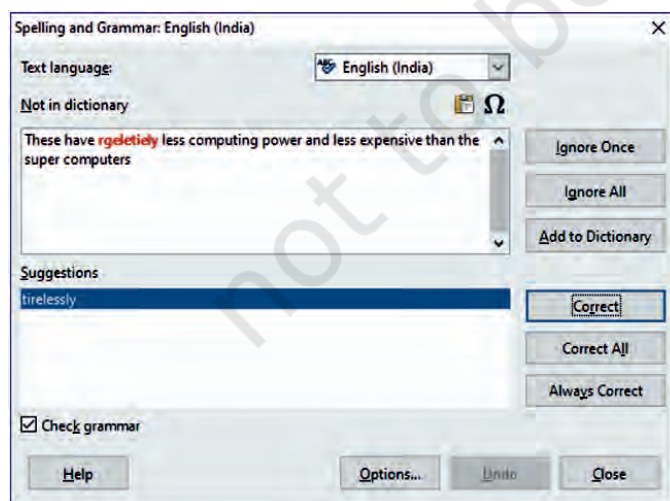
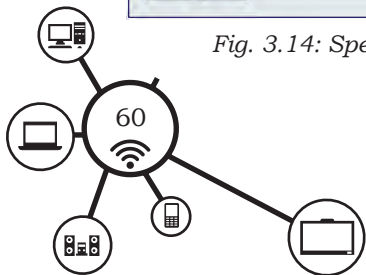


Fig. 3.14: Spelling and Grammar dialog box



You can choose to restart from the beginning of the document when the check reaches the end of the document.

Automatic Spell Checker checks each word as it is typed and displays a wavy red line under any unrecognised words. Right-click on an unrecognised word to open a context menu (Figure 3.15). Certain suggestions will be displayed for the selected word. Click on the most appropriate word out of the suggested words to replace the underlined word. After making corrections, the line disappears.

(1) Using synonyms and the thesaurus

Sometimes you search for a word having a similar in meaning to the word you have in mind. A word processor helps to look up synonyms (different words with the same meaning) and antonyms (words with the opposite meaning) in the thesaurus. The list of synonyms can be accessed from a context menu (Figure 3.16). Right-click on a word and point to **Synonyms** on the context menu. A submenu of alternative words and phrases are displayed. Click on a word or phrase in the submenu to replace it with the highlighted word or phrase in the document.

Synonyms are different from a dictionary. A dictionary contains definitions and pronunciations, whereas thesaurus will have words with similar meanings or opposite meanings.

Let's check the thesaurus for words which have similar meanings to 'market' in 'IT job market'.

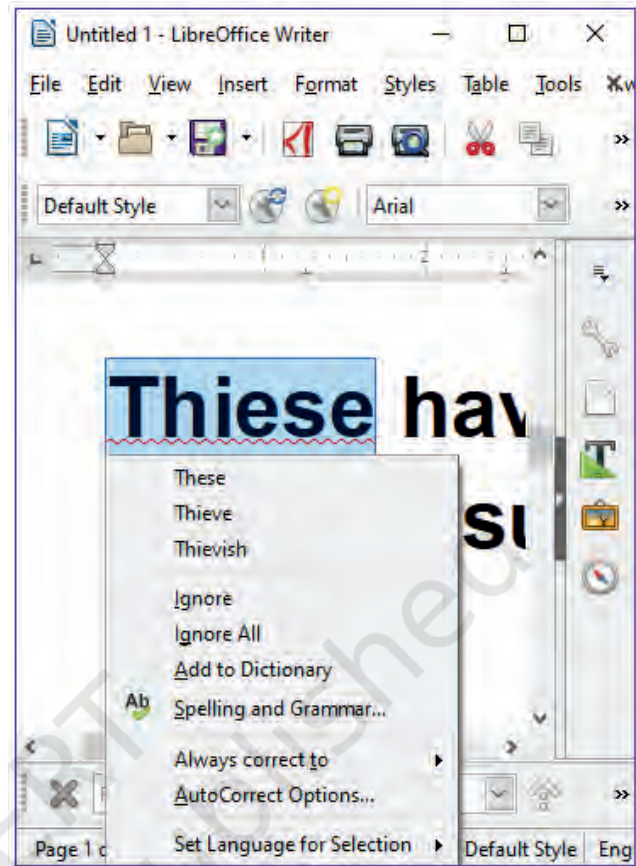


Fig. 3.15: Right click to spell check

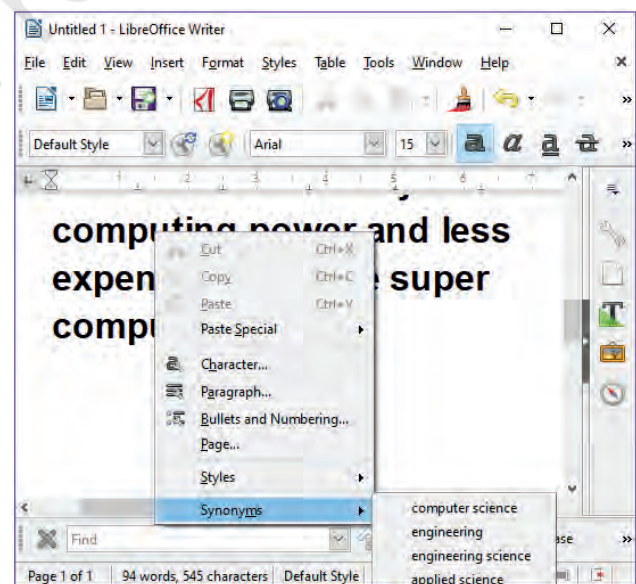


Fig. 3.16: Synonyms on the context menu

NOTES

Formatting a document

The first step in document preparation is to use page setup. The Page Formatting is explained in the next section. But for the document preparation, Page setup is taken here.

To setup a page, select and click on the **Format** → **PageSetup** and the **Page** option.

Page style dialog

The Page style dialog box has the several options as shown in Figure 3.17.

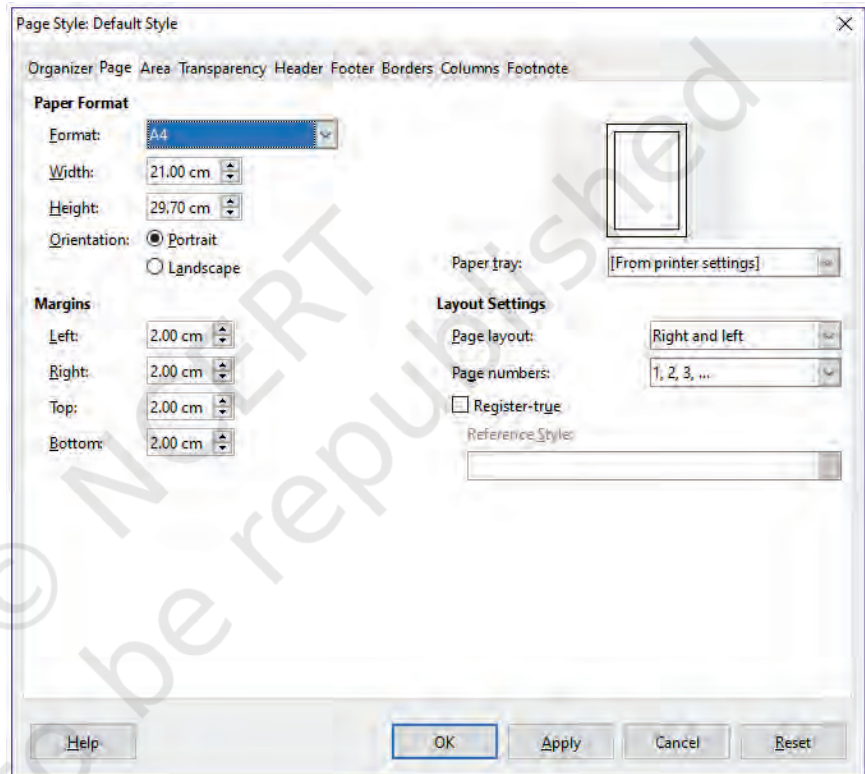
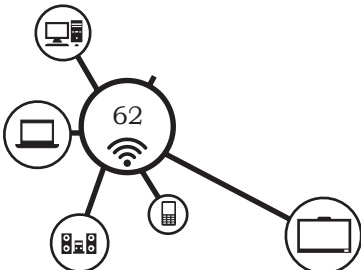


Fig. 3.17 : Page Style dialogue

It allows to select paper size and format (A4, A5, B4, Letter). User can adjust 'Orientation' as *Portrait* or *Landscape*. The user can set the Margins (Left, Right, Top, Down).

Formatting text

Formatting Text refers to the formatting of paragraphs and characters. To do the formatting, first select the text and then apply the required text formatting features.



There are various methods of formatting text. We can apply any one method as per the suitability. These methods are

- use the menu options from menu bar.
- use the readily available buttons on the formatting toolbar.
- use the context menu. The context menu appears by right clicking on the selected text.
- use the keyboard shortcut.

(a) Removing manual formatting

To see the effect of formatting the text, first remove manual formatting. For this, select the text and choose **Format** → **Clear Direct Formatting** from the Menu bar, or click the Clear **Direct Formatting** button on the Formatting toolbar, or use **Ctrl+M** from the keyboard. It will clear the existing formatting on the text and then you can apply the fresh formatting features.

(b) Common text formatting

Some of the common text formatting features generally used have been shown in Figure 3.18.

1. Changing font size – by selecting font size.
2. Changing font style – bold, italic, underline
3. Changing font type – by selecting font drop down.
4. Changing font colour – by selecting font colour icon.

On the Format Toolbar, you will find the buttons representing the letter a in Bold, Italic and Underline form. These are toggle buttons.

To apply any of the effect of bold, italic and underline, first select the text. Then press the desired buttons on the formatting toolbar. The keyboard shortcuts for bold (**Ctrl+B**), for italic (**Ctrl+I**) and (**Ctrl+U**) for underline. Applying the required font effects will change the font as shown in the Figure 3.18.

(c) Changing text case

It is possible to change the case of the text. There are 6 Change Case options in LibreOffice Writer as shown

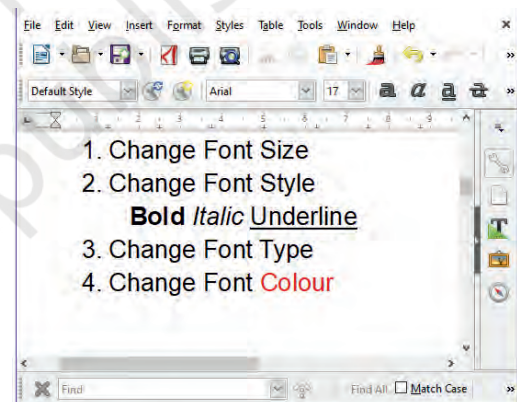
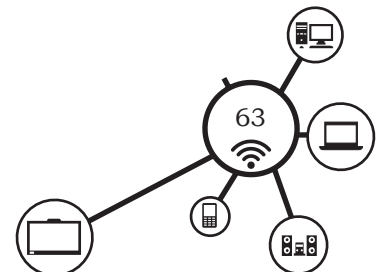


Fig. 3.18 : Text formatting



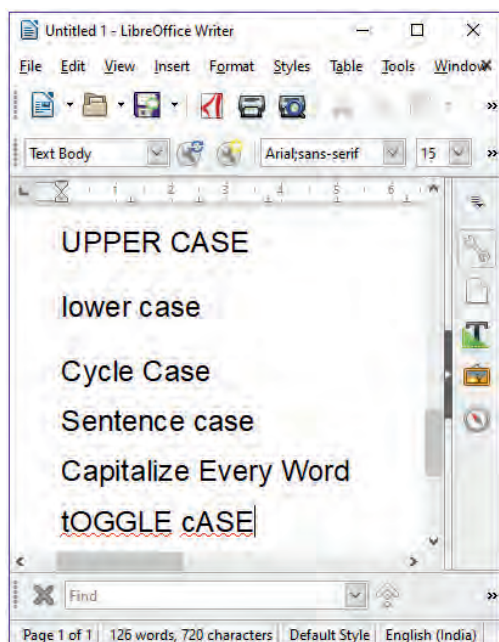


Fig. 3.19: Changing case

in Figure 3.19. These operate on currently selected text.

(d) Superscript and Subscript

For example, in the date 5th July, the 'th' character appearing after 5 is in the superscript case. In some situations, such as while writing scientific/chemical formula, such as O₂, the character 2 is in the subscript case.

Now, in our example, change the 5th July to 5th July.

- **To apply superscript:** Select the text and select **Format** → **Text** → **Superscript**
- **To apply subscript:** Select the text and select **Format** → **Text** → **Subscript**

Let's Practice 2

Open the Word Processing software and perform the following.

1. Prepare your page as follows.

Size – A4	Orientation Landscape	Margins – 2' from left and right 1.5' from top and bottom
-----------	--------------------------	--

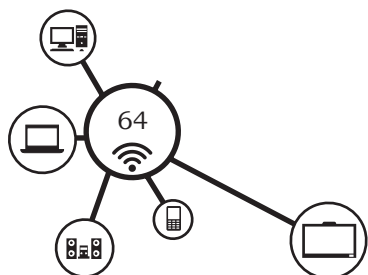
Use 'Page Setup' Dialogue Box. 2. Use Bold, Italic, Underline, Change Case, Font Color and Format the text as shown below and save it as Activity 3. Close the document.

REPORT

Field Visit to IT Job Fair

We visited the IT Job Fair, 2018 held at **Kasturchand Park, Nagpur** on 5th July. It was quite knowledgeable experience for us. We came to know about the various information in IT Sector.

The **Information Technology & Information Technology Enabled Services (IT-ITeS)** sector is a field which is undergoing rapid evolution and is changing the shape of Indian business standards. This sector includes software development, consultancies, software management, online services and **Business Process Outsourcing (BPO)**.



Paragraph style

A paragraph in a document can have several sentences, a single sentence, a single word, or no words at all. Every paragraph in a LibreOffice Writer document has a paragraph style. The paragraph style settings have a pop down window. One can change the paragraph style by clicking on the pop down window and selecting the choices as shown in Figure 3.20.

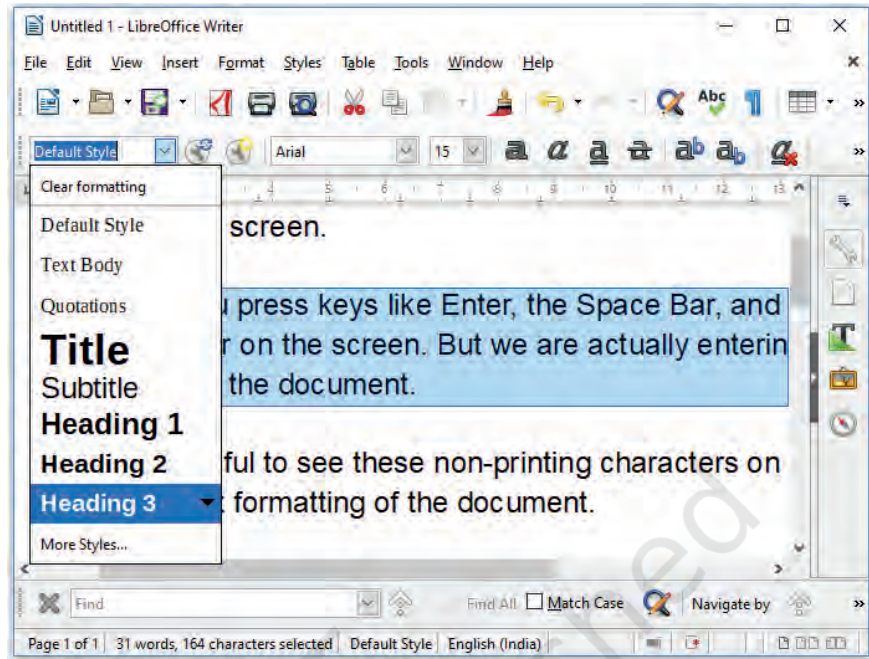


Fig. 3.20: Paragraph Style

(a) Indenting paragraphs

The entire paragraph can be indented in one step. Place the Text Cursor anywhere in the paragraph, select and click on the 'Increase Indent' tool. Each time when you click on the Increase Indent tool, the current paragraph's indent will increase. There is also a Decrease Indent tool that removes the indent.

Now increase the indent of the third paragraph in our assignment of Report. The output will be as shown below in Figure 3.21.

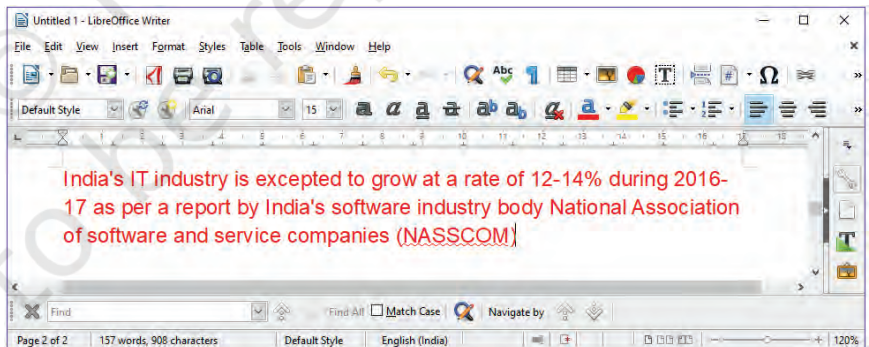
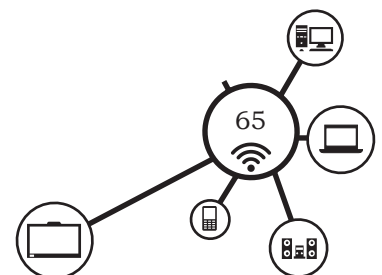


Fig. 3.21 : Paragraph indentation

(b) Aligning paragraphs

The paragraph can be aligned as Left, Right, Center and Justify. To align the paragraph, place the text cursor in the title paragraph, select the appropriate tool (Left, Right, Center or Justify) from the Format Toolbar.



To change the paragraph style

- First select the paragraph by paragraph selection method.
- Select the drop down arrow of paragraph style.
- Select Text Body from the pop down menu.
- Move the mouse pointer to outside the selected text and click the left mouse button once to de-select the text.

The selected words should now be centered in your document.

Move the mouse pointer over the four different alignment tools and read the Tool Tips, Align Left (**Ctrl+L**), Center Horizontally (**Ctrl+E**), Aligned Right (**Ctrl+R**) and Justified (**Ctrl+J**). The Justified option makes both the left and right sides of the paragraph line up with the margins. All these text alignment are shown in the Figure 3.22.

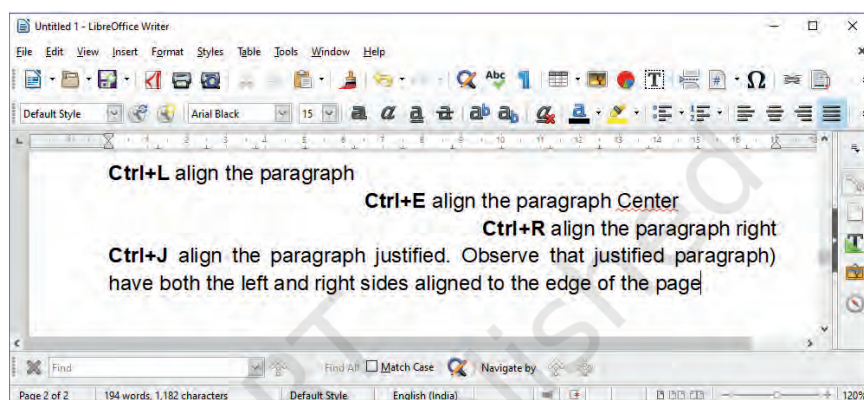


Fig. 3.22: Paragraph alignment

To explore more paragraph formatting features ...

- Select a paragraph
- Click on the required tools on 'Formatting Tool Bar' Or
- Open **Format** → **Paragraph** Dialogue Box
- Select the appropriate tools
- Click **Ok**

(c) Font colour, highlighting, and background colour

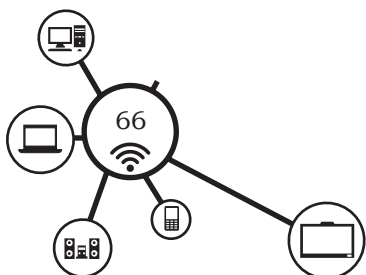
There are three more tools—Font Color, Highlighting, and Background tools on the Format Toolbar.

- To change the font color, select the small down pointing arrow ▼ on the right edge of the Font Color tool and select the colour from the colour box.
- To change the highlight colour, select the small down pointing arrow ▼ on the right edge of the Highlighting tool and change the colour from the colour box.

Let's Practice 3

Open the LibreOffice Writer and perform the following:

1. Enter the text and format the paragraphs as shown in Table (given on next page) in Column A.
2. Format it again as shown in Column B (See Table on next page). Save and close the document.



Column A	Column B
What is a computer? A computer is an electronic device that manipulates information or data. It has the ability to store, retrieve, and process data. You can use a computer to type document, send email, and browse the web. You can also use it to handle spreadsheets, accounting database, management, presentations, games, and more.	What is a computer? A computer is an electronic device that manipulates information or data. It has the ability to store, retrieve, and process data. You can use a computer to type documents send email and browse the Web.

(d) Using the bullets and numbering

You can assign the bullets or numbering to the list items in the document by using the options on the Bullets and Numbering toolbar. You can also create a nested list by using the buttons on the Bullets and Numbering toolbar. The general options available for bullets and numbering are shown in Figures 3.23 and 3.24. A nested list has a sub-list under it. Bullets and Numbering dialog contains more detailed controls (Figure 3.25).

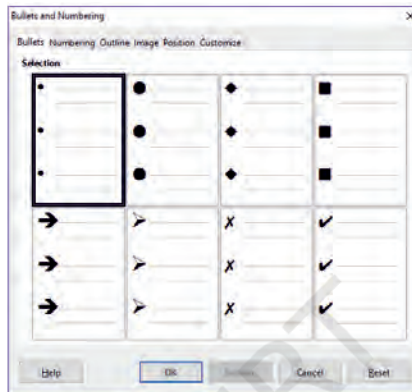


Fig. 3.23 : Bullets

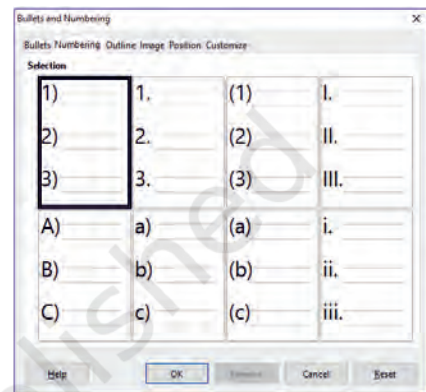


Fig. 3.24: Numbering

(e) Assigning colour, border and background

1. To assign background colour to the paragraph, first select the paragraph.
2. Select **Format** → **Paragraph** → **Area** → **Colour**, then select the colour.

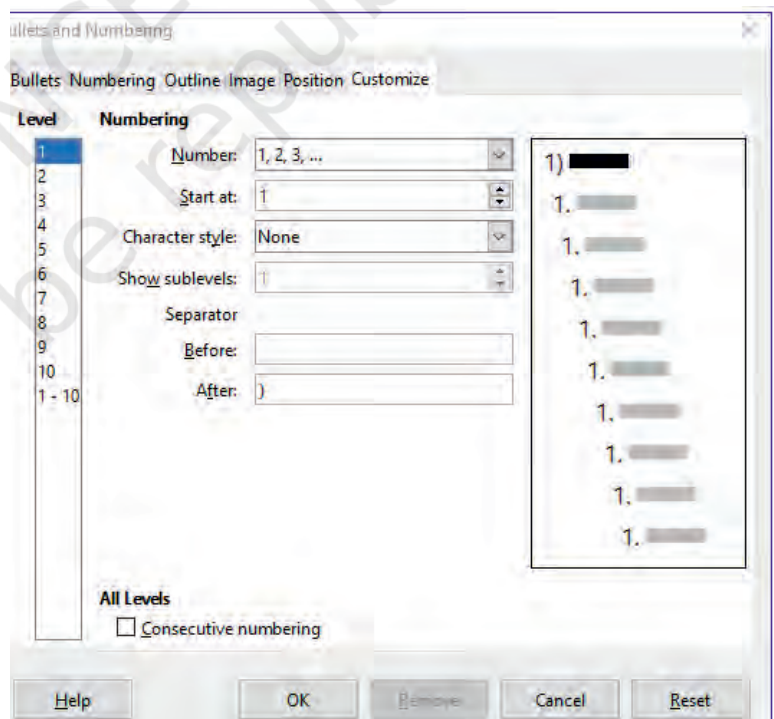
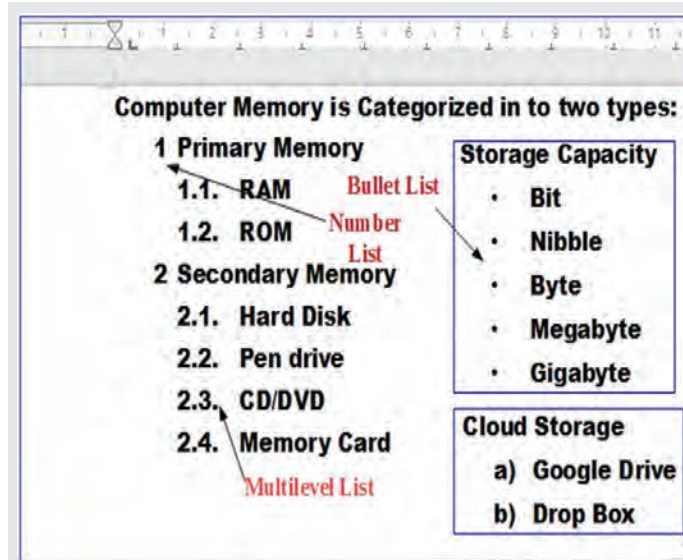


Fig. 3.25: Bullets and Numbering dialog

3. To assign border to the paragraph, select the paragraph, then select *Format* → *Paragraph* → *Borders* → *Select Line – Style, Width, Colour*.
4. After selecting, click '**Ok**'.



Let's Practice 4

Practice to assign normal bullets and numbering to the list items as shown in figure below. Create a new document and enter the text on Computer Memory. Assign the variety of bullets and numbering as shown in the adjacent figure.

Let's Practice 5

Make a list of bullets as shown in the adjacent figure. Save the document. Close the document.

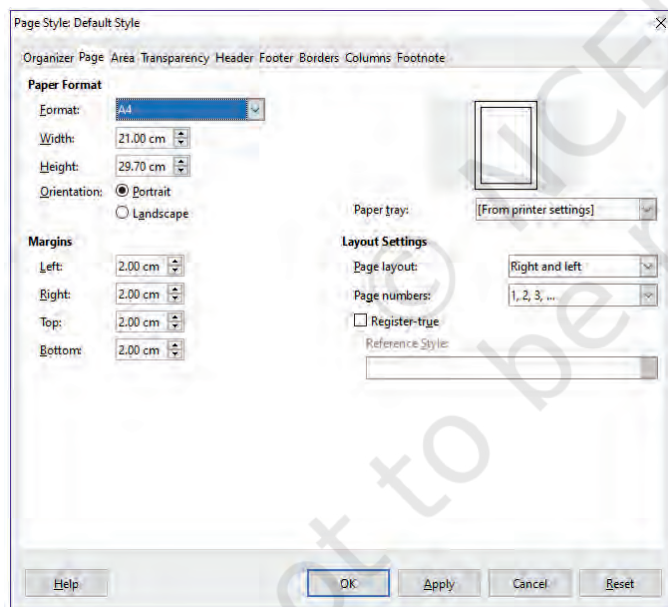


Fig. 3.26: Formatting page

Page formatting

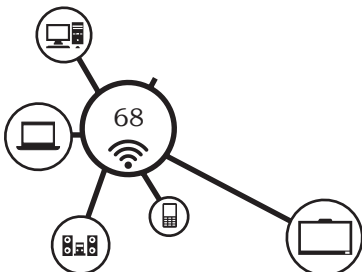
(a) Setting up basic page layout using styles

Page *styles* define the basic layout of all pages in the document. It includes page size, margins, header and footer, border and background, number of columns, etc. (Figure 3.26).

The *Default Style* is assigned to the new document by default. It appears on the taskbar of the writer window. To change the various parameters of the page, just click on the *Default Style* on the taskbar or click on the **Format** → **Page**.

(b) Inserting a page break

In multi-page documents the text flows from one page to the next as you add information. In certain cases we may require to break the current page and move the next heading or next chapter to the new page in



the same document. In such cases we have to break the page forcefully and take the cursor to the next page to insert the new heading. This is called as a page break.

To break the current page and start the new page select **Insert** → **Page Break** from the Menu bar or use the keyboard command (**Ctrl + Return**).

The Page break can also be narrowed down to the line and column, by using **Insert** → **Manual Break**, as shown in Figure 3.27.

(c) Creating header/footer and page numbers

In a multi-page document, it becomes necessary to add a header and footer to document for more readability. Headers appear at the top of every page; footers appear at the bottom of a page. Headers and footers are specified by page styles; therefore, all the pages with the same page style will display the same header and footer.

To insert header in the document, select **Insert** → **Header and Footer** → **Header**

To insert footer in the document, select **Insert** → **Header and Footer** → **Footer**

You can give the document name or chapter name in the header section and page number in the footer section.

To enter page numbers in the footer section, place the cursor in the footer section and select **Insert** → **Page Number**.

(d) Defining borders and backgrounds

Assigning borders and backgrounds to important paragraphs, frames and pages give attractive look to the document. For example, by assigning borders or backgrounds a reader is able to differentiate the points to remember from the regular text.

- (i) Adding border: It is possible to apply the border, either to individual characters or to selected text. The process is similar in each case. The preset

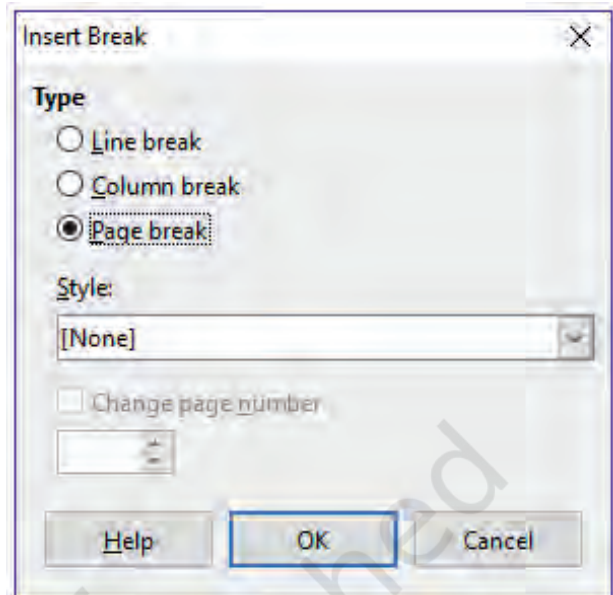
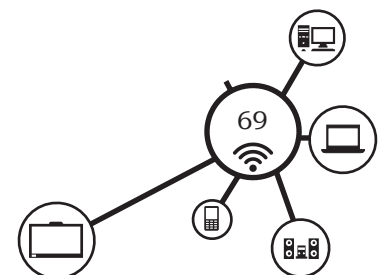


Fig. 3.27 : Insert manual break

Different types of software

1. Application Software
 - a. LibreOffice
 - Writer
 - Calc
 - Impress
 - b. Microsoft Office
 - c. Gimp
 - d. Adobe Photoshop
2. System Software
 - (i) Windows
 - (ii) Linux
 - (iii) Mac



Insert Elements in Writer document

- Images
- Shapes
- Objects
- Chart
- Symbols
- Special Character
- Tables
- Header and Footer
- Page Numbers
- Columns
- WordArt/Fontwork

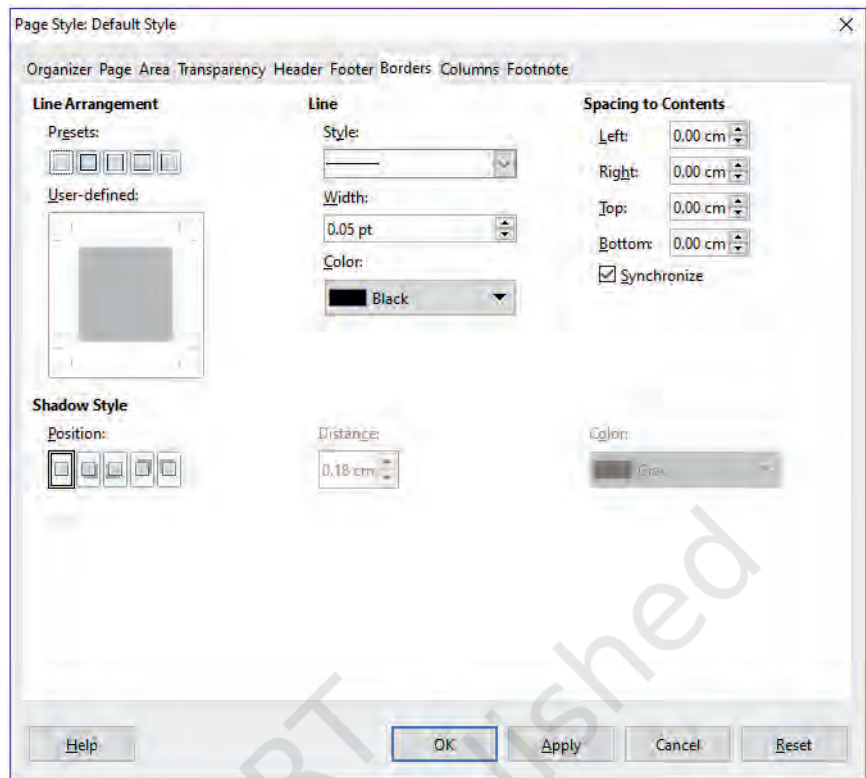


Fig. 3.28: Adding border to paragraph

shows the preview of the selected border (Figure 3.28).

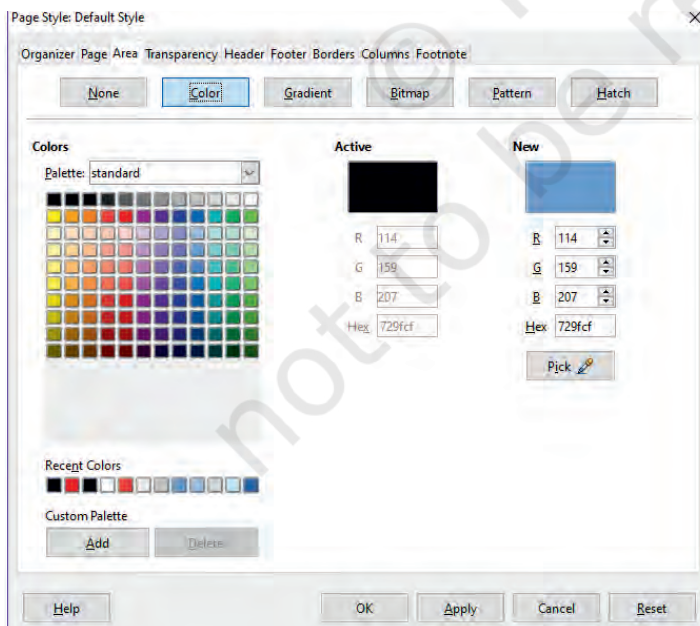
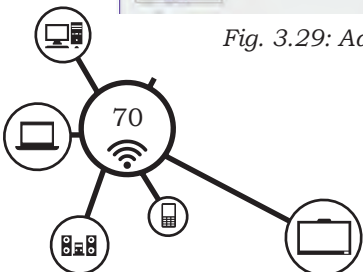


Fig. 3.29: Adding background to paragraph

(ii) Adding background colour: To add background color to the paragraph, select the paragraph. Select the Area tab from the Paragraph dialog. Alternately, right-click anywhere in the paragraph, and choose Paragraph from the context menu. In the dialog, select the Area tab, then choose Color. Select the color from the color grid to use for this frame, and then click **OK** to apply it to the background (Figure 3.29).

The color, gradient, bitmap, pattern, hatch can be added in the same way by clicking the respective buttons in the dialog.



To delete a color, gradient, bitmap, or other background, select **None** near the top of the Area page of the Frame dialog.

(e) Inserting images, shapes, special characters in a document

The regular text in the document can be made attractive and more informative by inserting the various elements as listed below. You can also explore more tools to be inserted in the document.

- (i) Inserting image: If you wish to include any picture or image in your document, the image file should be stored in your hard disk or external storage, such as Pen drive. To insert an image in your document, position the cursor where you want to insert the file, select **Insert** → **Image**. Another alternative is, just click on the insert image icon, located below the Formatting Toolbar. A file manger will appear from where you can select the image file. Select the image file and click on Open button or just double click on the image file. The image will get inserted in the file (Figure 3.30).

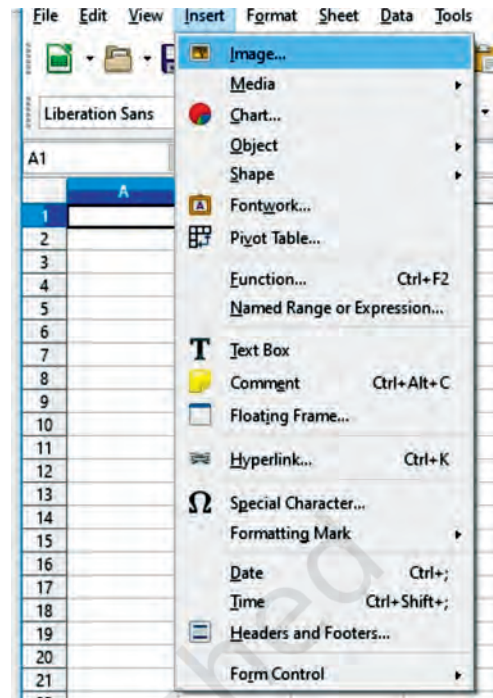


Fig. 3.30: Selecting insert image option from Insert menu option

- (ii) Inserting special characters: Sometime we may require to enter the special character, such as ¶ or which cannot be typed by using the keyboard. LibreOffice Writer provides a feature to enter the number of special characters as shown in the following dialog. To do this select **Insert** → **Special Character** (Figure 3.31).

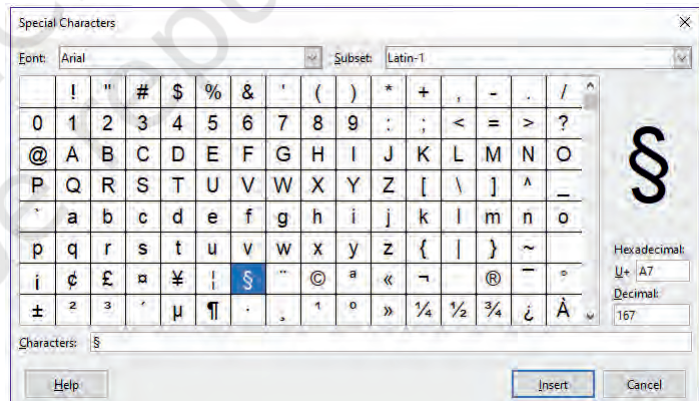
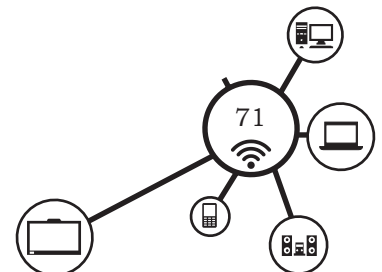


Fig. 3.31 : Inserting special character

- (iii) Inserting shapes: It is possible to insert various shapes in your document. The variety of shapes consists of Lines, Arrows, Symbols, Stars, Callouts, Flowcharts. For this, keep the cursor in the place you wish to add the shape and select **Insert** → **Shape** and then choose the further element you wish to insert.



(f) Dividing the document page into columns

You may have seen some documents where its page is divided into two or three columns. It is used in magazines and newspapers. It is possible to arrange the regular text into columns before or after adding the text.

To divide the page into columns, select **Format** → **Column**. A Column dialogue box as shown in Figure 3.32 will appear. Enter the number of columns in the Column entry box. Give the value for spacing between the columns and click **OK**. On selecting the number of columns up to 3, the formatted page will look like as shown in Figure 3.33.

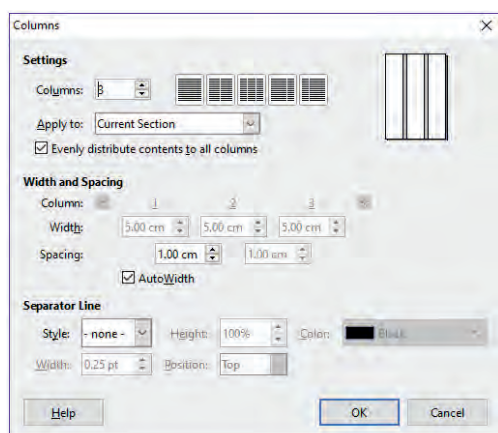


Fig. 3.32 : Column dialog box

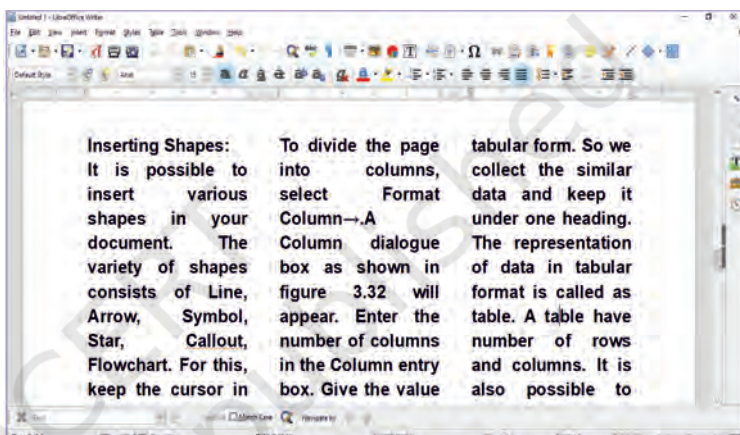


Fig. 3.33: Page formatted into 3 columns

(g) Formatting the shape or image

User can format the shape or image inserted in the document. For instance, user can change its size, colour, add borders, change its position, etc.

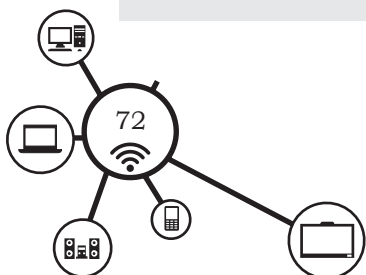
First, select the shape or image by clicking on it. Then make use of the Tool Bar to perform the required changes.

Creating and managing tables

In a document it is normally seen that some data are represented in tabular form. So we collect the similar data and keep it under one heading. The representation of data in a tabular format is called as table. A table has a number of rows and columns. It is also possible to have a table with one row and one column.

Consider an example of representing your school timetable, your marksheet, your teachers teaching

- Create tables with rows and columns
- Delete rows/columns
- Merge cells
- Split cells
- Colour the table
- Change text direction



various subjects. To represent such data you have to create a table. LibreOffice Writer provides a very rich tool for creating and managing a table. The various features of the table are:

Time Table Class IX									
Day/ Period	1	2	3	4		5	6	7	8
Time	7:30 to 8:10	8:10 to 8: 50	9:00 to 9:40	9:40 to 10:20	10:20 to 10:40	10:40 to 11:20	11:20 to 12:00	12:10 to 12:50	12:50 to 13:30
Day 1					LUNCH BREAK				
Day 2									
Day 3									
Day 4									
Day 5									
Day 6									

(a) Creating a table

The simplest way to create a table is, click the **Table** icon on the Standard toolbar. On the drop-down graphic, choose the size of the table. To create the table, click on the cell representing the last row of the last column that you want. Holding down the mouse button (Figure 3.34) over the Table icon will also display the graphic.

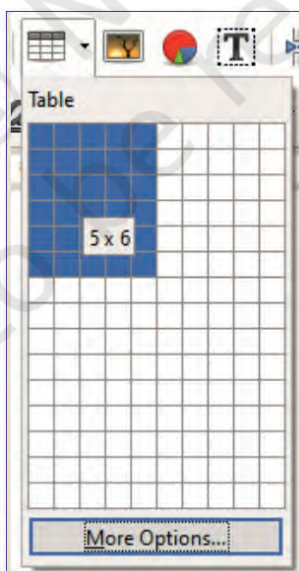


Fig. 3.34: Creating table

Another way to create a table is by using the Table dialog. Position the cursor where you want to insert the table, then:

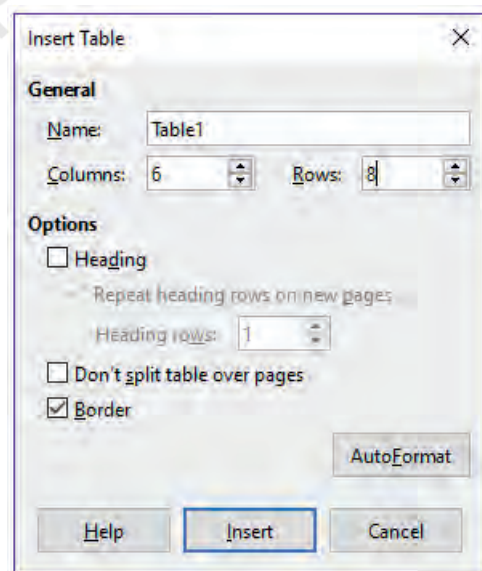
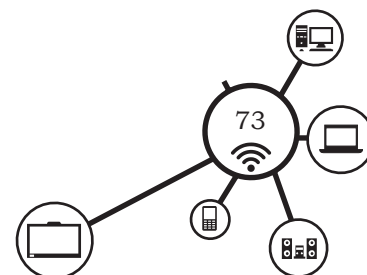


Fig. 3.35 : Insert Table

Select **Table** → **Insert Table** from the Menu bar as shown in Figure 3.35 (or Press **Ctrl+F12**).



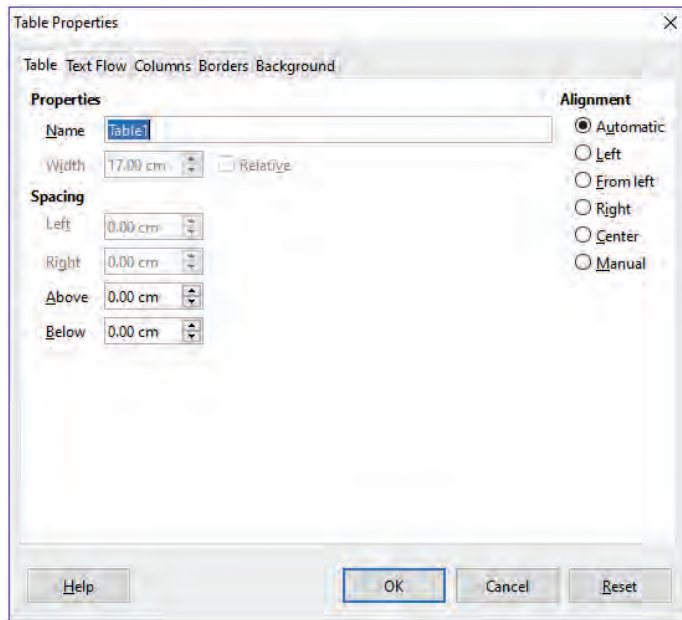


Fig. 3.36 : Table properties

It will create a simple table. After creating a table, you can explore more features. For this, select **Table** → **Properties**.

(b) Inserting rows and columns

To insert one row or column in the table:

- Place the cursor in the row or column before or after which you want to add new rows or columns.
- Click on the **Rows Above or Rows Below icons in the Table toolbar** to insert one row above or below the selected one.
- Click on the **Columns Left or Columns Right icons in the Table toolbar** to insert a column to the left or right of the selected one.
- Choose **Insert** → **Rows Above/Below or Insert** → **Columns Above/Below**. Set number to define the number of rows or columns to be inserted, and select the Position as Before or After.
- Click **OK** to close the dialog box.

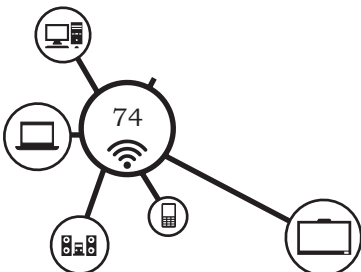
(c) Deleting rows and columns

To delete one or more rows or columns, place the cursor in the row or column you want to delete and do one of the following:

- Click on the Rows or Columns icons on the Table toolbar
- Right-click and choose **Delete** → **Rows** or **Delete** → **Columns**.
- Press **Alt+Delete** on the keyboard and use the arrow keys to delete rows or columns as described above for inserting.

(d) Splitting and merging tables

One table can be split into two tables, and two tables can be merged into a single table. Tables can only be split horizontally.



(i) To split a table

- Place the cursor in a cell that will be in the top row of the second table after the split (the table splits immediately above the cursor).
- Choose **Table** → **Split Table** from the Menu bar.
- A Split Table dialog opens. You can select No heading or an alternative formatting for the heading—the top row(s) of the new table.
- Click **OK**. The table is then split into two tables separated by a blank paragraph.

(ii) To merge two tables

- Delete the blank paragraph between the tables. You must use the Delete key (not the Backspace key) to do this.
- Select any cell in one of the tables.
- Right-click and choose Merge Tables in the context menu. You can also use **Table** → **Merge Table** from the Menu bar.

(e) Deleting a table

(i) To delete a table

- Click anywhere in the table.
- Choose **Table** → **Delete Table** from the Menu bar.

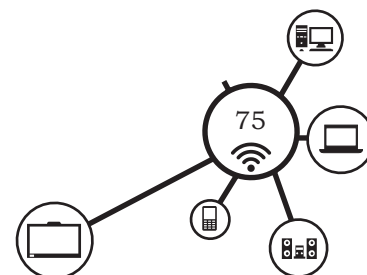
Or

- Select from the end of the paragraph before the table to the start of the paragraph after the table.
- Press the *Delete* key or the Backspace key.

(f) Copying a table

To copy a table from one part of the document and paste onto another part:

- Click anywhere on the table.
- From the Menu bar choose **Table** → **Select** → **Table**.
- Press *Ctrl+C* or click the **Copy** icon on the Standard toolbar.
- Move the cursor to the target position and click on it to fix the insertion point.



- Press *Ctrl+V* or click the **Paste** icon in the Standard toolbar.

(g) Moving a table

To move a table from one part of a document to another part:

- Click anywhere in the table.
- From the Menu bar, choose **Table** → **Select Table**.
- Press *Ctrl+X* or click the **Cut** icon in the Standard toolbar.
- Move the cursor to the target position and click on it to fix the insertion point.
- Press *Ctrl+V* or click the **Paste** icon in the Standard toolbar. (This pastes the cells and their contents and formatting.)
- Return to the original table, click somewhere in it and then choose **Table** → **Delete Table** from the Menu bar.

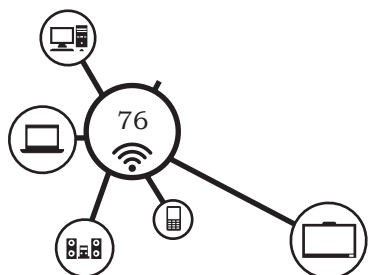
Let's Practice 6

Create a table as shown in the figure below. Save it in your folder.

Time Table Class 9									
Day/ Period	1	2	3	4		5	6	7	8
Time	7:30 to 8:10	8:10 to 8: 50	9:00 to 9:40	9:40 to 10:20	10:20 to 10:40	10:40 to 11:20	11:20 to 12:00	12:10 to 12:50	12:50 to 13:30
Day 1					LUNCH BREAK				
Day 2									
Day 3									
Day 4									
Day 5									
Day 6									

Printing a document

To quickly print the document without any option, Click the Print icon. The entire document will be sent to the default printer defined for your computer.



Print preview

Print Preview is useful to check the document before printing. A user can check whether the document is prepared as needed, such as indentation, borders, etc.

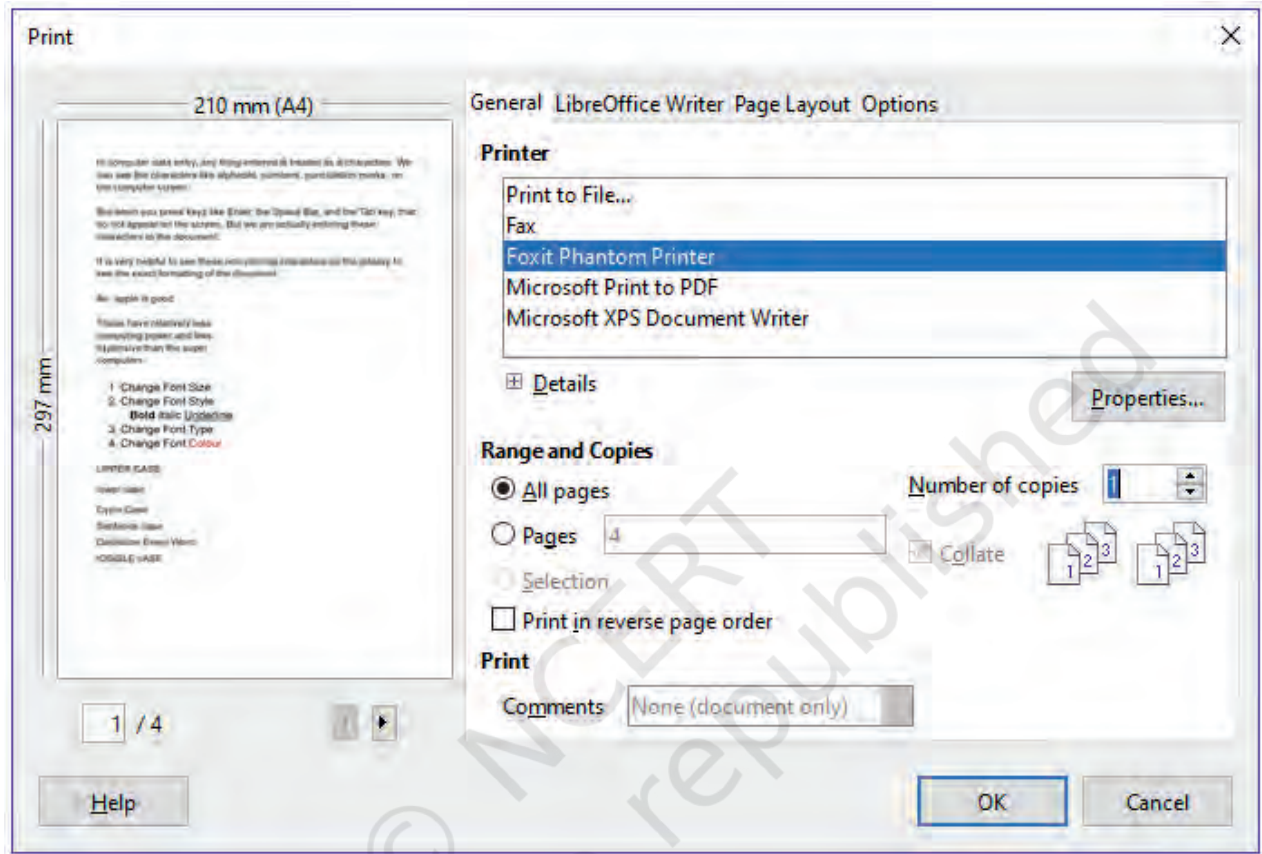


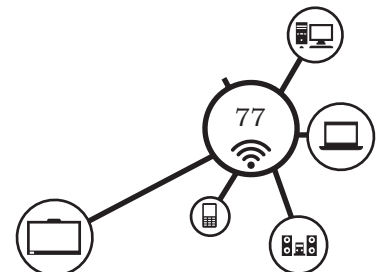
Fig. 3.37: Controlling printing

Controlling printing

To print the document with certain options, use the Print dialog (**File** → **Print** or **Ctrl+P**). A Print dialog box will appear as shown in Figure 3.37.

From the Print dialog, you can choose options as per your requirement. They are Printer, Properties, Print Range, Copies and Options. The selected options will work for the current document only.

If you click on a small triangle (▼), a list of names of printers (only those which are installed on your computer) will appear in line with the Name. You can select the printer which you want.



Printing all pages, single and multiple pages

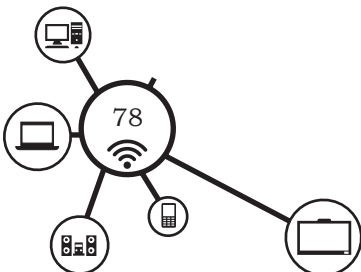
One can select the printing option as per their choice. There are three options to print the number of pages in a document.

- To print all the pages in sequence, choose the option All pages.
- To print a single page, or number of non-consecutive pages, choose the option Pages, and give the page numbers separated by comma. If you want to print the pages that are consecutive give the range of pages first and last page (for example 3-8).
- To print only the selected text, choose the option, Selection.

Mail Merge

Mail Merge is a very important feature of word processor. It is used to create a series of same documents with multiple addresses. Mail merge is the process of merging the main document (letter or certificates) with the mailing address of various persons. The main document is merged with the mailing address, hence the name mail merge. It is used to send invitations, letters or to print certificates for several people. For example, if you wish to inform your customers of a new product, then the company information and information about the new product are the same in all the documents, but the recipient information changes (first name, last name, address, greeting ...).

For example, if your principal or class teacher wants to send a letter or notice to your parents regarding any meeting or function, obviously, the matter of the letter will be the same but the addresses will be different for different parents. One way is, to create a letter in Writer, copy the address from address list to change the address of each set of parents and print the letter. The procedure of copying and changing is repeated as many times as the number of parents. This way creating multiple documents becomes very time consuming and tedious. It is not possible if there are hundreds or thousands of addresses. The word processor has a special feature of mail merge



to accomplish this task in one stroke. In mail merge two documents are created. One with the common contents is the main document or form letter and other holding the address list is called the data source. The form letter contains the actual information and variable names for the data which varies in different letters. Data source contains values of the corresponding variables of the main document. For example, the address of all the parents with respective time would be stored in data source.

Form letter consists of the main document and the data source.

Creating the data source

A data source is a set of mailing addresses in the form of a rows and columns generally called database. The content of the database is in the form of data records. Each row is a record of each person, which contains the various fields, such as name, address, pincode.

To create an address book using spreadsheet or database is little easier, as they use the table format to store the data. It is also possible to create an address book during the mail merge process using mail merge wizard (Figure 3.38[a]).

Using Mail Merge:

1. Create a new document and type the letter to be sent to the multiple recipients.

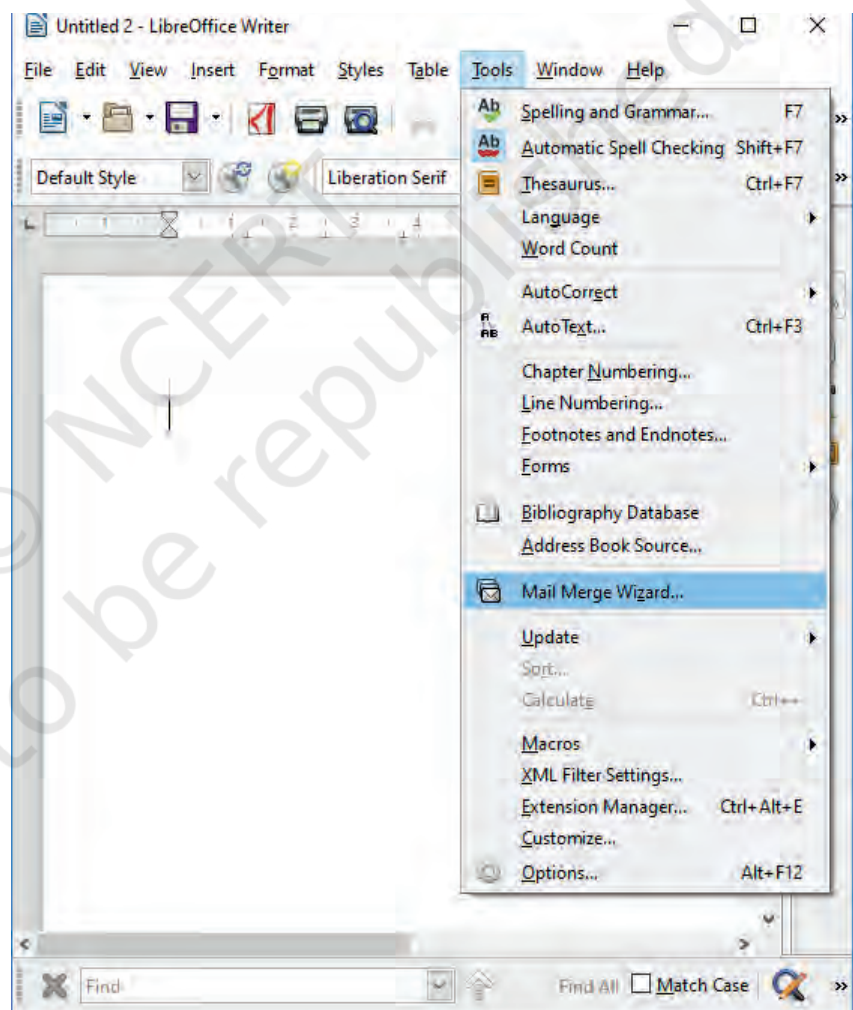
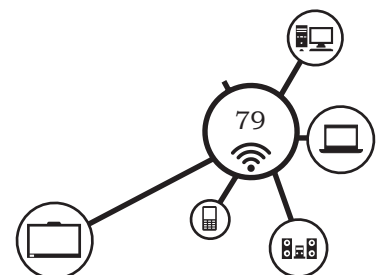


Fig. 3.38 (a) Select Mail Merge Wizard



2. To create multiple letters using Mail Merge Wizard, select **Tool** → **Mail Merge Wizard**, as shown. A window will appear as shown in Figure 3.38(b).

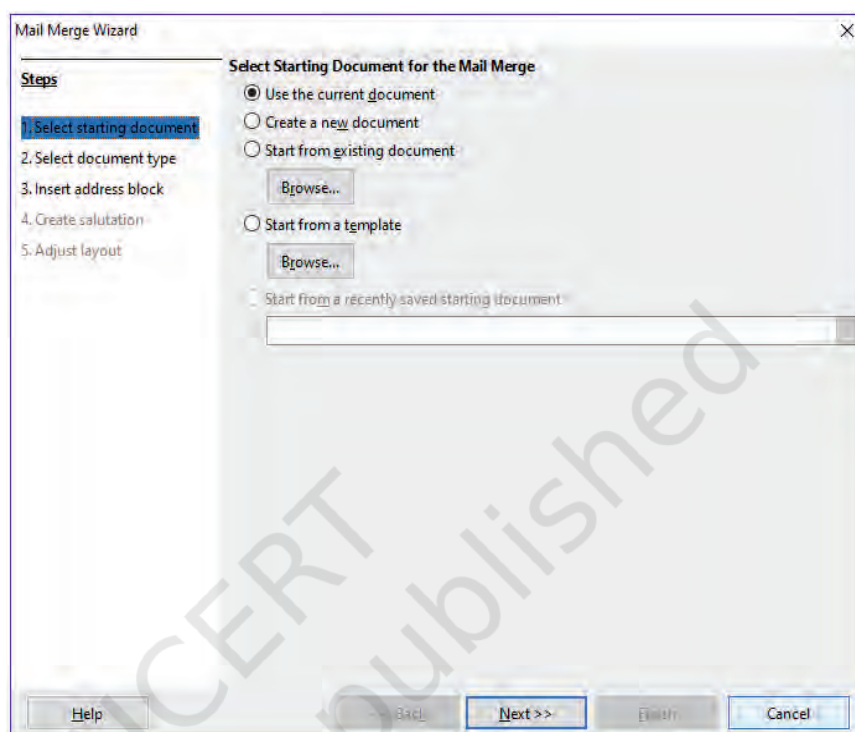


Fig. 3.38 (b) Select Main document

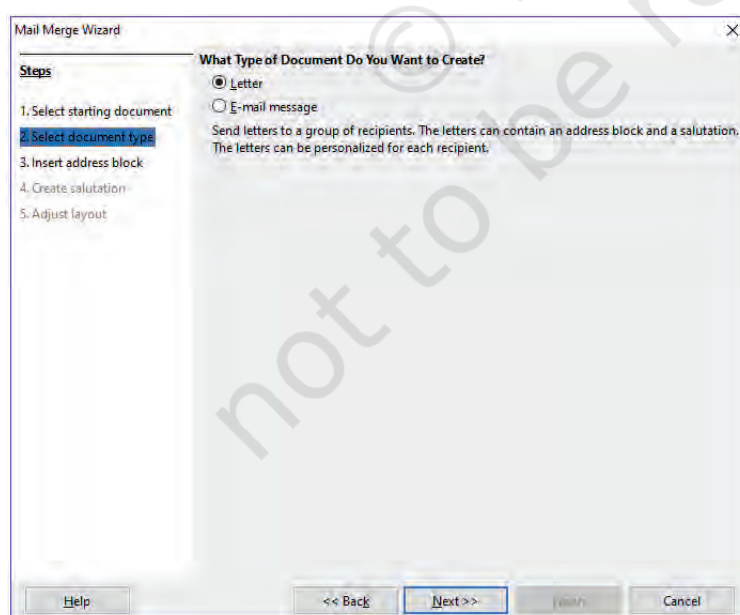
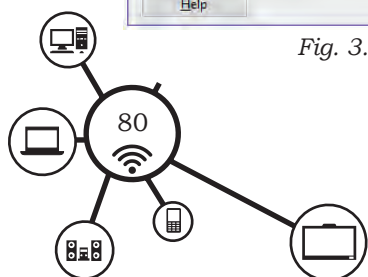


Fig. 3.38 (c) Select document type

3. Select Step1, '**Select Starting document**' → **Use the current document** → **Next**'. Click on the **Next** button move to the next step.
4. In Step 2, select the **Document type** → **Letter** → **Next** as shown in Figure (3.38c)
5. In Step 3, click on the button "**Select Address List**". The "**Select Address List**" window will open, which will



allow you to create the recipient list as shown in Figures 3.38 (d and e).

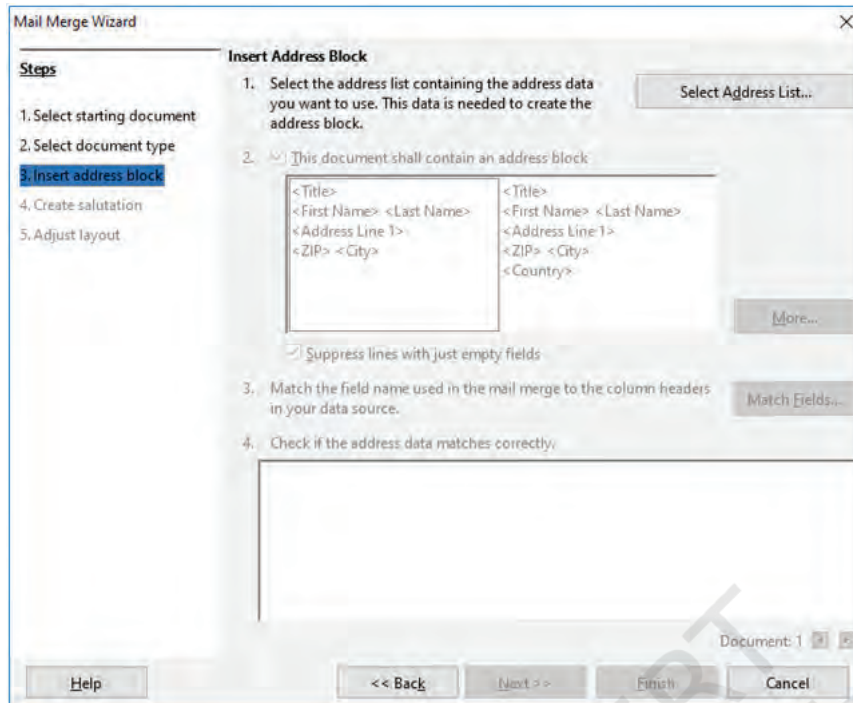


Fig. 3.38 (d) Select Address List

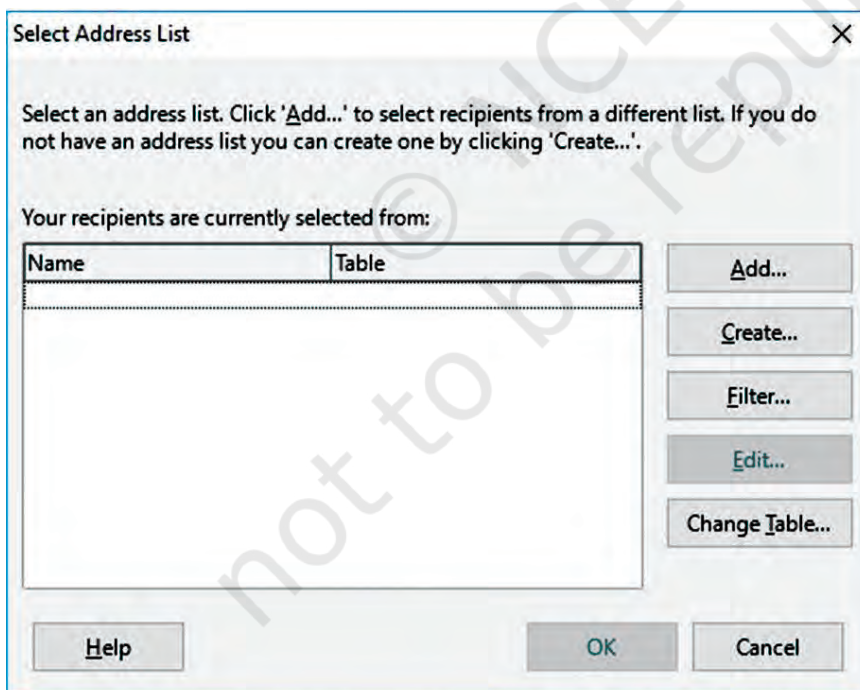
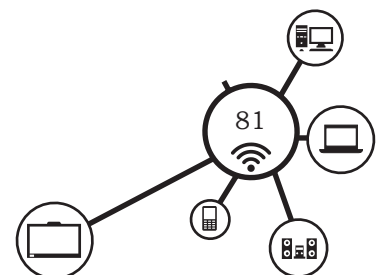


Fig. 3.38 (e) Create Recipient List

6. Click on the **Create** button. After clicking on the **Create** button a New **Address List** window will

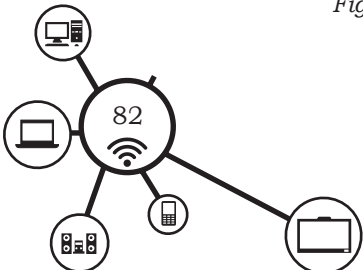


appear as shown in Figure (3.38f). In this window under the **Address Information** section you can enter the information of the recipient as shown in the Figure 3.38 (f).

Fig. 3.38 (f) New Address List

Fig. 3.38 (g) Adding new address list

7. If you want to fill the data of the recipient as per the default fields, then enter the data as shown in Figure 3.38 (g).
8. If you wish to **customise** the fields of recipient information, click on Customise button. A '**Customise Address List**' window will appear as shown in Figure 3.38 (h). Now you can add, delete or rename any field name. You can also



change the order of appearance of the fields using up/down arrow button.

- (a) Add (for a new field)
- (b) Delete (to delete an unnecessary field)
- (c) Rename (to change the name of the field)

After customising the fields, enter the data in the new format.

9. After entering the data of first recipient as shown in Figure 3.38 (g), click on the **New** button to enter the information of the next recipient. After entering the information of the entire recipient, click on the **OK** button to close the list.

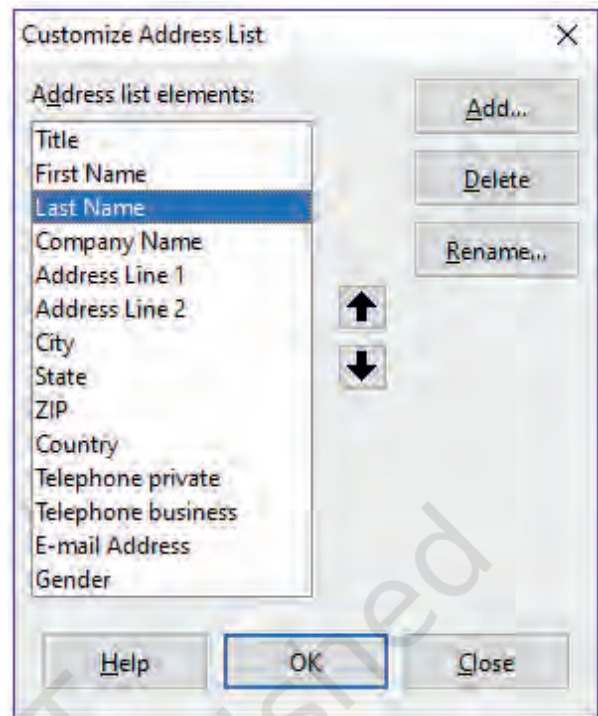


Fig. 3.38 (h) Customizing filed names

10. After clicking **OK** button, the **Save As** dialog box as shown in Figure 3.38 (i) will appear, which will allow to save the list of recipient in **.CSV** format (say MyList.csv) as shown in Figure 3.38(i).

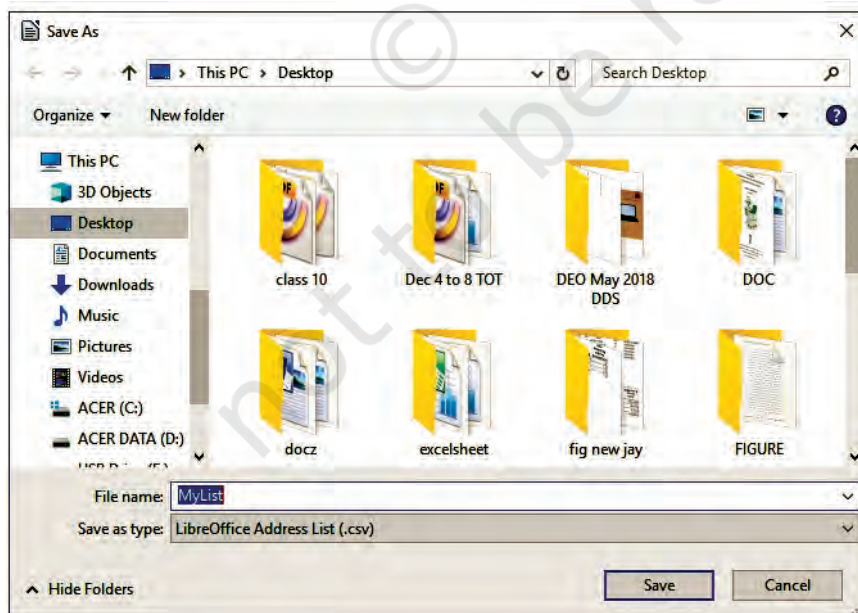


Fig. 3.38 (i) Save recipient list in .CSV format

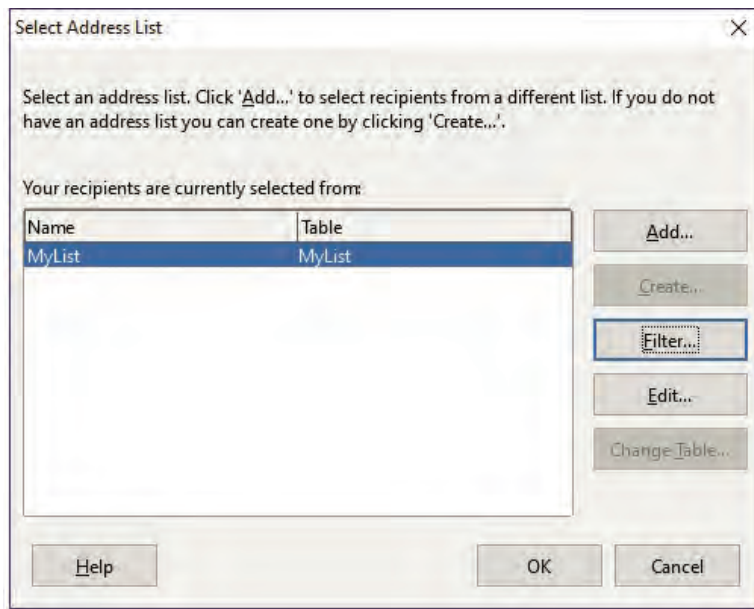


Fig. 3.38: (j) Recipient list created

11. After saving the list a window will appear as shown in Figure 3.38 (j), which will display the various recipient list created till now. You can select any of the created list till now. Select the required list and click on **OK** button from any of the list to send the letter.

12. After clicking on **OK** button, you will move to Step 3 of Mail Merge Wizard

Wizard, a window Insert Address Block will appear, which will show you the address block as shown in Figure 3.38 (k).

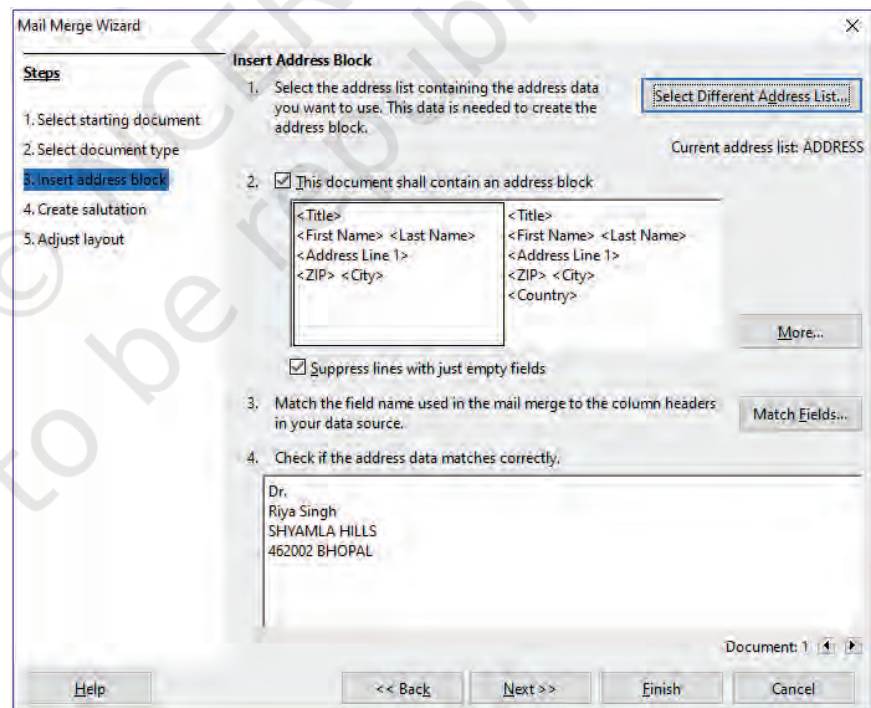
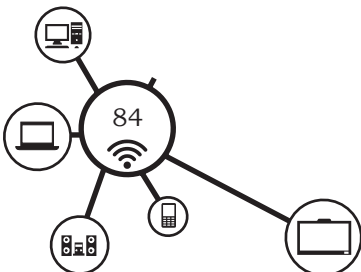


Fig. 3.38: (k) Insert Address Block

13. Click on **Next** button, you will move to Step 4 of Mail Merge Wizard. A **Create Salutation** window



will appear as shown in Figure 3.38 (l) to set the salutations for male and female recipients. A way of distinguishing one group from another is defined by choosing from the offered Field names, for example, Gender and by entering the Field value, for example, Female.

14. Click on **Next button**, you will move to last Step 5 of Mail Merge Wizard. An Adjust layout window will appear as shown in Figure 3.38 (m) to set the layout of the recipient address on the page. You can set the top and left margin. Click on Finish button to merge the letter with the recipients address.

15. In the next step, the Writer will display the document with the Mail Merge Toolbar below the standard toolbar as shown in Figure 3.38 (n).

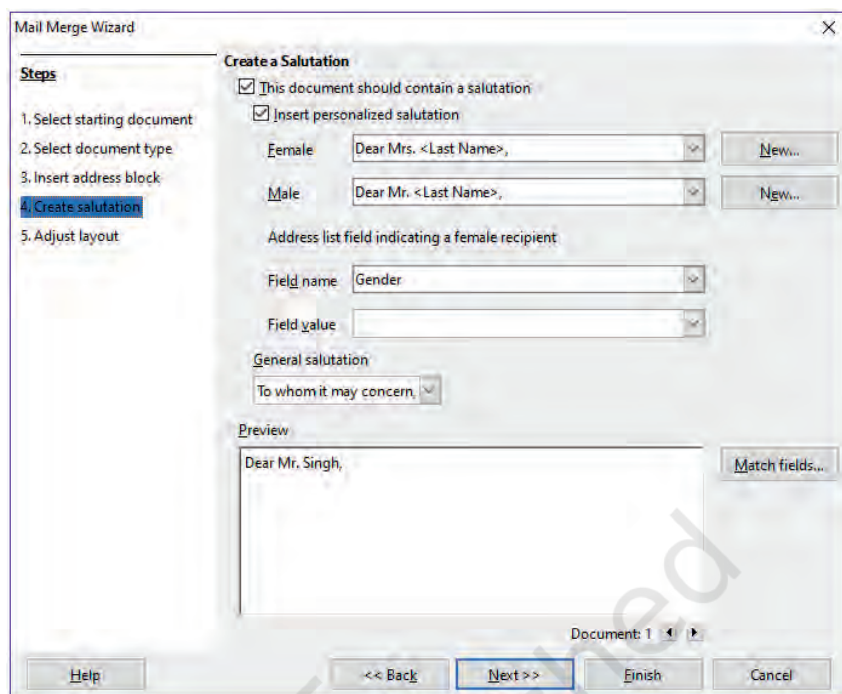


Fig. 3.38 (l) Create salutation

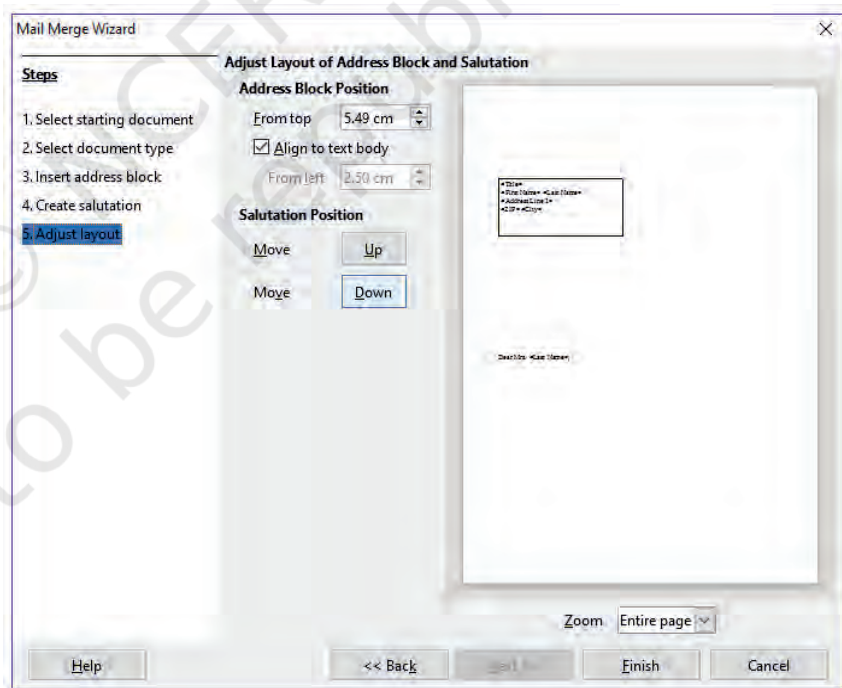


Fig.3.38 (m) Adjust layout of Address Block

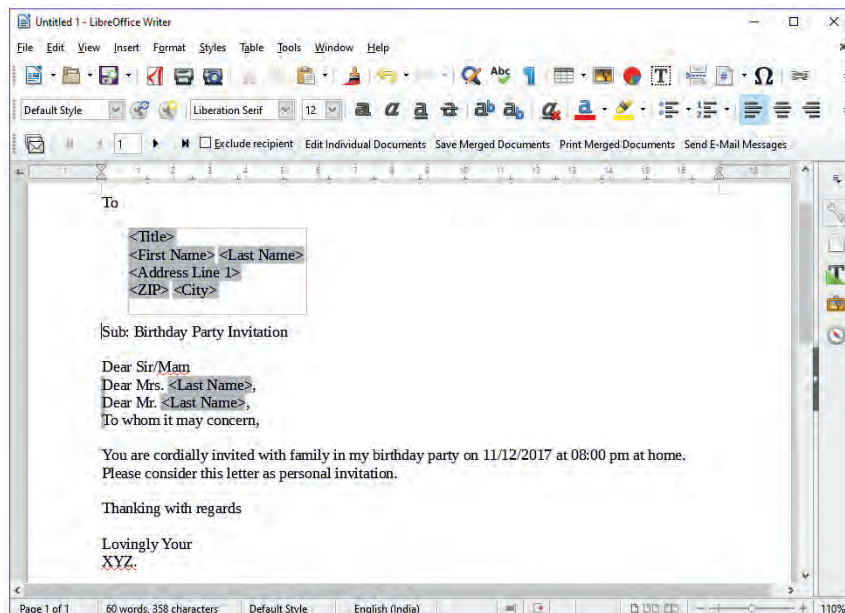


Fig. 3.38 (n) Letter with mail merge toolbar

16. Now click on **Edit Individual Documents** button to merge the letter with the address of the recipients. Here you can verify all letters of the recipients before printing.
17. You can use the other options on the Mail Merge toolbar, such as

- (a) to exclude some of the recipient check on the checkbox of **Exclude recipient**.
- (b) to save the merged document, click on the **Save Merged Documents** button.
- (c) to print the merged document, click on the **Print Merged Documents** button.
- (d) to send the letters by email, click on the **Send Email Messages** button.

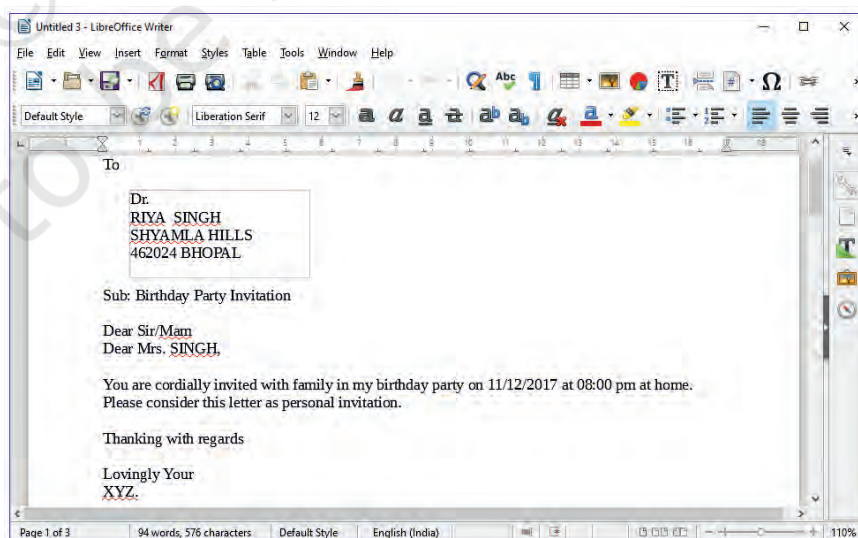
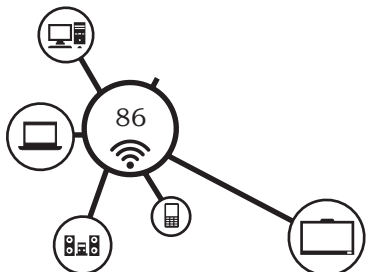


Fig. 3.38 (o) Final letter merged with the address



Let's Practice 7

1. Type the letter shown in the figure given below.
Do not type the words and symbols appearing in between <...>, as these are the fields. Keep single space. Save the document in your folder.

**Computer Centre
DMS School
Bhopal**

Date: 3 August 2018

<Title>

< Address Line1 >

< Address Line2 >

Teacher Parent Interact Day

Please take this opportunity to discuss the progress of your child <Child Name> by meeting the class teacher on <date> at <Time> at the Classroom.

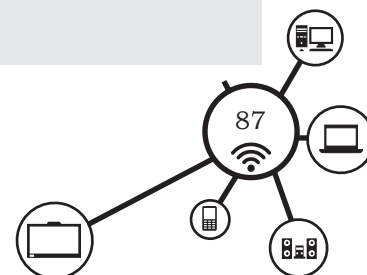
Principal

2. Use Mail Merge. For Data source/Address List, enter data of 10 people as shown in the table below.

Title	First Name	Last Name	Address 1	Address 2	Child Name	Date	Time
Mr.	Raman	Sinha	M P Nagar	Bhopal	Deepti	25-07-2018	9:00 am
Dr.	Manish	Mangal	Shyamla Hills	Bhopal	Shravya	25-07-2018	9:30 am
Mrs.	Manmeet	Kuar	Akriti City	Indore	Simran	26-07-2018	9:00 am

Let's Practice 8

1. Open the Word Processing software and prepare the following.
 - Certificates
 - Invitation cards
 - Forms

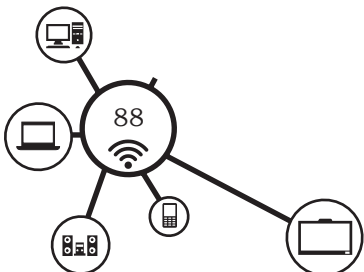


- Letters
 - Announcements
 - A banner
2. Save the document. Create its PDF file.

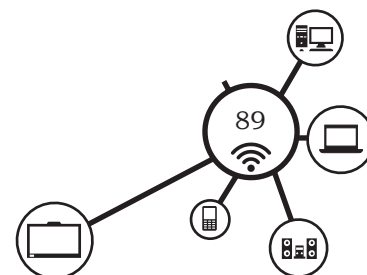
Check Your Progress

A. Multiple Choice Questions

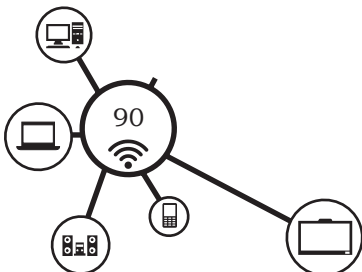
1. Which of following is not a component of the Office Suite?
(a) Writer
(b) Impress
(c) Internet Explorer
(d) Base
2. The most widely used word processing software in late 1970s was_____.
(a) Word Perfect
(b) Word
(c) Word Star
(d) Writer
3. We can change the mistakes noticed in which of the following?
(a) Electronic typewriter
(b) Word processor software
(c) Simple typewriter
(d) Both (a) and (b)
4. Header and Footer is available in which of the following menus?
(a) File Menu
(b) Insert Menu
(c) View Menu
(d) Edit Menu
5. To hide or view ruler we should go to which of the following menus?
(a) Tools Menu
(b) Insert Menu
(c) View Menu
(d) Edit Menu
6. To check the grammar we should go to which of the following menus?
(a) Tools Menu
(b) Insert Menu
(c) View Menu
(d) Edit Menu



7. To replace a word Bombay with Mumbai, we should go to which of the following menus?
- (a) Tools Menu
 - (b) Edit Menu
 - (c) View Menu
 - (d) Language Menu
8. To close an opened document, we should go to which of the following menus?
- (a) File Menu
 - (b) Insert Menu
 - (c) View Menu
 - (d) Edit Menu
9. Which of the following is the default extension of the writer file?
- (a) .obt
 - (b) .doc
 - (c) .odt
 - (d) .docx
10. Which of the following technique selects a sentence in Writer?
- (a) Single click (Pressing left button of mouse)
 - (b) Double Click
 - (c) Triple Click
 - (d) None of the above
11. Which of the following is a shortcut key to Redo any operation?
- (a) CTRL + R
 - (b) CTRL + Y
 - (c) CTRL + X
 - (d) CTRL + Z
12. To find a word in a document we can use which of the following function key?
- (a) F5 key
 - (b) F8 key
 - (c) F1 key
 - (d) None of the above
13. Spellings are corrected automatically in Writer because of which of the following features?
- (a) Auto Text
 - (b) Auto Correct
 - (c) Auto Complete
 - (d) All of the above
14. The default table size is_____.
- (a) 1 column, 1 row
 - (b) 2 columns, 1 row
 - (c) 2 columns, 2 rows
 - (d) 1 column, 2 rows



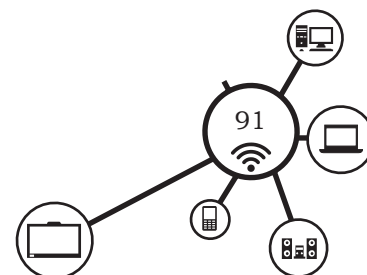
15. What is the shape of the mouse pointer when drawing a table?
(a) Pencil
(b) White pointing arrow
(c) Black pointing arrow
(d) Black plus
16. Which shortcut key is used for automatic spell checking?
(a) SHIFT + INSERT
(b) SHIFT + F7
(c) CTRL + INSERT
(d) TAB + INSERT
17. Which shortcut key is used to insert table?
(a) CTRL + F12
(b) ALT + DELETE
(c) CTRL + DELETE
(d) TAB + DELETE
18. Which of the following is not valid type of data source in mail merge?
(a) Spreadsheet
(b) Text files
(c) MySQL
(d) CSV file
19. The default orientation of a page in Writer is_____.
(a) portrait
(b) landscape
(c) book
(d) None of the above
20. Which of the following does not come under page formatting?
(a) Setting margins
(b) Find and replace
(c) Setting header and footer
(d) Page orientation
21. Saving an existing document with some other name using the Save As option_____.
(a) replaces the current document
(b) leaves the current document intact
(c) is not possible
(d) closes the document
22. Keyboard shortcut to italicise the selected text is
(a) Ctrl + U
(b) Shift + U
(c) Ctrl + I
(d) Shift + I



23. Which option should be used to type H₂O, to get 2 at its proper place?
 - (a) Bold
 - (b) Superscript
 - (c) Underline
 - (d) Subscript
24. What option should be used to change the word 'Books' to the word 'Copies' in a document?
 - (a) Find
 - (b) Find and Replace
 - (c) Spell check
 - (d) Spelling and grammar check
25. What is the option to print the document so that the height of the page is less than its width?
 - (a) Landscape
 - (b) Portrait
 - (c) Indent
 - (d) Tab setting

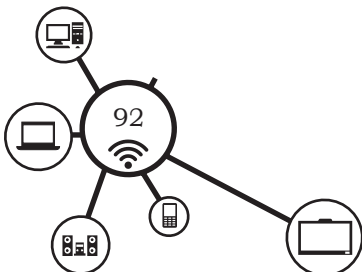
B. Fill in the blanks

1. The submenu item with three dots '...' just after the submenu name, denote that it will open the _____.
2. The submenu item with right hand side arrows '►', means, clicking on it will open _____.
3. Formatting Tool Bar contains various options for _____.
4. By pressing the Home key you jump to the _____ and by pressing the End key you jump to _____.
5. After using the undo command, to go back again to the previous position the, _____ option or command is used.
6. Double click is used to select the _____.
7. Headers appear at the _____ and footers appear at the _____ of every page.
8. In the _____ page orientation the height of the page is less than its width.
9. The _____ option is used to see how the document will look like when it will be printed.
10. In mail merge the file holding the mailing addresses is called as _____.



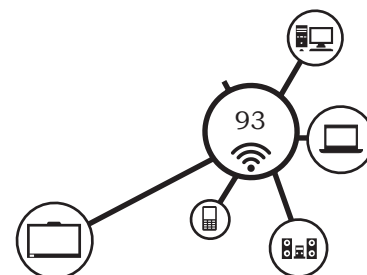
C. State whether the following statements are True or False

1. To open word processor 'Window' menu option is selected.
2. Current file name is shown in Status Bar.
3. Open icon for opening a file is part of Standard Tool Bar.
4. Format Menu contains the options that apply to the whole document.
5. It is possible to open a MS-Word file in Libre Office-Writer.
6. We cannot open Libre Office-Writer file in MS-Word.
7. Writer does not permit to copy a selected text in to another document.
8. It is possible to copy a selected text without using Menu options and keyboard options.
9. To open the 'Find & Replace' dialog box, we have to go to Format menu.
10. We can find all the cities included in a document using 'Find and Replace' feature of Writer.
11. While typing if an incorrect spelling is detected a red line is marked under it. After correcting it, the red line is converted into green line.
12. The text written in Header and Footer is printed on each page of the document.
13. The page number appears with gray background and is printed with background.
14. Writer creates a table as wide as the page area.
15. A new column is created in table by pressing tab key.
16. Mail merge is used to prepare multiple copies of the same document.
17. The Form Letter contains the variable information in mail merge.
18. The portrait and landscape orientations are set in Paper option under properties.
19. In Print Range by default current page is selected for printing.
20. By default the page size is A4.



D. Short answer questions (50 words)

1. In a document all the occurrences of word “this” have to be changed to “these”. Which option is suitable for this and what is the shortcut command used for it?
2. Which two documents are essential for mail merge?
3. Explain the concept of Word Processing.
4. List the various software available for word processing.
5. Write difference between a text editor and a word processor software. Write the name of any text editor or word processor available in market.
6. List the various components of LibreOffice suite. Explain each component in one line.
7. Compare the features of manual typewriter, electronic typewriter and word processing software.
8. Explain the different views to display a document.
9. What are the various methods for selecting the text in a document? Give the steps to select a paragraph.
10. What are the special characters? How can you insert them in a document?
11. How will you count the total words of a document?
12. What are the various menu of Writer GUI?
13. What is the default extension assigned to the document in Writer when you save it? Write down the steps to save the document to Microsoft Word document?
14. What is the importance of password in the document? How will you protect the document using password in Writer?
15. What is mail merge? Write down the steps to create mailing labels to paste on wedding cards.
16. What are the advantages of table? Prepare your report card of Class VIII in table format.
17. Write an application to your Principal for field visit to any IT Industry.



Practical Exercise

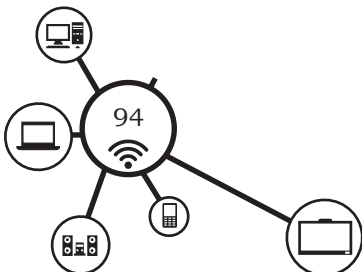
1. Open writer with the help of icon and exit. Again open writer from the applications option available on the desktop.
2. Draw all the icons of standard toolbar and write its uses in your practical note book.
3. Draw all the icons of formatting toolbar and write its uses in your practical note book.
4. Create a new text document (using menu bar) showing your name address and the name of your school. Save this file with name mydocument1 at the desktop location.
5. Open the documents mydocument1; modify it by adding your division and name of your class teacher. Save this file as mydocument2 at any other location.
6. Open both the documents and switch from one to other. Close one of them and save other as mydocument3 with password.
7. Open the document mydocument3 and zoom it for 50%, 75%, 130% and 200%.
8. Open the file my document 1 and type the text given in the box below:

The Word completion facility is little different than Auto Correct facility. While typing as and when you type two-three characters, Writer tries to guess which word you are typing and offers to complete the word for you. To accept the suggestion, press Enter. Otherwise, continue typing. Note that this facility is available only for those words which are already typed in the same document that is the word completion facility is available for a word getting typed at least for second time.

Close the document and save it.

9. Open the mydocument2 and type at least 15 cities of your state. Use Cut and Paste to arrange them in dictionary order.
10. Open the document mydocument3 and copy the first three sentences from mydocument 1 and close both the files.
11. Open mydocument2 and type the following at the end of the document:

S. No.	Name	City	Total Marks (OUT OF 300)
1.	RIYA	INDORE	245
2.	HARMAN	ITARSI	267
3.	JAYANT	BHOPAL	276



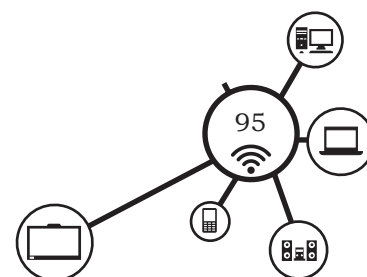
4.	AVIRAL	JABALPUR	284
5.	ABHUDAY	UJJAIN	235
6.	ALANKRITA	GWALIOR	258

12. Open mydocument2 where you have stored 15 cities in dictionary order. Delete cities at position number 3 and 7. Undo your deletion and delete cities at position number 5 and 8.
13. Open mydocument1. Find all the occurrences of the word 'the' and replace it with 'e' if it is not in the beginning of the sentence.
14. Open mydocument3 and insert a character 0 in front of all the cities except Bhopal. Insert the character @ in front of Bhopal.
15. Find out the number of words for the third paragraph.
16. Type your own address and store it in the table of Auto Text. Use it in any other document.
17. Create the table as shown below by merging cells? Write the steps.

18. Create a table showing results of randomly selected 5 students of standard 9 as shown in the following table:

S.No.	R.No.	Hindi	English	Maths	Science	SST
1	1	25	24	24	24	24
2	4	15	23	26	23	15
3	6	25	21	24	25	17
4	7	24	20	17	24	24
5	9	22	16	23	21	26
6	11	20	18	22	22	26

19. Perform the operations stated below.
 - (a) Write steps to count total words in a document?
 - (b) Is it possible to select the vertical block? If yes, then write the steps.
 - (c) What are the steps to select a non-consecutive text in writer?
 - (d) What is Special character in writer and how will you insert in a document?



20. Perform the operations stated below.

- Change the width of column to best fit the content (Text should fit exactly)
- Move the table in the Centre position.
- Increase the row height.
- Make the data of all the cells vertically left aligned.
- Insert a column to the left of the last column and type the total of marks obtained by all the students.
- Split the second cell into two cells horizontally and type subject name and roll number in upper and lower cells.
- Insert a column to the left column inserted and move the content of the last column to the newly inserted column.
- Type the average marks in the last column.

21. Create the table given below use cell merge where required:

State : Madhya Pradesh				
Crop	Wheat	Pulse	Rice	Average
East	504	240	274	339.33
West	547	455	108	370
North	444	208	206	286
South	247	647	648	514

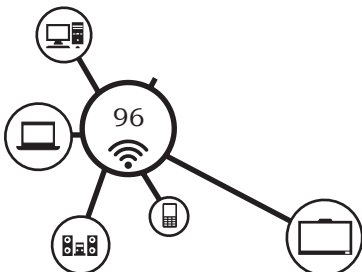
22. The time table prepared for Class IX using a word processor as shown below:

Time Table: Class IX – D

Class Teacher : ABC								
Mon	Hindi	Maths	Maths	Eng	SSC	Science	SUPW	SUPW
Tue	Science	Science	SSC	Eng	Maths	Maths	Hindi	SSC
Wed	SSC	Maths	Science	Eng	Sc.(Pr.)	Sc.(Pr.)	Sc.(Pr)	Games
Thu	IT	IT	Maths	Eng	Sc.	S. Sc.	SSC	Games
Fri	Maths	Maths	Science	Eng	SSC	Hindi	Maths	CTP

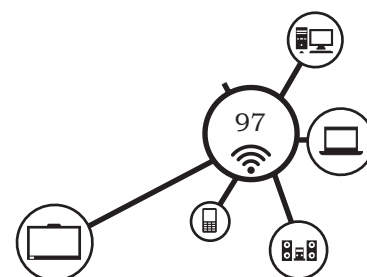
The class teacher recommended some changes in the time table to that should looks as follows:

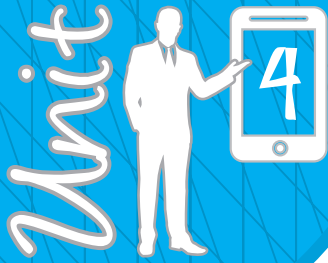
Class Teacher : ABC									
	1	2	3	4		5	6	7	8
Mon	Hindi	Maths		Eng.	B R E A K	SSC	Science	SUPW	SUPW
Tue	Science		SSC	Eng.		Maths	Maths	Hindi	SSC
Wed	SSC	Maths	Science	Eng.		Sc.(Pr.)	Sc.(Pr.)		Games
Thu	IT		Maths	Eng.		Sc.	SSC		Games
Fri	Maths		Science	Eng.		SSC	Hindi	Maths	CPT
Sat	Meditation		Activity			House Meeting		Bal Sabha	



Name the word processing features that should be used to make the changes. The changes recommended are listed below:

1. The headline should be centre aligned
2. The Class Teacher's name should span along all the columns in the first row.
3. Add another row after the first row to indicate period number.
4. The day names should be in italics bold.
5. At all the places in the table where a subject occurs twice for consecutive columns, it should be displayed only once spread over the two columns.
6. There should be a column after 4th period to accommodate 'BREAK'.
7. There should be a row for Saturday.
8. Period numbers and 'BREAK' should be in Bold.
9. Make border tick in size of BREAK.
10. The table should be centre aligned.





Electronic Spreadsheet



17925CH04

INTRODUCTION

In our daily life or at workplace we have to perform various calculations. Various methods are used depending on the nature of calculations. We use our fingers or mental calculations to perform simple calculations and use a calculator for longer calculations. In science and engineering, scientific calculators are used to perform complex calculations. Spreadsheet application is a tool which is used to perform all kinds of calculations easily and accurately.

In your childhood, you might have used a special notebook with small cells marked with rows and columns to practice mathematics. We have also learned the multiplication table. Spreadsheet is a long sheet of rows and columns on the computer screen to do data analysis and calculation. In other words, a spreadsheet is a grid which interactively manages and organises data in rows and columns. It is also called as Electronic Spreadsheet. It is used for managing financial and accounting documents, creating data reports, generating invoices, data analysis from scientific and statistical researches, and for doing a variety of calculations on data.

A spreadsheet software can also store, manipulate and create graphical representations of data.

User can enter data into a spreadsheet, do the formatting, calculate and analyse the data for decision making. Besides user's data, spreadsheet packages also provide built-in formulae and functions for common mathematical, financial, statistical, and logical operations in a very sophisticated manner. Spreadsheet packages are widely used for data analysis and accounting applications. Because of these abilities the spreadsheet packages are used as a universal programme for structured data preparation and processing.

As spreadsheets became larger, they became difficult to manage. To handle the increasing size of the spreadsheet, the concept of a workbook was identified. LibreOffice Calc is used to perform the following activities accurately and efficiently.

- Tabulation of data
- Simple mathematical calculations
- Complex calculations using formula and functions
- Arranging data in ascending and descending order (sorting)
- Filtering the required data
- Check the validity of data
- Protection of data using passwords
- Saving for future use

Getting Started with Libreoffice Calc

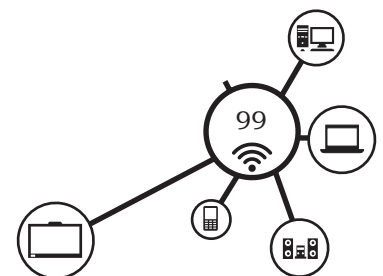
There are various types of spreadsheet applications developed by various software corporation. LibreOffice Calc is the spreadsheet application of LibreOffice suite.

Starting LibreOffice Calc

When installing the operating system Linux (Ubuntu), the LibreOffice gets installed by default along with the icons for each component of LibreOffice (Writer, Calc, Impress, etc.). These icons are then placed on the launcher. In Windows, you need to download LibreOffice from its official website and install it on your computer.

Spreadsheet Softwares

- Microsoft Excel
- LibreOffice Calc
- OpenOfficeCalc
- Apple Inc. Numbers



(a) To start the LibreOffice Calc in Windows

- In Windows, find the shortcut of LibreOffice on **Start menu** or on the desktop. **Double click** the shortcut to open LibreOffice.
- Or Click the window menu, select LibreOffice application, then click LibreOffice Calc (Figure 4.1). The Calc spreadsheet window will open.

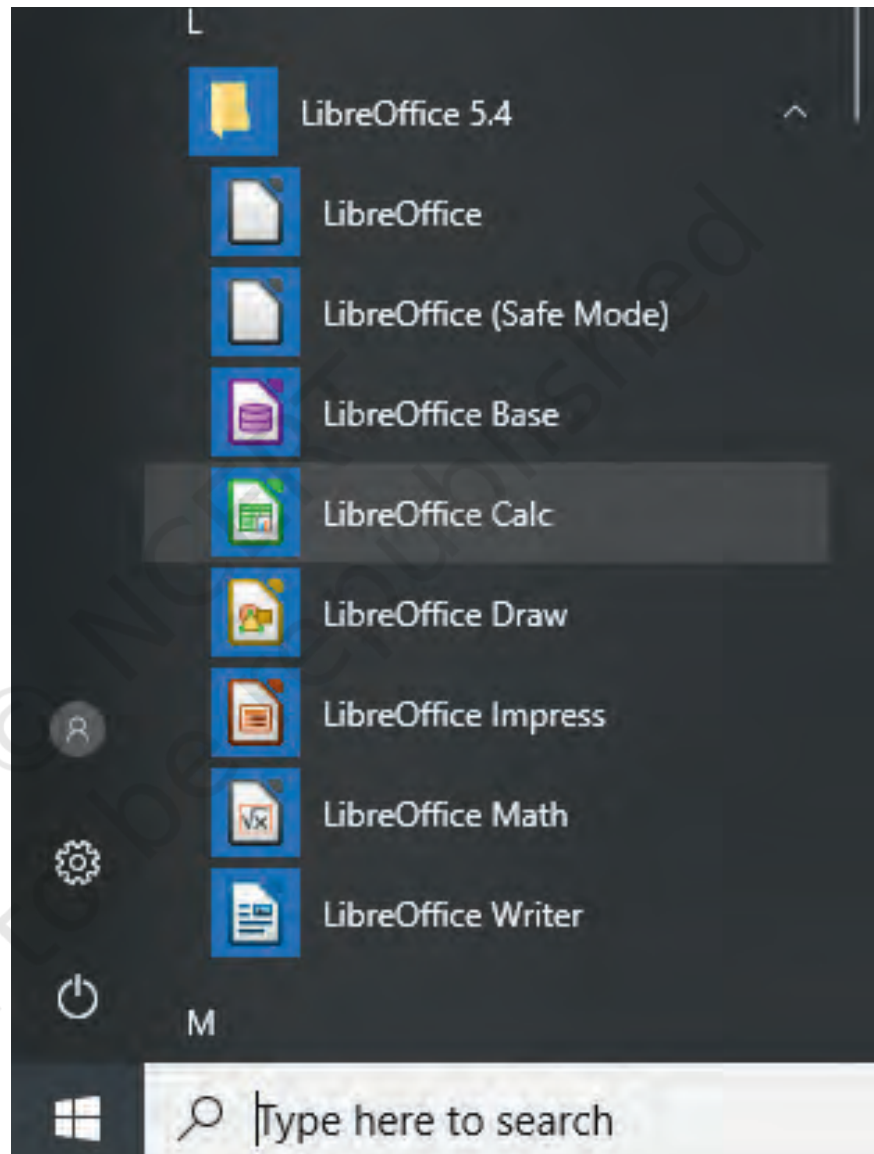
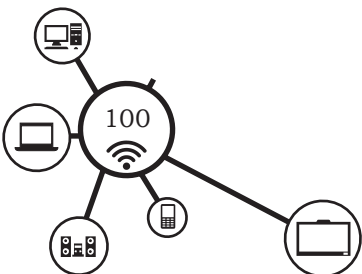


Fig. 4.1 : Starting LibreOffice Calc in Windows



(b) To start LibreOffice Calc in Linux

In Ubuntu Linux, find the Calc icon on application launcher or search it by clicking on “Show Applications” as shown in Figure 4.2.

Parts of LibreOffice Calc

Figure 4.3 shows the parts of LibreOffice Calc.

A brief explanation about the parts is given below.



Fig. 4.2: Starting LibreOffice Calc in Ubuntu Linux

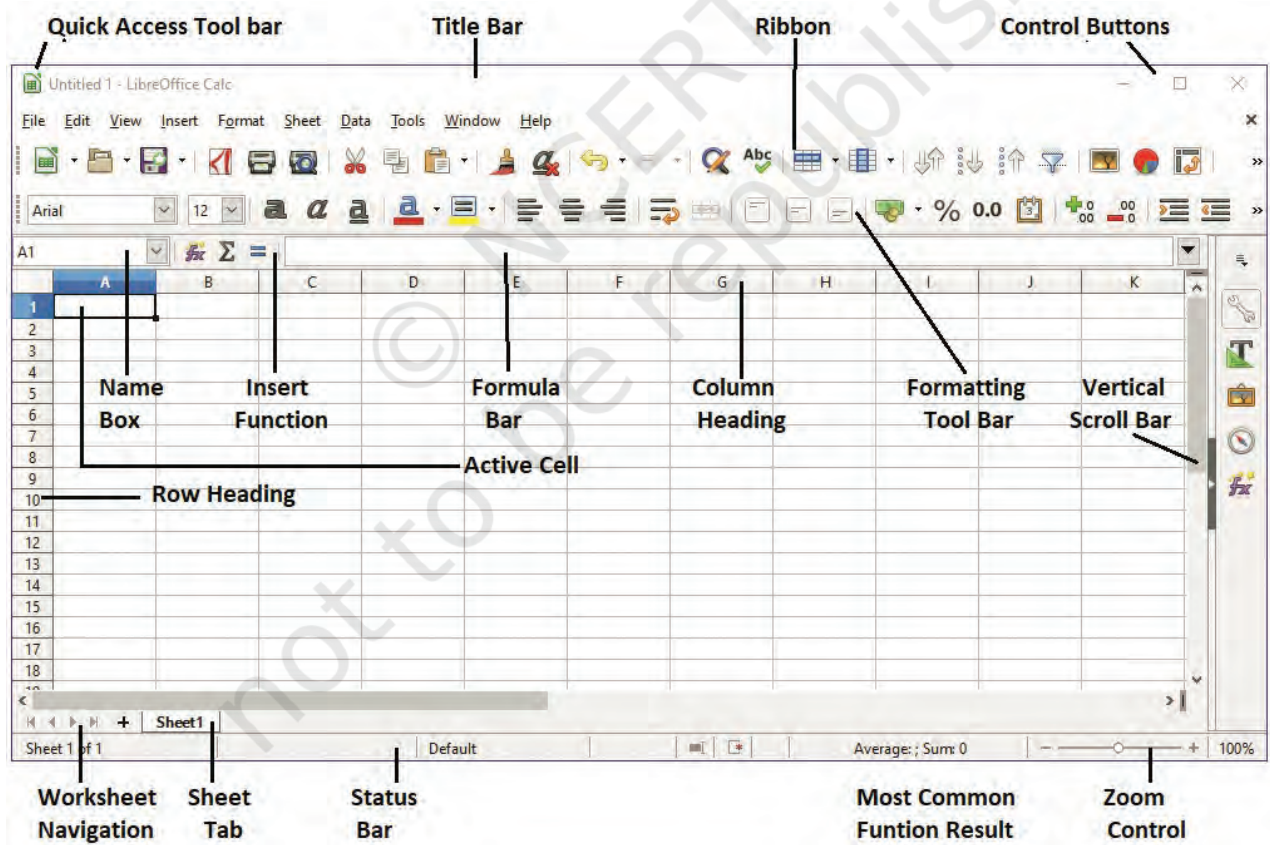
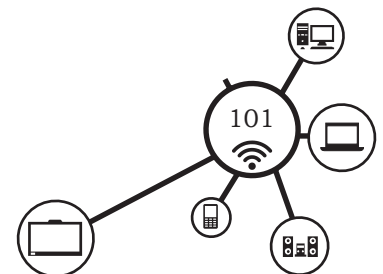
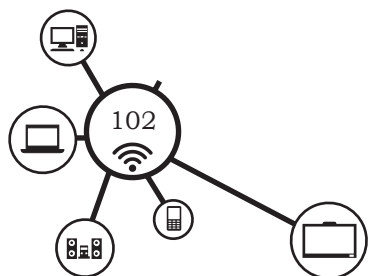


Fig. 4.3: User interface showing the parts of LibreOffice Calc

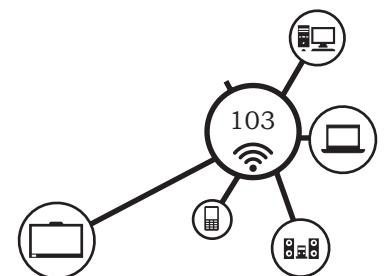


NOTES

- (a) **Title bar:** The Title bar, located at the top, shows the name of the current spreadsheet. When the spreadsheet is newly created, its name is Untitled X, where X is a number. The first created spreadsheet takes the name as Untitled 1, second is Untitled 2 and so on.
- (b) **Menu bar:** Menu bar is located just below the Title bar. It contains the menus with commands for various tasks. Each menu item has a submenu called pull-down menu. The various menu items are briefly explained below.
- (i) **File:** contains commands applied to entire document — *Open, Save, Wizards, Export as PDF, Print, Digital Signatures and so on.*
 - (ii) **Edit:** contains editing commands — *Undo, Cut, Copy, Paste, Select, Find & Replace and so on.*
 - (iii) **View:** contains commands for modifying the user interface — *Toolbars, Column & Row Headers, Full Screen, Zoom and so on.*
 - (iv) **Insert:** contains commands for inserting elements into a spreadsheet — *Image, Media, Chart, Object, Shapes, Date, Time, Headers and Footers.*
 - (v) **Format:** contains commands for modifying the layout of a spreadsheet — *Cells, Rows, Columns, Page, Styles and Formatting, Alignment and so on.*
 - (vi) **Styles:** for managing styles.
 - (vii) **Sheet:** contains commands to insert and delete cell, rows and columns, insert sheet, rename sheet, fill cell, etc.
 - (viii) **Data:** contains commands for manipulating data — *Define range, sort, and so on.*
 - (ix) **Tools:** contains various functions to check and customise spreadsheet — *Spelling, Language, Gallery, Macros and so on.*
 - (x) **Window:** contains commands to display window — *New Window, Split and so on.*
 - (xi) **Help:** contains links to the help system included in the software and other miscellaneous functions — *Help, License Information, Check for Updates and so on.*



- (c) **Toolbars:** The Calc opens with the Standard and Formatting toolbars at the top of the workspace by default. These toolbar provide a wide range of common commands and functions. Placing the mouse cursor over any icon displays a small box called a tooltip. It gives a brief explanation of the icon function.
- (i) **Standard toolbar:** The standard tool bar shows the icons for most common operations, such as editing, arranging, filtering, etc., used while working on the spreadsheet.
 - (ii) **Formatting toolbar:** Formatting toolbar has the most common operation related to formatting datasheet. It includes buttons for font selection, size of text, alignment, cell value formatting and indentation, etc.
 - (iii) **Formula toolbar:** It allows entering and editing the formula in the cell. Formula bar consists of the following:
 - **Name box:** shows the cell reference, for example A1.
 - **Functions wizard:** search the function from the list of available functions.
 - **Sum:** used to total the numbers in the cells above the selected cell. The sum is placed in the selected cell.
 - **Function:** clicking on the Function icon inserts an equals (=) sign into the selected cell and the Input line allow formula to be entered.
 - **Input line:** displays the contents of the selected cell (data, formula, or function) and allows editing the cell contents. To edit inside the **Input line** area, click in the area, then type the changes. To edit within the current cell, just double-click in the cell.
- (d) **Worksheet:** The worksheet in Calc is also referred to as spreadsheet. The spreadsheet can have many sheets. Each sheet can have many individual cells arranged in rows and columns. The sheet tab shows its default name as Sheet1, Sheet2, Sheet3,



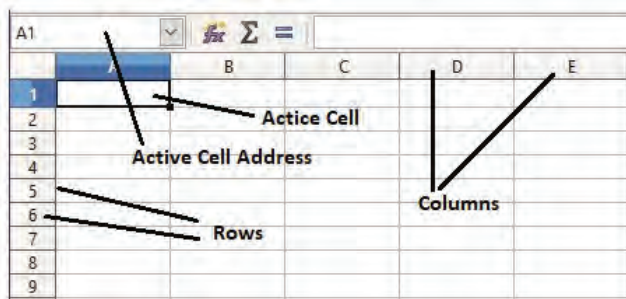


Fig. 4.4: Rows, columns and active cell

(e) Rows and columns: The sheet is divided into vertical columns and horizontal rows. Each sheet can have a maximum of **1,048,576 (2^{20})** rows and **1024 (2^{10})** columns. The rows are numbered as 1,2,3,4,... and columns are numbered as A, B, C, D, ..., Z, AA, AB, AC, ..., AZ, BA to BZ, CA,..., AMJ.

(f) Cell and cell address: The intersection of a row and column is called a cell. It is the basic element of a spreadsheet. It holds data, such as text, numbers, formulas and so on. A cell address is denoted by its column (letter) and row number. For example, D4, E9, Z89 are the valid example of cell address.

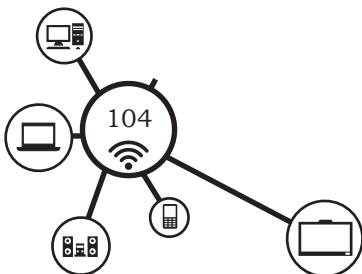
- (i) Active cell: In a spreadsheet, cell is the place where we enter the data. Before entering any data in the cell, it has to be first selected by placing a cursor on it. When we position the mouse cursor on a cell, it gets selected, and is ready to take data from the user. This selected or activated cell is called as active cell. It is always highlighted, with a thick border. The address of the active cell is displayed in the name box. The figure shows, B3 as the active cell in the worksheet.

Let's Practice 1

Write the cell address of the following

- First row and first column
- First column and last row
- First row and last column
- Last column first row
- Seventh column and tenth row
- Tenth column and nineteenth row
- The cell address LK89 is situated in row number and column letter

- (ii) Active cell in a worksheet: To enter data in the cell, it should be selected first. Active cell in a worksheet can be moved and selected by the key or a combination of keys.



Key or Key Combination	Result of Key or Combination
Arrow keys (←↑→↓)	Move a single cell in arrow direction
Ctrl + Arrow Keys	Moves the cell to the end of the data range in a particular direction
Home	Moves to column A along the row where the active cell is
Ctrl + Home	Moves the cell to A1 position
Ctrl + End	Moves to bottom right cell of the data range
Page Up	Moves the worksheet one screen up
Page Down	Moves the worksheet one screen down

(iii) Range of cells: A block of adjacent cells in a worksheet which is highlighted or selected is called a range of cells. Observe the worksheets below.

- The **column range** is the number of cells spread across the column. The cell address is represented by single column letter and multiple row number in a sequence. In this example the column letter C is constant with rows varying from 2 to 7. The range of cells starts in C2 and ends in C7. This range of cells consists of the cells, namely C2, C3, C4, C5, C6, and C7. The range of cells starts in C2 and ends in C7 and it is represented by C2:C7 as shown in Figure 4.5.

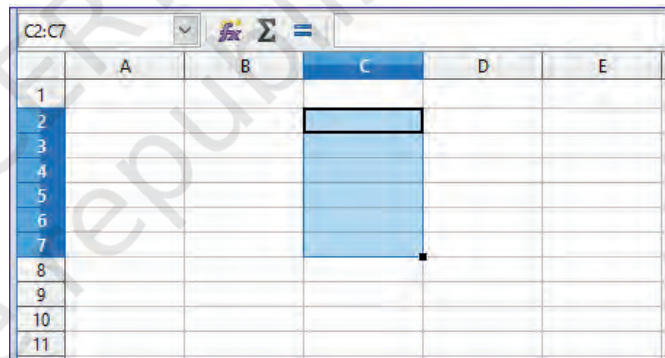


Fig. 4.5: Column Range

- The **row range** is the number of cells spread across the row. The cell address is represented by single row number with columns varying from B to D columns. The range of cells starts in B3 and ends in D3. This range of cells consists of the cells, namely B3, C3, D3, and it is represented by B3:D3 as shown in Figure 4.6.
- The **row and column range** is the number of cells spread across the row and columns. This

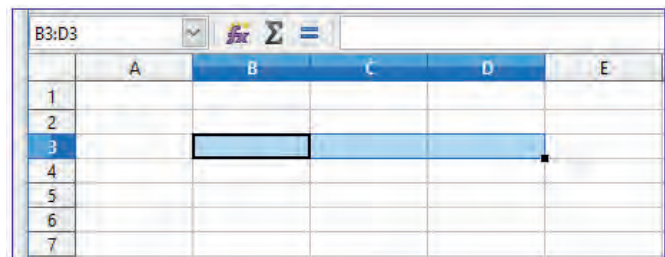
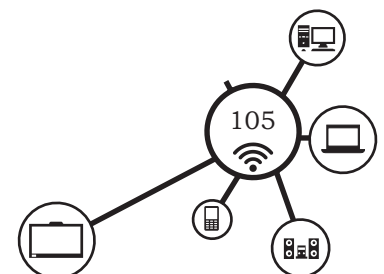


Fig. 4.6: Row Range



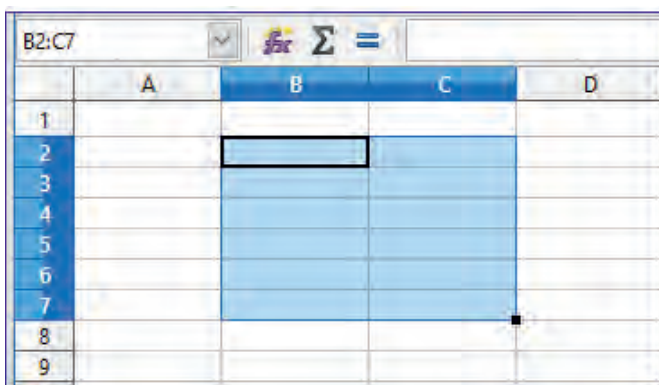
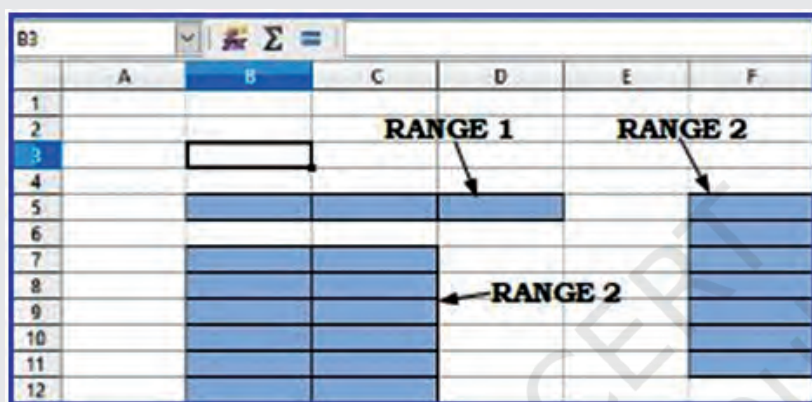


Fig. 4.7: Row & Column Range

range is a matrix with number of rows and number of columns. In this example, the range starts in cell B2 and ends in cell C7. This range of cells consists of the cells from B2 to B7 and cells from C2 to C7. The range is represented by B2:C7 as shown in Figure 4.7.

Note: The control key is used to select more than one 'range of cells' in a worksheet. The control key is marked as 'Ctrl' on the keyboard.



Let's Practice 2

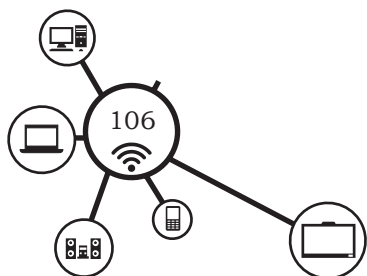
Answer the questions based on the following worksheet.

1. What is the address of the first cell represented by Range 1?
2. What is the address of the last cell represented by Range 1?
3. Write the cell range represented by Range 1.
4. Write the cell range represented by Range 2.
5. What is the name of the cell range along a row?
6. What is the name of the cell range along a column?
7. Write the cell range represented by Range 3.
8. Give the number of cells in the cell range represented by Range 3.

Entering data

To enter any data in a worksheet, practically in the cell, it is required to select the cell. Cell can be selected by positioning the pointer in a cell. The data to be entered can be the label, values or formula.

(a) Label: Label is the any text entered by using a keyboard. It may combine with letters, numbers, and special symbols. By



default the labels are left aligned as shown in Figure 4.8.

	A	B	C	D	E	F
1	NAME	CLASS	SEC	EMAIL ID	TELEPHONE	
2	RIYA	XI	A	riya@gmail.com	8989712345	
3	ANUJ	XI	A	anuj101@yahoo.com	8989723456	
4	HIRDESH	X	B	hirdesh@mail.com	8989734567	
5	JAYESH	X	B	jayeshsh85@rediffmail.com	8987456789	
6	SAUMYA	IX	B	saumya123@gmail.com	8899775566	
7	TEENA	IX	C	teenacutie@mail.com	9988776655	
8	YUVRAJ	IX	C	yuvi1122@hotmail.com	8877665544	
9						
10						
11						
12						

Labels are Left Align by default

Values are Right Aligned by Default

Fig. 4.8: Labels are left aligned and values are right aligned by default

(b) Values: The numerical data consisting of only numbers are called values. By default values are right aligned. There are various forms of values, such as integer, decimal and so on as shown in Figure 4.9.

(c) Formulae: Any expressions that begins with an equals '=' is treated as formula. In the expression, the '=' followed by values, cell address and functions are called as formula. When a formula is entered in a cell in a worksheet the value of the equation is displayed in the cell and the formula is shown in the formula bar.

	A	B	C
1	Integer	58	
2	Decimal	9.545	
3	Fractional	1 2/3	
4	Percentage	84.00%	
5	Scientific	8.75E+21	
6	Date	9. May. 2018	
7	Time	12:45:00	
8	Currency	₹123.00	
9			
10			

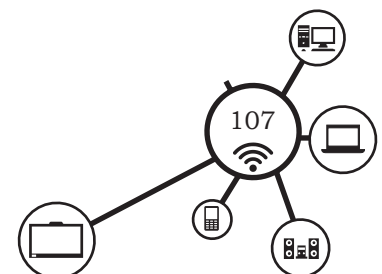
Fig. 4.9: Values are right aligned

Note: The values do not display the preceding zero. If any value (e.g., telephone numbers), preceded by 0, then the first letter '0' is not displayed, when the data is value. To show the preceding '0', the data type has to be specified as 'Text'.

	A	B	C	D
1	5	4	20	
2				

Fig.4.10 Expressions as formula

Example: Getting the total value of cells A1 and B1 into cell C1 see Figure 4.10.



Mathematical operators used in formulae

Spreadsheet Software has the most powerful features to calculate numerical data using formulae. As we use a calculator for calculation, Calc can add, subtract, divide, multiply and much more. LibreOffice Calc uses standard operators for formulae, such as a plus(+), minus(-), multiplication (*), a division (/) for arithmetic operation.

Note: The order of evaluation can be changed by using brackets. (The expressions within the brackets are evaluated first).

Mathematical Operators		Operator precedence	
+	addition	First	()
-	subtraction	Second	^
*	multiplication	Third	/, *
/	division	Fourth	+, -
^	exponentiation (power)		

Simple calculations using values and operators

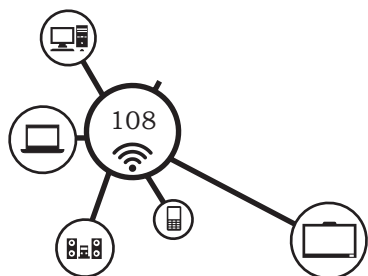
Table 4.1 below shows a few formula written using values and operators. More than one mathematical operator can be included in the formula. Let us learn how to evaluate the operators in order. See the Tables 4.1 and 4.2.

Table 4.1: Writing simple formula

Operator	Formula	Result
Addition (+)	= 23+ 6	29
Subtraction	0 – 6	- 6
Multiplication (*)	9*6	54
Division (/)	88/8	11
Exponentiation (^)	2 ^ 5	32

Table 4.2: Use of brackets in simple equations

Formula	Evaluation	Result
= 4+5*3	= 4+15	19
= (4+5)*3	= 9*3	27
= 5*4^2	= 5*16	80
= (5*4)^2	= 20^2	400
= (4/4)^2	= 2^2	4
= 16/(4^2)	= 16/16	1



Let's Practice 3

Evaluate the following equations using operator precedence and then test the result in the spreadsheet

1. $8-4/2$
2. $5*5+8$
3. $3+5*4$
4. 2^5+8
5. $3+2^2$
6. $5+6*2^2$
7. $8/4*4$
8. $-4/2+2$
9. $1+2^2-2$
10. $4*3/2$

Formulae with cell addresses and operators

The main advantage of entering formula with cell addresses and operators, works just like a variable. When the values of the cells concerned change, the results obtained by the formula also get updated accordingly. Suppose to add the values in two cells A1 and A2 and get the addition in cell A3. If we position the cursor in cell A3 and simply add the values as $=5+8$, then we will get the correct addition in cell A3. But if we change the values in cell A1 to 6 and A2 to 7, then again we have to get the addition in the cell A3 by writing $=6+7$. But if we write the general formula in cell A3 as $=A1+A2$. Then we need not to do the addition in cell A3. We will get the respective addition with the change in values in cell A1 and A2.

Example: For calculating the volume of a box with given length, width and height in cells A2, B2 and C2, respectively, see the formula to derive the volume entered in cell D2 (see Figure 4.12).

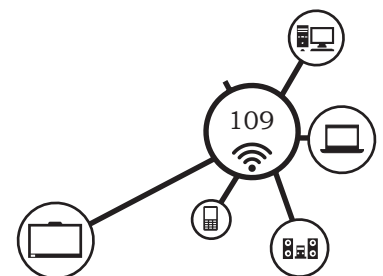
SUM				
	A	B	C	D
1	Length	width	Height	Volume of box
2	12	14	16	$=A2*B2*C2$
3				
4				

Figure 4.12: Volume of Box

Let's Practice 4

Create a worksheet based on the Figure 4.12. Observe the changes in values obtained from the formula in column D when you enter different values in cells A2, B2 and C2.

Note: Formula starts with '=' sign and nothing should be written on the left side of the equal sign ('='). If you forgot to put the '=' before the formula, it will be treated



as a label. If you write the formula B1=A2+A3 in cell B2, then it will be taken as a label and calculations will not be performed. When you enter formula with the equal sign ('='), a formula bar gets activated automatically. This helps in knowing whether the entered text is a formula or not (Figure 4.14).

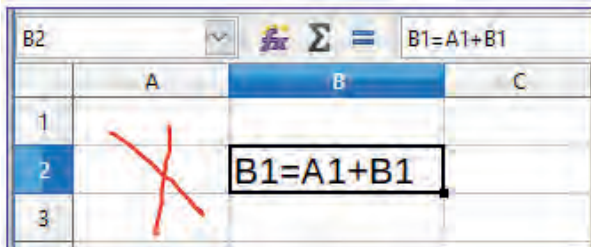


Fig. 4.13: Incorrect way of formula

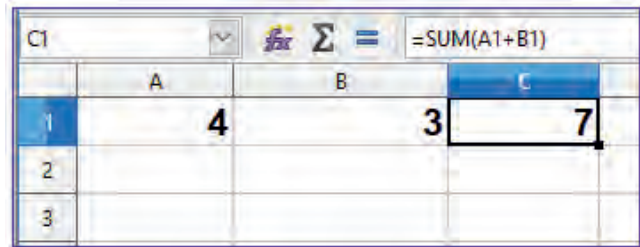


Fig. 4.14: Correct way of formula

Example: Let us create a simple spreadsheet to prepare a shopping bill of stationary of the following items.

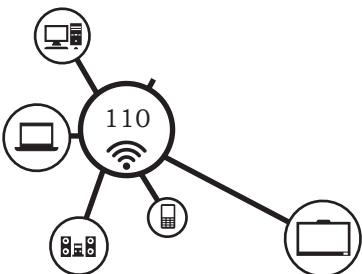
Item	Quantity	Unit Price
Register	3	40
Single Rule Copy	12	25
Notebook	6	30
Pencil Box	1	50
Color Box	1	120
Notebook Cover	20	3

The steps to create the spreadsheet are as mentioned below:

Step 1: Open the LibreOffice Calc by using the standard process.

Step 2: Observe that the Calc has created the worksheets automatically. Give the specific name to the worksheet say 'Stationary Bill'. To do this

- Select the menu **Sheet** → **Rename Sheet**.
- Give appropriate name, say '**Stationery Bill**' to the worksheet and click **OK**. Notice the change in the worksheet name.



Step 3: Enter the data given in the above table in the worksheet.

To enter the above data in the worksheet '**Stationery Bill**' do the following:

- Click (click means left click) on the cell A1. Enter the word "Item" and press the enter key.
- Click on the cell B1. Enter the word "Quantity" and press the enter key.
- Click on the cell C1. Enter the word "Unit Price" and press the enter key.

You may drag the column to resize it. It may be required to resize a column while entering name of items. To resize, put the mouse at the edge of the column, and drag it to the required length. Select the heading cells and make them bold using formatting toolbar. Now enter the data so that the worksheet appears as shown in Figure 4.15.

	A	B	C
1	Item	Quantity	Unit Price
2	Register	3	40
3	Single Rule Copy	12	25
4	Notebook	6	30
5	Pencil Box	1	50
6	Colour Box	1	120
7	Notebook Cover	20	3
8			

Fig. 4.15: Data entry of text, number and formula

Step 4: Save the worksheet with appropriate name so that the data may not be lost. To save the worksheet, click on **File** → **Save**. A Save dialog box will appear as shown in Figure 4.16. Select the location where you want to save the file. Enter the name of the file say, '**Stationery_Bill**', and Click on the Save button. The spreadsheet file will get saved by default in ODF format with the name **Stationery_Bill.ods**. Remember the name and location of file, to retrieve it in future.

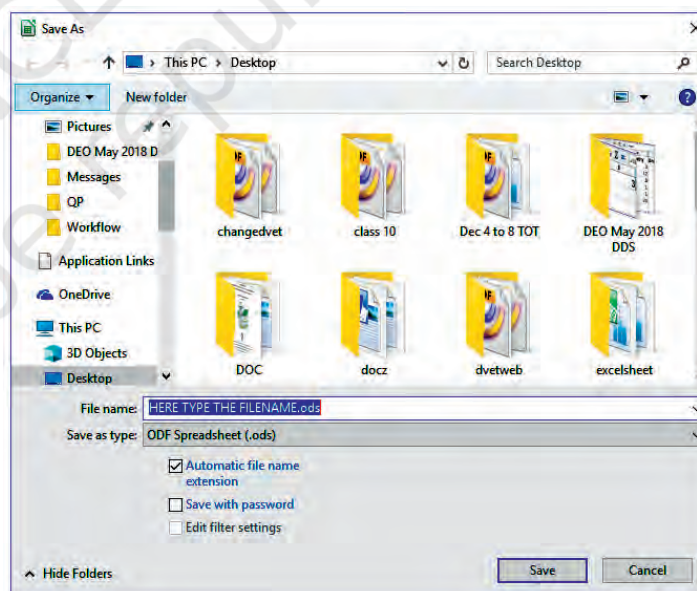
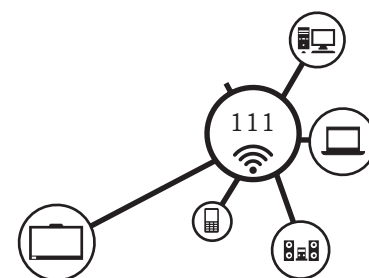


Fig. 4.16: Saving worksheet using Save dialog box

Now calculate the total cost of each item in this worksheet. Enter the heading as we will insert a new



column right to the 'Unit Price' and give the heading as 'Total Cost' in the cell D1. Here we do not need to insert the new column. Since we are editing the spreadsheet in the sequential manner, the next column is available for data entry. However, if you want to enter the data in the previous column then you have to insert the column before the column C. So that data in column C shifts to column D and an empty column C is created.

To insert the column before any column, position the cursor on any cell of the column before which you want to insert the column and select

Sheet → **Insert Columns** → **Columns** → **Columns left**
(Figure 4.17)

Similarly, to insert the column to the right select

Sheet → **Insert Columns** → **Columns** → **Columns right**

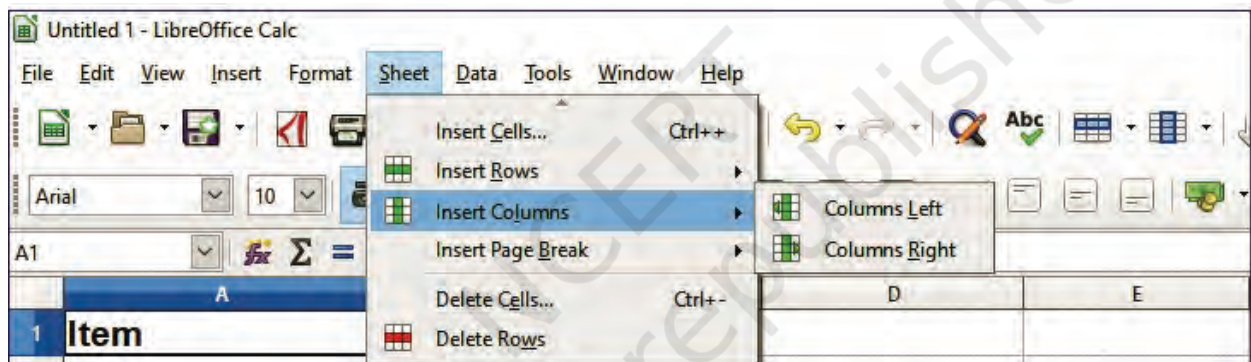


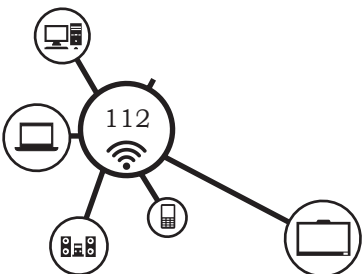
Fig. 4.17: Inserting column in the spreadsheet

D8				=D2+D3+D4+D5+D6+D7
	A	B	C	D
1	Item	Qty	Unit Price	Total Cost
2	Register	3	40	=B2*C2
3	Single Rule Copy	12	25	=B3*C3
4	Note Book	6	30	=B4*C4
5	Pencil Box	1	50	=B5*C5
6	Colour Box	1	120	=B6*C6
7	Note Book Cover	20	3	=B7*C7
8				=D2+D3+D4+D5+D6+D7
9				

Fig. 4.18: Inserting formula in the spreadsheet

Now to calculate the total cost in column D for each item, move the cursor on the cell D2, and enter the formula '=B2*C2' to calculate the total cost for 'Register'. We need to apply the same formula for the next items. So instead of writing the formula again and again in the next cell

D3 to D7, click on the cell D2, hold and drag it down to D7. The formulas to calculate the total cost will be get copied. Observe that the address of the cell gets changed automatically as shown in Figure 4.18. Now enter the



formula in Cell D8 as ‘=D2+D3+D4+D5+D6+D7’ to calculate the Total Cost of all items.

Let's Practice 5

Prepare the worksheet as shown in Figure 4.18. Change the values in cells B1 and B2. Observe the results obtained from the formulae in cells D2, D3, D4, D5, D7 and D8.

Example: Calculating the area and volume of a cube when the length of one side is given (Figure 4.19).

Let's Practice 6

Create a worksheet as shown in Figure 4.17. Change the values in cell B1 and observe the results obtained from the formulae in the cells B2, B3 and B4.

	A	B
1	Side Length of the Cube	4
2	Side Area of the Cube	=B1^2
3	Total Area of the Cube	=6*B1^2
4	Volume of the Cube	=B1^3
5		

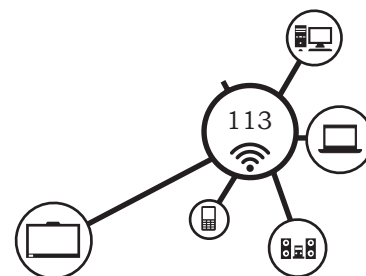
Fig. 4.19: Finding area and volume of a cube

Note: The results obtained from a formula (based on cell addresses) always get updated automatically when the values of these cells mentioned in the formula change.

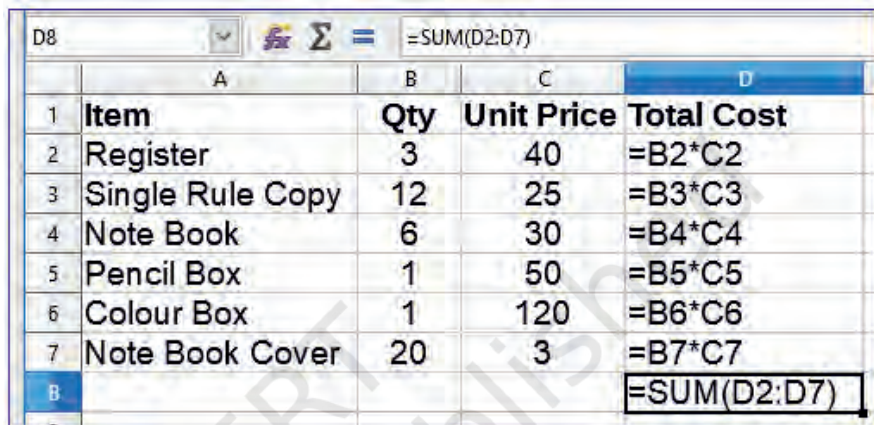
Formula	Result
=A1*B1-D2	
=D1-C2/A2	
=B3^C3-A3	
=A1*C1/C3	
=D2*C4*E1	
=A3/B3+A2*D1	
=A1+(B2*C2)-B3+C2/B2	
=B2-B3+B1*(D1+D2^B1)	
=A2^B3-C2+A3*(B3+C1)	
=A3/C3*(D2*D1)	
=D3/C3/B3*A3+B2	
=(D3/(A1+B2))^C2	

Use of functions to do calculations

In the example of Stationery Bill, to calculate the total cost of all the items to obtain the bill amount, we need to add the amount of each item. We may add each cell by using the formula. Position the cursor on the cell D8, and enter the formula ‘=D2+D3+D4+D5+D6+D6+D7’ and get the total in cell D8. But this may not be practically possible if



there are hundreds of items and also there are more chances of error. When there is a large quantity of data it becomes difficult and complex task to write formula using only the cell addresses. In such situations, LibreOffice Calc provides built in functions. SUM is the function to get the sum of range of cells. So we can use the function, 'Sum(D2:D7)' in D8 cell (Figure 4.20) to obtain the total cost of all the items. In the function we need to include only the cell range (starting and last cell address).



	A	B	C	D
1	Item	Qty	Unit Price	Total Cost
2	Register	3	40	=B2*C2
3	Single Rule Copy	12	25	=B3*C3
4	Note Book	6	30	=B4*C4
5	Pencil Box	1	50	=B5*C5
6	Colour Box	1	120	=B6*C6
7	Note Book Cover	20	3	=B7*C7
8				=SUM(D2:D7)

Fig 4.20: Using functions in the spreadsheet

Think on, which of the following method will be more appropriate to add cell data.

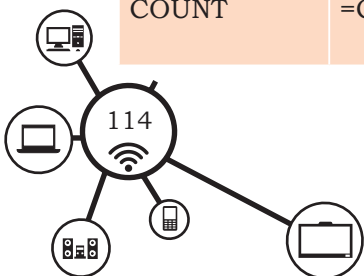
= D2+D3+D4+D5+D6+D7 – Method 1

= SUM (D2:D7) – Method 2

The spreadsheet applications contain different functions to meet the requirements of different fields. The basic commonly used functions are given in the Table 4.4.

Table 4.4: Commonly used basic functions in Calc

Function	Syntax	Use
SUM	=SUM(Number1,Number2,.....)	Adds the values contained in a range of cells.
AVERAGE	=AVERAGE(Number1,Number2,....)	Finds out the average of the values contained in a range of cell
MAX	=MAX(Number1,Number2,.....)	Finds out the largest value contained in a range of cells.
MIN	=MIN(Number1,Number2,.....)	Finds out the smallest value contained in a range of cells.
COUNT	=COUNT(Number1,Number2,.....)	Counts the number of cells within a range of cells.



G7				
	A	B	C	D
1	5	5	7	8
2	8	7	4	7
3	5	5	8	7
4	1	8	5	2
5				

Fig. 4.21: Sample data to work on functions

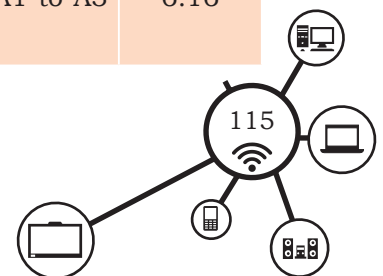
Let us identify the various ways in which a function can be used. Based on the sample data in Figure 4.21, the results of the functions are evaluated from Table 4.5 to Table 4.9. Verify the result.

Table 4.5: SUM function

Formula	Meaning	Result
=SUM (A1,B1,C1)	The sum of cells A1,B1 and C1	17
=SUM(A1:C1)	The sum of cells in the range of cells from A1 to C1	17
=SUM(A1:C1,B2)	The sum of cells in the range of cells from A1 to C1 and B2	24
=SUM(B1:C2)	The sum of cells in the range of cells from B1 to C2	23
=SUM(A1:A3,C1:C3)	The sum of cells in the range of cells from A1 to A3 and C1 to C3	37

Table 4.6 : AVERAGE function

Formula	Meaning	Result
=AVERAGE (A1,B1,C1)	The average of cells A1, B1 and C1	5.66
=AVERAGE (A1:C1)	The average of cells in the range of cells from A1 to C1	5.66
=AVERAGE (A1:C1,B2)	The average of cells in the range of cells from A1 to C1 and B2	6.33
=AVERAGE (B1:C2)	The average of cells in the range of cells from B1 to C2	5.75
=AVERAGE (A1:A3,C1:C3)	The average of cells in the range of cells from A1 to A3 and C1 to C3	6.16



Note: When the average is calculated a decimal number with several decimal places may be used. You need the required decimal places in the relevant cell range.

Table 4.7: MAX function

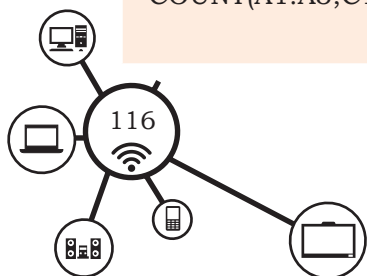
Formula	Details	Result
=MAX(A1,B2,C1)	Finds out the largest value among cells A1,B2 and C1	7
=MAX(A2:C2,B3)	Finds out the largest value among the range of cells from A2 to C2 and the cell B3	8
=MAX(A1:C1)	Finds out the largest value among the range of cells from A1 to C1	7
=MAX(A1,B1:C2)	Finds out the largest value among the range of cells from A1 to B1 and the cell C2	7

Table 4.8: MIN function

Formula	Details	Result
=MIN(A1,B2,C1)	Finds out the smallest value among cells A1, B2 and C1	5
=MIN(A2:C2,B3)	Finds out the smallest value among the range of cells from A2 to C2 and the cell B3	4
=MIN(A1:C1)	Finds out the smallest value among the range of cells from A1 to C1	5
=MIN(A1,B1:C2)	Finds out the smallest value among the range of cells from B1 to C2 and the cell A1	4

Table 4.9: Count Function

Formula	Details	Result
=COUNT(A1,B1)	Counts the number of cells that contain numbers among cells A1, B1	2
=COUNT(A1:C1)	Counts the number of cells that contain numbers in the range of cells from A1 to C1	3
=COUNT(A1:A4)	Counts the number of cells that contain numbers in the range of cells from A1 to A4	3
=COUNT(A1:C1,B2)	Counts the number of cells that contain numbers in the range of cells from A1 to C1 and B2	4
=COUNT(B1:C3)	Counts the number of cells that contain numbers in the range of cells from B1 to C3	6
=COUNT(A1:A3,C1:C3)	Counts the number of cells that contain numbers in the range of cells from A1 to A3 and the range of cells from C1 to C3	6



Let's Practice 7

Using functions

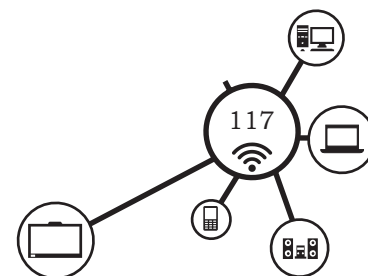
The Figure 4.22 shows marks scored by students in three different subjects.

E6				
	A	B	C	D
1	Student Name	Hindi	English	Maths
2	HARMAN	77	76	85
3	JAYANT	78	75	80
4	RIYA	75	87	74
5	AVIRAL	87	68	76
6	HRIDAY	80	74	71

Fig. 4.22: Marks scored by students in different subjects

Provide answers for the following queries using functions.

1. Write the formula in E2 to find the total marks scored by HARMAN.
2. Copy the formula entered in E2 for other students.
3. Write the formula in F2 to find the average marks scored by HARMAN?
4. Copy the formula entered in F2 for other students.
5. Write the formula in cell B7 to find the highest score in Hindi.
6. How will you find the highest score in English and Maths?
7. Write the formula in cell B8 to find the total number of students who appeared in Hindi?
8. Write the formula in cell B9 to find the lowest score in Hindi.
9. How will you find the lowest score in English and Maths?
10. How will you find the highest score in Hindi, English and Maths?



Formatting the worksheet

The cell holds any type of data in the spreadsheet. The cell data can be formatted using formatting toolbar or cell formatting window. It is also possible to format the cell using Format cells dialog box as shown in the Figure 4.23. The Format cells dialog box can be opened using **Format→cells** using the Format menu, or from context menu opened through right clicking the cell. The various options in the **Format→cells** dialog is briefly explained in the Table 4.10.

Table 4.10: Formatting tool

S.No.	Tool	Details
1.	Font	Apply different font types on a worksheet
2.	Font Size	Apply different font sizes on a worksheet
3.	Bold	Make the selected text bold
4.	Italic	Italicize the selected text
5.	Underline	Underline the selected text
6.	Left Alignment	Align text in a cell to the left
7.	Center Alignment	Align text in a cell to the center
8.	Right Alignment	Align text in a cell to the right
9.	Increase decimal places	Show more precise value by showing more decimal places
10.	Decreased decimal places	Show less precise decimal places

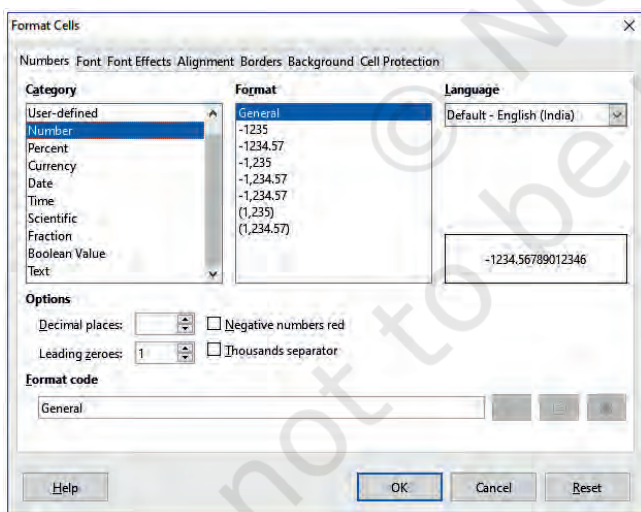


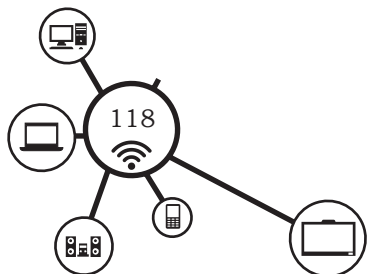
Fig. 4.23: Format cells dialog box

Use of dialog boxes to format values

The format cells dialog box in the toolbar can be used to find more about formatting a cell or range of cell. You can open this **Format Cell** dialog box by pressing the shortcut key **Ctrl+1** as shown in Figure (4.23).

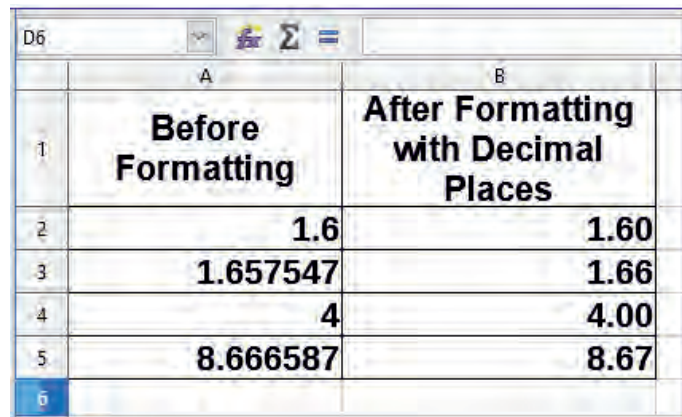
Formatting a range of cells with decimal places

The division of different numbers may result in varied decimal places in the quotient. In such cases it is necessary to format the number to a fixed number of decimal places.



Following are the steps to format a cell to the required number of decimal places:

- Select the range of cells.
- Open the 'format cells dialog' box
- Click the 'Number' tab
- Select the 'Number'
- Change the decimal places as required
- Click 'OK'



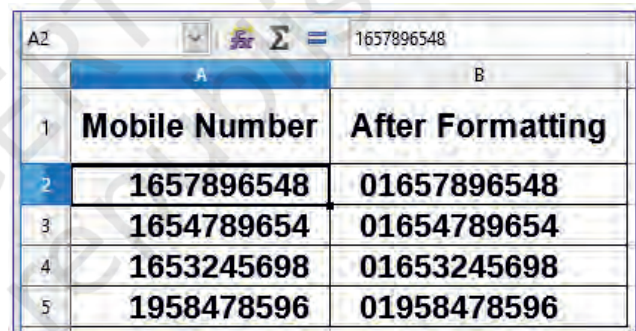
	A	B
1	Before Formatting	After Formatting with Decimal Places
2	1.6	1.60
3	1.657547	1.66
4	4	4.00
5	8.666587	8.67

Fig. 4.24: Formatted to two decimal places

Formatting a range of cells to be seen as labels

In a telephone number, the STD code starts with 0. But while entering the telephone number with the STD code the first digit zero ('0'), disappears from the telephone number. This is because the telephone number is stored as a numeric value, and the numeric value does not have a preceding zero. If you make these numeric values as text, then the complete telephone number will appear with a preceding zero. So format the whole range of cells consisting of telephone number as 'text'. Follow the steps below in order to format a range of cells as text as shown in Figure 4.25.

- Select the range of cells
- Open the 'format cells dialog' box
- Click the Number tab
- Select Text
- Click 'OK'
- Enter numbers

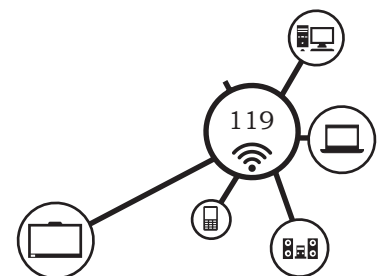


	A	B
1	Mobile Number	After Formatting
2	1657896548	01657896548
3	1654789654	01654789654
4	1653245698	01653245698
5	1958478596	01958478596

Figure 4.25: Formatting a range of cells as labels

Formatting of a cell range as scientific

In a spreadsheet, by default the date format is in American Format; (mm/dd/yyyy) (mm-month, dd-date, yyyy-year). The date 12/09/2018 means that it is the



1	09/12/2018
2	Sunday 9 December 2018
3	09/12/18
4	12/Sep
5	

Figure 4.26: Various date formats

09th day of December 2018. In a spreadsheet application, the user can change this Date in many different formats (Figure 4.26). To do these follow the below steps.

- Select the range of cells.
- Open the 'Format cells dialog' box
- Click the 'Number' tab
- Select the 'Date' category
- Select the date format
- Click 'OK'

Formatting a range of cells to display times

Time is indicated in a computer as 10:35:53 AM. The common format of this is hh:mm:ss AM/PM (Figure 4.27). Here, hh means hours, mm means minutes and ss means second. Follow the steps below to format a range of cells to display the time.

1	Display Time as different formats
2	10:35:53 AM
3	10:35:53
4	10:35 AM
5	10:35
6	
7	

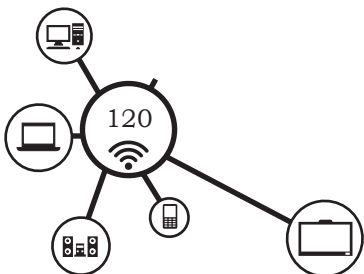
Fig. 4.27: Various time formats cell range

- Select the cell range
- Open the 'format cells dialog' box
- Click the 'Number' tab
- Select the 'Time' category
- Select category Time should be displayed
- Click 'Ok'

Formatting alignment of a cell range

The labels and values can be aligned to the left, center or right of a cell range by using the alignment icons  (Left, Right, Center) on the standard toolbar.

- Select the range of cells
- Open the 'format cells dialog' box
- Click the 'Alignment' tab
- Select left, right or center
- Click 'OK'



Create the worksheet as shown in Figure 4.28 using formatting tools and formulae.

- Center align row 1.
- Make row 1 and row 2 Bold.
- Italicise cells A3, A4, A5.
- Use function AVERAGE in cell E3 to calculate the average of Hindi (B3) English (C3) and Maths (D3).
- Copy this formula by dragging it from E3 to E6.
- Use function AVERAGE and write a formula in B7 to calculate the average of Class 9 (B3), Class 10 (B4), Class 11 (B5), Class 12 (B6) for the subject Hindi.
- Copy this formula by dragging it from B7 to D7 and use them to calculate the average for English and Maths.

Usage of Books class wise					
1	Class	Hindi	English	Maths	Average
2	9	22	42	32	32.00
3	10	27	24	33	28.00
4	11	29	25	25	26.33
5	12	20	27	26	24.33
6	Average	24.5	29.5	29.0	

Fig. 4.28: Worksheet with various formats

Speeding up data entry

The most important ability of a spreadsheet is to drag and drop the contents of one cell to another by using a mouse. Calc includes several other tools for automating input, especially of a repetitive task. They include the fill tool, selection lists, and the ability to input information into multiple sheets of the same document.

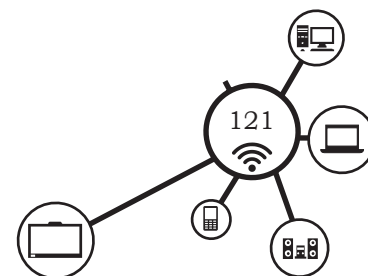
Using the fill handle

The Calc Fill Handle tool is used to fill the next cells till you drag it with the next predefined value. For example, if you want to fill the numbers in sequence of 1,2,3..., or days of the week as Monday, Tuesday, ..., or month name as Jan, Feb,..., enter the first two values, select them and drag to the next cells till you wish to continue the series in sequence.

- (a) For number series:** Type the numbers 1, 2 in two consecutive cells and select them using a mouse. Click on the right down corner of the selected cells, hold down the first button of mouse and drag downward till you want to continue as shown in Figure (4.29).

	A	B	C
1			
2		1	
3		2	
4		3	
5		4	
6		5	
7		6	
8		7	
9		8	
10		9	
11		10	
12			

Figure 4.29: Fill handle for number series



Here you can get a series on different interval also by giving the difference between two consecutive cell values and drag them. For example, to draw odd number series type 1 in the first cell and 3 in the next cell and then drag them to fill odd number series.

- (b) Copying a formula:** If you wish to apply the same formula to the number of cells in the rows or columns, you need not enter the formula again and again in each cell. A formula can be copied. It saves the time and efforts in the case of long and complex formulae and reduces chances of errors.

(i) Use of copy and paste commands for copying formulae

Following are the steps to copy a formula using the copy-paste command

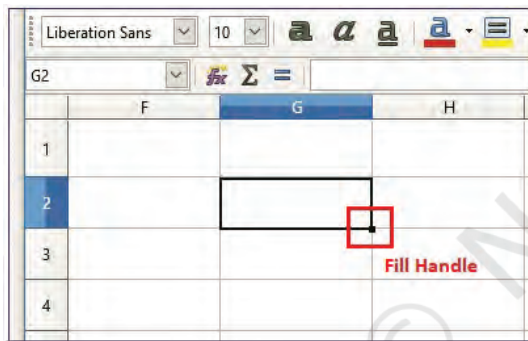


Fig. 4.30: Fill handle

- Select the cell
- Copy the contents of the selected cell (**Ctrl+C**)
- Select the cell to which the formula is to be pasted
- Paste the contents in the selected cell (**Ctrl+V**)

- (c) Fill handle of a cell:** The small black square in the bottom-right corner of the selected cell or range is called a fill handle (see Figure 4.30).

(d) Uses of fill handle for copying formulae:

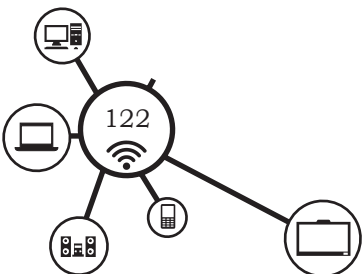
Follow the steps below to copy formula using the fill handle.

- Select the cell which contains the formula
- Click the small black square in the bottom-right corner of the selected cell
- Drag the fill handle up to the required cell

Let's Practice 7

A. Copy the formula using Fill Handle

1. Create the worksheet as shown in Figure 4.30.



- Click on Cell A2 and using Fill Handle, Drag it till Cell A15. You will get the list of all the Days' name.
- Click on Cell B2 and using Fill Handle, Drag it till Cell B15. You will get the list of all the Months' name.
- Select Cell C2 and C3 using a mouse. Now using Fill Handle in cell C3 drag it till Cell C15, you will get a list of Natural numbers.
- Select Cell D2 and D3 using a mouse. Now using Fill Handle in cell D3 drag it till Cell D15, you will get a list of Even numbers.
- Select Cell E2 and E3 using mouse. Now using Fill Handle in cell D3 drag it till Cell E15, you will get a list of Odd numbers.

After these five activities, you will get the sheet as shown in Figure 4.31.

	A	B	C	D	E
1	Day Name	Month Name	Natural Number	Even Number	Odd Number
2	Sunday	January	1	2	1
3			2	4	3
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

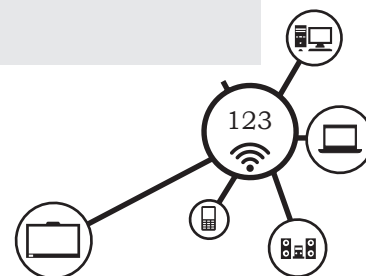
Fig. 4.30 Activity sheet for fill handle

	A	B	C	D	E
1	Day Name	Month Name	Natural Number	Even Number	Odd Number
2	Sunday	January	1	2	1
3	Monday	February	2	4	3
4	Tuesday	March	3	6	5
5	Wednesday	April	4	8	7
6	Thursday	May	5	10	9
7	Friday	June	6	12	11
8	Saturday	July	7	14	13
9	Sunday	August	8	16	15
10	Monday	September	9	18	17
11	Tuesday	October	10	20	19
12	Wednesday	November	11	22	21
13	Thursday	December	12	24	23
14	Friday	January	13	26	25
15	Saturday	February	14	28	27

Fig. 4.31 Result of fill Handle activity

2. Create a worksheet as shown in Figure 4.32 with all student names and marks.

- Type the formula in cell H2 as **=SUM(C2:G2)**. You will get the total marks of Amit. Now drag the formula using Fill Handle in cell H2 to H11 to get the total of all marks.



- Type the formula in cell I2 as **=AVERAGE(C2:G2)**. You will get the average marks of Amit. Now drag the formula using Fill Handle in cell I2 to I11 to get the total of all marks. After that you will your sheet as shown in Figure 4.33.

Sno	Name	Hindi	English	Science	Maths	Biology	Total	Average
1	Amit	65	84	33	30	69		
2	Deepak	31	41	87	57	35		
3	Chetna	77	48	72	35	65		
4	Firoz	76	79	33	73	76		
5	Gagan	41	93	52	87	29		
6	Meena	90	84	92	43	54		
7	Nikki	30	90	39	44	59		
8	Tejpal	93	74	42	84	48		
9	Vinay	62	81	74	93	86		
10	Yusuf	27	27	28	61	48		

Fig. 4.32: Activity sheet for formula dragging

Sno	Name	Hindi	English	Science	Maths	Biology	Total	Average
1	Amit	65	84	33	30	69	281	56.2
2	Deepak	31	41	87	57	35	251	50.2
3	Chetna	77	48	72	35	65	297	59.4
4	Firoz	76	79	33	73	76	337	67.4
5	Gagan	41	93	52	87	29	302	60.4
6	Meena	90	84	92	43	54	363	72.6
7	Nikki	30	90	39	44	59	262	52.4
8	Tejpal	93	74	42	84	48	341	68.2
9	Vinay	62	81	74	93	86	396	79.2
10	Yusuf	27	27	28	61	48	191	38.2

Fig. 4.33: Result of Activity sheet for formula dragging

Referencing

Referencing is the way to refer the formula or function from one cell to the next cell along the row or column. There are three types of referencing.

- Relative referencing
- Mixed referencing
- Absolute referencing

Till now we have used Relative referencing in the earlier examples.

(a) Relative Referencing

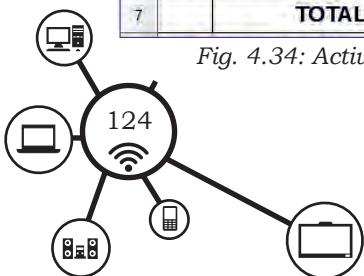
When you drag any formula in any row or column in any direction, the formula gets copied in the new cell with the relative reference. Almost all spreadsheet applications use relative referencing by default.

	A	B	C	D	E
1	SNO	ITEM NAME	PRICE	QTY	TOTAL
2	1	PENCIL	4	20	=C2*D2
3	2	RUBBER	3	10	=C3*D3
4	3	COPY	25	30	=C4*D4
5	4	BOOK	150	4	=C5*D5
6	5	BOARD	45	15	=C6*D6
7	TOTAL		=SUM(D2:D6)		=SUM(E2:E6)

Fig. 4.34: Activity for using Relative reference

	A	B	C	D	E
1	SNO	ITEM NAME	PRICE	QTY	TOTAL
2	1	PENCIL	4	20	80
3	2	RUBBER	3	10	30
4	3	COPY	25	30	750
5	4	BOOK	150	4	600
6	5	BOARD	45	15	675
7	TOTAL		79		2135

Fig. 4.35: Use of Relative referencing



When we drag the formula downwards in columns, the row number of the cell address gets one added. In the same way, when you drag the formula horizontally from the left to the right column, the column name of the cell address is added on to the next column letter.

Refer Figure 4.34, in cell E2, the formula = **C2*D2** has been used to calculate the total price of the pencil. In cell D7, the formula =**SUM(D2:D6)** has been used to calculate total quantity of all items. Now drag formula from cell E2 to E6 vertically and from Cell D7 to D8 horizontally. In Figure 4.34, you can observe that the formula in cell E3 to E6 is C3*D3, C4*D4, C5*D5, and C6*D6. The row numbers have got added by one while column names are constant. As you drag formula from cell D7 to E7, the formula gets changed to SUM (E2:E6) from SUM (D2:D6). The column names get changed, while row numbers will remain same.

Note: To see the formula after dragging as shown in Figure 4.34, Select from Menu **View>Show Formula**.

Let's Practice 8

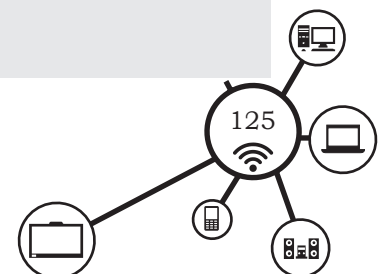
A. Show the formula in cell used in Figure 4.35 for column Total and Average.

1. Prepare a worksheet as shown in Figure 4.36 to calculate the Gross Salary of employees.

	A	B	C	D	E	F	G	H
1	Sno	Name	Basic Salary	TA (6%)	DA (14 %)	HRA (10%)	CPF (3%)	Gross Salary
2	1	Amit Sharma	12000	=C2*6/100	=C2*14/100	=C2*10/100	=C2*3/100	=SUM(C2:G2)
3	2	Deepak Gautam	9000					
4	3	Chetna Agrawal	15000					
5	4	Firoz Khan	8500					
6	5	Gagan Tomar	15600					
7	6	Meena Kumari	9800					
8	7	Nikki Khanna	16500					
9	8	Tejpal Singh	14600					
10	9	Vinay Kumar	14900					
11	10	Yusuf Pathan	12800					

Fig. 4.36: Displaying formula in Relative reference

2. Type the formula in Cell D2, E2, F2, G2 and H2 as shown in the figure. Now drag each formula



you have typed till row 11 to calculate the gross salary of each person. Finally calculate the total salary of all persons in Cell H12 yourself.

(b) Mixed referencing: As we have seen, when we drag the formula, row number or column name get change in relative reference. Again consider the same sheet prepared in Figure 4.36 with the following changes.

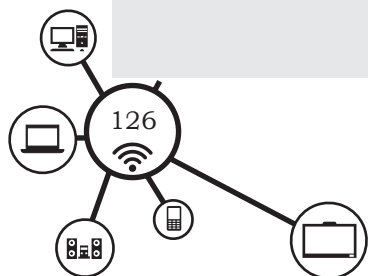
1. Make a new column **GR Total** in **Cell J1** as shown in Figure 4.37.
2. Type **Grace Marks 20** in **Cell C14**.
3. Now calculate the Grand Total of marks in cell J2 by formula **=H2+C14**.
4. Now drag the formula vertically from **Cell J2 to J11** and check if the grace marks are added for all the students or not.
5. The result shows that only in cell J2, 20 marks are added, with no other change.

Now to see the formula, from Menu **View>Show Formula** for what exactly Calc did in this case as shown in Figure 4.37.

	A	B	C	D	E	F	G	H	I	J
1	Sno	Name	Hindi	English	Science	Maths	Biology	Total	Average	GR Total
2	1	Amit	65	84	33	30	69	=SUM(C2:G2)	=AVERAGE(C2:G2)	=H2+C14
3	2	Deepak	31	41	87	57	35	=SUM(C3:G3)	=AVERAGE(C3:G3)	=H3+C15
4	3	Chetna	77	48	72	35	65	=SUM(C4:G4)	=AVERAGE(C4:G4)	=H4+C16
5	4	Firoz	76	79	33	73	76	=SUM(C5:G5)	=AVERAGE(C5:G5)	=H5+C17
6	5	Gagan	41	93	52	87	29	=SUM(C6:G6)	=AVERAGE(C6:G6)	=H6+C18
7	6	Meena	90	84	92	43	54	=SUM(C7:G7)	=AVERAGE(C7:G7)	=H7+C19
8	7	Nikki	30	90	39	44	59	=SUM(C8:G8)	=AVERAGE(C8:G8)	=H8+C20
9	8	Tejpal	93	74	42	84	48	=SUM(C9:G9)	=AVERAGE(C9:G9)	=H9+C21
10	9	Vinay	62	81	74	93	86	=SUM(C10:G10)	=AVERAGE(C10:G10)	=H10+C22
11	10	Yusuf	27	27	28	61	48	=SUM(C11:G11)	=AVERAGE(C11:G11)	=H11+C23
12										
13										
14		Grace Marks	20							

Fig. 4.37: Display formula in mixed referencing

In this case as cell address H2 changes from H3 to H11. In the same way the cell address C14 also changes



from C15 to C23. Since there is no value in cell C15 to C23, the result in the cell J3 to J11 are not affected. So to calculate grand total of all students, modify the formula in Cell J2, keeping the address cell C14 constant.

In **Mixed Referencing**, the \$ sign is used before row number or column name to make it constant.

Now modify formula in cell J2 as **H2+C\$14** and drag it downward from cell J2 to J11. Observe the column J from cell J2 to J11 in Figure 4.38, the cell address C14 is constant.

	A	B	C	D	E	F	G	H	I	J
1	Sno	Name	Hindi	English	Science	Maths	Biology	Total	Average	GR Total
2	1	Amit	65	84	33	30	69	281	56.2	301
3	2	Deepak	31	41	87	57	35	251	50.2	
4	3	Chetna	77	48	72	35	65	297	59.4	
5	4	Firoz	76	79	33	73	76	337	67.4	
6	5	Gagan	41	93	52	87	29	302	60.4	
7	6	Meena	90	84	92	43	54	363	72.6	
8	7	Nikki	30	90	39	44	59	262	52.4	
9	8	Tejpal	93	74	42	84	48	341	68.2	
10	9	Vinay	62	81	74	93	86	396	79.2	
11	10	Yusuf	27	27	28	61	48	191	38.2	
12										

Fig. 4.38: Uses of mixed referencing

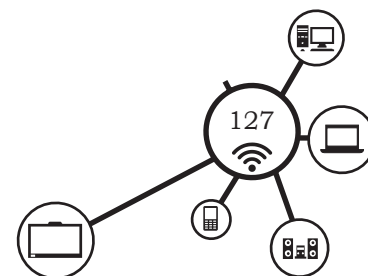
The output of this activity is shown in Figure 4.39. It is observed that in column J from cell J2 to J11, in the formula, value of cell C14 is constant. The grace marks denoted in C14 cell are being added in each (cell J2 to J11). The cell address H2 is relatively changing from H2 to H11, but cell C14 remains constant. This is **mixed referencing** in which one cell address name is variable and one cell address is constant.

	A	B	C	D	E	F	G	H	I	J
1	Sno	Name	Hindi	English	Science	Maths	Biology	Total	Average	GR Total
2	1	Amit	65	84	33	30	69	=SUM(C2:G2)	=AVERAGE(C2:G2)	=H2+C\$14
3	2	Deepak	31	41	87	57	35	=SUM(C3:G3)	=AVERAGE(C3:G3)	=H3+C\$14
4	3	Chetna	77	48	72	35	65	=SUM(C4:G4)	=AVERAGE(C4:G4)	=H4+C\$14
5	4	Firoz	76	79	33	73	76	=SUM(C5:G5)	=AVERAGE(C5:G5)	=H5+C\$14
6	5	Gagan	41	93	52	87	29	=SUM(C6:G6)	=AVERAGE(C6:G6)	=H6+C\$14
7	6	Meena	90	84	92	43	54	=SUM(C7:G7)	=AVERAGE(C7:G7)	=H7+C\$14
8	7	Nikki	30	90	39	44	59	=SUM(C8:G8)	=AVERAGE(C8:G8)	=H8+C\$14
9	8	Tejpal	93	74	42	84	48	=SUM(C9:G9)	=AVERAGE(C9:G9)	=H9+C\$14
10	9	Vinay	62	81	74	93	86	=SUM(C10:G10)	=AVERAGE(C10:G10)	=H10+C\$14
11	10	Yusuf	27	27	28	61	48	=SUM(C11:G11)	=AVERAGE(C11:G11)	=H11+C\$14
12										

Figure 4.39: Result of mixed referencing after modifying formula

In this activity, the row number has been kept constant. The column name can also be kept constant by using \$ sign before column name (as \$C14) in any formula, if dragging the formula horizontally.

(c) Absolute referencing: In Absolute referencing, a \$ symbol is used before the column name as well as row number to make it constant in any



formula. For example, \$C\$12, \$D\$5, etc. In this case, even if you drag your formula in any direction, the cell name remains constant. This type of referencing is used in higher classes.

Thumb rule for referencing

Types of Cell Reference

Example	Type of reference
A1	Relative reference
\$A1	Mixed reference (Column letter is absolute)
A\$1	Mixed reference (Row number is absolute)
\$A\$1	Absolute reference (No change)

Creation of Charts Using Spreadsheets

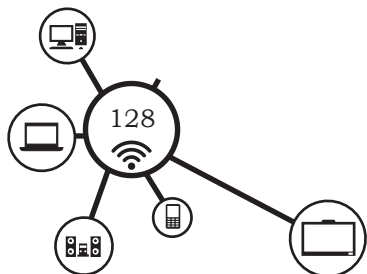
It is not easy to comprehend, compare, analyse or present data when they are represented as numbers. But when data are presented in the form of charts they become an effective tool to communicate. Let us learn how spreadsheet applications are used for this purpose. The various types of charts are given below.

Table 4.10: Types of charts

Types	Purpose
Column Chart	Comparing classes of data items in group. Group comparison
Bar Chart	Comparing classes of data items in group. Group comparison
Line Chart	Comparing classes of data items in group. Group comparison
Pie Chart	Comparing classes of data items as percentage.
XY Scatter Chart	Comparing data in pairs

Let us use the worksheet below to create a **column chart**.

- Follow the steps given below to create charts.
- Select the range of data (A1:F7)
- *Insert* → *Chart*
- Select the type of chart



- Select the chart (Column Chart)
- Click finish. A chart as shown in Figure 4.40 will be displayed.

Example: Quadratic function chart of the equation $Y=X^2-5X-3$ is given in the Figure 4.41.

1. Enter the values 2 to 7 in axis as shown in worksheets.
2. Enter the formula below in cell B2.
 $= B1^2-5*B1-3$
3. Copy the formula entered in B2 upto K2
4. Mark A1:A2 a data range
5. Insert → Chart → XY Scatter

	A	B	C	D	E
1	Usage of Books class wise				
2	Class	Hindi	English	Maths	Average
3	9	22	42	32	32.00
4	10	27	24	33	28.00
5	11	29	25	25	26.33
6	12	20	27	26	24.33
7	Average	24.5	29.5	29.0	

Fig. 4.40: Worksheet with chart

	A	B	C	D	E	F	G	H	I	J
1	X	-2	-1	0	1	2	3	4	5	6
2	Y	11	3	-3	-7	-9	-9	-7	-3	3
3										

Figure 4.41: Column chart

	A	B	C	D	E	F
1	Provide Answer based on worksheet below					
2		A	B	C	D	E
3	1	5	6	7	8	9
4	2	10	11	12	13	14
5	3	15	16	17	18	19
6	4	20	21	22	23	24
7	5	25	26	27	28	29

Fig. 4.42: Quadratic function values of x, y

Let's Practice 9

A. Provide answers of the following, based on the worksheet in Figure 4.43.

- Name the cell range consisting of number 12, 10, 19.
- Name the cell range consisting of number 27, 20, 15, 22.
- Write the formula in B8 using only cell addresses to calculate the total of the values from B2 to B7.

	A	B	C	D	E	F	G
1	Name	Math	Science	English	History	Sanskrit	Total
2	Harman	86	84	57	71	82	
3	Ankur	89	79	84	78	85	
4	Diksha	52	56	69	84	59	
5	Manish	40	86	36	74	69	
6	Harshita	89	43	42	63	76	
7	Sheetal	52	85	40	34	57	
8	Jyotsana	84	65	71	88	81	

Fig. 4.43: Answers based on the worksheet

- Write the formula in G3 using function to calculate the total of the values from B3 to F3.
- Write how you would copy the formula in F3 to F4.
- Write the formula in B8 using function to calculate the average of the values from B3 to B7.

B. Create the worksheet below in Calc

Use a single function and create the formula.

	A	B	C	D	E	F	G
1	Name	Math	Science	English	History	Sanskrit	Total
2	Harman	86	84	57	71	82	
3	Ankur	89	79	84	78	85	
4	Diksha	52	56	69	84	59	
5	Manish	40	86	36	74	69	
6	Harshita	89	43	42	63	76	
7	Sheetal	52	85	40	34	57	
8	Jyotsana	84	65	71	88	81	

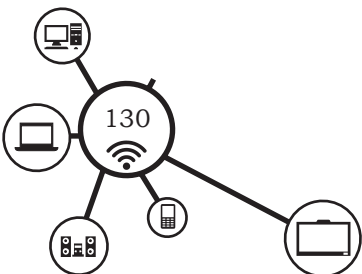
Fig. 4.44: Marks List

1. Enter the formula in G2 to calculate the total marks scored by Harman
2. Enter the formula in H2 to calculate the average scored by Harman.
3. Enter the formula in B9 to find out the highest score obtained for science.
4. Enter the formula in B10 to find out the lowest score obtained by students in each subject.
5. Enter the formula in B11 to find out the number of students present for each subject.
6. Enter the formula in B12 to find out the average score of each subject.

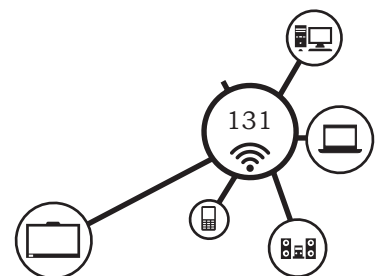
Check Your Progress

A. Multiple Choice Questions

1. Which of the following technique can be used to allow only date value in cell?
 - (a) Data formatting
 - (b) Data sorting
 - (c) Data filtering
 - (d) Data validation



2. Which of the following options when selected deletes all data validation?
 - (a) Delete formatting
 - (b) Delete all
 - (c) Delete formula
 - (d) Delete me
3. We can replace multiple occurrences of a word using which of the following facilities of Calc?
 - (a) Find and replace
 - (b) By replace only
 - (c) By copy command
 - (d) By preview command
4. What is the name of mechanism to arrange the data in a particular order?
 - (a) Sorting
 - (b) Searching
 - (c) Filtering
 - (d) Validating
5. What is the name of mechanism to filter out unnecessary data?
 - (a) Sorting
 - (b) Searching
 - (c) Filtering
 - (d) Validating
6. Which of the following type of package does Calc refer to?
 - (a) Spreadsheet
 - (b) Double sheet
 - (c) Multi-sheet
 - (d) Cannot determine
7. Which of the following is an extension of a worksheet created in Calc?
 - (a) .ods
 - (b) .odd
 - (c) .xls
 - (d) .obj
8. How can one calculate the total of values entered in a worksheet column of?
 - (a) By manual entry
 - (b) By auto-sum
 - (c) By formula
 - (d) By sum function
9. If we move a cell containing a formula having reference to another cell in the worksheet what will happen to the cell numbers used in the formula?
 - (a) The cell row and columns are changed at destination.
 - (b) The cell row change at destination.
 - (c) The cell columns are changed at destination.
 - (d) No change will occur.
10. What is the correct way to enter a function in Calc?
 - (a) Directly typing function name in a cell
 - (b) Using function wizard or selecting from toolbar
 - (c) Both (a) and (b)
 - (d) Depends on the function



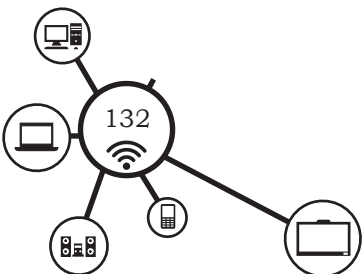
11. A function should start with _____.
 (a) '=' sign (b) alphabets
 (c) numbers (d) All of the these
12. Which of the following option is used to print a chart?
 (a) Insert → Chart (b) File → View
 (c) File → Print (d) View → Chart
13. How many axes does charts in Calc have?
 (a) Two (b) Three
 (c) Two or three (d) Four
14. The chart preview can be seen in _____.
 (a) Page preview (b) Chart preview
 (c) Export chart (d) All of these

B. Fill in the blanks

1. The column immediately next to column "Z" is _____.
2. The default extension of a workbook created using a LibreOffice Calc spreadsheet is _____.
3. The spreadsheet feature used to continue the series is called as _____.
4. The formula "=MIN(C1:C5)" stored in cell C6 when copied to cell D6 changes to _____.
5. The formula in cell A2 is =B2+C3. On copying this formula to cell C2, C2 will change to _____.
6. The cell address of the cell formed by the intersection of the ninth column and the eighth row will be _____.
7. \$A1\$B2 is an example of _____ referencing in spreadsheet software.
8. Numbers entered into a cell are automatically _____ aligned.
9. If A1:A5 contain the numbers 16, 10, 3, 25 and 6 then =Average(A1:A5;60) will display _____.
10. In _____referencing, the reference changes rows and columns automatically when it is copied to a new cell.

C. State whether the following statements are True or False

1. A cell is a combination of row and column.
2. A spreadsheet is also called as worksheet.



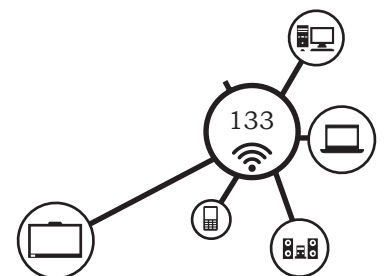
3. There are 'n' number of sheets in a spreadsheet.
4. In a spreadsheet, we can change the column width and row height.
5. \$A1\$B2 is an example of mixed referencing.

D. Solve the following in a spreadsheet

1. Cell A1 contains the number 10 and B1 contains 5. What will be the contents of cell C1, if the formula $=A1+B1*2^3$ is entered in cell C1?
2. The contents of Cell A1, B1, C1 and D1 are 5, -25, 30 and -35, respectively. What will be the value displayed in cell E1 which contains the formula $=MIN(A1:D1)$.
3. Cell D5 contains the formula $=B\$5+C5$ and this formula is copied to cell E5, what will be the copied formula in cell E5?
4. Cell D5 contains the formula $=B5 + C5$ and this formula is copied to cell E5, what will be the copied formula in cell E5?
5. Cell D5 contains the formula $=B5 + C\$5$ and this formula is copied to cell E6, what will be the copied formula in cell E6?

E. Short answer questions (50 words)

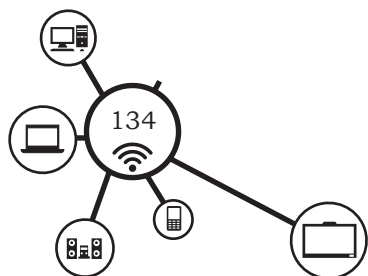
1. What do you call the document created in a spreadsheet application?
2. What are the steps to create a new spreadsheet?
3. What is the difference between spreadsheet, worksheet and sheet?
4. What is the default name of the worksheet? How can it be renamed?
5. Write the steps to insert and delete the worksheet in Calc.
6. What is an active cell? How to delete the contents of an active cell?
7. What is relative and absolute cell address in the spreadsheet?
8. Explain any two operations performed on data in a spreadsheet.
9. How do formulae work in a spreadsheet?
10. Can you include more than one mathematical operators in a formula?



11. How to make visible the desired toolbar a spreadsheet?
12. Give the syntax and example of any three mathematical functions in spreadsheet.
13. Give the syntax and example of any three statistical functions in spreadsheet.
14. Give the syntax and example of any three decision making functions in spreadsheet.
15. Give the syntax and example of any three date and time functions in spreadsheet.
16. Give the syntax and example of any three logical functions in spreadsheet.
17. Give the syntax and example of any three string functions in spreadsheet.
18. Explain the advantages of drawing a chart in Calc.
19. Explain in one line each the various types of charts.
20. Write the steps to insert a chart in Calc.
21. Name and explain any five components of a chart in a spreadsheet package.

Practical Exercise

1. Explore in how many formats can you save the Calc worksheet using the Save as option. Verify it by opening in the software.
2. Open a Calc document, add seven sheets using Sheet tab, colour them as rainbow color such as "Violet", "Indigo,"etc. Make sure that "Indigo" sheet is recoloured with indigo colour and so on.
3. Try auto-fill tool with negative numbers.
4. Try auto-fill tools with two dates. Write 15-08-2013 in a cell and in its adjacent cells write a successive data. Drag the content to next 10 cells. Using this technique try to create a monthly calendar.
5. Add your name in to the dictionary so that the red line will not be displayed under it.
6. Implement the example of the shopping bill discussed in this chapter. Study any bill you get from a super store and implement it in Calc.
7. Generate the Calc document with your in all your marks six different subjects. Make total of the marks find out average and percentages from the data.
8. Make a list as given below and sort the list according to Class and then by names.



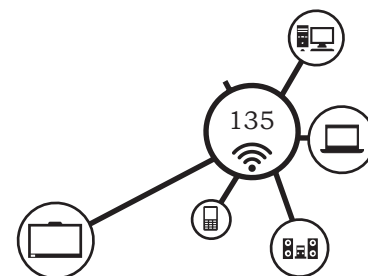
Name	Class	Section	Date of Birth	Month of Birth	Year of Birth
Khushi	Class 9	D	06	February	2004
Diya	Class 9	A	08	June	2006
Kushaal	Class 3	C	10	July	2010

9. Filter the list of friends you have created in Question 8 above, so that it will display only those friends information whose birth dates are in the month of August.
10. Use help to find information about sorting and filtering. Prepare notes on these topics using Help.
11. Use your notes on data validation and also use the data you have entered in Question 8 of this exercise, to validate the data in the date of birth column so that nobody can enter data such as 33. You have to make data validation in such a way that it will accept only 1 to 31 numbers as date of birth values.
12. Consider your marks of different subjects and prepare a simple marksheet containing school name, student's number, student's name, class and marks. Also find percentages and marks and grade.
13. Make a small survey in your area and find out the newspaper invited in each house for at least 10 houses. Collect data, arrange them and prepare 3D pie chart based on this.
14. Consider a mathematical function, such as $Y=3*X+1$. Calculate the value of Y for each even value of X, as given in the table below.

Value of X	2	4	6	8	10
Value of Y	?	?	?	?	?

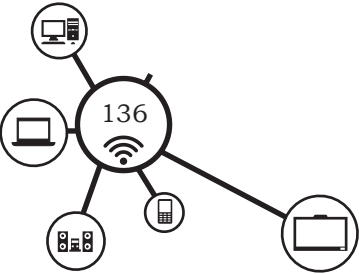
For this do the following:

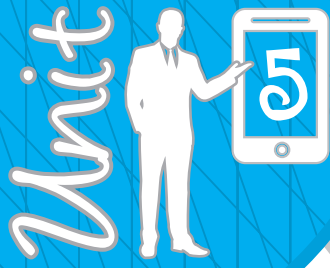
- (a) Enter these values in Calc worksheets
 - (b) Use formula to find out the values of X for each even value of Y
 - (c) Plot a line chart of X and Y values together
 - (d) Format the chart as per your choice
15. Collect the electricity bill of your home for each month from January to December (12 months). Create a worksheet with the data of Name



of the Month and Bill Amount as below. Enter the data in a worksheet and develop the chart of various types. Conclude your result that which type of chart will be more appropriate for such type of data.

Month	Bill Amount
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	





Digital Presentations

INTRODUCTION

Presenting information clearly and effectively is a key skill to get your message or opinion across the audience. Today, presentation skills are highly required in almost every field. Presentation skills include content as well as flow of presentation. There are a number of advantages of using a presentation prepared with computer.



A presentation includes

- Regular text
- Lists items
- Table
- Graphics elements
- Sound and Video
- Animation

Presentation is used to present the project proposal in business organisations. Presentation is highly used in teaching and training. The concepts that are difficult to explain, can be easily presented to the audience in a simple way using any presentation software. For example, a teacher wants to teach any biological system

NOTES

of human a complete system can be demonstrated using pictures and animation very effectively through a presentation. Machine parts and operation of various machines can be easily shown. We can also print the presentation in different ways.

Impress is one of the important components of *LibreOffice* suite from **The Document Foundation**. It is free, open source and widely used by large community to create presentation. You can create presentation using text, graphics and animations for class lecture, corporate training and invited talk. The presentation created in LibreOffice Impress can be opened in other presentation software like MS PowerPoint.

Using Impress, we can read MS PowerPoint presentations and its templates. We can also open any Impress presentation in MS Power Point but with slightly different look and feel. LibreOffice Impress runs on Windows, Linux, and Mac. It may look slightly different on different operating system.

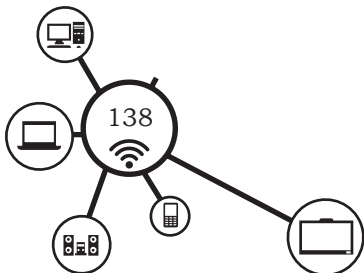
If you don't have any presentation software on your computer and you have an Internet connection then you can easily use the presentation software. The presentation software like MS-Office 365 PowerPoint, Google Presentation or Microsoft SkyDrive PowerPoint are available to make your presentation. These are the software available under the cloud platform in the Internet.

In LibreOffice Impress, an effective presentation can be created by using different multimedia elements. The text editing and formatting, such as bold, colours, text alignment, borders, drawing, etc., of presentation in Impress uses the same commands and options as that of Writer and Calc.

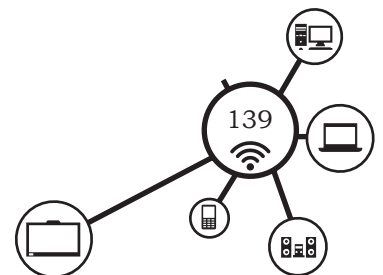
Characteristics of a good quality presentation

A good quality presentation is required to convey the message clearly to the audience. The following points or guidelines have to be taken care of while preparing a good quality presentation.

- (a) **Number of lines:** On one page or slide try to include 5 to 8 lines. Adding more number of lines or a paragraph may take more time to read as the font size may become too small.



- (b) **Font-size:** While preparing the presentation, you need to take care of the room size, distance between the screen and the audience. Accordingly the font size of the texts in the presentation may be decided. It will be appropriate to keep the font size at 32 points or more, so that the audience can easily read the contents.
- (c) **Correct use of grammar and language:** The grammar and language should be correct in your presentation, because if you make a mistake that will replicate to the number of persons in the audience. So you must present the contents error free in terms of grammar, spellings of language by reading the slides carefully.
- (d) **Inserting images, drawings, tables or graphs:** Try to avoid inserting more than two graphics (images, drawings, tables or charts) in any slide. Inserting too many graphics becomes confusing for the audience.
- (e) **Use of colours:** Try to use dark colours, bold letters with different fonts to highlight certain points. Use fair or silent background colours and dark colours for fonts. Give attention to the contrast of background and foreground colours. Bring the variation in colours of the fonts as per the readability. Use of dark-coloured fonts over a dark background, or taking only one colour red throughout the whole presentation is not a good practice. Consider the factor that which colour will be more comfortable for the human eyes to see. Use different colours somewhere in between the presentation to show the importance of words.
- (f) **Animation and videos:** Do not include more than one animation or video in one slide. Including more than one, will overlap the sounds and may cause confusion to the audience.
- (g) **Pay attention to target group:** While creating the presentation, give attention to meet the requirements of the target audience. Focus on the contents, sequence of the topics in such a way that it makes a flow to attract the attention of the audience from the objectives. Otherwise,



the audience might be lost. For example, if you include a video or animation of 5 minutes, it will divert the attention of the audience and the whole objective of the presentation may be lost.

Let's Practice 1

1. List the advantages of Impress with multimedia projector for presentation purpose.
2. List the possible multimedia contents that are included while creating a presentation.
3. List the important points to be considered while making an attractive presentation.
4. Prepare the storyboard of presentation that you wish to create.

Getting started with LibreOffice Impress

Starting LibreOffice Impress

To start LibreOffice Impress, just double click its shortcut icon on the desktop. In general, you will find a shortcut of LibreOffice on the desktop or on the Quick Launch Taskbar. The process may slightly differ according to the operating system (Windows or Linux) that you are using.

To start LibreOffice Impress in **Windows**, double click its shortcut icon on the desktop. Or click on the *Start or Windows button*, select *LibreOffice* → *LibreOffice Impress* from application window.

In **Ubuntu Linux**, open the LibreOffice Impress by any of the following options.

- Find the LibreOffice Impress icon on the application launcher, and click it to start the application.
- Find the LibreOffice Impress icon through “Show Applications” icon on the launcher. To search, enter the word “*impress*” and select *LibreOffice Impress* from the search results.

After starting *Impress*, its initial window will open as shown in Figure 5.1. It shows the various parts of the *Impress* application window.

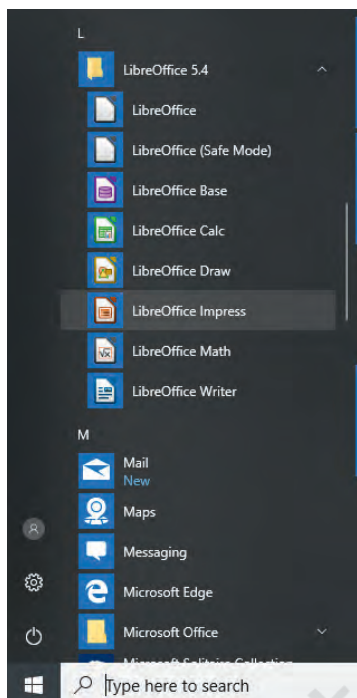
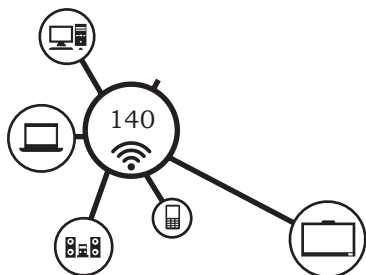


Fig. 5.1: Starting LibreOffice Impress



(a) **Parts of Impress window:** The parts of Impress main window are shown in the Figure 5.2.

(i) **Title bar:** It contains the name of presentation file with extension (.odp) and presentation application as LibreOffice Impress. It is always of the top of the LibreOffice Impress title bar window. Window manipulation buttons are located in the right corner. These are Minimize, Maximize/Restore and Close buttons.

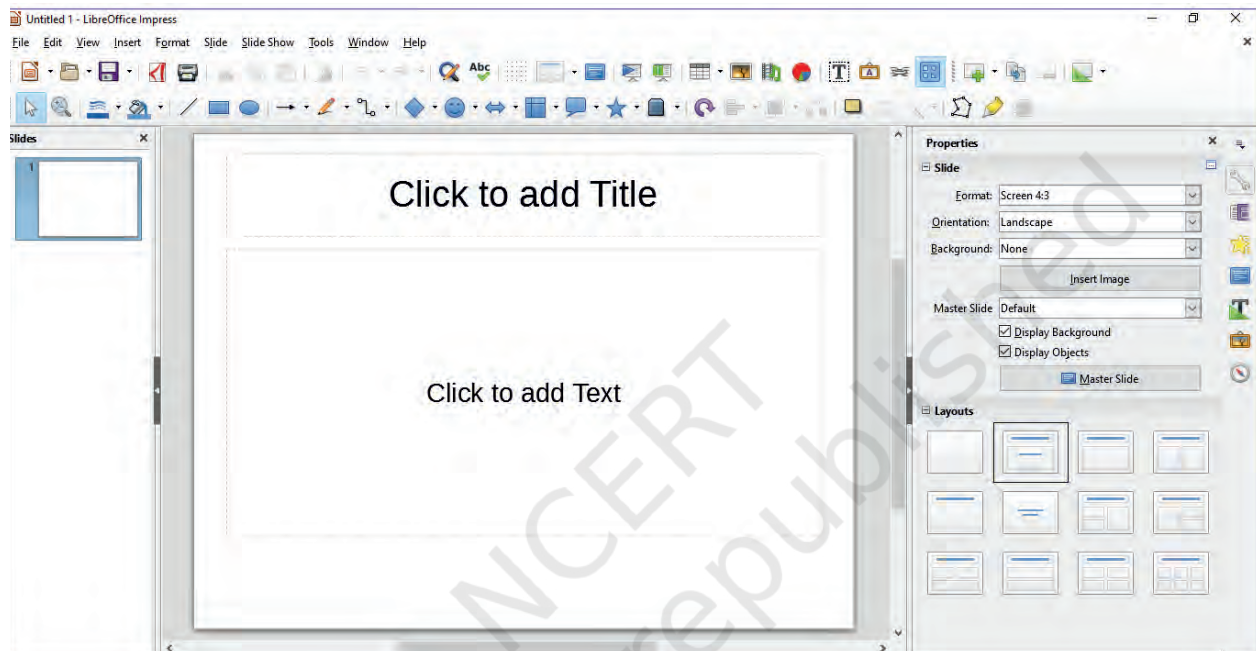
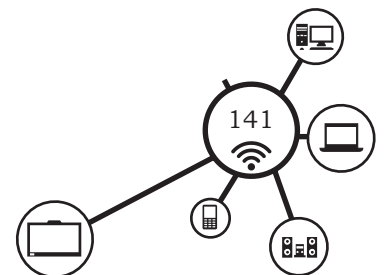


Fig. 5.2: Parts of the Impress window

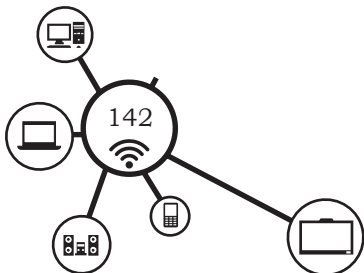
(ii) **Menu Bar:** It contains the menus with logically grouped commands. All the commands required to create the presentation are found here. The various menus are as under:

- **File:** File menu is used to perform basic operations on the presentation (saving, opening an existing one, creating a new one, etc.).
- **Edit:** This menu contains functions for copying, cutting and pasting text segments.
- **View:** It is used for window view adjustment (different view types are selected, zooming, etc.) and for adding toolbars.
- **Insert:** This menu is used to insert various objects like tables, shapes, textbox, and charts into a presentation.



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- **Format:** It contains functions for text formatting.
 - **Slide:** It is used to insert new slide, duplicate slide or delete slide.
 - **Slide show:** It is a tool for viewing presentations.
 - **Tools:** They are used to control spelling in a presentation.
 - **Window:** It is used for viewing already opened presentations.
 - **Help:** It is used to see the help of any topic on Impress.
- (iii) Various toolbar: There are various toolbar to manage GUI of Impress. You can use these toolbar as and when required for various tasks.
- **Standard toolbar:** Each menu of the menu bar are placed here as icons for easy operations.
 - **Slide pane:** It is a vertical pane to see the slide in small size to navigate on any slide easily. As you click on particular slide, that slide will be displayed in larger size in middle of the window. Now you can modify and make required changes, add or remove effects to complete the slide.
 - **Workspace:** This is the central part of the window, where the presentation slides are created, text is entered, images and other objects are inserted.
 - **Slides:** This is in the left part of the window, display presentation slides in the thumbnail form. The pane can be closed and opened if you click on the Slide Pane command in the View menu.
 - **Tasks pane:** Task pane is on the right part of the window. Task pane is made up of five components. All components are NOT open as you start this pane. You need to select the relevant object to open it.
 - **Master pages:** You can modify the base architecture of slide. You can make the presentation base and the common style for all slides using this. There are a few default slide master pages available in Impress.
 - **Layouts:** You can prepare your own layout and keep these safe for future use using this software.



You can select any of these and modify it or use it as required.

- **Table design:** This gives styles for creating tables. Anyone can modify the style according to his or her own choice.
- **Custom animation:** There are many animation features for the texts, drawings, etc., in a slide. Using this feature you can add, change or remove animation features.
- **Slide transition:** Using slide transition, you can set the way, how the slide will appear during presentation. There are too many ready-made alternatives available. You can also modify features like speed of transition, sound effects, automated transition, etc.
- **Drawing toolbar:** Using drawing toolbar, you can make various artistic works in the presentation to make your presentation effective.
- **Insertion point:** It is a location of the cursor where your text will appear as you type anything (means location where the cursor is blinking).
- **Status bar:** It displays information about the active presentation, the current position of the cursor and the zoom slider. It can be adjusted according to user preferences. Status bar can be turned off in the View menu by selecting the Status bar command.
- **Zoom control:** This tool is used to zoom in or zoom out the slide.

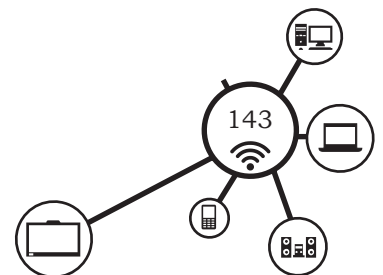
Closing LibreOffice Impress

To close the Impress application directly, select the *manipulation button Close (×)*, or select the **File Menu**→**Exit** command or use the keyboard shortcut **Alt+F4** or **Ctrl+Q**.

Creating a Presentation

Creating a presentation using template

To create a new blank presentation, select the **File Menu**→**New** or click on the icon *New* or use the combination of keys **Ctrl+N**.



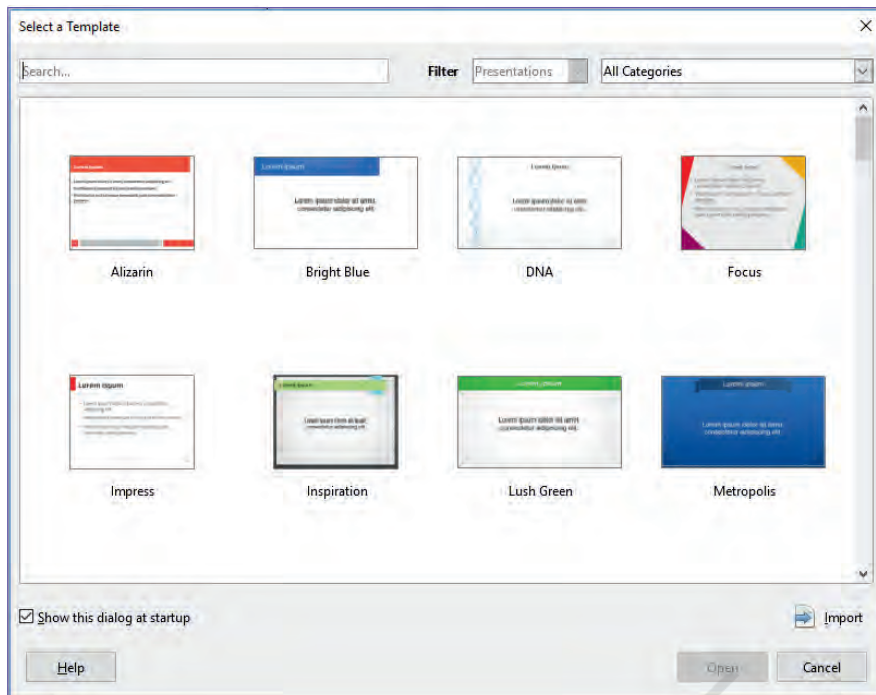


Fig. 5.3: Select a template

A window '**Select a Template**' will appear. Choose a template as per your choice by clicking on the template as shown in Figure 5.3 to start preparing the presentation.

Prepare your presentation using template. The selected template appears in the form of title slide layout as shown in Figure 5.4.

When creating a presentation, the first slide is normally the title slide. You can use

either a blank layout or one of the title layouts as per your title slide. Now enter the title text in this slide as shown in Figure 5.5.

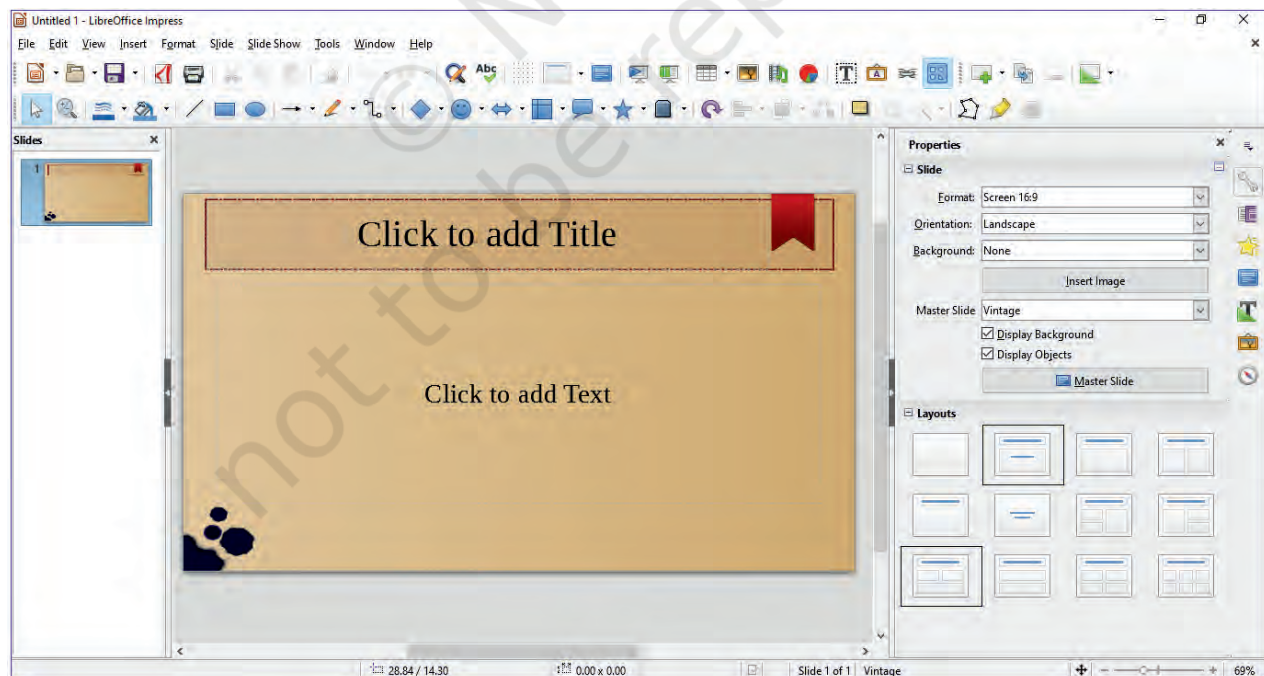
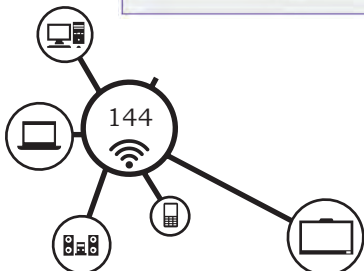


Fig. 5.4 : Creating a Presentation using template



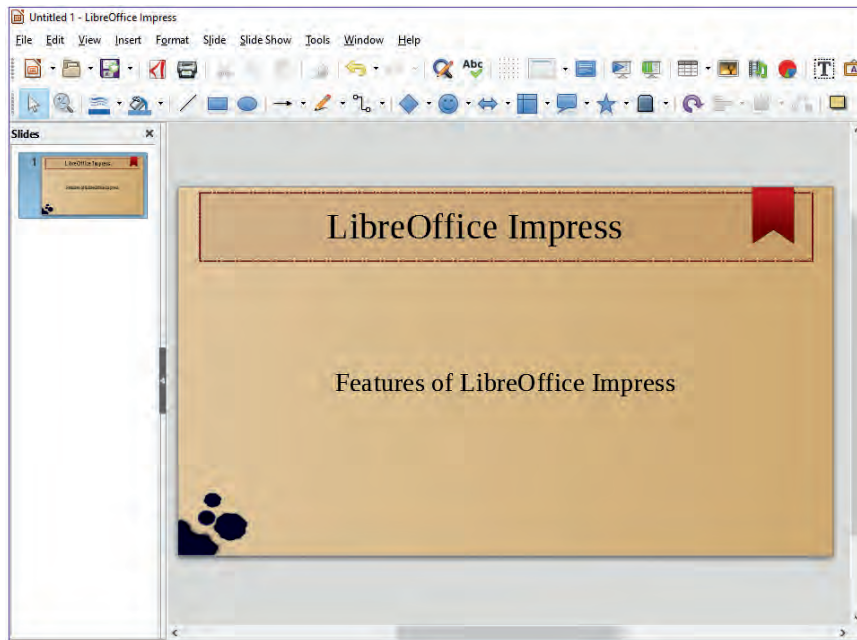


Fig. 5.5 : Enter title of the slide

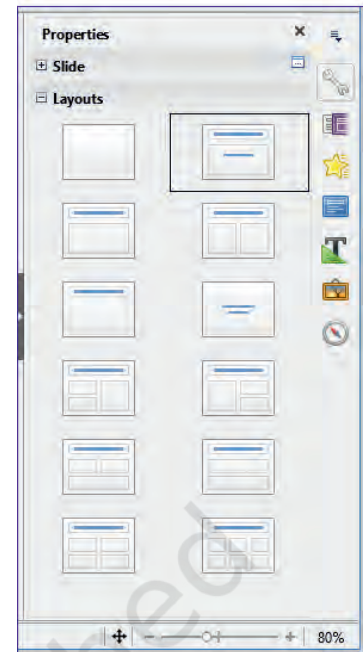


Fig. 5.6: Slide Layouts

Selecting slide layout

The appropriate layout can be selected from Layouts section in the Properties window. The layouts included in LibreOffice range from a blank slide to a slide with six content boxes and a title as shown in Figure 5.6.

You can also select a slide layout by using menu, **Slide** → **Slide Layout** → **Title slide** as shown in Figure 5.7. The layout you have selected will be applicable in the right side of the window. Alternatively, you can select the slide in the Slides Pane, it will appear in the Workspace and here you can select the required layout from the Layouts section in the Sidebar.

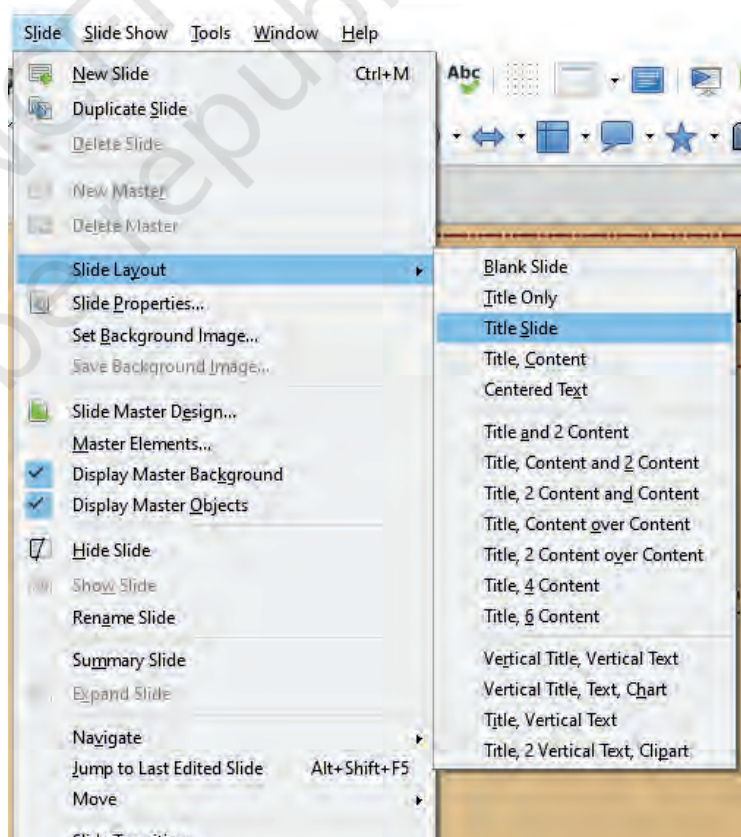


Fig. 5.7: Selecting slide layout – Title slide

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- (a) **Adding text:** To add text to a slide that contains a text frame, click on Click to add text in the text frame and then type your text. The Outline styles are automatically applied to the text as you insert it. The Figure 5.5 shows the slide after adding the text.
- (b) **Saving a presentation:** While creating a presentation, you can save it to the disk with some name, so that the content may not be lost or to use the presentation further.
 - (i) To save the presentation, you are working on, follow the steps as given below: Select the **File Menu**→**Save**, or, use the shortcut key combination **Ctrl+S**, or click on the **Save** button on the **Standard Toolbar**.

This will open the **Save** dialog box as shown in Figure 5.8, which allows to select the location on the disk and assign the name to save the presentation.

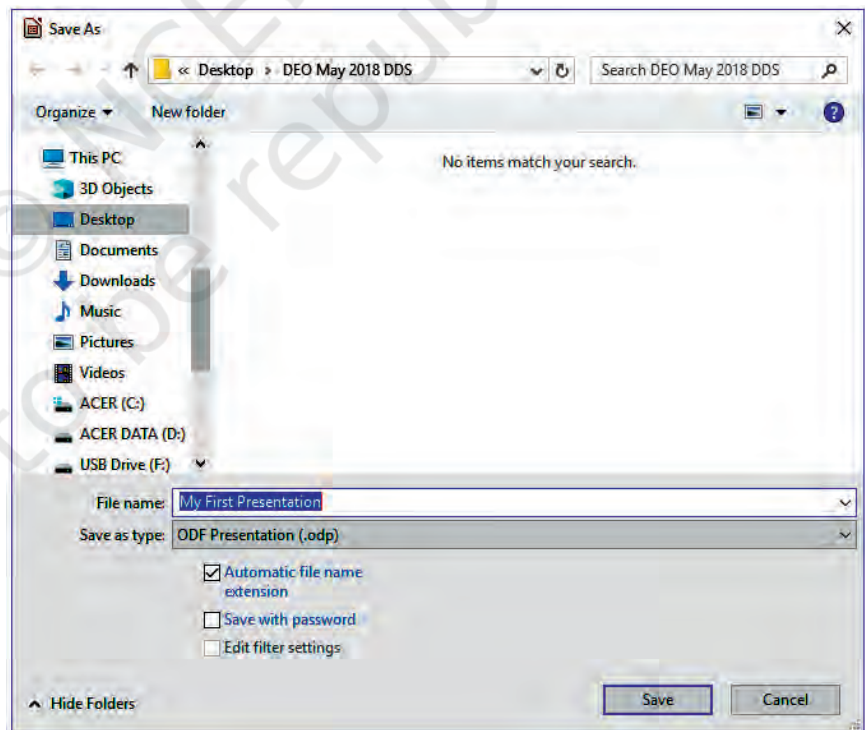
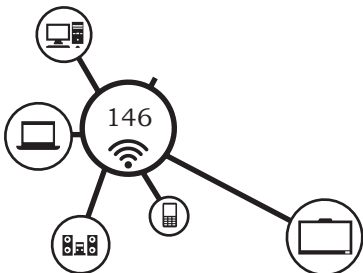


Fig. 5.8 : Saving the presentation



- (ii) To change the location in drive open the directory in which you want to save the file
- (iii) Enter a name of presentation file
- (iii) Click Save
- (vi) If the presentation is already saved the contents will be updated in that presentation file.
- **Saving a presentation with different name:**
To save the presentation with a different name, select **File**→ **Save As** or, use the shortcut key combination **Shift+Ctrl+S**. In Save As dialog box, a new file name can be entered as shown in Figure 5.9 in the File Name field. Saving is finished by using the **Save** button.

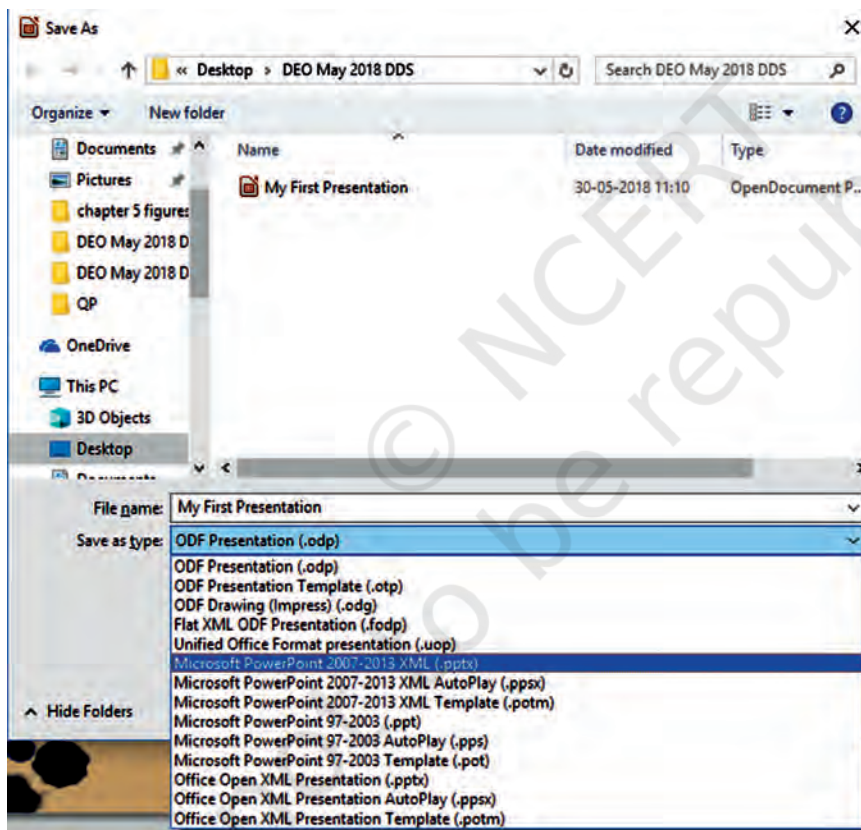
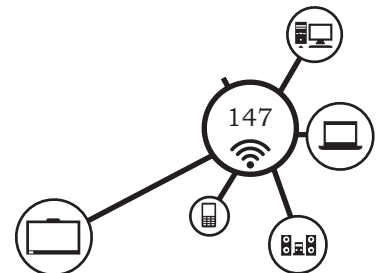


Fig. 5.9: Saving presentation in different format

- **Saving with a different format:** By default the presentation is saved with **.odp** extension. To save a presentation as another file type, select **File**→**Save As**. In the Save As dialog box, click on

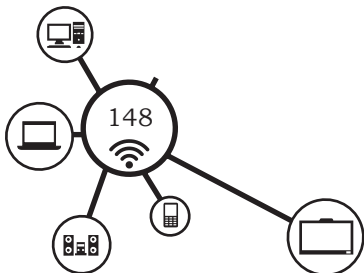


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the All Formats drop-down menu and select the choice from the offered programs, for example, Microsoft PowerPoint 97/2000/XP/ 2003 (*.ppt) or (*.pptx) as shown in Figure 5.9.

(c) Running a slide show

- (i) To run the slide show, click **Slide Show** → **Start from First Slide** on the main menu bar or Click the **Slide Show** icon on the Presentation toolbar or the Slide Sorter toolbar or Press F5. The slide show starts to run.
 - (ii) By clicking the mouse button, you can move to the next slide. Or you can use the arrow keys on the keyboard to go to the next slide or the previous one. You can also Press the Spacebar key on the keyboard to proceed to the next slide.
 - (iii) Right-click anywhere on the screen to open a menu for navigating the slides and set other options.
 - (iv) In the last slide, you will get a message **Click to exit presentation**. Just click the mouse button or press any key on the keyboard to exit the presentation.
 - (v) If you want to exit the slide show at any time, just press the Esc key.
- **Saving a presentation as HTML:** To publish the presentation on the web or to open the presentation in the web browser, save it in HTML format (HyperText Markup Language), which could be opened in any web browser. To save the presentation as html:
 - (i) Click on **File** → **Export**
 - (ii) Select the directory in which you want to save the file
 - (iii) Enter a file name
 - (iv) Click Save
 - **Save a file in PDF format:** A Portable Document Format (PDF) of the presentation can be created by saving a file in the PDF format, which can be viewed with the free Adobe Acrobat Reader.



However, it cannot be edited. To save a file in the PDF format:

- (i) Click on **File** → **Export as PDF**
- (ii) Select the directory in which you wish to save the file
- (iii) Enter a file name
- (iv) Click Save

(d) Closing a presentation

- (i) To close a presentation, select **File Menu** → **Close** or use the keyboard shortcut keys **Ctrl+W**.
- (ii) To open a presentation again, select **File** → **Open** command, or, use the keyboard shortcut keys **Ctrl+O**.
- (iii) It will open the **Open dialog box**. Specify the location of the file that is to be opened in the *Look in* field, select the files and, open it with the *Open* command.

(e) Using Help

Help function is located in the Help menu. By selecting the LibreOffice Help tab, a window is opened with a list of available help topics.

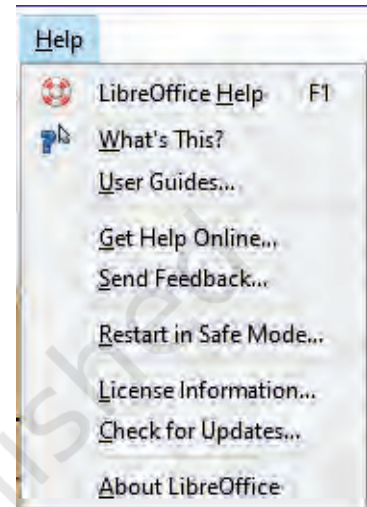


Fig. 5.10 : Help Function

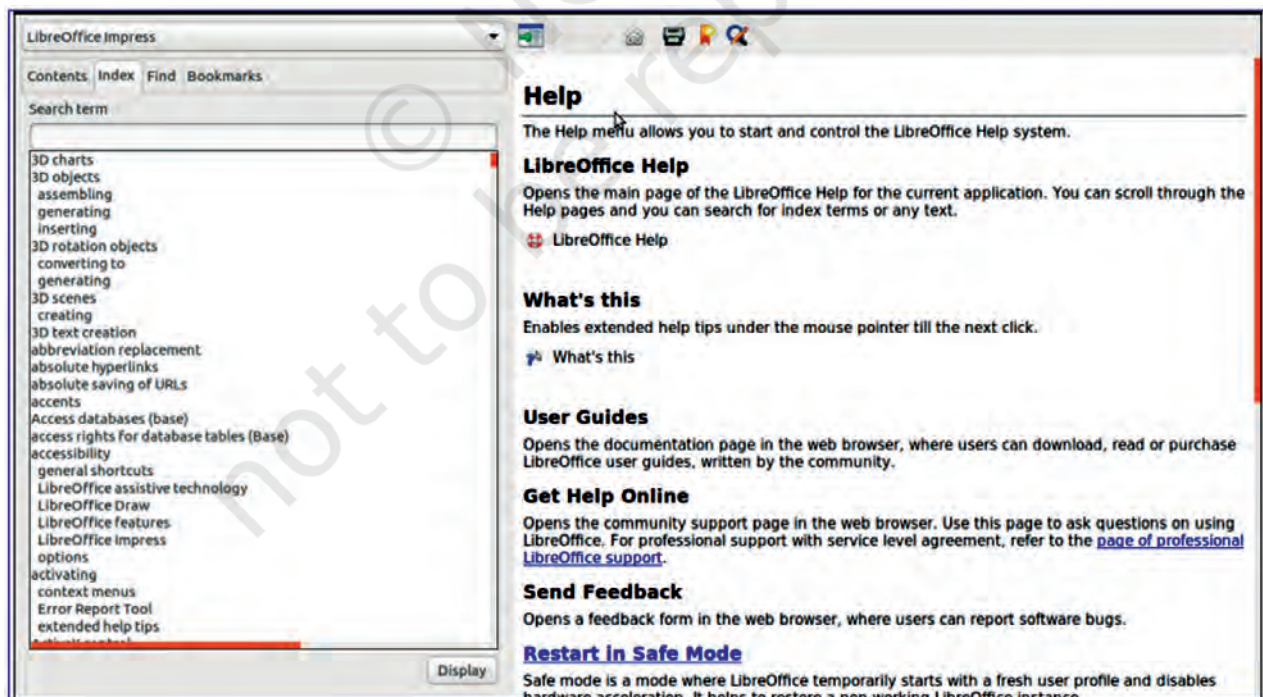
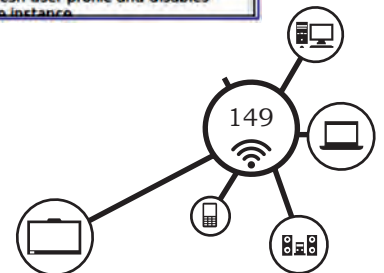


Fig. 5.11 : LibreOffice Impress Help



In the Search item text box you can enter a term to explore. The quickest way to open the Help function is by using the F1 function key.

Working with slides

Now to carry forward the presentation work, the next slide has to be added. The new slide can be inserted into the presentation by inserting a new slide as well as inserting a duplicate slide. Inserting a duplicate slide will insert the copy of the existing or current slide into the presentation.

Inserting a duplicate slide

Sometimes, you may wish to insert the same slide as the previous ones just like the first page of the book has the title of the book and the same title also appears on the cover page of the book. In such a case you may copy the slide to the next slide. In simple words, you want to duplicate an already created slide. So to insert the duplicate slide:

- (i) Select the slide you want to duplicate from the Slides Pane.
- (ii) Select from menu bar **Slide** → **Duplicate Slide**.
- (iii) Or, right-click on the slide and select **Duplicate Slide** from the menu.

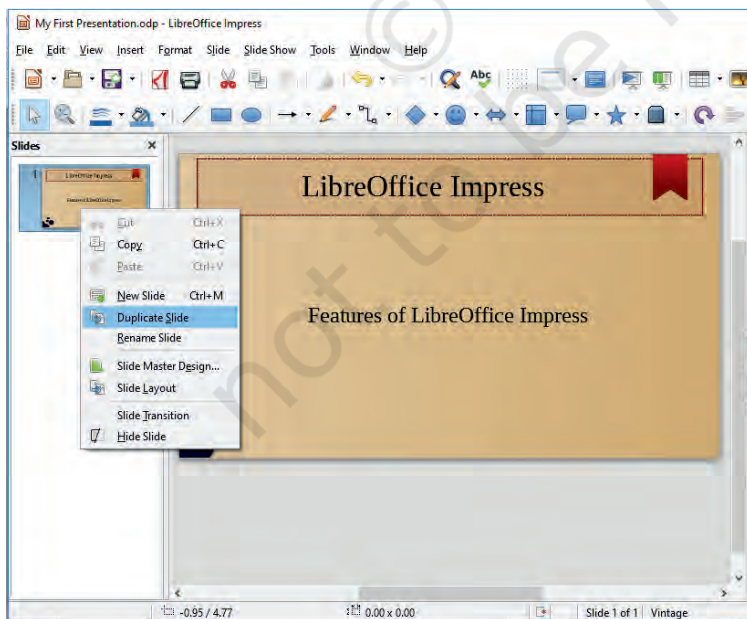
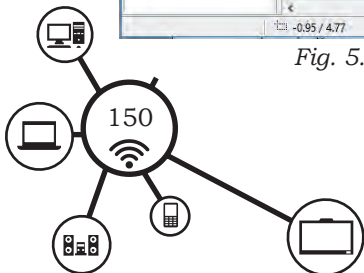


Fig. 5.12 : Inserting duplicate slide

- (iv) Or, right-click on a slide in Workspace and select **Slide** → **Duplicate Slide** from the menu.
- (v) Or, click the **Duplicate Slide** icon in the Presentation toolbar.
- (vi) You can insert the duplicate slide in your presentation by using one of the above options. After inserting a duplicate slide the presentation will look like as shown in Figure 5.12.



Inserting new slides

To insert a new slide, use any of the following way.

- (i) Select from menu bar **Slide** → **New Slide**.
- (ii) Or, right-click on a slide and select **New Slide** from the context menu.
- (iii) Or, right-click in an empty space in the Workspace and select **Slide** → **New Slide** from the context menu.
- (iv) Or, click the **New Slide** icon in the Presentation toolbar.
- (v) Or, use the keyboard shortcut **Ctrl+M**.
- (vi) Now insert the new (third) slide into the presentation by using one of the options given in the 'Insert new slide'. After inserting a new slide the presentation will look as shown in Figure 5.13 (b).

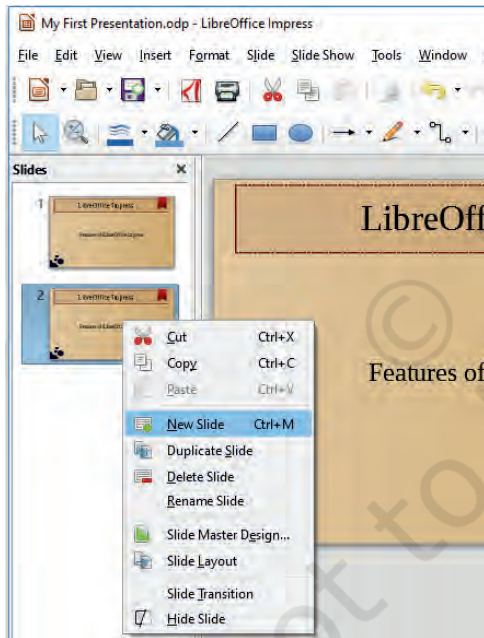


Fig. 5.13 (a) After inserting new slide

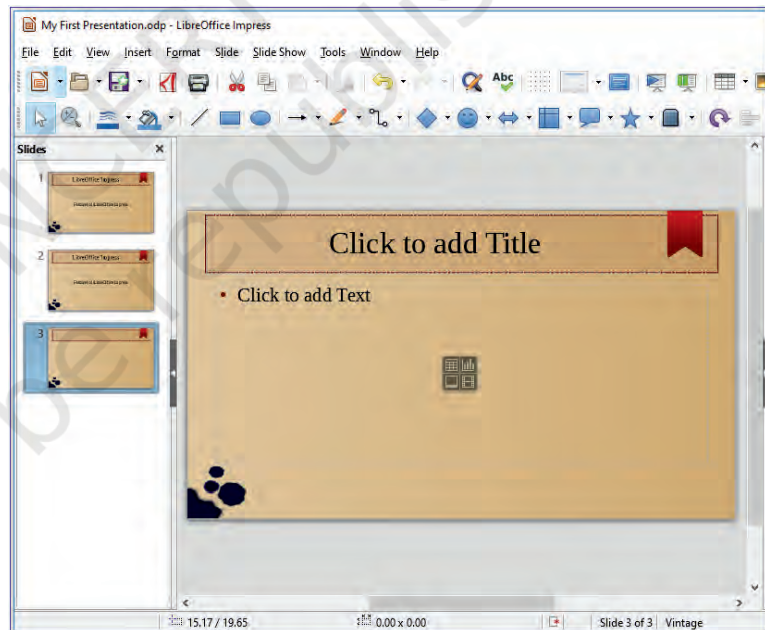
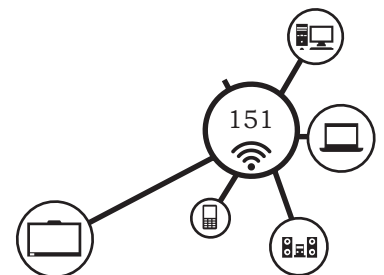


Fig. 5.13 (b) Inserting new slide

Slide layout

After inserting a new slide, the layout contains one or more content boxes. Each of these content boxes can be configured to contain text, movies, images, charts or tables. You can select the icon based on the content by



clicking on the corresponding icon that you want to display as shown in the middle of the content box (Figure 5.14).

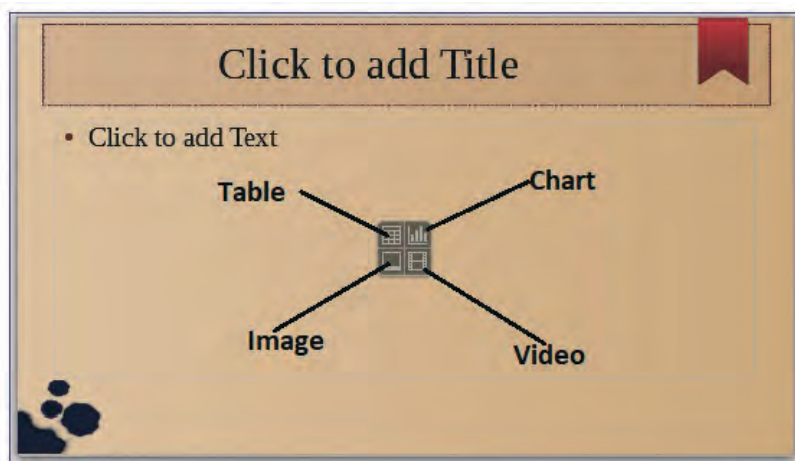


Figure 5.14: Selecting content type

To change the layout of a slide, just select the slide in the Slides Pane. It will appear in the Workspace and select the desired layout from the Layouts section in the Sidebar. Several layouts contain one or more content boxes. To use the content box for text, click on **Click to add text**. Enter the text as you want to display in the slide.

Copying and moving slides

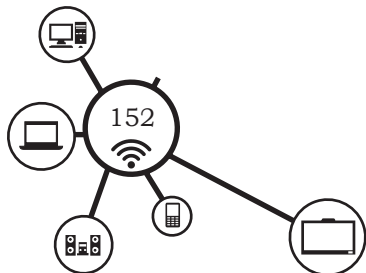
The slides once created can be reused within the presentation or in another presentation. To move the slide to another location use **cut and paste** process. To copy the slide, use the process of **copy and paste**.

(a) Cut and paste: To cut and paste something in a presentation

- (i) Select the slide by marking it in the Slide Shorter view, or on the left side of the screen in the Normal view.
- (ii) Click on the right mouse button, and select the **Cut** option (if you want to move it) or **Copy** option (if you want to copy it), from the context menu.
- (iii) Mark the place in the presentation where you want to move or copy the slide.
- (iv) Right click the mouse button, select the Paste option from the context menu.

(b) Using keyboard shortcuts: *Cut, Copy and Paste operations* can also be performed by the combination of keys:

- (i) Cut – Ctrl + X
- (ii) Copy – Ctrl + C
- (iii) Paste – Ctrl + V



(c) Drag and drop copying and moving method:

The copy, cut and paste operations can also be performed by 'Drag and Drop' method:

- (i) Select the slide that you want to copy.
- (ii) Click and hold the left mouse button on the marked slide, and at the same time press and hold the *Ctrl* button.
- (iii) Move the mouse cursor to the desired location.
- (iv) Release the left mouse button, and then release the *Ctrl* button. The copy is pasted to another location.
- (v) Moving the text via 'drag and drop' method can be done in the same way like copying, but without using the *Ctrl* button.

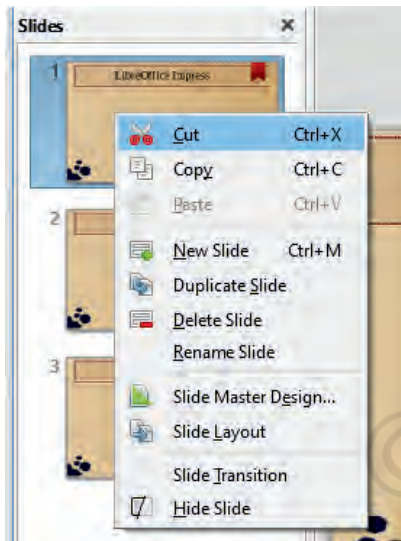


Fig. 5.15 (a) Cut slide

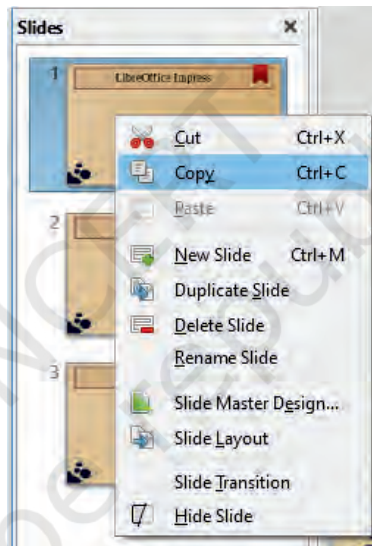


Fig. 5.15 (b) Copy slide

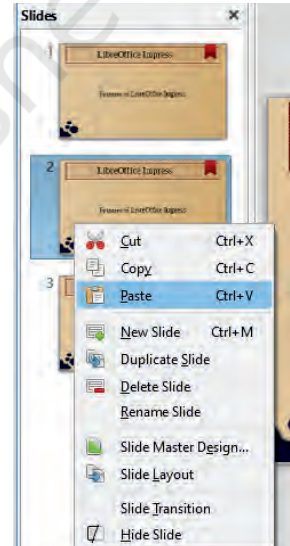


Fig. 5.15 (c) Paste slide

(d) Deleting slides: To delete any slide from a presentation, first it should be selected. To delete one or more slides

- (i) Select the slide(s) by marking them in the Slide Pane
- (ii) Right click the mouse button on the selected slide
- (iii) Select the Delete Slide option in the context menu



Fig. 5.16 Delete slide

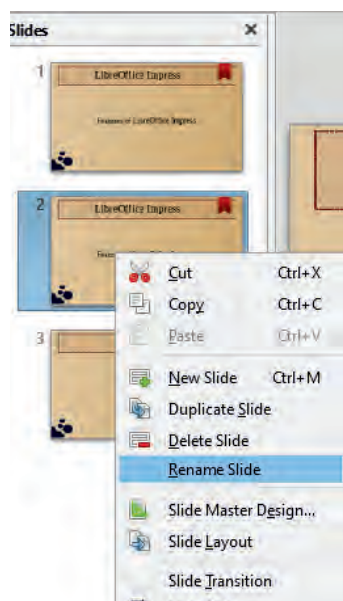


Fig. 5.17 : Rename slide

(iv) Another quick way to delete the slide is just select the slide and press the Delete button from the keyboard

(e) **Renaming a slide:** The slides are named as slide1, slide2,... by default. It is possible to give the name to the slide by renaming it. To rename a slide:

- (i) Select the slide by marking them in the Slide Pane
- (ii) Right click the mouse button on the selected slide
- (iii) Select the Rename slide option in the context menu
- (iv) A Rename Slide dialog box will appear where you can assign the new name to the slide

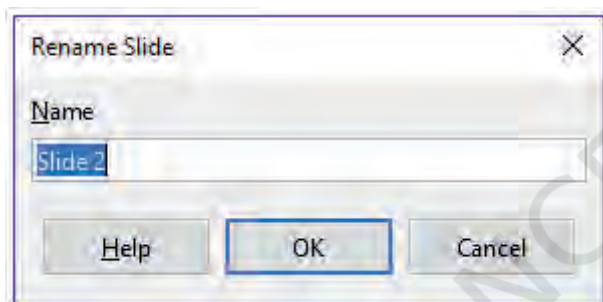


Fig. 5.18: Rename Slide dialog box

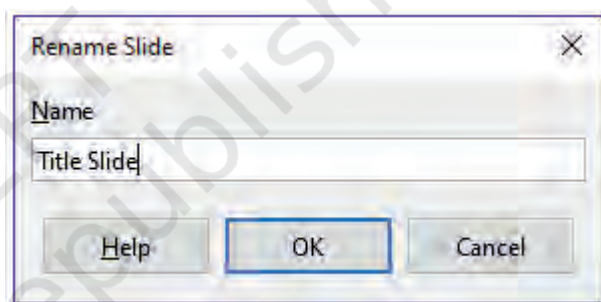
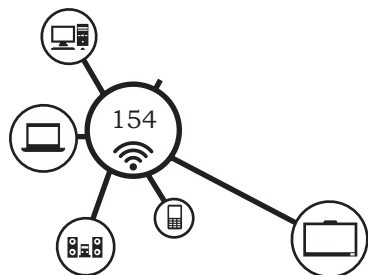


Fig. 5.19 : After renaming a Slide

Copying, moving and deleting content

Impress is the component of LibreOffice. So you can use the same commands and options that of LibreOffice Writer for text editing in LibreOffice Impress. To copy or move some text or an object in the presentation to another location (in the same presentation or another presentation), it is necessary to first select the text.

- (i) Select the text and click the right mouse button.
- (ii) Select the **Copy** option from the context menu (keyboard shortcut: *Ctrl + C*) for copying or **Cut** option (keyboard shortcut: *Ctrl + X*) to cut.
- (iii) Position the cursor on the location on the slide, to which you want to move or copy the content.



(iv) Press the right mouse button and select the **Paste** option from the context menu (keyboard shortcut: *Ctrl + V*).

(a) **Deleting the text:** It is easy to delete the text of the slides. The **delete** and **backspace** button on keyboard is used to delete the text. The **delete** key deletes the character on the right of the cursor, and the **backspace** button deletes the character on the left of the cursor. Pressing delete key or backspace keys deletes one character at a time. To delete the line or paragraph of text, first select the text and then press the delete key. Alternately you can use the cut option to delete the text.

(b) **Undoing and returning the changes:** Impress keeps the history of recent changes made. When we execute a command on some text, for example delete the text, we are able to reverse what we have done. This is known as the undo function. It is also possible after having undone the change, get it back. This is called the redo function. These options are located in the Standard toolbar, and can also be performed using keyboard shortcut keys *Ctrl + Z* is used for Undo and *Ctrl + Y* is used for Redo.

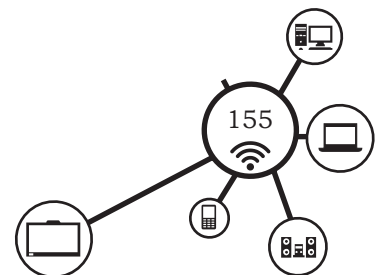
Sometimes you may apply any command or option by mistake. To revert this mistake, there is a function called as **Undo**. It returns the document to its previous state. Pressing the key combination **Ctrl+Z** undoes the last change you have made. Pressing it again, will undoes one before that, and so on.



Alternately, use **Edit→Undo**. Using this method, the menu will indicate what type of operation you will be undoing. Another way to do this is to press the undo icon on the function bar.



Redo function is used to revert the result of the Undo function. It can be used many times, as the Undo function was used. To use this function use Edit →Redo. If you want to rollback your undo command, you can use redo. You can also execute the redo function by pressing the redo icon on the function bar, or by using the keyboard shortcut **Ctrl+Y**.



View a presentation

The presentation created in Impress can be viewed in a number of ways. One may wish to view the presentation in larger or smaller or in medium size. It is possible to view the presentation as per the user's requirement.

Controlling the size of the view

Zoom and View Layout dialog box opens in the View tab. It is possible to select among the proposed values to increase zoom, or enter your own value, which must be a whole number.

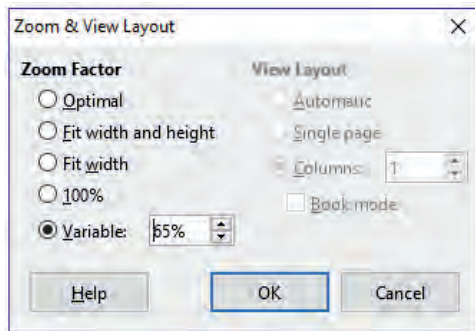


Fig. 5.20 (a) Zoom & View Layout dialog

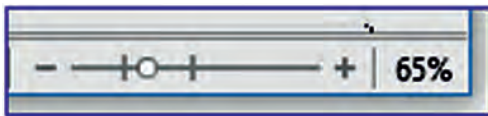


Fig 5.20 (b) Zoom in out using slider

Other ways to zoom are:

- (i) use of the *Zoom slider* on the *Status bar*
- (ii) use of the *Zoom button* on the *Standard toolbar*
- (iii) use the menu option *View → Zoom → Zoom*, the Zoom and View Layout dialog box will open. Select the appropriate option from it

Zoom slider on the Status bar has two marked sections. If you are positioned in the first highlighted section, the entire slide will display within the Workspace. If you position yourself to the second one, the increase of 100% of the slide, will be displayed.

Workspace views

The various workspace views are in the drop-down list of the View menu. These views are *Normal*, *Outline*, *Notes*, *Slide Sorter*, *Slide Master*, *Notes Master*, *Handout Master*. The appropriate view can be selected from the View menu.

(a) Normal view: As shown in Figure 5.21, it is the main view for working with individual slides. This view is used to

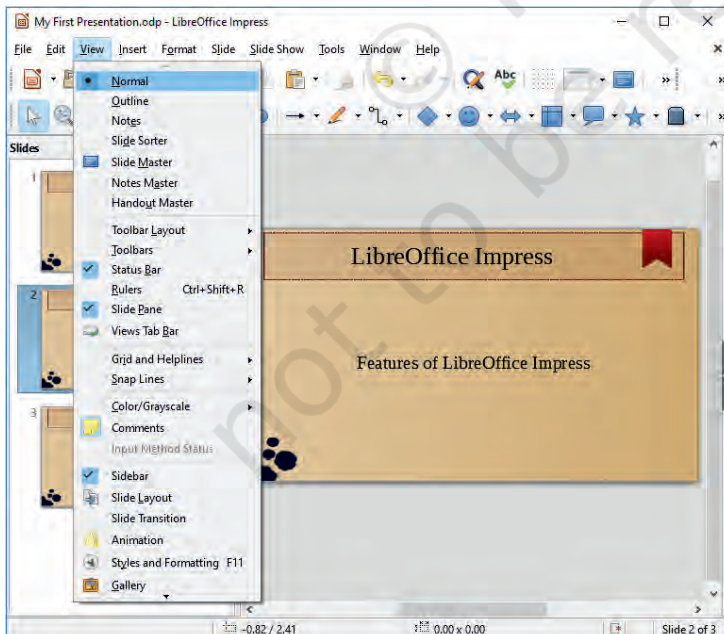
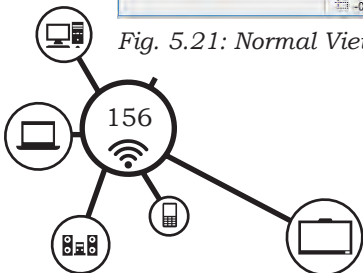


Fig. 5.21: Normal View



format and design and to add text, graphics, and animation effects. In this view, the slide is displayed in the middle of the window. On the left side of the window, the pane with slides thumbnails (slides) is displayed (if the Slide Pane is selected, from the View menu).

(b) Outline view: As shown in Figure 5.22, it contains all the slides of the presentation in a sequence. It shows each slide in the outline format. Only the text contained in each slide is displayed inside the Workspace. It displays slide text in the form of a structure.

(c) Notes view: As shown in Figure 5.23, it is used to add notes to a slide for the information of presenter. It is not seen by the audience while showing the presentation. It displays the area in which the notes, are used to help during the presentation.

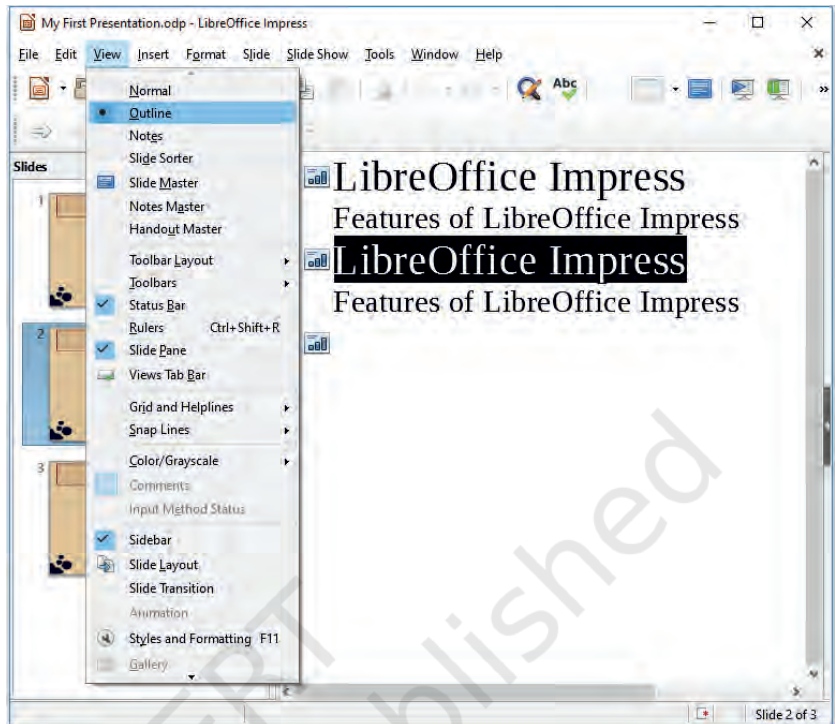


Fig. 5.22 :Outline View

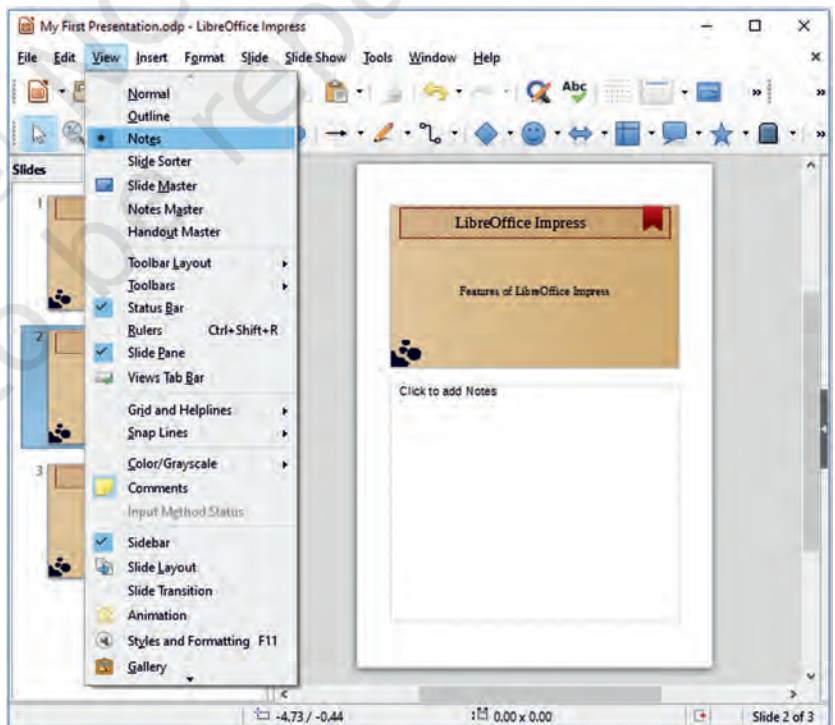


Fig. 5.23 : Notes View

NOTES

(d) **Slide Sorter view:** As shown in Figure 5.24, it contains all of the slide thumbnails. It is suitable for rearranging the slide order. It is used to sort slides with the 'drag and drop' method. Use this view to work with a group of slides or with only one slide.

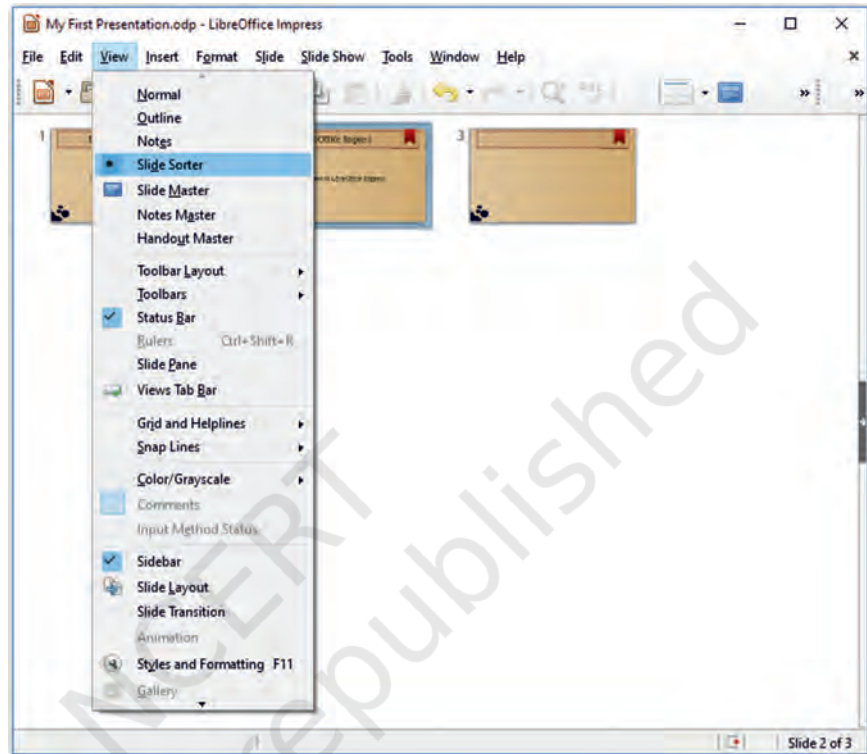


Fig. 5.24 : Slide Sorter View

Formatting text

The contents of the slides can be formatted in various ways. The most common way is to use the formatting icons on the Formatting toolbar. Another way is by selecting **Format**→**Text** from the menu bar, and the third way is by using the keyboard shortcuts. The various formatting options are explained below and shown in the Figure 5.25.

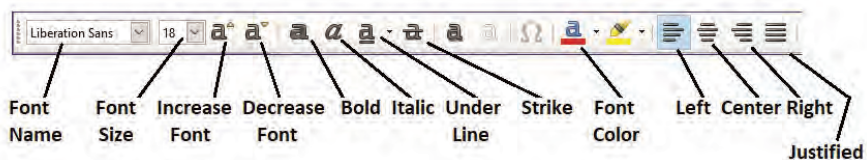
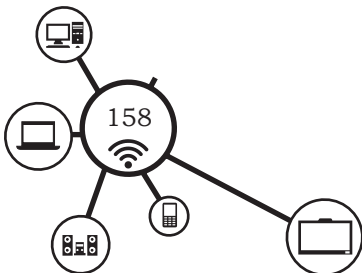
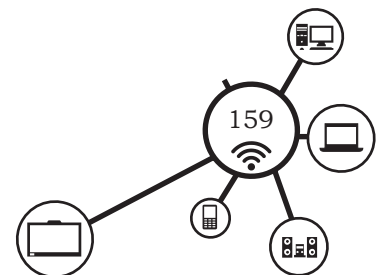


Fig. 5.25 : Formatting toolbar options



- (i) Font name: Click on the font type drop-down display to see the list of fonts and select a font name.
- (ii) Size: Click on the font size drop-down display to see the list of font sizes from where you can select the font size.
- (iii) Increase font size: Clicking on a with upward arrow, will increase the size of the text (Keyboard shortcut: **Ctrl+]**).
- (iv) Decrease font size: Clicking on a with downward arrow, will decrease the size of the text (Keyboard shortcut: **Ctrl+[**).
- (v) Bold: Clicking on **a** changes the text to bold (Keyboard shortcut: **Ctrl+B**).
- (vi) Italic: Clicking on *a* changes the text to italic (Keyboard shortcut: **Ctrl+I**).
- (vii) Underline: Clicking on a changes the text to underline (Keyboard shortcut: **Ctrl+U**).
- (viii) Strikethrough: Clicking on ~~a~~ draws a line through the selected text.
- (ix) Superscript : Clicking on ^a raises the selected text above baseline (Keyboard shortcut: **Shift+Ctrl+P**).
- (x) Subscript: Clicking on _a lowers the selected text above baseline (Keyboard shortcut: **Shift+Ctrl+B**).
- (xi) Font colour: Clicking on drop-down box (▼) to the right of font colour icon opens the colour pallet from where you can change the font colour.
- (xii) Highlighting: Clicking on drop-down box (▼) to the right of highlight colour icon opens the colour pallet from where you can change the highlight colour.

There are other text formatting options that are used sometimes while working with paragraphs.



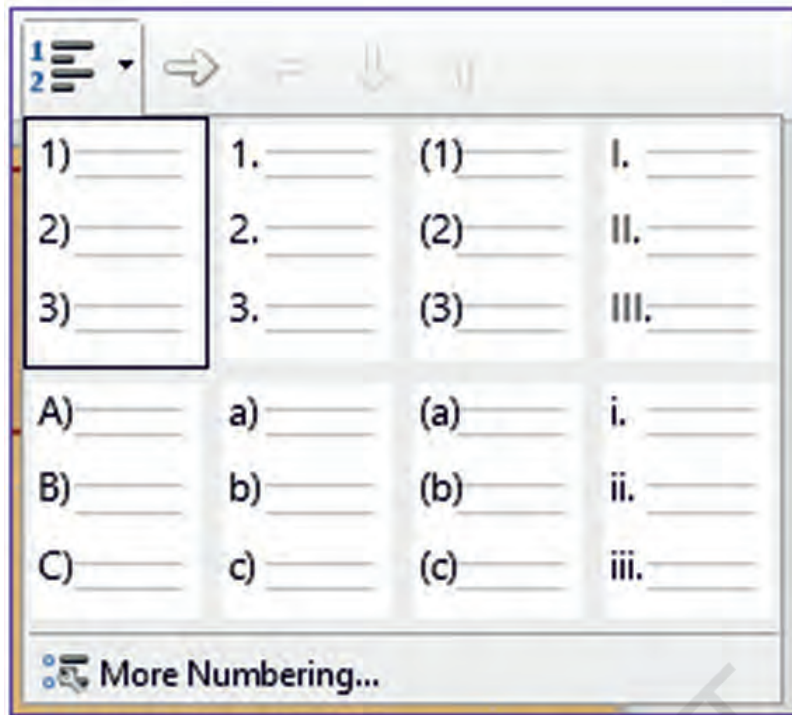


Fig. 5.26: Selecting numbers

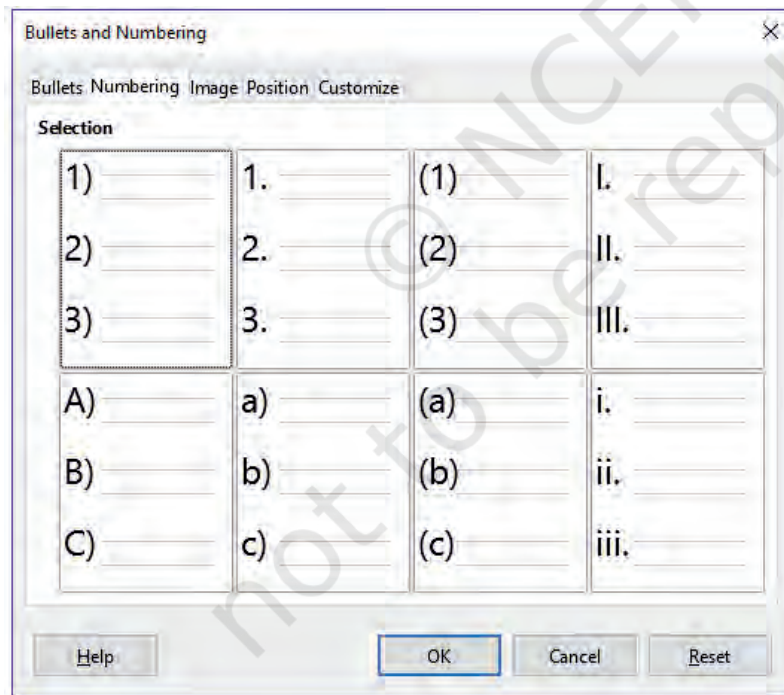
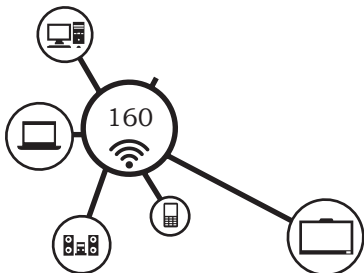


Fig. 5.27 : Bullets and numbering dialog box

- (i) The alignment  icons are used to align the text to the Left, Center, Right, or Justify.
- (ii) Align top, align center vertically, align bottom are used to align the selected text to the top, center or bottom of the text box.
- (iii) Bullets and numbering: Creates a bulleted or numbered list from selected paragraphs. Click on the small triangle to the right of the icon to select a bullet or numbering formatting option from a drop-down list as shown in Figure 5.26.
- (iv) Clicking on **More Options** at the bottom of these drop-down lists open the Bullets and Numbering dialog as shown in Figure 5.27.
- (v) Increase paragraph spacing, decrease paragraph spacing: It increases or decreases the spacing above and below the selected paragraphs.
- (vi) Line spacing: Adjust the spacing between the lines of a selected



paragraph. Click on the small triangle to the right of the icon and select the type of line spacing from the drop-down list (Figure 5.28).

Working with tables

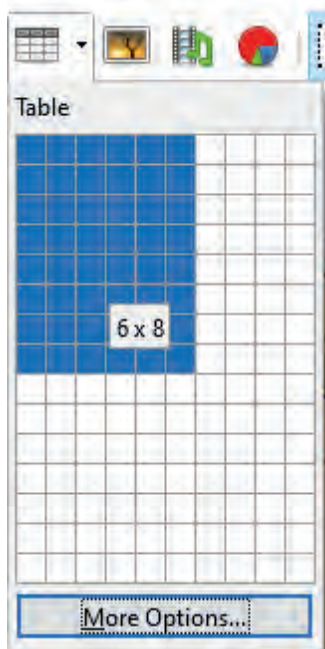


Fig. 5.29 Creating table

Inserting tables

Tables are inserted by selecting the Table icon on the Standard toolbar, or by selecting the Table command on the Insert tab. In the Insert Table dialog box, the Number of columns and the Number of rows are specified.

We have already seen that when we insert a blank slide in the presentation, we can create a table by clicking on the table icon. Tables can also be inserted by selecting the Table icon on the Standard toolbar as shown in Figure 5.29. By clicking on the arrow next to the Table icon, the Table drop-down menu

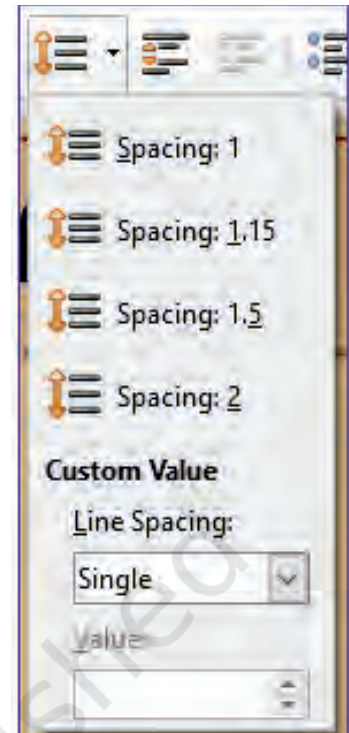


Fig. 5.28 : Line Spacing

opens, by dragging the cursor, the desired number of rows or columns can be selected.

A Table can be inserted from the Insert menu by selecting **Insert** → **Table**. In the Insert Table dialog box, the Number of columns and the Number of rows are specified as shown in Figure 5.30. In the Insert Table dialog box, the Number of columns and the Number of rows are specified.

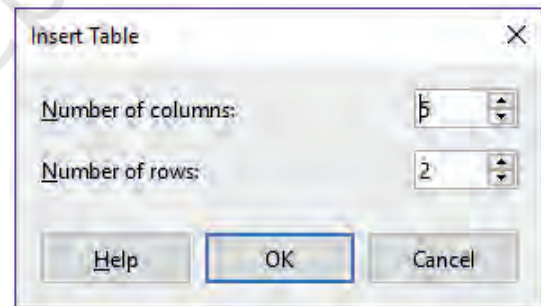


Fig. 5.30: Insert Table Dialog

Entering and editing data in a table

The content is put in table by placing the insertion point in a table cell and entering text. Moving the insertion point in a table can be done in three ways:

- by pressing the left mouse button
- by pressing the TAB key on a keyboard
- by using arrow keys on the keyboard

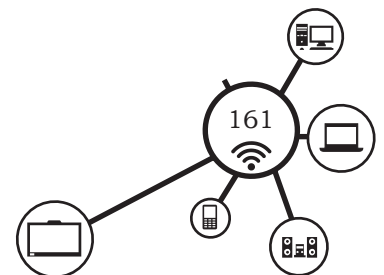




Fig. 5.31: Selecting a table cell

(a) Selecting a cell: To select a cell within a table, position the mouse cursor along its left edge, and when the cursor changes to a sloped white arrow, press right mouse button (Figure 5.31).

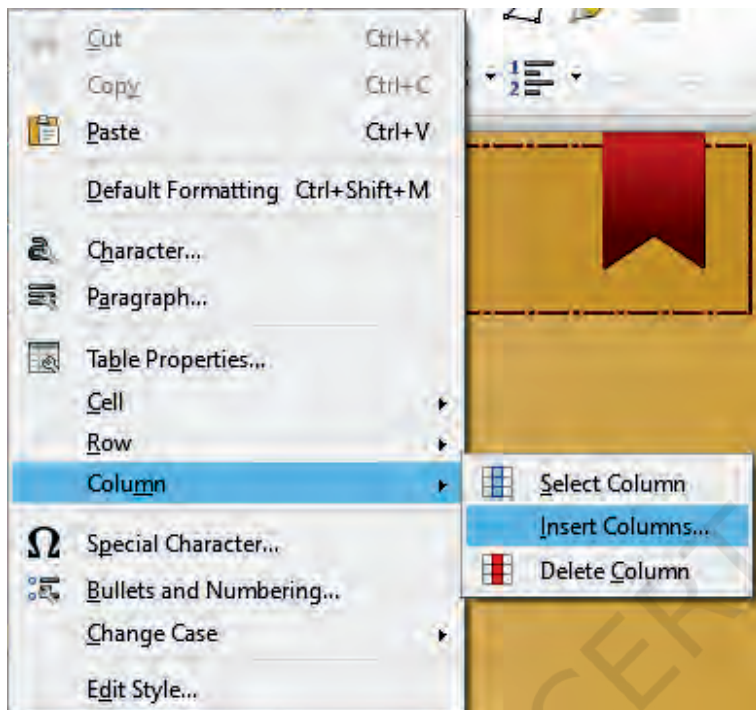


Fig. 5.32: Selecting column in a table

(b) Selecting a row/column:

To select a row or column in a table, position the row or column to select, and when the mouse cursor changes to a sloped white arrow press the left mouse button and drag it to the end of the row or column. A row or column can also be selected by pressing the right mouse button on the row or column you want to select, and selecting the row or column and Select the option from the context menu as shown in Figure 5.32.

(c) Selecting a table: To select an entire table, first click on its edge. When the mouse cursor changes to a sloped white arrow, click on the left mouse button. To move the table, position on its edge, and when the cursor changes to a sloped white arrow, drag the table to a specified location.

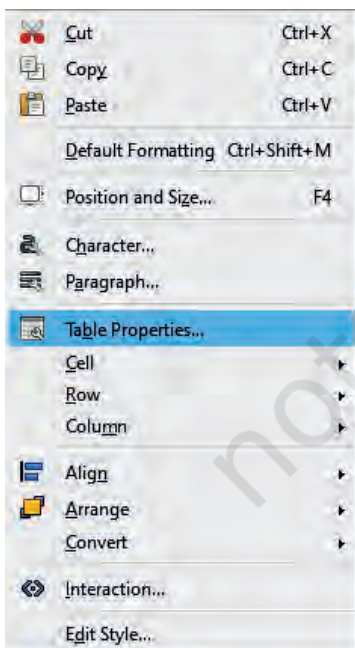


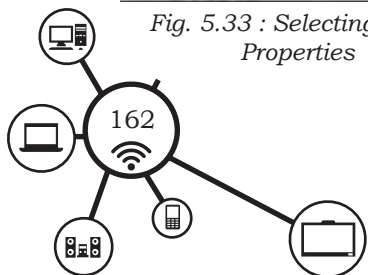
Fig. 5.33 : Selecting Table Properties

Adjusting column width and row height using the mouse

To change the width of the column, position on the border line between the two columns, and when the cursor changes to a (↔) sign, press the left mouse button, hold and drag it until the column achieves the desired width. The same can be done for adjusting the row height.

Table borders and background

The various table formatting options can be applied on the table just like Writer. The borders and background



can be assigned to the table. To do this, right click on the table border, the Table Properties dialog box will open as shown in Figure 5.34, from where you can change the borders and background of the table.

- (a) Deleting a table:** To delete a table, Click on the slide and drag a selection box over the table to select it, then press the Delete key, Or Click on the table border to select the table and press the Delete key.

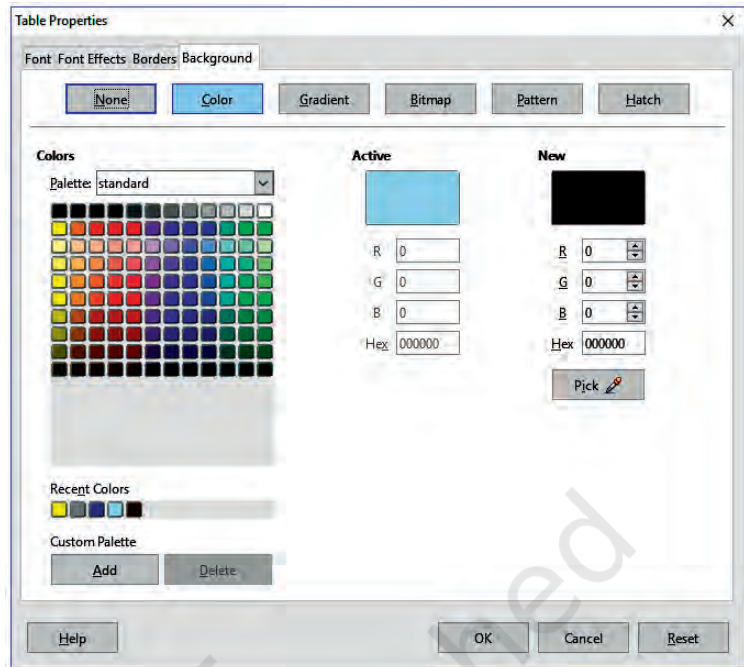


Fig. 5.34 : Table Properties Dialog box

Adding and formatting images

Graphics can be inserted in the presentations for giving more information. Images can be inserted from the gallery, files stored in the computer.

Inserting an image from a file

- (i) To insert an image into presentation, select **Insert** → **Image** on the menu bar or, click on the Insert Image icon located on the standard toolbar. The **Insert Image** dialog opens.
- (ii) Select the file from the desired directory. By selecting the Preview option, a thumbnail of the selected image will be displayed in the preview pane on the right as shown in Figure 5.35.

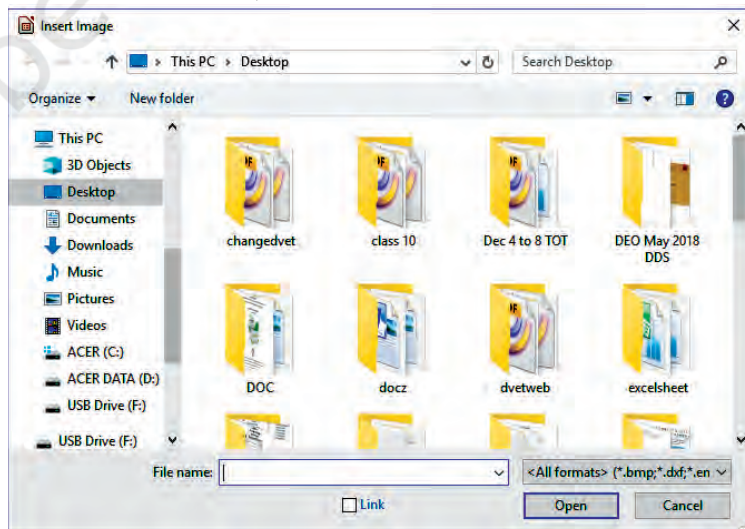


Fig. 5.35: Insert Image Dialog box

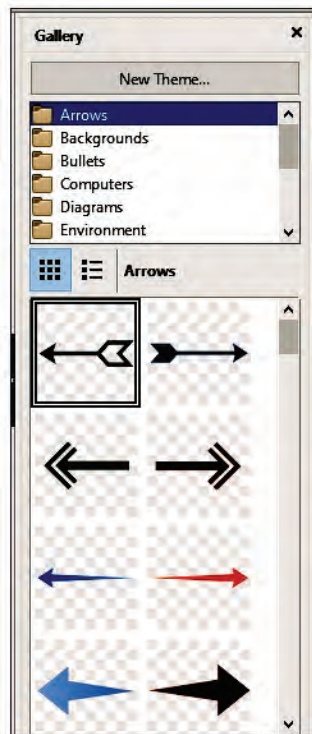


Fig. 5.36: Insert from gallery

Inserting an image from the gallery

The Gallery contains the images that can be used in a presentation. To insert an image from the gallery:

- (i) Select **Insert** → **Media** → **Gallery** from the menu. The Gallery displays the available themes with images (Figure 5.36).
- (ii) Select a theme and scroll to find a suitable image.
- (iii) Click on the image and drag it onto the workspace.
- (iv) Release the mouse button and the image will be placed into your slide.

Formatting images

Formatting an image includes moving, resizing, rotating an image. The image inserted into a presentation can be formatted.

Moving images

- (i) To move the image in the slide, click on an image, observe that the cursor changes to hand shape (Figure 5.37).
- (ii) Click and drag the picture to the desired position.
- (iii) Release the mouse button.

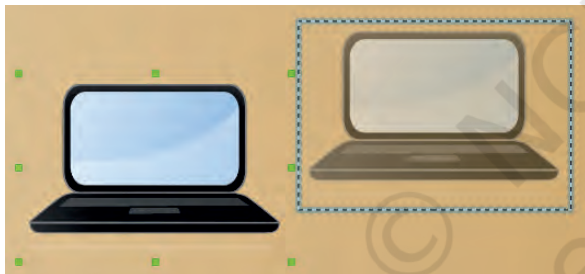


Fig. 5.37 : Moving Image

Resizing images

- (i) Select the image by clicking on it. Observe that selection handles are displayed.
- (ii) Position the cursor over one of the selection handles. The cursor changes the shape giving a graphical representation of the direction of the resizing.
- (iii) Click and drag to resize the image (Figure 5.38).
- (iv) Release the mouse button when satisfied with the new size.

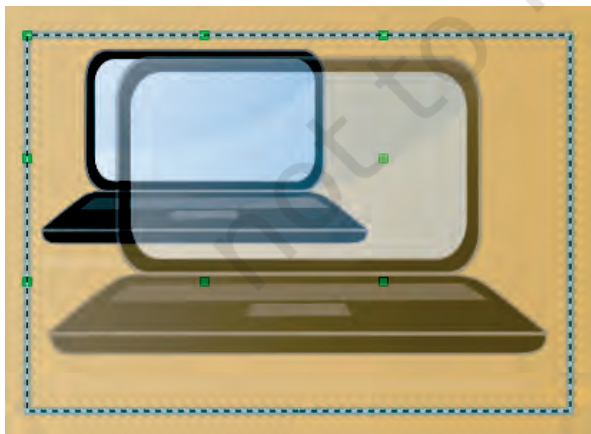
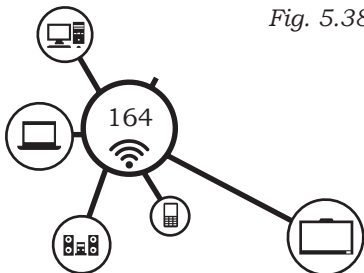


Fig. 5.38: Resizing Image



Rotating images

- (i) The image can be rotated in any direction using the Rotate icon. To manually rotate an image:
- Select the image to display the selection handles.
 - Click the **Rotate**  icon on the Line and Filling toolbar.
 - Click again on the selected image and the selection handles change shape and colour (Figure 5.39).
 - Click the mouse and move in the direction in which you want to rotate the image.
 - When satisfied, release the mouse button.

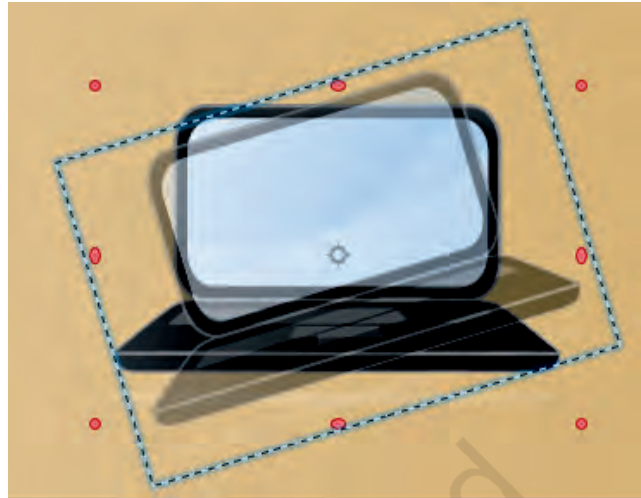


Fig. 5.39: Rotating image

Formatting using the Image toolbar

When an image is selected, the Image toolbar becomes available under the Properties window as shown in Figure 5.40. This toolbar provides a number of formatting options. The Image toolbar can also be displayed by selecting **View** → **Toolbars** → **Image** from the menu bar.

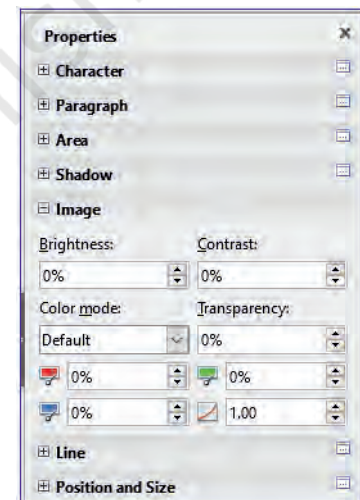


Fig. 5.40: Image toolbar

Managing graphic objects

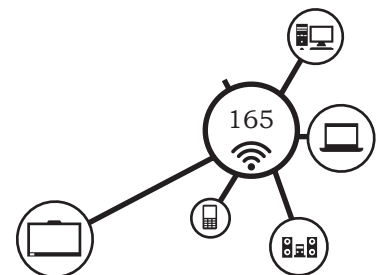
Drawing tools

Impress provides various drawing tools. The Drawing toolbar having the majority of the tools used to create graphical objects as shown in Figure 5.41. To activate this toolbar, select **View** → **Toolbars** → **Drawing** from the main menu bar.



Fig. 5.41: Drawing toolbar

- (a) **Drawing lines:** To draw a line follow the below given procedure.



- (i) Click on the small triangle to the right of the line tool and select the desired line from the available selection (Figure 5.42).

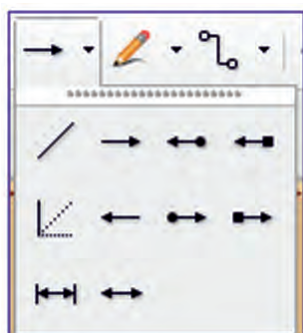


Fig. 5.42 : Lines



Fig. 5.43 Select Drawing shapes



Fig. 5.44: Dragging to slide

- (ii) Click and drag on the slide to create the line or shape and release the mouse button.

- (b) **Drawing shapes:** As similar to drawing a line, you can draw shapes by selecting the desired shapes from the available selection and clicking and dragging on the slide. An example of drawing the human face shape has been illustrated in Figure 5.45.

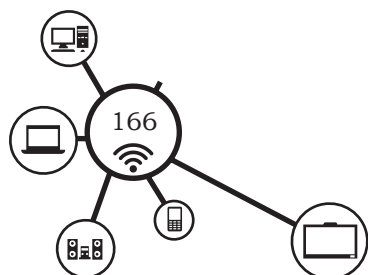


Fig. 5.45: Grouped object

Grouping objects

More than one object can be grouped together and treated as a single object. A group formed by grouping the objects can be formatted as a single object, moved, rotated, deleted, and so on. To group objects together:

- (i) Select the objects to be grouped using selection tool on the Drawing toolbar and draw a rectangle around the objects to be grouped, or hold down the Shift key and click on each object. To select all the objects, go to **Edit** → **Select All** on the main menu bar or use the keyboard combination **Ctrl+A**.
- (ii) When the selection handles are displayed, go to **Format** → **Group** on the main menu bar or use the keyboard combination **Ctrl+Shift+G** or right-click on an object within the selected group and select **Group** from the context menu. An example of grouped objects has been shown in Figure 5.45.



Ungrouping

To ungroup objects follow the below given procedure:

- (i) Select the group by clicking on any one of the objects in the group.
- (ii) When the selection handles are displayed, go to **Format** → **Group** → **Ungroup** on the menu bar or use the keyboard combination **Ctrl+Alt+Shift+G** or right-click on the group and select **Ungroup** from the context menu.

Working with Slide Masters

Impress comes with various slide masters. These slide masters are available in the **Master Pages** section of the **Sidebar**. There are three subsections, namely **Used in this Presentation**, **Recently Used**, and **Available for Use**. Click the expand marker next to the name to expand it (see Figure 5.46). It will show thumbnails of the slides. Just click the collapse marker to collapse the subsection to hide the thumbnails. Every slide masters shown in the **Available for Use**, lists form templates with the same name.



Fig.5.46: Sidebar Master Section

Adding transitions

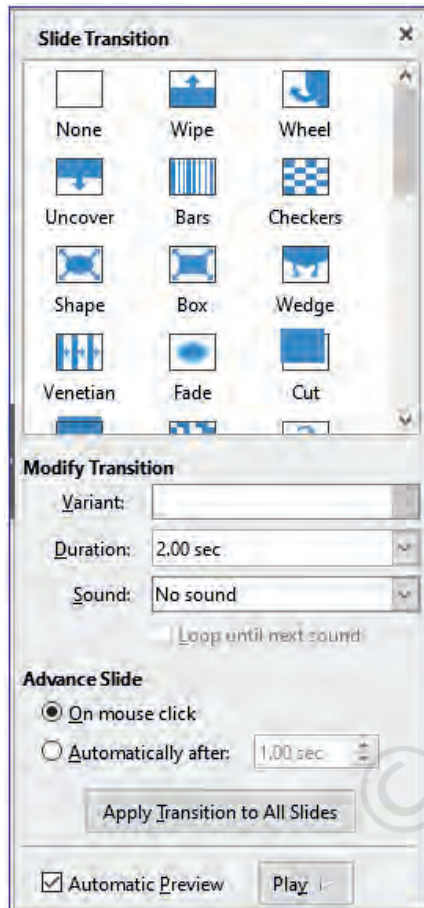


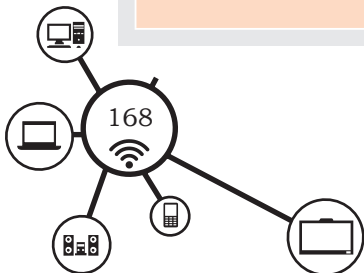
Fig. 5.47: Transition effects

- (i) In the Sidebar, select the **Slide Transition** icon to open the Slide Transition section.
- (ii) In the **Slides pane** or **Slide Sorter view**, select the slides to apply the transition. If you want to apply the transition to all the slides, do not select any slides.
- (iii) In the **Apply to selected slides** list, select a transition.
- (iv) Modify the selected transition by changing the speed or adding a sound, in the **Modify transition** section. To play a sound during transitions, select a sound from the **Sound** list.
- (v) If a sound is selected, the **Loop until next sound** option becomes active. Select this option to play the sound repeatedly until another sound starts.
- (vi) Select how to advance to the next slide: manually (By mouse click) or automatically (Automatically after). To select an automatically advance, you will have to specify how long the slide should remain visible before it automatically advances to the next slide.
- (vii) To apply transition to all slides, click **Apply to All Slides**.
- (viii) To start the slide show from the current slide, check transitions, click **Slide Show**.

Let's Practice 2

Make a presentation on the basis of clue given below.

Model Story Board	
Slide 1 Subject: ICT Mela, PSSCIVE, Bhopal Color: Green Various ICT Techniques	(Font size: 28) Background: Sky blue Animation: Fade in Slide transition:..... Various ICT Techniques with different Colour

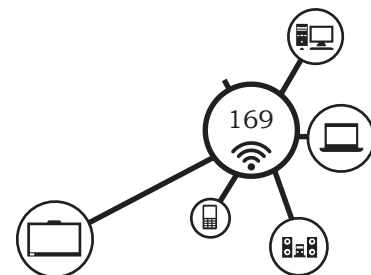


Slide 2 Objectives of the Study 1. To find out the reason behind of ICT Mela. 2. To find out the areas of ICT Mela. 3. 4 .	Font size: (Study objectives : 44) Others: 32 Color: Red Background color: Light Yellow Animation : Fade in Slide Transition:
Slide 3 Preparation steps for showing your method of learning. 1. 2.	Font size : (Preparation Steps : 24) Others : 32 Colour : Blue Background colour : Light Yellow Animation : Fade in Slide Transition:

Check Your Progress

A. Multiple Choice Questions

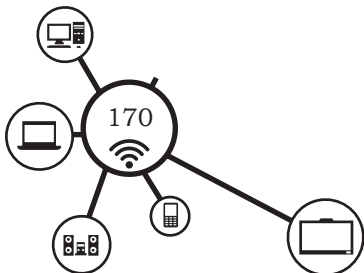
- Which of the following option is not available on Presentation Wizard?
 - Empty presentation
 - Form template
 - Open new presentation
 - Open existing presentation
- Which of the following is not a part of main Impress window?
 - Slides pane
 - Workspace
 - Work pane
 - Task pane
- Which of the following is not a section of tasks pane?
 - Master pages
 - Layouts
 - Custom View
 - Custom animation
- Which view button listed below is not one of those available in the workspace?
 - Normal view
 - Outline view
 - Thumbnail view
 - Notes
- Which view is generally used for creating, formatting and designing slides?
 - Normal view
 - Outline view
 - Notes
 - Slide Sorter view
- The slide show can be exited at any time during the show by pressing which of the following keys?
 - Space bar
 - End key
 - Break key
 - Esc key



7. Which of the following features is used to create a new slide show with the current slides but presented in a different order?
 - (a) Rehearsal
 - (b) Custom Slide show
 - (c) Slide Show Setup
 - (d) Slide Show View
8. Which of the following feature is used to progress the slide show automatically while speaking on the topic?
 - (a) Custom Animation
 - (b) Rehearse Timing
 - (c) Slide Transition
 - (d) Either (a) or (b)

B. Fill in the blanks

1. _____ is used to maintain consistency in design and colour in the presentation.
2. _____ view is used to view all the slides simultaneously.
3. _____ is used to perform basic operations on the presentation
4. Master Page is used to modify the _____ of the slide.
5. To create a new blank presentation, use the key combination _____.
6. In every presentation, first slide should be _____.
7. To save a presentation, we can use key combination _____.
8. In LibreOffice Impress, by default the presentation is saved with _____ extension.
9. The keyboard shortcut key for slide show is _____.
10. The short cut key to close the LibreOffice impress is _____.
11. The short cut key to insert a new slide is _____.
12. The _____ view is used to apply animation on the content of slide
13. A paper copy of presentation given to the audience is known as _____.
14. To play a sound during transitions, select a sound from the _____ list.
15. To play the sound repeatedly, the _____ is used.

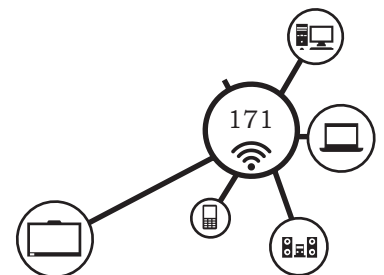


C. State whether the following statements are True or False

1. The order of the slides cannot be changed in slides pane
2. Slide design or layout can be changed for multiple slides simultaneously.
3. Every slide in a presentation has exactly one slide master.
4. Animations once applied can be changed but cannot be removed.
5. Slide names are included in outline view.
6. The notes added to slides can be seen during the presentation.
7. A presentation can have multiple slide masters.
8. A user can create his/her own slide master.
9. Once a pre-defined slide master is selected, the background of slide cannot be changed.
10. The text added to the header is displayed on the first slide only.
11. The text added to the footer is displayed on the last slide only.
12. User can create his/her own template and use it in the Presentation Wizard.
13. The Notes View is used for the audience.
14. It is not possible to insert audio or video clips in the presentation.
15. Header and footer can be inserted in the presentation.

D. Short answer questions (50 words)

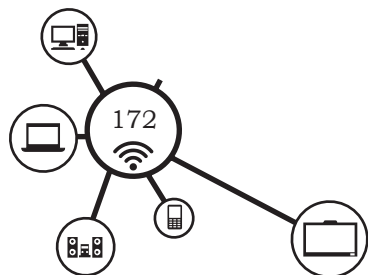
1. List the possible multimedia contents that are included while creating a presentation.
2. List the important points to be considered while making an effective presentation.
3. What are the advantages of using a presentation?
4. What objects can be inserted to slides in Impress?
5. What are the steps to add picture or object to the slide?
6. How can text be added to header or footer on the sliders?
7. Describe the use of fields available in header and footer.



8. Write the steps to create a template.
9. Write down the steps to add slide transition in your presentation.
10. How will you add the slide number at the bottom of each slide?
11. How will you insert a company's logo (picture) in first slide of your presentation?
12. How will you add the name of the company on the top of the each slide?
13. Write down the steps to create a table in a presentation.
14. Write down the steps to insert a chart in slide.
15. What are the five views of presentation?

Practical Exercise

1. Create a presentation which gives an overview of the science subject. This presentation should contain the following slides:
 - (i) Title of the subject (use title slide layout only)
 - (ii) Index
 - (iii) Introduction of each chapter (Minimum one slide per chapter should be prepared.)
2. For the presentation created in Q.1 above, do the following:
 - (i) Rename each slide with the chapter name.
 - (ii) Change the font for the slide title.
 - (iii) Add a footer that contains the current date and your school name.
 - (iv) Apply at least one master page to your presentation.
 - (v) Hide slides of even chapters and see the effect.
 - (vi) Start the slide show after setting the option as Change slides manually. (Navigator should be visible during the presentation).
3. For the presentation created in Q.1, do the following:
 - (i) Convert the presentation to a PDF file.
 - (ii) Set the Handout view such that there are 4 slides per page.



4. Create a presentation which demonstrates details of a car launched by any company of your choice. Include the following sliders:
 - (i) Introduction of the company
 - (ii) List of cars the company sells.
 - (iii) Introduction of the new car launched.
5. For the presentation created in the question above, add the following functionalities:
 - (i) All models of the car should be displayed in tabular format. (Model name, Basic Price, Average, Capacity)
 - (ii) Modify the appearance of the table and set animation effect as box
 - (iii) Add the image of the each model with its description.
 - (iv) Change the background colour of each slides of your presentation.

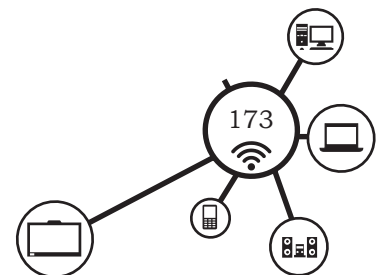
List of General Shortcut Keys used in LibreOffice

Shortcut keys for controlling dialogs

Shortcut Keys	Effect
Enter key	Activates the focused button in a dialog
Esc	Terminates the action or dialog
Spacebar	Toggles the focused check box in a dialog
Arrow keys	Changes the active control field in an option section of a dialog
Tab	Advances focus to the next section or element in a dialog
Shift+Tab	Moves the focus to the previous section or element in a dialog
Alt+Down Arrow	Opens the list of the control field currently selected in a dialog These shortcut keys apply not only to combo boxes but also to icon buttons with pop-up menus. Close an opened list by pressing the Escape key

Shortcut keys for controlling documents and windows

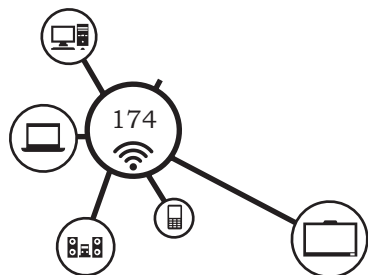
Shortcut Keys	Effect
Ctrl+O	Opens a document
Ctrl+S	Saves the current document
Ctrl+N	Creates a new document
Ctrl+Shift+N	Opens Templates and Documents dialog
Ctrl+P	Prints document
Ctrl+F	Activates the Find toolbar



Ctrl+H	Calls the Find & Replace dialog
Ctrl+Shift+F	Searches for the last entered search term
Ctrl+Shift+J	Toggles the view between full screen mode and normal mode in Writer or Calc
Ctrl+Shift+R	Redraws the document view
Ctrl+Shift+I	Enable or disable the selection cursor in read-only text
F1	Starts the LibreOffice Help
Shift+F1	Context Help
Shift+F2	Turns on Extended Tips for the currently selected command, icon or control
F6	Sets focus in next sub-window (for example, document/data source view)
Shift+F6	Sets focus in previous sub-window
F10	Activates the first menu (File menu)
Shift+F10	Opens the context menu
Ctrl+F4 or Alt+F4	Closes the current document (close LibreOffice when the last open document is closed)
Ctrl+Q	Exits application

Shortcut keys for editing or formatting documents

Shortcut Keys	Effect
Ctrl+Tab	When positioned at the start of a header, a tab is inserted
Ctrl+X	Cuts out the selected elements
Ctrl+C	Copies the selected items
Ctrl+V	Pastes from the clipboard
Ctrl+Alt+Shift+V	Pastes unformatted text from the clipboard. The text is pasted using the format that exists at the insertion point
Ctrl+Shift+V	Opens the Paste Special dialog
Ctrl+A	Selects all
Ctrl+Z	Undoes last action
Ctrl+Y	Redoes last action
Ctrl+Shift+Y	Repeats last command
Ctrl+I	The Italic attribute is applied to the selected area. If the cursor is positioned in a word, this word is also marked in italic
Ctrl+B	The Bold attribute is applied to the selected area. If the cursor is positioned in a word, this word is also put in bold
Ctrl+U	The Underlined attribute is applied to the selected area. If the cursor is positioned in a word, this word is also underlined
Ctrl+M	Removes direct formatting from selected text or objects (as in Format - Clear Direct Formatting)



Answer Key

UNIT 2: DATA ENTRY AND KEYBOARDING SKILLS

A. Multiple choice questions

1. d 2. a 3. c 4. d 5. d

B. Fill in the blanks

1. muscle 2. words per minute 3. Alpha Numeric
4. current 5. 12 6. Numeric 7. Cursor
8. Last 9. right-hand 10. four, five

C. State whether the following statements are True or False

1. T 2. F 3. F 4. T 5. T 6. T 7. T 8. T
9. F 10. F 11. T 12. F 13. F 14. F 15. F

UNIT 3: DIGITAL DOCUMENTATION

A. Multiple choice questions

1. c 2. c 3. b 4. b 5. c 6. a 7. b
8. a 9. c 10. c 11. d 12. d 13. a 14. a
15. b 16. b 17. a 18. b 19. a 20. b 21. b
22. c 23. d 24. b 25. a

B. Fill in the blanks

1. dialog box 2. another submenu 3. formatting a document
4. beginning of the line, the end of a line 5. redo 6. word
7. top, bottom 8. landscape 9. print preview 10. data source

C. State whether the following statements are True or False

1. T 2. F 3. F 4. T 5. T 6. T 7. F
8. T 9. F 10. T 11. T 12. T 13. T 14. T
15. F 16. F 17. T 18. T 19. T 20. T

UNIT 4: ELECTRONIC SPREADSHEET

A. Multiple choice questions

1. a 2. a 3. c 4. a 5. d 6. d 7. a
8. d 9. c 10. d 11. a 12. c 13. a 14. d
15. a 16. c 17. a 18. b 19. d 20. d 21. c
22. a 23. a 24. c 25. b

B. Fill in the blanks

1. AA 2. .ods 3. Fill handle 4. =MIN(D1:D5) 5. =D2+E3
6. I8 7. mixed 8. right 9. 20 10. Relative

NOTES

C. State whether the following statements are True or False.

1. F 2. T 3. F 4. T 5. T

D. Solve the following in a spreadsheet

- a. 50, b. -35, c. =\$B\$5 + D5 d. =\$B5 + D5 e. =\$B5 + D5

UNIT 5: DIGITAL PRESENTATIONS

A. Multiple choice questions

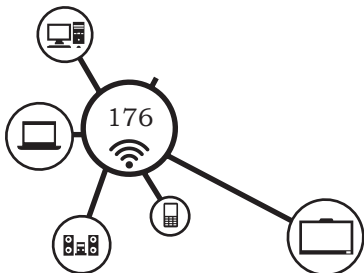
1. a 2. b 3. b 4. a 5. d 6. d 7. c
8. a 9. b 10. c 11. d 12. c 13. d 14. b
15. b 16. 17. 18. 19. 20.

B. Fill in the blanks

1. Master slide 2. slide sorter 3. File Menu 4. Base architecture
5. Ctrl + N 6. Title Slide 7. Ctrl + S 8. .odp
9. F5 10. CTRL + W 11. Ctrl + M 12. Normal View
13. Handouts 14. Sound 15. loop until next sound

C. State whether the following statements are True or False

1. T 2. T 3. T 4. F 5. T 6. T 7. F
8. T 9. F 10. F 11. T 12. T 13. F 14. F
15. T



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Unit 2

Figs 2.1–2.4 (a&b), 2.8–2.23

Unit 3

Figs 3.2–3.38

Unit 4

Figs 4.1–4.44

Unit 5

Figs 5.1–5.4

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Unit 2

Fig. 2.5 <https://bit.ly/2LTsWGp>

Fig. 2.6 <https://bit.ly/2HReNH4>

Fig. 2.7 <https://bit.ly/2LU32lB>

NOTES

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CBSE | DEPARTMENT OF SKILL EDUCATION

CURRICULUM FOR SESSION 2026-2027

INFORMATION TECHNOLOGY (SUB. CODE – 402)

JOB ROLE: DOMESTIC DATA ENTRY OPERATOR

CLASS – IX

COURSE OVERVIEW:

A Data Entry Operator/Analyst is a person who is responsible for entering data into different applications and computer databases, manage and maintain effective record keeping. In addition, S/he is responsible for organizing files, collecting and managing data to be entered into the computer. S/he is also responsible for security of data and safeguard of the computer network.

With every office and organization seeking to become computerized, the demand for data entry operators/analysts is on a rise. Data entry operators/analysts usually work in an indoor, office setting using a computer and other electronic machines. To be in the profession of data entry/analysis, one has to have computer literacy, high typing speed, organization skills, concentration skills, communication skills and an ability to sit for long periods of time entering and computing data.

OBJECTIVES OF THE COURSE:

In this course, the students will be introduced to the fundamental concepts of digital documentation, digital spreadsheet, digital presentation, database management and internet security.

The following are the main objectives of this course:

- To familiarize the students with the world of IT and IT enabled services.
- To provide an in-depth training in use of data entry, internet and internet tools.
- To develop practical knowledge of digital documentation, spreadsheets and presentation.
- To enable the students to understand database management system and have updated knowledge about digital record keeping.

- To make the students capable of getting employment in Private Sector, Public Sector, Ministries, Courts, House of Parliament and State Legislative Assemblies.
- To develop the following skills:
 - Data Entry and Keyboarding skills
 - The concept of Digital Documentation
 - The concept of Digital Presentation
 - The concept of Electronic Spreadsheet
 - The concept of Databases
 - Internet Technologies

SALIENT FEATURES

To be a data entry operator/analyst, one requires a lot of hard work and practical hands-on experience. One should have an intensive knowledge of Office applications, computer operations, and knowledge of clerical, administrative techniques and data analysis. Along with this, as a data entry operator/analyst, you will be expected to have fast typing speed, accuracy, and efficiency to perform tasks.

As a data entry operator/analyst, one should improve their computer skills, numerical and literacy skills. These skills can help one expand into a new career path in the future.

SCHEME OF UNITS

This course is a planned sequence of instructions consisting of units meant for developing employability and vocational competencies of students of Class IX opting for skill subject along with other education subjects. The unit-wise distribution of hours and marks for class IX is as follows:

INFORMATION TECHNOLOGY (SUBJECT CODE - 402)**CLASS – IX (Session 2026-2027)****Total Marks: 100 (Theory-50 + Practical-50)**

	UNITS	NO. OF HOURS for Theory and Practical		MAX. MARKS for Theory and Practical
Part A	Employability Skills			
	Unit 1 : Communication Skills-I	10		2
	Unit 2 : Self-Management Skills-I	10		3
	Unit 3 : ICT Skills-I	10		1
	Unit 4 : Entrepreneurial Skills-I	15		3
	Unit 5 : Green Skills-I	05		1
	Total	50		10
Part B	Subject Specific Skills	Theory	Practical	Marks
	Unit 1: Introduction to IT- ITeS industry	2	4	4
	Unit 2: Data Entry & Keyboarding Skills	4	10	6
	Unit 3: Digital Documentation	10	26	10
	Unit 4:Electronic Spreadsheet	18	35	10
	Unit 5: Digital Presentation	10	31	10
	Total	44	106	40
Part C	Practical Work			
	Practical Examination			15
	Written Test			10
	Viva Voce			10
	Total			35
Part D	Project Work/ Field Visit			
	Practical File/ Student Portfolio			10
	Viva Voce			05
	Total			15
	GRAND TOTAL	200		100

DETAILED CURRICULUM/TOPICS:

Part-A: EMPLOYABILITY SKILLS

S. No.	Units	Duration in Hours
1.	Unit 1: Communication Skills-I	10
2.	Unit 2: Self-Management Skills-I	10
3.	Unit 3: Basic Information and Communication Technology Skills-I	10
4.	Unit 4: Entrepreneurial Skills-I	15
5.	Unit 5: Green Skills-I	05
	TOTAL	50

NOTE: Detailed Curriculum/ Topics to be covered under Part A: Employability Skills can be downloaded from CBSE website.

Part-B – SUBJECT SPECIFIC SKILLS

- Unit 1: Introduction to IT- ITeS industry
- Unit 2: Data Entry & Keyboarding Skills
- Unit 3: Digital Documentation
- Unit 4: Electronic Spreadsheet
- Unit 5: Digital Presentation

UNIT 1: INTRODUCTION TO IT-ITeS INDUSTRY

S. No.	LEARNING OUTCOMES	THEORY	PRACTICAL
1	Appreciate the applications of IT	• Introduction to IT and ITeS, BPO services, • BPM industry in India, • Structure of the IT-BPM industry, • Applications of IT in home computing, everyday life, library, workplace, education, entertainment, communication, business, science and engineering, banking, insurance, marketing, health care, IT in the government and public service	- Identify and list the various IT enabled services, Observe the application of IT in various areas.

UNIT 2: DATA ENTRY AND KEYBOARDING SKILLS

S. No.	LEARNING OUTCOMES	THEORY	PRACTICAL
1.	Use keyboard and mouse for data entry	- Keyboarding Skills, - Types of keys on keyboard, Numeric keypad, - Home keys, Guide keys, - Typing and deleting text, - Typing ergonomics, - Positioning of fingers on the keyboard, Allocation of keys to fingers on four different rows, - Pointing device – Mouse, Mouse operations.	- Identify the keys and its use on the keyboard, - Demonstrate to use various keys on the keyboard, - Demonstrate to type the text, numbers, special character using appropriate keys on the keyboard, - Practice the correct typing ergonomics, - Practice to place fingers on correct key in four different row of keyboard, - Practice various mouse operations.
2.	Use typing software	- Introduction to Rapid Typing Tutor, - Touch typing technique, - User interface of Typing Tutor, - Typing text and interpret results, - Working with lesson editor, - Calculating typing speed, - Typing rhythm.	- Identify the user interface of typing tutor, - Practice to type text in typing tutor software and interpret the results, - Practice to work in lesson editor, - Calculate the typing speed - Practice to improve typing - Using typing tutor software.

UNIT 3: DIGITAL DOCUMENTATION

S. No.	LEARNING OUTCOMES	THEORY	PRACTICAL
1.	Create a document using a word processor	- Introduction to word processing, - Word processing applications, - Introduction to Word Processing tool - Creating a document, Parts of a Word Processor Window,	- List the available word processing applications. - Introduce with the parts of the main window. - Change document views. - Start a new document. - Open an existing document. - Save a document. - Close a document.
2.	Apply Editing features	- Text editing – Undo and Redo, - Moving and copying text, - Copy and Paste, - Selecting text, - Selection criteria,	- Editing of text in a document - Demonstrate to use undo and redo option, - Use the keyboard and mouse options to select, cut, copy, paste, and move text.

S. No.	LEARNING OUTCOMES	THEORY	PRACTICAL
		• Selecting non-consecutive text items, • Selecting a vertical block of text, • Find and replace option, • Jumping to the page number, • Non-printing characters, • Checking spelling and grammar, • Using Synonyms and Thesaurus.	• Demonstrate to select nonconsecutive text items, vertical block of text, • Search and replace text in a document. • Jump to the given page number in a document, • Insert non-printing characters in a document, • Apply Spelling and grammar option of document. • Demonstrate to use Synonyms and Thesaurus.
3.	Apply formatting features	• Page style dialog • Formatting text – Removing manual formatting, Common text formatting, Changing text case, Superscript and Subscript • Formatting paragraph – Indenting paragraphs, Aligning paragraphs, Font colour, highlighting, and background colour, Using bullets and numbering, Assigning colour, border and background to paragraph. • Page formatting – setting up basic page layout using styles, Inserting page break, Creating header/footer and page numbers, • Defining borders and backgrounds, Inserting images shapes, special characters in a document, Dividing page into columns, Formatting the shape or image.	• Apply various text formatting options for the text, • Demonstrate to format paragraphs – indent/align paragraphs, assign font colour, highlighting, and background colour, • Assign number or bullets to the lists items • Demonstrate to assign colour, border and background to paragraph • Demonstrate the page formatting – set up basic page layout using styles, • Insert page break, Create header/footer and page numbers • Define borders and backgrounds • Insert images, shapes, special characters in a document • Divide page into columns, • Format the shape or image.
4.	Create and work with tables	• Creating table in Word Processor • Inserting row and column in a table • Deleting rows and columns • Splitting and merging tables • Deleting a table • Copying a table • Moving a table.	• Demonstrate and do the following in Word Processor: • Create table, • Insert and delete rows and column in a table, • Split and merge tables, • Delete a table, • Copy or move from one location to another location of document.

S. No.	LEARNING OUTCOMES	THEORY	PRACTICAL
5.	Use Print Options	• Printing options in Word Processor. • Print preview, • Controlling printing, • Printing all pages, single and multiple pages.	• Demonstrate to print the document, selected pages in the document • Print the document with various options, • Preview pages before printing.
6.	Understand and apply mail merge	• Introduction to mail merge • Concept of data source for mail merge.	• Demonstrate to print the letters using mail merge, • Do the following to achieve • Create a main document, • Create the data source, • Enter data in the fields, • Merge the data source with main document, • Edit individual document, • Print the merged letter, • Save the merged letter.

UNIT 4: ELECTRONIC SPREADSHEET

S. No.	LEARNING OUTCOMES	THEORY	PRACTICAL
1.	Create a Spreadsheet	• Introduction to spreadsheet application • Starting a spreadsheet • Parts of a spreadsheet • Worksheet – Rows and Columns, Cell and Cell Address, • Range of cells – column range, row range, row and column range.	• Start the spreadsheet, • Identify the parts of Calc, • Identify the rows number, column number, cell address, • Define the range of cell, • Identify row range, column range, row & column range
2.	Apply formula and functions in spreadsheet	• Different types of data, • Entering data – Label, Values, Formula • Formula, how to enter formula, • Mathematical operators used in formulae, • Simple calculations using values and operators, • Formulae with cell addresses and operators, • Commonly used basic functions in a spreadsheet – SUM, AVERAGE, MAX, MIN, Count • Use of functions to do calculations.	• Demonstrate to enter the text, numeric data in a cell, • Identify the label, values and formula in the cell, • Demonstrate to enter formula in a cell, • Construct the formula using mathematical operators, • Identify formulae with cell addresses and operators, • Identify the correct syntax of formula, • Use the basic functions to perform calculations on data.

S. No.	LEARNING OUTCOMES	THEORY	PRACTICAL
3.	Format data in the spreadsheet	• Formatting tool, • Use of dialog boxes to format values, • Formatting a range of cells with decimal places, • Formatting a range of cells to be seen as labels, • Formatting of a cell range as scientific, • Formatting a range of cells to display times, • Formatting alignment of a cell range, • Speeding up data entry using the fill handle, • Uses of fill handle to copy formulae.	• Identify the formatting tool, • Demonstrate to use of dialog boxes to format values, • Demonstrate to format range of cells with decimal places, • Demonstrate to format a range of cells to labels, • Demonstrate to format of a cell range as scientific, • Demonstrate to format a range of cells to display time, • Demonstrate to align cell data range, • Demonstrate to create number series using fill handle, • Copy formula by dragging the formula using fill handle.
4.	Understand and apply Referencing	• Concept of referencing, • Relative referencing, • Mixed referencing, • Absolute referencing.	• Demonstrate to use Relative referencing in spreadsheet, • Demonstrate to use Mixed referencing in spreadsheet, • Demonstrate to use Absolute referencing in spreadsheet.
5.	Create and insert different types of charts in a spreadsheet	• Importance of chart in spreadsheet • Types of chart	• Create different types of charts supported by a spreadsheet, • Illustrate the example of chart in a spreadsheet.

UNIT 5: DIGITAL PRESENTATION

S. No.	LEARNING OUTCOMES	THEORY	PRACTICAL
1.	Understand features of an effective presentation	• Concept of presentation, • Elements of presentation, • Characteristics of an effective presentation	• Identify and list the elements of presentation, • List the characteristics of an effective presentation.
2.	Create a presentation	• Introduction to presentation software, • Opening a presentation software • Parts of presentation window, • Closing a presentation • Creating a presentation using template, • Selecting slide layout, • Saving a presentation, • Running a slide show, • Save a presentation in PDF, • Closing a presentation, • Using Help.	• Start the presentation application • various components of main Impress window • Observe the different workspace views. • Create a new presentation using wizard. • Run the presentation, • Save the presentation, • Close the presentation, • Demonstrate to use Help in presentation.

S. No.	LEARNING OUTCOMES	THEORY	PRACTICAL
3.	Work with slides	- Inserting a duplicate slide, - Inserting new slides, - Slide layout, - Copying and moving slides, - Deleting and renaming slides - Copying, moving and deleting contents of slide, - View a presentation, - Controlling the size of the view, - Workspace views – Normal, Outline, Notes, Slide sorter view.	- Demonstrate to insert a new slide and duplicate slide in a presentation, - Change the slide layout, - Demonstrate to copy and move slides in the presentation, - Demonstrate to copy, move and delete contents of the slide, - Demonstrate to view a presentation in different views.
4.	Format text and apply animations	- Formatting toolbar, - Various formatting features, - Text alignment, - Bullets and numbering. - Custom Animation	- Identify and list the various options in formatting toolbar, - Apply the appropriate formatting option - Align the text in presentation, - Apply bullets and numbering to the list items in presentation - Apply Animation
5.	Create and use tables	- Inserting tables in presentation, - Entering and editing data in a table, - Selecting a cell, row, column, table, - Adjusting column width and row height, - Table borders and background	Demonstrate the following: - Insert table in presentation, - Enter and edit data in a table, - Select a cell, row, column, table, - Adjust column width and row height, - Assign table borders and background.
6.	Insert and format image in presentation	- Inserting an image from a file, - Inserting an image from the gallery, - Formatting images, - Moving images, - Resizing images, - Rotating images, - Formatting using the Image toolbar, - Drawing graphic objects – line, shapes, - Grouping and un-grouping objects	- Demonstrate to insert an image from file, gallery in presentation, - Apply formatting options to image in presentation, - Demonstrate to move, resize and rotate images, - Apply formatting options of Image toolbar, - Drawing line, shapes using graphic objects, Demonstrate to group and ungroup objects.
7.	Work with slide master	- Slide masters, - Creating the slide masters, - Applying the slide masters to all slide, - Adding transitions.	- Create the slide masters, - Apply the slide masters to the presentation, - Add transitions to presentation.

LIST OF EQUIPMENT/ MATERIALS:

The list given below is suggestive and an exhaustive list should be compiled by the teacher(s) teaching the subject. Only basic tools, equipment and accessories should be procured by the Institution so that the routine tasks can be performed by the students regularly for practice and acquiring adequate practical experience.

S. No.	ITEM NAME, DESCRIPTION & SPECIFICATION	QUANTITY
A	HARDWARE	
1.	Computer with latest configuration or minimum Pentium Processor with minimum 2GB RAM, 512 GB HDD, 17" LED Monitor, NIC Card, 3 button Mouse, 105 keys key board and built-in speakers and mic.	15
2.	Laser Printer - Black	01
3.	Inkjet Printers (Colour & Black)	01
4.	Scanner	01
5.	Online UPS 5 KVA	01
6.	16 Port Switches	01
7.	Air Conditioner 1.5 tonne	02
8.	Telephone line (For Internet)	01
9.	Fire extinguisher	01
B	SOFTWARE	
1.	Operating System Linux and Windows	
2.	Anti-Virus Latest version	
3.	Productivity Suite, Example –Libre Office	
C	FURNITURE	
1.	Class room chairs and desks	25
2.	Computer Tables	15
3.	Straight back revolving & adjustable chairs (Computer Chairs)	15
4.	Printer Tables	02
5.	Trainers Table	01
6.	Trainers Chair	01
7.	Steel cupboards drawer type	02
8.	Cabinet with drawer	01
9.	Steel Almira - big size	01
10.	Steel Almira- small size	01

TEACHER'S/ TRAINER'S QUALIFICATIONS:

Qualification and other requirements for appointment of teachers/trainers for teaching this subject, on contractual basis should be decided by the State/ UT. The suggestive qualifications and minimum competencies for the teacher should be as follows:

Qualification	Minimum Competencies	Age Limit
Diploma in Computer Science/ Information Technology OR Bachelor Degree in Computer Application/ Science/ Information Technology (BCA, B.Sc. Computer Science/ Information Technology) OR Graduate with PGDCA OR DOEACC A Level Certificate. The suggested qualification is the minimum criteria. However higher qualifications will also be acceptable.	- The candidate should have a minimum of 1 year of work experience in the same job role. - S/he should be able to communicate in English and local language. - S/he should have knowledge of equipment, tools, material, Safety, Health & Hygiene.	18-37 years (as on Jan. 01 (year)) - Age relaxation to be provided as per Govt. rules

Teachers/Trainers form the backbone of Skill (Vocational) Education being imparted as an integral part of Rashtriya Madhyamik Shiksha **Abhiyan** (RMSA). They are directly involved in teaching of Skill (vocational) subjects and also serve as a link between the industry and the schools for arranging industry visits, On-the-Job Training (OJT) and placement.

These guidelines have been prepared with an aim to help and guide the States in engaging quality Teachers/Trainers in the schools. Various parameters that need to be looked into while engaging the Vocational Teachers/Trainers are mode and procedure of selection of Teachers/ Trainers, Educational Qualifications, Industry Experience, and Certification/ Accreditation.

The State may engage Teachers/Trainers in schools approved under the component of scheme of Vocationalisation of Secondary and Higher Secondary Education under RMSA in following ways:

- (i) Directly as per the prescribed qualifications and industry experience suggested by the PSS Central Institute of Vocational Education (PSSCIVE), NCERT or the respective Sector Skill Council (SSC).
- OR**
- (ii) Through accredited Vocational Training Providers accredited under the National Quality Assurance Framework (NQAF*) approved by the National Skill Qualification Committee on 21.07.2016. If the State is engaging Vocational Teachers/Trainers through the Vocational Training Provider (VTP), it should ensure that VTP should have been accredited at NQAF Level 2 or higher.

** The National Quality Assurance Framework (NQAF) provides the benchmarks or quality criteria which the different organizations involved in education and training must meet in order to be accredited by competent bodies to provide government- funded education and training/skills activities. This is applicable to all organizations offering NSQF-compliant qualifications.*

The educational qualifications required for being a Teacher/Trainer for a particular job role are clearly mentioned in the curriculum for the particular NSQF compliant job role. The State should ensure that teachers/trainers deployed in the schools have relevant technical competencies for the NSQF qualification being delivered. Teachers/Trainers preferably should be certified by the concerned Sector Skill Council for the particular Qualification Pack/Job role which he will be teaching. Copies of relevant certificates and/or record of experience of the teacher/trainer in the industry should be kept as record.

To ensure the quality of the Teachers/Trainers, the State should ensure that a standardized procedure for selection of (Vocational) Teachers/Trainers is followed. The selection procedure should consist of the following:

- (i) Written test for the technical/domain specific knowledge related to the sector;
- (ii) Interview for assessing the knowledge, interests and aptitude of trainer through a panel of experts from the field and state representatives; and (iii) Practical test/mock test in classroom/workshop/laboratory.

In case of appointment through VTPs, the selection may be done based on the above procedure by a committee having representatives of both the State Government and the VTP.

The State should ensure that the Teachers/ Trainers who are recruited should undergo induction training of 20 days for understanding the scheme, NSQF framework and Vocational Pedagogy before being deployed in the schools.

The State should ensure that the existing trainers undergo in-service training of 5 days every year to make them aware of the relevant and new techniques/approaches in their sector and understand the latest trends and policy reforms in vocational education.

The Head Master/Principal of the school where the scheme is being implemented should facilitate and ensure that the (Vocational) Teachers/Trainers:

- Prepare session plans and deliver sessions which have a clear and relevant purpose and which engage the students;
- Deliver education and training activities to students, based on the curriculum to achieve the learning outcomes;
- Make effective use of learning aids and ICT tools during the classroom sessions;
- Engage students in learning activities, which include a mix of different methodologies, such as project based work, team work, practical and simulation based learning experiences;
- Work with the institution's management to organise skill demonstrations, site visits, on job trainings, and presentations for students in cooperation with industry, enterprises and other workplaces;
- Identify the weaknesses of students and assist them in up-gradation of competency;
- Cater to different learning styles and level of ability of students;
- Assess the learning needs and abilities, when working with students with different abilities
- Identify any additional support the student may need and help to make special arrangements for that support;
- Provide placement assistance

Assessment and evaluation of (Vocational) Teachers/Trainers is very critical for making them aware of their performance and for suggesting corrective actions. The States/UTs should ensure that the performance of the (Vocational) Teachers/Trainers is appraised annually. Performance based appraisal in relation to certain pre-established criteria and objectives should be done periodically to ensure the quality of the (Vocational) Teachers/Trainers.

Following parameters may be considered during the appraisal process:

- Participation in guidance and counseling activities conducted at Institutional, District and State level;
- Adoption of innovative teaching and training methods;
- Improvement in result of vocational students of Class X or Class XII;
- Continuous up-gradation of knowledge and skills related to the vocational pedagogy, communication skills and vocational subject;
- Membership of professional society at District, State, Regional, National and International level;
- Development of teaching-learning materials in the subject area;
- Efforts made in developing linkages with the Industry/Establishments;
- Efforts made towards involving the local community in Vocational Education
- Publication of papers in National and International Journals;
- Organization of activities for promotion of vocational subjects;
- Involvement in placement of students/student support services.

ART EDUCATION CLASS IX (2026-27)

The NCF-SE 2023 broadly classifies the Arts into Visual and Performing Arts (Music, Theatre, and Dance & Movement). It involves innovative and imaginative ways of expression in different forms using a variety of materials and media.

NEP 2020 helps students to utilize various aspects and forms of art and culture as the basis for learning concepts across subjects. A part of the thrust on experiential learning, art-integrated education, embedded in classroom transactions, not only creates joyful learning but also helps in imbibing the Indian ethos through the knowledge of Indian art and culture.

Art in School Education addresses the Goals and Competencies for every student to find diverse ways of persisting and solving problems. We not only create an artwork, but also enjoy the experience of viewing and responding to many forms of cultural expression. When they create artwork together and work collaboratively, they recognize one another's strengths and develop deeper connections with the world around them. Such a process nurtures empathy, appreciation, cooperation, and trust, all of which are fundamental for developing social and human values, such as ahimsa, love, compassion, friendship, and peaceful co-existence. As a common language, the Arts bring people together and lead them to develop acceptance, understanding, and mutual respect

Art classes involve three important processes—making artwork, thinking creatively in the Arts, and appreciating all forms of artistic expression down the ages. This immersive experience of producing art improves cognition, leaving a positive and long-lasting impact on the development of aesthetic sensibilities, expression, imagination, observation, crafting skills, creativity, and students' overall confidence in their own abilities.

Aims

Through Art students should be able to connect with their culture and appreciate the diversity of artistic expressions. For an effective Art Education programme, schools must aim to achieve:

- a. Joy in exploring and creating artwork:** This would mean gaining a variety of aesthetic experiences and deriving joy from all forms of art.
- b. Imagination and creativity:** Acquiring and applying creative thinking and artistic capacities through experimentation and sustained practice in the Arts is at the heart of Art Education.
- c. Empathy and sensitivity:** Meaningful experience in the Arts has great potential to nurture empathy and sensitivity towards the expressions of others.
- d. Understanding of connections with other disciplines:** The Arts teaches

appreciation of beauty in nature and the observation of details and patterns. This approach to the understanding of disciplines makes for aesthetic experiences in themselves.

- e. **Sense of belonging:** Through artistic engagement, students will find connections to their own culture and traditions, as well as learn an appreciation for India's multicultural diversity and knowledge of contemporary artists and art practices.
- f. **Development of Aesthetic Sensibilities:** Students should be able to describe the characteristics of things they find beautiful, do subjective interpretations, assess the aesthetic qualities of artwork based on the commonly accepted criteria in the Arts and expand their 'tastes' by participating in art processes.

Approach to learning different Arts Forms for Practice and Theory

Arts Education emphasizes the process over the product. The NCF-SE 2023 mentions three processes that are integral to the Arts:

- **Thinking Processes** refer to a wide range of cognitive activities in the Arts. It includes generating ideas, understanding the elements of art, inquiring into artistic processes, interpreting artwork, and connecting the Arts with other knowledge and experiences.
- **Making Processes** relate to the execution and production of work, utilizing the active engagement of mind and body to express ideas and emotions. This involves using a variety of creative tools, instruments, materials and techniques.
- **Appreciation Processes** include exposure to and awareness of diverse art forms and cultural practices. This process involves responding to artworks, discussing, describing and assessing aesthetic experiences; considering their social and historical contexts, and developing multiple perspectives along with respect for diverse opinions.

Visual Arts
• Visual Arts learning builds upon the student's knowledge of the elements of art and the principles of design. Through regular practice in creating compositions and other artworks, fundamental concepts, such as perspective, proportion, balance, focus, rhythm and harmony guide students in effectively expressing their ideas and expressions. • An introduction to art history and basic theories, such as Śaḍāṅga described in ancient treatises like the Citrasūtra, helps students to appreciate the aesthetically rich and continuous heritage of the Indian art traditions. • Exploration and experimentation with materials, tools and techniques also create opportunities for interdisciplinary linkages.

Music
• Music education includes singing diverse compositions across classical, folk, tribal and contemporary genres, enabling students to experience the richness of India's musical traditions. Students will explore ragas, rhythm patterns and instruments, study the historical evolution of music and its theoretical treatises, and understand how Indian music has gained global recognition through renowned musicians.
Theatre
• Theatre builds on the basic aspects of voice, body language and expression, along with costume, make-up and other backstage elements learned in earlier stages. • In practice, students explore the basics of direction, lighting and sound, and how these elements shape a scene's emotion and meaning. They experiment with abstract representation, where a single object or gesture can symbolise a broader idea. Through theoretical study, students will learn how theatre developed from the pre-Nāṭyaśāstra period to modern theatre, which uses design, technology, and realistic storytelling techniques. This integration of practice and theory enables learners to think both as artists and storytellers - understanding how every elements, such as light, sound and movement, can express an idea and create an experience that connects people across time.
Dance and Movement
• Dance and movement will be learnt through the application of concepts rooted in texts. Teachers are encouraged to ground instruction in regional dance practices, while also introducing students to dance forms from other regions. Various dance practices, major and other traditions will be learnt with emphasis on stylised body movements, emotional expression and the creative use of hand gestures. They are also introduced to analyse and journal the historical development of dance, taking cultural and geographical contexts into account. The interrelation between dance and other art forms is emphasised, and students are encouraged to integrate interdisciplinary concepts in their creative explorations.

Themes/ Concepts and Learning Outcomes (Suggestive Instructional Hours)

History of Arts (Common Chapter for all four Arts forms)

(30 hours)

Chapter Outlines/Key Concepts	Learning Outcomes
Common History chapter bringing together all art forms • Time period covers the prehistoric period to the late 11th century CE. • Tangible and intangible cultural heritage • Storytelling traditions from across India • Chronology of important milestones across all art forms • Ancient texts and literary sources that have guided Indian Arts Traditions • Geographical, socio-cultural and political influences on art practices • Art from around the world that shows parallel development and cross- cultural influences • Continuity of historical art traditions and connections with present times	• Students will be able to: Interact with peers, teachers, family members, and artists in their community to know more about Arts practices CG-1, C-1.2. • Create artwork, i.e., inspired by the ideas and processes from art history CG-1, C-1.2. • Identify and discuss the evolution of materials, processes & techniques used in various art forms CG- 3, C- 3.2. • Trace the historical development of visual arts, theatre, music and dance with examples CG-4, C- 4.1. • Identify the continuing ideas, practices, and art traditions mentioned in ancient Indian texts and treatises. CG-4, C- 4.1. • Discuss and correlate the geographic, social and cultural linkages across art forms that share a common time period. CG-4, C- 4.1. • Explain why they find an artwork or performance relevant to their interests, experience, and present social context. CG-4, C- 4.2.

Visual Arts

Chapter Outlines/Key Concepts	Learning Outcomes
Visual Arts Fundamentals (4 hours / 5 periods)	
1.1 Introductory discussion Prior knowledge, and learning and experiences in visual arts	Students will be able to: • Journal their interests, observations and experiences through visuals

experiences. 1.2 Visual Journal • Journaling through drawing and collage • Journaling related to other art forms. 1.3 Elements of Visual Arts 1.4 Principles of Visual Design 1.5 Sketching basics	and notes CG-1, C-1.1. • Practice basic Visual Arts processes regularly (e.g., Student spends 10 – 15 minutes every day to create drawing from observation) CG-2, C-2.1.
Exploration of Materials and Methods (7.5 hours/ 9 periods)	
2.1 Introduction to common materials, mediums and tools in Visual Arts 2.2 Proper use, maintenance, and storage of materials and tools 2.3 Explore sculptural and hand-crafting traditions in India. • Gather information & write about one Indian handcrafting tradition • Create a three-dimensional artwork using its technique, e.g., relief in clay, bamboo crafts, fabric toys, papier-mâché, jute or fibre crafts, etc. 2.4 Colour Theory Exercises • Colour wheel in different mediums • Colour tints, shades and tones • Complementary and Analogous colours 2.5 Perspective • Linear perspective • Aerial perspective • Create an artwork using linear and aerial perspective	Students will be able to: • Demonstrate familiarity with the use and maintenance of materials and tools used in Visual Arts CG-3, C-3.1. • Practice colour exercises using a variety of materials and mediums CG-3, C-3.1. • Apply perspective techniques to show spatial depth in their artwork CG-3, C-3.1. • Create a three-dimensional artwork using a hand-crafting technique from any part of India e.g., relief in clay, bamboo crafts, fabric toys, papier-mâché, jute or fibre crafts, etc. CG-3, C-3.2.
Creative Composition (5 hours/ 6 periods)	
3.1 Introduction to Composition • Realistic and Abstract representations • Compositional Layout • Importance of iterations 3.2 Create a 2D Composition (two	Students will be able to: • Create multiple iterations in process of developing their ideas and making artworks CG-3, C-3.1. • Compare multiple iterations of one's

options) • Create a four-part graphic story or comic strip (in colour) • Thematic painting or collage (choice of genres and themes can vary, such as still life, portrait, landscape, people in indoor or outdoor settings, imaginary composition)	artwork to explain how the arrangement of visual elements conveys different meanings and emotions CG-2, C-2.2.
Visual Arts Branches (1.6 hours/ 2 periods)	
4.1 Brief introduction to the different branches of Visual Arts: • Painting • Sculpture • Printmaking • Applied Art and Design disciplines Heritage crafts	Students will be able to: • Expresses their interests in various Visual Arts branches and makes inquiries about visual artists CG-1, C-1.1.

Music

Chapter Outlines/Key Concepts	Learning Outcomes
Music, Me and Us (5.8 hours/7 periods)	
1.1 Active Listening (10 minutes in every class across both grades) • Listen to a selection of music across various vidhaas or genres • Discuss the key identifying features of the vidhaa or genre. 1.2 Music and personal expression Activity: Create a personal playlist of songs that are in your memory and connect them to the mood and concept of navarasa. 1.3 Exploration of themes in folk music • Examine the lyrics of folk songs to learn more about a region. • Examine the various themes described in folk music. Activity: Create a piece of music or lyric that expresses a family history, tradition, or practice. • Journal the process of writing the	Students will be able to: • Describe a musical composition using general vocabulary of Music CG-3, C-3.2. • Describe how music is an integral part of personal and collective expression. CG-1, C-1.1; CG-2, C-2.1. • Describe the emotions expressed or evoked through music. CG-2, C-2.1. • Describe the thematic content and emotions expressed in folk music. Create and sing a piece of music that expresses a family history, tradition, or practice. CG-2, C-2.1.

lyrics and setting them to music. Activity: Maintain a journal or log that records ideas, observations from listening and creation activities.	
The Science of Music (5 hours/6 periods)	
2.1 Connections between Physics and Music Revisit how concepts of physics are fundamental to music. Reference to ancient treatises Activity: Experiment with varying the length of a string to manipulate frequency. 2.2 Connections between Biology and Music • Introduce the anatomy and physiology of the human vocal system. • Activity: Breathing exercises and vocal warm-ups. 2.3 Connections between Music and Mathematics • Introduce how concepts of pattern-making and Lowest Common Multiple (LCM) are applied in Music. Activity: Recite konnakol patterns demonstrating LCM.	Students will be able to: • Describe and demonstrate how sound is produced and manipulated. CG-1, C-1.1; CG-2, C-2.1. • Describe the role of the three main subsystems involved in voice production. CG-1, C-1.1; CG-2, C-2.1. • Recognize ways to care for one's voice and demonstrate vocal warm-ups. CG-1, C-1.1; CG-2, C-2.1. • Study how rhythmic patterns are created from various syllables. CG-1, C-1.1; CG-2, C-2.1. • Demonstrate the concept of LCM in tala. CG-2, C-2.1; CG-3, C-3.1.
Ragas and Talas (9 hours/ 10.8 periods)	
3.1 Revisiting Basic Elements and Swarasthanas of Indian Classical Music 3.2 Raga classification system • Raga jaatis (audava, shadava, and sampoorana) • Basic definition of thaata and melakarta systems Activity: Identify the number of notes in a raga. 3.3 Hindustani raag — alhaiya bilaval, carnatic raga, and	Students will be able to: • Identify and demonstrate the 12 note positions. CG-1, C-1.1; CG-3, C-3.1. • Describe the concepts of raga classification system with examples. CG-3, C-3.1. • Sings the notes of one raga each from Hindustani and Carnatic Music. Sings at least two compositions in a raga of Carnatic and/or Hindustani Music. CG-3, C-3.1 • Explain and demonstrate two talas

shankarabharanam. 3.4 Two compositions each in Hindustani and Carnatic Music 3.5 Hindustani taal — teentaal, jhaptaal Carnatic taals — aadi, rupaka Activity: Write a piece of music as per the taal cycle. Reflect on the process of writing a lyric and setting it to a taal.	each of Hindustani and Carnatic Music. CG-3, C-3.1. Compare a composition before and after setting it to taal. CG-2, C-2.1, C-2.2; CG-3, C-3.1, C-3.2
Collaborations and Impact of Indian Music on other types of Music around the World (5 hours/ 6 periods)	
4.1 Music and migration - Introduction to how migration influences music - Examples of music styles that have resulted from migration (e.g., Chutney, UK Bhangra, etc.) Activity: Building a memory box of songs as an archive of family or community memory. 4.2 Families of musical instrument with similar features across the world - Lute family and Flute family Activity: Examine the similarities and differences between related instruments in terms of their structure and sound.	Students will be able to: - Discuss how migration has influenced world and Indian music. CG-4, C-4.1. - Describe the various ways in which musical instruments can be categorized CG-2, C-2.1. - Identify and group musical instruments into similar families. CG-2, C-2.1.

Theatre

Chapter Outlines/Key Concepts	Learning Outcomes
Create your theatre company, Vision logo team, Research in theatre (5 hours/ 6 periods)	
1.1 Creating a theatre company: - Team building and collaboration - Vision of the Theatre Team: Creative thinking behind the name and logo, and defining purpose and goals 1.2 Research in Theatre - Individual or Group Research Activity: Students choose a topic	Students will be able to: - Discuss the ideas and processes that interest them in Dramatic Arts. CG-1, C-1.1. - Explore the potential of theatre for a social purpose. Demonstrates empathy and sensitivity in interacting with people. CG-1, C-1.2 - Interact with peers, teachers, family

that interests them in the Dramatic Arts. They engage with concepts and tools related to researching Dramatic Arts in society. • Conduct interviews with theatre personnel. • Conduct surveys and field Visits • Visits art galleries and watch different performances (such as melas, activity or cultural centres, auditoriums, museums, etc. • Studies selected literature and apply it to the research topic.	members and artists in their community to know more about the scope of the Dramatic Arts, e.g., enquire about access and locations of auditoriums, performers, types of plays, theatre groups, festivals, etc. CG- 1, C-1.2
Lighting and sound, Basic concepts of design, Lights and sound equipment, Background music and sound effects (3.20 hours/ 4 periods)	
2.1 Introduction to importance of light and sound in theatre • Lighting equipment, such as Par-can, profile, fresnal lens, patch panel, dimmer, etc. Sound equipment like microphones, amplifiers and speakers • Their functional roles in performance environments. Basic concepts of design: Explore how lighting and sound (stage lighting, background music and sound effects) influence mood, meaning, and emotional tone within a scene.	Students will be able to: • Identify differences in approaches and techniques of scene work at each step of the process, e.g., explain how the arrangement of various elements convey different meanings and emotions. CG-2, C-2.1. • Experiment with themes and ways of presentation during large collaborative projects targeted towards creating drama. CG-2, C-2.2 • Understand and applies concepts of light, lenses, electricity and sound in theatre. Able to blend the science concepts to enhance the creative output on stage. CG-3, C-3.1
Direction and Acting, Basic techniques and responsibilities of a director, Schools of acting, Facilitating workshops (6 hours/ 7 periods)	
3.1 Introduction to styles, techniques, and values related to direction: • Visualising a scene and its techniques • Styles and approaches to direction • Schools of acting in Indian and Western traditions • Facilitating workshops	Students will be able to: • Experiment with themes and projects targeted towards large collaborative projects targeted towards creating drama. CG-2, C-2.1 • Experiment with rehearsal techniques and run-throughs. CG-2, C-2.1 • Explore one's own abilities in

• Leadership, collaboration, and taking responsibility in the production process	performance as an individual and in groups. CG-2, C-2.2 • Demonstrate familiarity with the proper use and maintenance of costumes, props, stage equipment used for drama CG-3, C-3.1 • Experiment with theatre games, skill building activities and rehearsal techniques CG-3, C-3.1
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Stage aesthetics Colours and Symbolism in theatre (2.30 hours/ 3 periods)

4.1 Symbolism: Exploring various icons, indices and symbols through scene-building activities. 4.2 Colours and meaning building: Activities include colour theories in Natyashastra, the impact of colours on stage (sets, props, and costumes and their effects) 4.3 Art appreciation: Read different literatures beyond drama, poetry and short stories. Observe various types of drama from classical, folk, modern to build opinions and share thoughts. 4.4 Connect with other art forms: Visit art galleries, museums, auditoriums to watch different performances, interview artists from different disciplines, group discussion, etc., to enhance perspective and approach towards art.	Students will be able to: • Understand abstract representation on stage. Builds simple metaphors and symbol for story concepts. CG-4, C-4.1 • Consider multiple viewpoints and interpretations while responding to diverse forms of Indian dramatic arts and cultures presents non-judgemental and contextual views with an awareness of geography and cultural diversity. CG-3, C-3.2 • Identify differences in approaches and techniques of scene work at each step of process e.g., explains how the arrangement of various elements convey different meanings and emotions. CG-2, C-2.1
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Dance and Movement

Chapter Outlines/Key Concepts	Learning Outcomes
Components of Dance (4 hours/ 5 periods)	
1.1 Body Geometry: Concepts of saushthava, rekha and roopa 1.2 Revisiting rhythms and tempos 1.3 Introduction to the four abhinayas 1.4 Dance in Cinema Activity: Watch	Students will be able to: • Describe and demonstrate body alignment (saushthava) while performing dance movements. CG-3, C-3.1

a dance sequence from a film and write an entry it 1.5 Dance Project Activity: Watch a dance performance, and write an entry analyzing your observations of the performance	• Apply basic elements, such as footwork, hand gestures, rhythm, tempo and mood in dance sequences. CG-2, C-2.1 • Describe the classifications of dance (nṛtta and nṛtya), as well as four abhinayas and their application. CG-3, C-3.1 • Identify the dance form and correlates (nṛtta and nṛtya), abhinayas, rasa, and rhythm in the performances. CG-4, C-4.2 • Examines the four abhinayas through the work of important personalities across diverse art forms. CG-4, C-4.1
Dance as Visual Storytelling (4 hours/ 5 periods)	
2.1 Abhinaya in various dance traditions 2.2 Performing abhinaya Activity: Create performative situations or phrases applying the different abhinayas.	Students will be able to: • Discuss and compare the different types of abhinaya, and incorporate these into the creative practice. CG-3, C-3.2 • Perform movement sequences with different kinds of music and narration, and compare the experiences. CG-2, C-2.2
Cultural Connections through Dance (7.30 hours/ 9 periods)	
3.1 Indian dance cultures Activity: Learn and perform the local and regional dance forms. 3.2 Career journeys of artists Activity: Carry out a podcast and interview a performer, or visit a related institution. 3.3 Comparative analysis project on dance stories in India and Southeast Asia Create and perform a short dance performance combining element of the Southeast Asian dance forms, and discuss its similarities and differences	Students will be able to: • Interact with art professionals and find what interests them in Dance. CG-1, C-1.2 • Create a dance sequence inspired by the elements of diverse Indian and global dance forms. CG-3, C-3.1, C-3.2

Dance: A Journey from Concept to Creation (5 hours/ 6 periods)	
4.1 Choreography — rhythm and tempo, distance and space • Create and perform a short choreography incorporating concepts of space, direction, rhythm, and abhinaya. 4.2 Discuss the physical, mental and emotional well-being through movement	Students will be able to: • Contribute ideas and reflect the collaborative process of dance choreographies. CG-2, C-2.2 • Creatively use space and directions in solo and group choreographies. CG-3, C-3.1

Pedagogy or Instructional Methods

Arts Education not only develops skills and craft of making and performance, but develops broader arts appreciation and creative thinking capacities. Thus, art classes foster peer learning, encourage students to express themselves freely, exchange ideas, explore techniques in their work, and develop an appreciation of the diversity of art and aesthetics in India and the world.

Experiential Learning

The NCF-SE 2023 emphasises that art must be learnt through performing or making of artwork or performances. Rather than relying merely on explanation, theoretical concepts are learnt through activities, and students must be encouraged to apply them in their artistic expression. Students may be asked to demonstrate their creations and discuss their learning and reflections in groups. Encouraged to reflect on their experiences through regular journaling.

Collaboration

Learning is encouraged through group activities and discussions with peers. Classroom discussions of concepts, artworks and performances, and student work allow them to gain exposure to a variety of perspectives and aesthetics, and to learn to appreciate and accommodate diverse perspectives.

Interdisciplinarity

Activities have been designed by keeping in mind the meaningful connections of techniques, skills, materials across art forms and other disciplines. These activities promote learners' understanding of the linkages between the visual and performing arts, as well as other disciplines, such as Languages, Social Sciences, Sciences and Physical Education.

Emphasis on Local Culture and Resources

Teachers are encouraged to make use of local resources and local cultures in their teaching. Activities may be modified based on available resources, space

and infrastructure. While it is expected that students gain exposure to art and culture from across India and the world, it is essential that they are first made familiar with the art and traditions of their region. Workshops with local artists may provide exposure to new experiences and professions within the arts.

Effective Use of Teaching Learning Materials

Teachers are encouraged to show students relevant artworks and digital material, such as videos, photographs and audio recordings, and conduct classroom discussions and allow time for reflection. Visits to museums, heritage sites, performances, melas, etc., help students learn through exposure to art accessible in their regions.

Inclusivity

Teachers must encourage the participation of and collaboration among all students, regardless of gender, ability, or social background. Students with disabilities must be given equal opportunities and access to participate in all art activities and discussions. Teachers could modify activities to make them inclusive for all students in a class and should focus on what students with disabilities can do independently or with some guidance to empower them.

Visual Arts
Discussions • Large group discussions while introducing new concepts • Small group discussions for brainstorming and project work • Individual conversations while making an artwork • Practical activities • Exercises for core skills • Regular sketching and journaling • Theme-based projects that focus on making, completing and presenting artwork • Beyond the textbook: Alternatives and adaptations of textbook activities that can achieve competencies • Exposure visits or workshops • Visits to museums, art institutions, local art centres, melas, etc. • Interactive workshops with invited artists
Music
The five aspects in Music training incorporates: • Listening: Introduces the learner to the different forms of music, styles of rendition, and skills of musicians. Provides exposure to live Music programmes or concerts through multiple media platforms. • Responding: Imbibing different styles of singing, understanding the emotional content, copying, and also creating simultaneously is an essential tenet. • Creating: Tunes, lyrics and rendering in varied styles by combining vocal and

instrumental Music is an important aspect. This collaboration has created many styles of compositions.

- Presentation Skills: The setting of a stage, rapport with the audience, technical settings and adjustments are essential.
- Understanding the linkages of music to dance, drama, language, and also the tangible objects like heritage monuments, drawings and paintings.

Theatre

Group Activities

- Teamwork and leadership skills in planning
- Creative outputs and goals to be presented

Individual work

- Exercises for core skills
- Self-analysis and focus on individual interests
- Presentations of project works and opinions
- Exploratory activities of individual possibilities

Class Activities

- Visits to performances, meeting the cast and crew backstage
- Workshops with experienced technicians and artists
- In-class work and spontaneous project presentations
- Out of class work — meeting people, interviews, surveys

Dance and Movement

Threefold Aspect of Dance Education:

1. Seekhya (Learning or Training Methods)

- Textbook instructions are to be followed by the teacher, and theory will be taught from the textbook. Thus, the written material could be taught by any art teacher.
- Lessons modules to be provided with videos on DTLM.
- The basic pedagogy will focus on imparting the basics movements aided by concepts from dance treatises.
- Students may be encouraged to apply concepts with their imagination and creativity. For example, hand gestures can be explored with the learner building their vocabulary and language using the concept of hand gestures as a tool of communication.
- Attending workshops and lecture demonstrations will also be a component of the pedagogy.

2. Dekhya (Watching, Observing)

- The students will be encouraged to attend performances by maestros, and established exponents of Indian and global dance forms.
- Observe ritual and community dances that are part of the local culture of the region.

3. Parkhya (Contemplation, Discussion, Writing)

- Students are encouraged to research, journal and foster writing on dance.

Self-review of their dance and movement, and speaking on their personal experiences through dance will be a part of the pedagogy.

Art Education
Class IX (2026-27)
Theory

Time allowed: 2:00 hours

Maximum Marks: 40

S. No.	Themes/ Concepts	Marks
A.	History of Arts	20 Marks
B.	1. Visual Arts	4 Marks
	2. Music	4 Marks
	3. Theatre	4 Marks
	4. Dance	4 Marks
C.	Analytical note on an unseen image from the viewpoint of all art forms.(Integrated)	4 Marks

Practical
Visual Arts

Time allowed: 3 hours

Maximum Marks: 60

A.	External Assessment	40 Marks
1.	Composition layout	10 Marks
2.	Handling of colour	10 Marks
3.	Colour value/ hatching- cross hatching	5 Marks
4.	Overall	5 Marks
5.	Viva	10 Marks
B.	Internal Assessment	20 Marks
	• School event (Participation of student throughout the academic session)	5 Marks
	• Project report	5 Marks
	• Formative assessment (Average of Two best throughout the academic session)	10 Marks

Music

Time allowed: 10 minutes per student

Maximum Marks: 60

A.	External Assessment	40 Marks
1.	Presentation of the choice Raga of the candidate.	10 Marks
2.	Presentation of a composition in a classical/ tribal/ folk/ contemporary genre etc.	5 Marks
3.	Tala on presentation on hand demonstrating beats and matras and their relation with mathematical calculations.	5 Marks

4.	Overall performance	10 Marks
5.	Viva choice (Related to the knowledge of Rags, Talas, Forms or genre/ instruments in terms of sound and their structure.	10 Marks
B.	Internal Assessment	20 Marks
	School event (Participation of student throughout the academic session)	5 Marks
	Project report	5 Marks
	Formative assessment (Average of Two best throughout the academic session)	10 Marks

Theatre

Time allowed: 10 minutes per student

Maximum Marks: 60

A.	External Assessment	40 Marks
1.	Technique (voice, body language, expression)	10 Marks
2.	Concept/ idea/ story	5 Marks
3.	Confidence and creativity	5 Marks
4.	Application of concept learnt from the book	10 Marks
5.	Viva	10 Marks
B.	Internal Assessment	20 Marks
	School event (Participation of student throughout the academic session)	5 Marks
	Project report	5 Marks
	Formative assessment (Average of Two best throughout the academic session)	10 Marks

Dance

Time allowed: 10 minutes per student

Maximum Marks: 60

A.	External Assessment	40 Marks
1.	Presentation of Abhinaya	10 Marks
2.	Application of basic dance elements (Hand Movements, Body Movement, Foot Movement.) Based on the classical beats	5 Marks
3.	Performance of different rhythm and tempos.	5 Marks

4.	Presentation of any classical/ tribal/ folk/ contemporary gene etc.	10 Marks
5.	Viva (Related to the knowledge of hand movement, Pad Sanchalan, Abhinaya in different types of dance)	10 Marks
B.	Internal Assessment	20 Marks
	• School event (Participation of student throughout the academic session)	5 Marks
	• Project report	5 Marks
	• Formative assessment (Average of Two best throughout the academic session)	10 Marks

Note: The Theory paper will carry 40 marks and the Practical paper will carry 60 marks. The Practical marks will be calculated as the average of all four sections, i.e., Visual Arts, Music, Theatre, and Dance.

ART EDUCATION CLASS IX (2026-27)

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NEP 2020 helps students to utilize various aspects and forms of art and culture as the basis for learning concepts across subjects. A part of the thrust on experiential learning, art-integrated education, embedded in classroom transactions, not only creates joyful learning but also helps in imbibing the Indian ethos through the knowledge of Indian art and culture.

Art in School Education addresses the Goals and Competencies for every student to find diverse ways of persisting and solving problems. We not only create an artwork, but also enjoy the experience of viewing and responding to many forms of cultural expression. When they create artwork together and work collaboratively, they recognize one another's strengths and develop deeper connections with the world around them. Such a process nurtures empathy, appreciation, cooperation, and trust, all of which are fundamental for developing social and human values, such as ahimsa, love, compassion, friendship, and peaceful co-existence. As a common language, the Arts bring people together and lead them to develop acceptance, understanding, and mutual respect

Art classes involve three important processes—making artwork, thinking creatively in the Arts, and appreciating all forms of artistic expression down the ages. This immersive experience of producing art improves cognition, leaving a positive and long-lasting impact on the development of aesthetic sensibilities, expression, imagination, observation, crafting skills, creativity, and students' overall confidence in their own abilities.

Aims

Through Art students should be able to connect with their culture and appreciate the diversity of artistic expressions. For an effective Art Education programme, schools must aim to achieve:

- a. Joy in exploring and creating artwork:** This would mean gaining a variety of aesthetic experiences and deriving joy from all forms of art.
- b. Imagination and creativity:** Acquiring and applying creative thinking and artistic capacities through experimentation and sustained practice in the Arts is at the heart of Art Education.
- c. Empathy and sensitivity:** Meaningful experience in the Arts has great potential to nurture empathy and sensitivity towards the expressions of others.
- d. Understanding of connections with other disciplines:** The Arts teaches

appreciation of beauty in nature and the observation of details and patterns. This approach to the understanding of disciplines makes for aesthetic experiences in themselves.

- e. **Sense of belonging:** Through artistic engagement, students will find connections to their own culture and traditions, as well as learn an appreciation for India's multicultural diversity and knowledge of contemporary artists and art practices.
- f. **Development of Aesthetic Sensibilities:** Students should be able to describe the characteristics of things they find beautiful, do subjective interpretations, assess the aesthetic qualities of artwork based on the commonly accepted criteria in the Arts and expand their 'tastes' by participating in art processes.

Approach to learning different Arts Forms for Practice and Theory

Arts Education emphasizes the process over the product. The NCF-SE 2023 mentions three processes that are integral to the Arts:

- **Thinking Processes** refer to a wide range of cognitive activities in the Arts. It includes generating ideas, understanding the elements of art, inquiring into artistic processes, interpreting artwork, and connecting the Arts with other knowledge and experiences.
- **Making Processes** relate to the execution and production of work, utilizing the active engagement of mind and body to express ideas and emotions. This involves using a variety of creative tools, instruments, materials and techniques.
- **Appreciation Processes** include exposure to and awareness of diverse art forms and cultural practices. This process involves responding to artworks, discussing, describing and assessing aesthetic experiences; considering their social and historical contexts, and developing multiple perspectives along with respect for diverse opinions.

Visual Arts
• Visual Arts learning builds upon the student's knowledge of the elements of art and the principles of design. Through regular practice in creating compositions and other artworks, fundamental concepts, such as perspective, proportion, balance, focus, rhythm and harmony guide students in effectively expressing their ideas and expressions. • An introduction to art history and basic theories, such as Śaḍāṅga described in ancient treatises like the Citrasūtra, helps students to appreciate the aesthetically rich and continuous heritage of the Indian art traditions. • Exploration and experimentation with materials, tools and techniques also create opportunities for interdisciplinary linkages.

Music
• Music education includes singing diverse compositions across classical, folk, tribal and contemporary genres, enabling students to experience the richness of India's musical traditions. Students will explore ragas, rhythm patterns and instruments, study the historical evolution of music and its theoretical treatises, and understand how Indian music has gained global recognition through renowned musicians.
Theatre
• Theatre builds on the basic aspects of voice, body language and expression, along with costume, make-up and other backstage elements learned in earlier stages. • In practice, students explore the basics of direction, lighting and sound, and how these elements shape a scene's emotion and meaning. They experiment with abstract representation, where a single object or gesture can symbolise a broader idea. Through theoretical study, students will learn how theatre developed from the pre-Nāṭyaśāstra period to modern theatre, which uses design, technology, and realistic storytelling techniques. This integration of practice and theory enables learners to think both as artists and storytellers - understanding how every elements, such as light, sound and movement, can express an idea and create an experience that connects people across time.
Dance and Movement
• Dance and movement will be learnt through the application of concepts rooted in texts. Teachers are encouraged to ground instruction in regional dance practices, while also introducing students to dance forms from other regions. Various dance practices, major and other traditions will be learnt with emphasis on stylised body movements, emotional expression and the creative use of hand gestures. They are also introduced to analyse and journal the historical development of dance, taking cultural and geographical contexts into account. The interrelation between dance and other art forms is emphasised, and students are encouraged to integrate interdisciplinary concepts in their creative explorations.

Themes/ Concepts and Learning Outcomes (Suggestive Instructional Hours)

History of Arts (Common Chapter for all four Arts forms)

(30 hours)

Chapter Outlines/Key Concepts	Learning Outcomes
Common History chapter bringing together all art forms • Time period covers the prehistoric period to the late 11th century CE. • Tangible and intangible cultural heritage • Storytelling traditions from across India • Chronology of important milestones across all art forms • Ancient texts and literary sources that have guided Indian Arts Traditions • Geographical, socio-cultural and political influences on art practices • Art from around the world that shows parallel development and cross- cultural influences • Continuity of historical art traditions and connections with present times	• Students will be able to: Interact with peers, teachers, family members, and artists in their community to know more about Arts practices CG-1, C-1.2. • Create artwork, i.e., inspired by the ideas and processes from art history CG-1, C-1.2. • Identify and discuss the evolution of materials, processes & techniques used in various art forms CG- 3, C- 3.2. • Trace the historical development of visual arts, theatre, music and dance with examples CG-4, C- 4.1. • Identify the continuing ideas, practices, and art traditions mentioned in ancient Indian texts and treatises. CG-4, C- 4.1. • Discuss and correlate the geographic, social and cultural linkages across art forms that share a common time period. CG-4, C- 4.1. • Explain why they find an artwork or performance relevant to their interests, experience, and present social context. CG-4, C- 4.2.

Visual Arts

Chapter Outlines/Key Concepts	Learning Outcomes
Visual Arts Fundamentals (4 hours / 5 periods)	
1.1 Introductory discussion Prior knowledge, and learning and experiences in visual arts	Students will be able to: • Journal their interests, observations and experiences through visuals

experiences. 1.2 Visual Journal • Journaling through drawing and collage • Journaling related to other art forms. 1.3 Elements of Visual Arts 1.4 Principles of Visual Design 1.5 Sketching basics	and notes CG-1, C-1.1. • Practice basic Visual Arts processes regularly (e.g., Student spends 10 – 15 minutes every day to create drawing from observation) CG-2, C-2.1.
Exploration of Materials and Methods (7.5 hours/ 9 periods)	
2.1 Introduction to common materials, mediums and tools in Visual Arts 2.2 Proper use, maintenance, and storage of materials and tools 2.3 Explore sculptural and hand-crafting traditions in India. • Gather information & write about one Indian handcrafting tradition • Create a three-dimensional artwork using its technique, e.g., relief in clay, bamboo crafts, fabric toys, papier-mâché, jute or fibre crafts, etc. 2.4 Colour Theory Exercises • Colour wheel in different mediums • Colour tints, shades and tones • Complementary and Analogous colours 2.5 Perspective • Linear perspective • Aerial perspective • Create an artwork using linear and aerial perspective	Students will be able to: • Demonstrate familiarity with the use and maintenance of materials and tools used in Visual Arts CG-3, C-3.1. • Practice colour exercises using a variety of materials and mediums CG-3, C-3.1. • Apply perspective techniques to show spatial depth in their artwork CG-3, C-3.1. • Create a three-dimensional artwork using a hand-crafting technique from any part of India e.g., relief in clay, bamboo crafts, fabric toys, papier-mâché, jute or fibre crafts, etc. CG-3, C-3.2.
Creative Composition (5 hours/ 6 periods)	
3.1 Introduction to Composition • Realistic and Abstract representations • Compositional Layout • Importance of iterations 3.2 Create a 2D Composition (two	Students will be able to: • Create multiple iterations in process of developing their ideas and making artworks CG-3, C-3.1. • Compare multiple iterations of one's

options) • Create a four-part graphic story or comic strip (in colour) • Thematic painting or collage (choice of genres and themes can vary, such as still life, portrait, landscape, people in indoor or outdoor settings, imaginary composition)	artwork to explain how the arrangement of visual elements conveys different meanings and emotions CG-2, C-2.2.
Visual Arts Branches (1.6 hours/ 2 periods)	
4.1 Brief introduction to the different branches of Visual Arts: • Painting • Sculpture • Printmaking • Applied Art and Design disciplines Heritage crafts	Students will be able to: • Expresses their interests in various Visual Arts branches and makes inquiries about visual artists CG-1, C-1.1.

Music

Chapter Outlines/Key Concepts	Learning Outcomes
Music, Me and Us (5.8 hours/7 periods)	
1.1 Active Listening (10 minutes in every class across both grades) • Listen to a selection of music across various vidhaas or genres • Discuss the key identifying features of the vidhaa or genre. 1.2 Music and personal expression Activity: Create a personal playlist of songs that are in your memory and connect them to the mood and concept of navarasa. 1.3 Exploration of themes in folk music • Examine the lyrics of folk songs to learn more about a region. • Examine the various themes described in folk music. Activity: Create a piece of music or lyric that expresses a family history, tradition, or practice. • Journal the process of writing the	Students will be able to: • Describe a musical composition using general vocabulary of Music CG-3, C-3.2. • Describe how music is an integral part of personal and collective expression. CG-1, C-1.1; CG-2, C-2.1. • Describe the emotions expressed or evoked through music. CG-2, C-2.1. • Describe the thematic content and emotions expressed in folk music. Create and sing a piece of music that expresses a family history, tradition, or practice. CG-2, C-2.1.

lyrics and setting them to music. Activity: Maintain a journal or log that records ideas, observations from listening and creation activities.	
The Science of Music (5 hours/6 periods)	
2.1 Connections between Physics and Music Revisit how concepts of physics are fundamental to music. Reference to ancient treatises Activity: Experiment with varying the length of a string to manipulate frequency. 2.2 Connections between Biology and Music • Introduce the anatomy and physiology of the human vocal system. • Activity: Breathing exercises and vocal warm-ups. 2.3 Connections between Music and Mathematics • Introduce how concepts of pattern-making and Lowest Common Multiple (LCM) are applied in Music. Activity: Recite konnakol patterns demonstrating LCM.	Students will be able to: • Describe and demonstrate how sound is produced and manipulated. CG-1, C-1.1; CG-2, C-2.1. • Describe the role of the three main subsystems involved in voice production. CG-1, C-1.1; CG-2, C-2.1. • Recognize ways to care for one's voice and demonstrate vocal warm-ups. CG-1, C-1.1; CG-2, C-2.1. • Study how rhythmic patterns are created from various syllables. CG-1, C-1.1; CG-2, C-2.1. • Demonstrate the concept of LCM in tala. CG-2, C-2.1; CG-3, C-3.1.
Ragas and Talas (9 hours/ 10.8 periods)	
3.1 Revisiting Basic Elements and Swarasthanas of Indian Classical Music 3.2 Raga classification system • Raga jaatis (audava, shadava, and sampoorana) • Basic definition of thaata and melakarta systems Activity: Identify the number of notes in a raga. 3.3 Hindustani raag — alhaiya bilaval, carnatic raga, and	Students will be able to: • Identify and demonstrate the 12 note positions. CG-1, C-1.1; CG-3, C-3.1. • Describe the concepts of raga classification system with examples. CG-3, C-3.1. • Sings the notes of one raga each from Hindustani and Carnatic Music. Sings at least two compositions in a raga of Carnatic and/or Hindustani Music. CG-3, C-3.1 • Explain and demonstrate two talas

shankarabharanam. 3.4 Two compositions each in Hindustani and Carnatic Music 3.5 Hindustani taal — teentaal, jhaptaal Carnatic taals — aadi, rupaka Activity: Write a piece of music as per the taal cycle. Reflect on the process of writing a lyric and setting it to a taal.	each of Hindustani and Carnatic Music. CG-3, C-3.1. Compare a composition before and after setting it to taal. CG-2, C-2.1, C-2.2; CG-3, C-3.1, C-3.2
Collaborations and Impact of Indian Music on other types of Music around the World (5 hours/ 6 periods)	
4.1 Music and migration - Introduction to how migration influences music - Examples of music styles that have resulted from migration (e.g., Chutney, UK Bhangra, etc.) Activity: Building a memory box of songs as an archive of family or community memory. 4.2 Families of musical instrument with similar features across the world - Lute family and Flute family Activity: Examine the similarities and differences between related instruments in terms of their structure and sound.	Students will be able to: - Discuss how migration has influenced world and Indian music. CG-4, C-4.1. - Describe the various ways in which musical instruments can be categorized CG-2, C-2.1. - Identify and group musical instruments into similar families. CG-2, C-2.1.

Theatre

Chapter Outlines/Key Concepts	Learning Outcomes
Create your theatre company, Vision logo team, Research in theatre (5 hours/ 6 periods)	
1.1 Creating a theatre company: - Team building and collaboration - Vision of the Theatre Team: Creative thinking behind the name and logo, and defining purpose and goals 1.2 Research in Theatre - Individual or Group Research Activity: Students choose a topic	Students will be able to: - Discuss the ideas and processes that interest them in Dramatic Arts. CG-1, C-1.1. - Explore the potential of theatre for a social purpose. Demonstrates empathy and sensitivity in interacting with people. CG-1, C-1.2 - Interact with peers, teachers, family

that interests them in the Dramatic Arts. They engage with concepts and tools related to researching Dramatic Arts in society. • Conduct interviews with theatre personnel. • Conduct surveys and field Visits • Visits art galleries and watch different performances (such as melas, activity or cultural centres, auditoriums, museums, etc. • Studies selected literature and apply it to the research topic.	members and artists in their community to know more about the scope of the Dramatic Arts, e.g., enquire about access and locations of auditoriums, performers, types of plays, theatre groups, festivals, etc. CG- 1, C-1.2
Lighting and sound, Basic concepts of design, Lights and sound equipment, Background music and sound effects (3.20 hours/ 4 periods)	
2.1 Introduction to importance of light and sound in theatre • Lighting equipment, such as Par-can, profile, fresnal lens, patch panel, dimmer, etc. Sound equipment like microphones, amplifiers and speakers • Their functional roles in performance environments. Basic concepts of design: Explore how lighting and sound (stage lighting, background music and sound effects) influence mood, meaning, and emotional tone within a scene.	Students will be able to: • Identify differences in approaches and techniques of scene work at each step of the process, e.g., explain how the arrangement of various elements convey different meanings and emotions. CG-2, C-2.1. • Experiment with themes and ways of presentation during large collaborative projects targeted towards creating drama. CG-2, C-2.2 • Understand and applies concepts of light, lenses, electricity and sound in theatre. Able to blend the science concepts to enhance the creative output on stage. CG-3, C-3.1
Direction and Acting, Basic techniques and responsibilities of a director, Schools of acting, Facilitating workshops (6 hours/ 7 periods)	
3.1 Introduction to styles, techniques, and values related to direction: • Visualising a scene and its techniques • Styles and approaches to direction • Schools of acting in Indian and Western traditions • Facilitating workshops	Students will be able to: • Experiment with themes and projects targeted towards large collaborative projects targeted towards creating drama. CG-2, C-2.1 • Experiment with rehearsal techniques and run-throughs. CG-2, C-2.1 • Explore one's own abilities in

Leadership, collaboration, and taking responsibility in the production process	performance as an individual and in groups. CG-2, C-2.2 - Demonstrate familiarity with the proper use and maintenance of costumes, props, stage equipment used for drama CG-3, C-3.1 - Experiment with theatre games, skill building activities and rehearsal techniques CG-3, C-3.1
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Stage aesthetics Colours and Symbolism in theatre (2.30 hours/ 3 periods)

4.1 Symbolism: Exploring various icons, indices and symbols through scene-building activities. 4.2 Colours and meaning building: Activities include colour theories in Natyashastra, the impact of colours on stage (sets, props, and costumes and their effects) 4.3 Art appreciation: Read different literatures beyond drama, poetry and short stories. Observe various types of drama from classical, folk, modern to build opinions and share thoughts. 4.4 Connect with other art forms: Visit art galleries, museums, auditoriums to watch different performances, interview artists from different disciplines, group discussion, etc., to enhance perspective and approach towards art.	Students will be able to: - Understand abstract representation on stage. Builds simple metaphors and symbol for story concepts. CG-4, C-4.1 - Consider multiple viewpoints and interpretations while responding to diverse forms of Indian dramatic arts and cultures presents non-judgemental and contextual views with an awareness of geography and cultural diversity. CG-3, C-3.2 - Identify differences in approaches and techniques of scene work at each step of process e.g., explains how the arrangement of various elements convey different meanings and emotions. CG-2, C-2.1
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Dance and Movement

Chapter Outlines/Key Concepts	Learning Outcomes
Components of Dance (4 hours/ 5 periods)	
1.1 Body Geometry: Concepts of saushthava, rekha and roopa 1.2 Revisiting rhythms and tempos 1.3 Introduction to the four abhinayas 1.4 Dance in Cinema Activity: Watch	Students will be able to: Describe and demonstrate body alignment (saushthava) while performing dance movements. CG-3, C-3.1

a dance sequence from a film and write an entry it 1.5 Dance Project Activity: Watch a dance performance, and write an entry analyzing your observations of the performance	• Apply basic elements, such as footwork, hand gestures, rhythm, tempo and mood in dance sequences. CG-2, C-2.1 • Describe the classifications of dance (nṛtta and nṛtya), as well as four abhinayas and their application. CG-3, C-3.1 • Identify the dance form and correlates (nṛtta and nṛtya), abhinayas, rasa, and rhythm in the performances. CG-4, C-4.2 • Examines the four abhinayas through the work of important personalities across diverse art forms. CG-4, C-4.1
Dance as Visual Storytelling (4 hours/ 5 periods)	
2.1 Abhinaya in various dance traditions 2.2 Performing abhinaya Activity: Create performative situations or phrases applying the different abhinayas.	Students will be able to: • Discuss and compare the different types of abhinaya, and incorporate these into the creative practice. CG-3, C-3.2 • Perform movement sequences with different kinds of music and narration, and compare the experiences. CG-2, C-2.2
Cultural Connections through Dance (7.30 hours/ 9 periods)	
3.1 Indian dance cultures Activity: Learn and perform the local and regional dance forms. 3.2 Career journeys of artists Activity: Carry out a podcast and interview a performer, or visit a related institution. 3.3 Comparative analysis project on dance stories in India and Southeast Asia Create and perform a short dance performance combining element of the Southeast Asian dance forms, and discuss its similarities and differences	Students will be able to: • Interact with art professionals and find what interests them in Dance. CG-1, C-1.2 • Create a dance sequence inspired by the elements of diverse Indian and global dance forms. CG-3, C-3.1, C-3.2

Dance: A Journey from Concept to Creation (5 hours/ 6 periods)	
4.1 Choreography — rhythm and tempo, distance and space • Create and perform a short choreography incorporating concepts of space, direction, rhythm, and abhinaya. 4.2 Discuss the physical, mental and emotional well-being through movement	Students will be able to: • Contribute ideas and reflect the collaborative process of dance choreographies. CG-2, C-2.2 • Creatively use space and directions in solo and group choreographies. CG-3, C-3.1

Pedagogy or Instructional Methods

Arts Education not only develops skills and craft of making and performance, but develops broader arts appreciation and creative thinking capacities. Thus, art classes foster peer learning, encourage students to express themselves freely, exchange ideas, explore techniques in their work, and develop an appreciation of the diversity of art and aesthetics in India and the world.

Experiential Learning

The NCF-SE 2023 emphasises that art must be learnt through performing or making of artwork or performances. Rather than relying merely on explanation, theoretical concepts are learnt through activities, and students must be encouraged to apply them in their artistic expression. Students may be asked to demonstrate their creations and discuss their learning and reflections in groups. Encouraged to reflect on their experiences through regular journaling.

Collaboration

Learning is encouraged through group activities and discussions with peers. Classroom discussions of concepts, artworks and performances, and student work allow them to gain exposure to a variety of perspectives and aesthetics, and to learn to appreciate and accommodate diverse perspectives.

Interdisciplinarity

Activities have been designed by keeping in mind the meaningful connections of techniques, skills, materials across art forms and other disciplines. These activities promote learners' understanding of the linkages between the visual and performing arts, as well as other disciplines, such as Languages, Social Sciences, Sciences and Physical Education.

Emphasis on Local Culture and Resources

Teachers are encouraged to make use of local resources and local cultures in their teaching. Activities may be modified based on available resources, space

and infrastructure. While it is expected that students gain exposure to art and culture from across India and the world, it is essential that they are first made familiar with the art and traditions of their region. Workshops with local artists may provide exposure to new experiences and professions within the arts.

Effective Use of Teaching Learning Materials

Teachers are encouraged to show students relevant artworks and digital material, such as videos, photographs and audio recordings, and conduct classroom discussions and allow time for reflection. Visits to museums, heritage sites, performances, melas, etc., help students learn through exposure to art accessible in their regions.

Inclusivity

Teachers must encourage the participation of and collaboration among all students, regardless of gender, ability, or social background. Students with disabilities must be given equal opportunities and access to participate in all art activities and discussions. Teachers could modify activities to make them inclusive for all students in a class and should focus on what students with disabilities can do independently or with some guidance to empower them.

Visual Arts
Discussions • Large group discussions while introducing new concepts • Small group discussions for brainstorming and project work • Individual conversations while making an artwork • Practical activities • Exercises for core skills • Regular sketching and journaling • Theme-based projects that focus on making, completing and presenting artwork • Beyond the textbook: Alternatives and adaptations of textbook activities that can achieve competencies • Exposure visits or workshops • Visits to museums, art institutions, local art centres, melas, etc. • Interactive workshops with invited artists
Music
The five aspects in Music training incorporates: • Listening: Introduces the learner to the different forms of music, styles of rendition, and skills of musicians. Provides exposure to live Music programmes or concerts through multiple media platforms. • Responding: Imbibing different styles of singing, understanding the emotional content, copying, and also creating simultaneously is an essential tenet. • Creating: Tunes, lyrics and rendering in varied styles by combining vocal and

instrumental Music is an important aspect. This collaboration has created many styles of compositions.

- Presentation Skills: The setting of a stage, rapport with the audience, technical settings and adjustments are essential.
- Understanding the linkages of music to dance, drama, language, and also the tangible objects like heritage monuments, drawings and paintings.

Theatre

Group Activities

- Teamwork and leadership skills in planning
- Creative outputs and goals to be presented

Individual work

- Exercises for core skills
- Self-analysis and focus on individual interests
- Presentations of project works and opinions
- Exploratory activities of individual possibilities

Class Activities

- Visits to performances, meeting the cast and crew backstage
- Workshops with experienced technicians and artists
- In-class work and spontaneous project presentations
- Out of class work — meeting people, interviews, surveys

Dance and Movement

Threefold Aspect of Dance Education:

1. Seekhya (Learning or Training Methods)

- Textbook instructions are to be followed by the teacher, and theory will be taught from the textbook. Thus, the written material could be taught by any art teacher.
- Lessons modules to be provided with videos on DTLM.
- The basic pedagogy will focus on imparting the basics movements aided by concepts from dance treatises.
- Students may be encouraged to apply concepts with their imagination and creativity. For example, hand gestures can be explored with the learner building their vocabulary and language using the concept of hand gestures as a tool of communication.
- Attending workshops and lecture demonstrations will also be a component of the pedagogy.

2. Dekhya (Watching, Observing)

- The students will be encouraged to attend performances by maestros, and established exponents of Indian and global dance forms.
- Observe ritual and community dances that are part of the local culture of the region.

3. Parkhya (Contemplation, Discussion, Writing)

- Students are encouraged to research, journal and foster writing on dance.

Self-review of their dance and movement, and speaking on their personal experiences through dance will be a part of the pedagogy.

Art Education
Class IX (2026-27)
Theory

Time allowed: 2:00 hours

Maximum Marks: 40

S. No.	Themes/ Concepts	Marks
A.	History of Arts	20 Marks
B.	1. Visual Arts	4 Marks
	2. Music	4 Marks
	3. Theatre	4 Marks
	4. Dance	4 Marks
C.	Analytical note on an unseen image from the viewpoint of all art forms.(Integrated)	4 Marks

Practical
Visual Arts

Time allowed: 3 hours

Maximum Marks: 60

A.	External Assessment	40 Marks
1.	Composition layout	10 Marks
2.	Handling of colour	10 Marks
3.	Colour value/ hatching- cross hatching	5 Marks
4.	Overall	5 Marks
5.	Viva	10 Marks
B.	Internal Assessment	20 Marks
	• School event (Participation of student throughout the academic session)	5 Marks
	• Project report	5 Marks
	• Formative assessment (Average of Two best throughout the academic session)	10 Marks

Music

Time allowed: 10 minutes per student

Maximum Marks: 60

A.	External Assessment	40 Marks
1.	Presentation of the choice Raga of the candidate.	10 Marks
2.	Presentation of a composition in a classical/ tribal/ folk/ contemporary genre etc.	5 Marks
3.	Tala on presentation on hand demonstrating beats and matras and their relation with mathematical calculations.	5 Marks

4.	Overall performance	10 Marks
5.	Viva choice (Related to the knowledge of Rags, Talas, Forms or genre/ instruments in terms of sound and their structure.	10 Marks
B.	Internal Assessment	20 Marks
	School event (Participation of student throughout the academic session)	5 Marks
	Project report	5 Marks
	Formative assessment (Average of Two best throughout the academic session)	10 Marks

Theatre

Time allowed: 10 minutes per student

Maximum Marks: 60

A.	External Assessment	40 Marks
1.	Technique (voice, body language, expression)	10 Marks
2.	Concept/ idea/ story	5 Marks
3.	Confidence and creativity	5 Marks
4.	Application of concept learnt from the book	10 Marks
5.	Viva	10 Marks
B.	Internal Assessment	20 Marks
	School event (Participation of student throughout the academic session)	5 Marks
	Project report	5 Marks
	Formative assessment (Average of Two best throughout the academic session)	10 Marks

Dance

Time allowed: 10 minutes per student

Maximum Marks: 60

A.	External Assessment	40 Marks
1.	Presentation of Abhinaya	10 Marks
2.	Application of basic dance elements (Hand Movements, Body Movement, Foot Movement.) Based on the classical beats	5 Marks
3.	Performance of different rhythm and tempos.	5 Marks

4.	Presentation of any classical/ tribal/ folk/ contemporary gene etc.	10 Marks
5.	Viva (Related to the knowledge of hand movement, Pad Sanchalan, Abhinaya in different types of dance)	10 Marks
B.	Internal Assessment	20 Marks
	• School event (Participation of student throughout the academic session)	5 Marks
	• Project report	5 Marks
	• Formative assessment (Average of Two best throughout the academic session)	10 Marks

Note: The Theory paper will carry 40 marks and the Practical paper will carry 60 marks. The Practical marks will be calculated as the average of all four sections, i.e., Visual Arts, Music, Theatre, and Dance.



SECONDARY SCHOOL CURRICULUM PART-I (CLASSES IX-X) 2026-27



CENTRAL BOARD OF SECONDARY EDUCATION

ACADEMIC UNIT, INTEGRATED OFFICE COMPLEX,
SECTOR 23, PHASE-I, DWARKA, NEW DELHI

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a ¹**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the² [unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

1. Subs, by the Constitution (Forty-Second Amendment) Act, 1976, sec. 2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs, by the Constitution (Forty-Second Amendment) Act, 1976, sec. 2, for "unity of the Nation" (w.e.f. 3.1.1977)

THE CONSTITUTION OF INDIA

Chapter IV A

FUNDAMENTAL DUTIES

ARTICLE 51A

Fundamental Duties - It shall be the duty of every citizen of India-

- (a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;
- (b) to cherish and follow the noble ideals which inspired our national struggle for freedom;
- (c) to uphold and protect the sovereignty, unity and integrity of India;
- (d) to defend the country and render national service when called upon to do so;
- (e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;
- (f) to value and preserve the rich heritage of our composite culture;
- (g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;
- (h) to develop the scientific temper, humanism and the spirit of inquiry and reform;
- (i) to safeguard public property and to abjure violence;
- (j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;
- ¹(k) who is a parent or guardian to provide opportunities for education to his/her child or, as the case may be, ward between age of six and fourteen years.

1. Ins. by the constitution (Eighty - Sixth Amendment) Act, 2002 S.4 (w.e.f. 12.12.2002)

भारत का संविधान

1

उद्देशिका

हम, भारत के लोग, भारत को एक सम्पूर्ण 'प्रभुत्व-संपन्न समाजवादी पंथनिरपेक्ष लोकतंत्रात्मक गणराज्य बनाने के लिए, तथा उसके समस्त नागरिकों को:

सामाजिक, आर्थिक और राजनैतिक न्याय,
विचार, अभिव्यक्ति, विश्वास, धर्म

और उपासना की स्वतंत्रता,
प्रतिष्ठा और अवसर की समता

प्राप्त कराने के लिए²
तथा उन सब में व्यक्ति की गरिमा

²और राष्ट्र की एकता और अखंडता
सुनिश्चित करने वाली बंधुता बढ़ाने के लिए

दृढ़संकल्प होकर अपनी इस संविधान सभा में आज तारीख 26 नवम्बर, 1949 ई० को एतद्वारा इस संविधान को अंगीकृत, अधिनियमित और आत्मार्पित करते हैं।

1. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 की धारा 2 द्वारा (3.1.1977) से "प्रभुत्व-संपन्न लोकतंत्रात्मक गणराज्य" के स्थान पर प्रतिस्थापित।
2. संविधान (बयालीसवां संशोधन) अधिनियम, 1976 की धारा 2 द्वारा (3.1.1977) से "राष्ट्र की एकता" के स्थान पर प्रतिस्थापित।

भाग 4 क

मूल कर्तव्य

51 क. मूल कर्तव्य - भारत के प्रत्येक नागरिक का यह कर्तव्य होगा कि वह -

- (क) संविधान का पालन करे और उसके आदर्शों, संस्थाओं, राष्ट्रध्वज और राष्ट्रगान का आदर करे;
- (ख) स्वतंत्रता के लिए हमारे राष्ट्रीय आंदोलन को प्रेरित करने वाले उच्च आदर्शों को हृदय में संजोए रखे और उनका पालन करे;
- (ग) भारत की प्रभुता, एकता और अखंडता की रक्षा करे और उसे अक्षुण्ण रखे;
- (घ) देश की रक्षा करे और आह्वान किए जाने पर राष्ट्र की सेवा करे;
- (ङ) भारत के सभी लोगों में समरसता और समान भ्रातृत्व की भावना का निर्माण करे जो धर्म, भाषा और प्रदेश या वर्ग पर आधारित सभी भेदभाव से परे हों, ऐसी प्रथाओं का त्याग करे जो स्त्रियों के सम्मान के विरुद्ध हैं;
- (च) हमारी सामासिक संस्कृति की गौरवशाली परंपरा का महत्त्व समझे और उसका परिरक्षण करे;
- (छ) प्राकृतिक पर्यावरण की जिसके अंतर्गत वन, झील, नदी, और वन्य जीव हैं, रक्षा करे और उसका संवर्धन करे तथा प्राणी मात्र के प्रति दयाभाव रखे;
- (ज) वैज्ञानिक दृष्टिकोण, मानववाद और ज्ञानार्जन तथा सुधार की भावना का विकास करे;
- (झ) सार्वजनिक संपत्ति को सुरक्षित रखे और हिंसा से दूर रहे;
- (ञ) व्यक्तिगत और सामूहिक गतिविधियों के सभी क्षेत्रों में उत्कर्ष की ओर बढ़ने का सतत प्रयास करे जिससे राष्ट्र निरंतर बढ़ते हुए प्रयत्न और उपलब्धि की नई उंचाइयों को छू ले;
- ¹(ट) यदि माता-पिता या संरक्षक हैं, छह वर्ष से चौदह वर्ष तक की आयु वाले अपने, यथास्थिति, बालक या प्रतिपाल्य के लिये शिक्षा के अवसर प्रदान करे।

1. संविधान (छयासीवां संशोधन) अधिनियम, 2002 की धारा 4 द्वारा प्रतिस्थापित।

1.1 CBSE Curriculum

CBSE curriculum reflects the nation's shared vision of education rooted in the Constitution of India and aligned with the aspirations of the National Education Policy (NEP) 2020. The National Curriculum Framework for School Education (NCFSE) 2023 has been developed as a foundational document for realising the vision of NEP 2020 in school education. As articulated in the NCFSE 2023, curriculum encompasses the entirety of students' organised experiences in school including goals, content, pedagogy, assessment, school culture, and learning environment.

In alignment with this national framework, CBSE has adopted the principles, stage design, Learning Standards, and assessment approach articulated therein. It is being implemented in a phased and systematic manner across classes and domains. In this perspective, curriculum is a coherent and integrated design that aligns with the:

- Aims of Education
- Learning Outcomes
- Assessment Practices
- Curricular Goals & Competencies
- Pedagogical Approaches
- School Culture & Processes

CBSE Secondary School Curriculum, therefore, seeks to operationalise the vision of NEP 2020 through the structured guidance of NCFSE 2023, aiming to develop learners who are rational, ethical, creative, compassionate, aware of their Indian roots, and prepared for democratic, cultural, and economic participation in a rapidly changing world.

The curriculum is guided by clearly defined Learning Standards, ensuring a meaningful flow from broad educational aims to measurable competencies and learning outcomes, thereby strengthening coherence between teaching, learning, and assessment.

1.2 Salient Features of the CBSE Secondary School Curriculum

In consonance with the principles and stage-specific expectations of NCFSE 2023 and as part of its phased implementation roadmap, the CBSE Secondary School Curriculum indicates CBSE's roadmap for NCFSE implementation and strives to:

01 Promote Holistic Development

Foster intellectual, physical, socio-emotional, ethical, and aesthetic growth, ensuring mind-body well-being and balanced holistic development.

02 Align with Learning Standards and Competency-Based Education

Structure curriculum around clearly defined Curricular Aims, Goals, Competencies, and Learning Outcomes.

03 Encourage Conceptual Understanding

Reduce content load to core essentials and enable deeper disciplinary understanding through inquiry, discussion, and application.

04 Adopt Effective and Engaging Pedagogy

Promote experiential, inquiry-driven, discussion based, project-based, arts-integrated, sports-integrated, and activity-based learning appropriate to the Secondary Stage.

05 Transform Assessment Culture

Shift assessment from testing memorisation to evaluating competencies and higher-order thinking. Promote assessment 'as', 'of' and 'for' learning, in alignment with emerging Board examination reforms.

06 Foster Rational Thought and Autonomy

Develop critical thinking, logical reasoning, creativity, and informed decision-making and reflective capacities.

07 Strengthen Constitutional Values and Democratic Participation

Integrate ethical reasoning, Fundamental Duties, citizenship values, inclusion, empathy, and pluralism into curricular processes.

08 Promote Multidisciplinary and Flexible Learning Pathways

Enable flexibility and choice across subject groups in the Secondary Stage while ensuring both breadth and disciplinary depth.

09 Integrate Art, Physical Education, and Well-being as Core Areas

Recognise Art Education and Physical Education as integral curricular areas with defined learning standards and performance-based assessments.

10 Embed Vocational Education and respect

Integrate vocational capacities, work-based learning, and exposure to local crafts and industries, aligned progressively with future world of work.

11 Advance Environmental Literacy and Sustainable Practices

Develop environmental awareness, interdisciplinary understanding, and action - oriented capacities for sustainable living.

12 Promote Multilingualism and Cultural Rootedness

Encourage multilingual proficiency, including Indian languages, strengthening cultural literacy and pride in India while nurturing global citizenship.

13 Ensure Inclusive and Equitable Education

Promote inclusive practices responsive to diverse learners, socio-economic contexts, and varied abilities.

14 Leverage Educational Technology, Computational Thinking, and Artificial Intelligence

Integrate educational technology meaningfully while preserving strong teacher-student engagement. Establish Computational Thinking (CT) and Artificial Intelligence (AI) as core compulsory competencies up to the Secondary stage, fostering algorithmic thinking, data literacy, and ethical AI use etc.

1.3 Curricular Areas at Secondary Level

In accordance with the National Curriculum Framework for School Education (NCFSE) 2023, the CBSE Secondary Curriculum is structured across defined curricular areas to ensure both breadth and depth of learning. Students engage with Languages, Mathematics, Science, and Social Science, along with Art Education, Physical Education and Well-being, Vocational Education, and Interdisciplinary Areas.

Operationally, the Secondary School is envisioned as a learner-centred space where students build self-concept, resilience, enterprise, sportspersonship, and aesthetic sensibility. Schools are encouraged to design contextual and experiential learning environments that connect knowledge with real-life application, supporting students in becoming autonomous, responsible, and future-ready citizens.

Therefore, for the purpose of fostering core competencies in learners, this curriculum encompasses major learning areas as under:

(i) Languages

Languages include two official languages of India i.e. Hindi, English and 42 other languages. Thus, all scheduled languages listed in the 8th schedule of the Constitution of India are being offered, in addition to other Indian regional languages and foreign languages.

The curricula in languages focus on listening, speaking, reading and writing skills and, hence, develop effective proficiencies in all these areas. Language Education at the Secondary Stage is guided by the stage-wise design and Learning Standards of the NCFSE 2023. To operationalise the recommendations of NCFSE 2023, CBSE issued *Circular No. Acad-30/2025 dated 22 May 2025* laying down Implementation Guidelines for Language Instruction under NCFSE–2023 across Foundation, Preparatory and Middle-to-Secondary Stages.

In accordance with this circular and NCFSE's multilingual vision, languages are organised through a structured three-language framework across stages viz, **R1, R2 and R3**.

As per the recommendations of NCFSE-2023, two out of these three languages must be languages native to India.

In continuation of the Board's phased implementation of multilingual education, R3 (Third Language) shall be made compulsory from Class VI with effect from Academic Session 2026–27, ensuring that every learner studies at least two Indian languages. The same cohort shall continue R3 progressively up to Class X. The implementation schedule, as notified by the Board, shall be as follows:

Table 1

Academic Session	Class in which R3 is Compulsory
2026–27	Class VI
2027–28	Class VI, VII
2028–29	Class VI, VII, VIII
2029–30	Class VI, VII, VIII, IX
2030–31	Class VI, VII, VIII, IX, X

This phased introduction ensures smooth curricular transition and alignment with Secondary Stage assessment reforms.

Students in Classes IX–X will study three languages. The languages chosen at R1 and R2 must be different, i.e., the same language cannot be offered simultaneously at more than one level.

Only for classes IX-X

Choice of Language (from Table 7 ahead) from 2026-27 to 2028-29

R1: Any Language from the ones offered by CBSE

R2: Language other than the one offered as R1

Choice of Language (from Table 7 ahead) from 2029-30, including the R1 and R2

R3: Language other than the ones offered as R1 and R2

i

Until NCERT develops level-specific textbooks for different languages, the same NCERT textbooks will be used for both R1 and R2 levels. (Please refer to the list in table 7). However, the Board examinations for R1 and R2 in 2028 will differ for class X, even though they are based on the same textbooks; for example, students will study Textbook *Kaveri* (English class IX) at R1/R2 level. Based on the same textbook, Syllabus will be different for R1 and R2 levels and the assessment will also be different for the two levels, i.e. R1 and R2. SQP and MS for class IX will also be provided at the initial transition phase.

ii

Till the above scheme is fully operational, i.e. for students currently in class VII and higher, it is compulsory that all students must have studied three languages up to class VIII. Those students who could not clear the third language in class VIII and have been promoted to class IX, shall be examined by the concerned schools at the end of Class IX in the same syllabus and textbooks as prescribed for class VIII. Those who are still unable to clear the third language at the end of class IX may be given another opportunity in class X. No student shall be eligible to appear in the Secondary School Examination of the Board at the end of class X unless she/he has passed in the third language. This arrangement to continue till R3 is introduced in class IX, i.e. 2029-30. However, CwSN are exempted from the study of the second and third languages.

iii

For Regional Languages, the Board will continue to prescribe the textbooks being followed in classes IX and X in the respective State Boards where the language is taught, till the time NCERT textbooks in these languages are available. Schools are also advised to bring to the notice of CBSE the changes, if any, brought out at the commencement of the session by the respective State Boards, in the textbooks of the language of their State. Schools are directed to strictly follow the textbooks prescribed by CBSE in its curriculum. Changes, if any, can be adopted only after CBSE notifies it.

Medium of Instruction (Mol) Option

In accordance with Section 1.6.1 of NCFSE 2023, and as reiterated in the CBSE Circular Acad 30/2025 dated 22.05.2025 schools must offer at least one language native to India as an option for Medium of Instruction from preparatory stage (Grade 3) up to Grade 12, where the primary Mol is not such language. For example, if the primary Mol is English, then one Indian language may be offered as an option for Mol up to Grade 12.

Pedagogical and Assessment Approach in Languages

The NCFSE-2023 emphasises the adoption of multilingual classroom strategies, including comparison across languages, contextual vocabulary development, and the use of rich literary resources. Schools are required to align curriculum materials, teacher training, and assessment practices to reflect multilingual pedagogy. Assessment in language prioritises comprehension, articulation, analytical ability, and application over rote memorisation.

Inclusion and Relaxations

Clause 17(i) of the RPwD Act, 2016, states *“The appropriate government shall make measures to make suitable modifications in the curriculum and examination system to meet the needs of students with disabilities, such as extra time for completion of examination paper, facility of scribe or amanuensis, exemption from second and third language courses”*.

In compliance with this stipulation, suitable curricular and examination modifications including exemption from second and third language courses, where applicable, shall be provided to children with special needs.

(ii) Mathematics

Mathematics education at the Secondary Stage develops clarity of thought, precision, logical reasoning, and problem-solving abilities. It enables learners to recognise patterns, understand relationships, and model real-world situations using quantitative and abstract tools. In alignment with the vision of NCFSE 2023, Mathematics is viewed not merely as a body of procedures, but as a disciplined way of thinking that fosters rationality and autonomy.

The curriculum builds strong conceptual foundations in number systems, algebra, geometry, mensuration, statistics, and probability, while encouraging students to engage with mathematical reasoning, argumentation, and proof in age-appropriate ways. Learners develop the ability to formulate problems, choose suitable strategies, analyse results, and communicate mathematical ideas with clarity. Connections with science, technology, economics, and everyday life are emphasised to make learning meaningful and relevant

a Pedagogical Approach

Teaching-learning processes prioritise conceptual understanding over mechanical procedures. Classroom interactions include exploration of patterns, guided discovery, problem-solving discussions, use of manipulatives and visual representations, and integration of technology where appropriate. Students are encouraged to explain their reasoning, compare multiple solution strategies, and learn constructively from errors. Regular practice is balanced with opportunities for investigation and mathematical thinking.

b Assessment Approach

Assessment follows the competency-based principles of NCFSE 2023 and evaluates understanding, reasoning, and application rather than routine memorisation. Question design includes problem solving tasks, case-based items, data interpretation, and situations requiring logical justification.

(iii) Science

Science education at the Secondary Stage nurtures curiosity about the natural world and develops the capacity to understand it through systematic inquiry. Through the study of Physics, Chemistry, and Biology, learners explore fundamental principles governing physical, chemical, and biological processes, while building a scientific temper grounded in observation, evidence, and logical reasoning. In keeping with the vision of NCFSE 2023, the focus is on deep conceptual understanding rather than the accumulation of facts.

Students learn to ask meaningful questions, design and interpret investigations, analyse data, and evaluate scientific claims. They apply scientific knowledge to issues related to health, environment, sustainability, and technology, thereby connecting classroom learning with real-world contexts. Science education thus supports rational thought, informed decision-making, and responsible citizenship.

a Pedagogical Approach

Teaching-learning processes emphasise inquiry, experimentation, and experiential engagement. Laboratory work, hands-on activities, demonstrations, field observations, modelling, and problem solving tasks form the core of pedagogy. Students are encouraged to hypothesise, test ideas, interpret evidence, and reflect on errors as part of the learning process. Collaborative exploration and discussion strengthen conceptual clarity and analytical thinking.

b Assessment Approach

Assessment aligns with the competency-based design of NCFSE 2023 and evaluates understanding, application, and reasoning. Question formats include case-based items, data interpretation, experimental analysis, and problem-solving tasks. Practical assessment emphasises investigative skills, accuracy of observation, interpretation of results, and scientific communication. Formative assessment through experiments, projects, and reflective tasks supports continuous learning and conceptual growth.

(iv) Social Science

Social Science education at the Middle and Secondary Stages, aligned with the Learning Standards framework of NCFSE 2023 develops informed, reflective, and responsible citizens through the study of History, Geography, Political Science, and Economics.

The curriculum fosters rational inquiry, ethical reasoning, constitutional values, and democratic participation. Learners engage with disciplinary methods such as interpretation of historical sources, spatial and environmental analysis, understanding of political institutions, and economic reasoning. They examine social, political, economic, and environmental processes, connect local contexts with national and global developments, and understand Fundamental Rights, Duties, and civic responsibilities.

a Pedagogical Approach

Pedagogy emphasises inquiry-based, discussion-oriented, and experiential learning. Students analyse primary and secondary sources, maps, data, and case studies; participate in debates and collaborative tasks; and undertake projects linked to real-life and local contexts. The focus is on interpretation, evidence-based reasoning, and perspective-taking rather than passive content reception.

b Assessment Approach

Assessment aligns with the competency-based design of NCFSE 2023 and evaluates conceptual understanding, analytical ability, and application. Tools include source-based and case-based questions, data and map interpretation, structured responses requiring argumentation, and project-based tasks. Formative assessment through discussions, presentations, and reflective writing supports continuous learning.

(v) Art Education

Art Education at the Secondary Stage nurtures imagination, aesthetic sensibility, cultural literacy, empathy, and socio-emotional well-being. In keeping with the vision of NCFSE 2023, the Arts are recognised as a core curricular area, integral to holistic development, with no separation between curricular and co-curricular domains.

The curriculum emphasises three interrelated processes: making art (creation and performance), thinking creatively in the arts, and appreciating artistic expression. Through sustained engagement with Visual Arts, Music, Theatre, and Dance & Movement, learners experience joy, confidence, persistence, and collaborative problem-solving, while developing a sense of belonging to India's rich and diverse cultural heritage.

Curriculum design integrates three dimensions of knowledge:

- Perceptual Knowledge – sensory experiences, emotional engagement, and aesthetic awareness;
- Procedural Knowledge – skills of creating, performing, and working with tools and materials;
- Conceptual Knowledge – understanding elements and principles such as rhythm, space, balance, colour, movement, and narrative.

Local art traditions serve as a starting point, with gradual expansion to regional, national, and global forms. Arts integration across subjects is encouraged, with emphasis on creative process over product.

a Pedagogical Approach

Art pedagogy is process-oriented, experiential, collaborative, and developmentally appropriate. Learning experiences are rooted in local culture and resources, while encouraging exploration, improvisation, and interdisciplinary connections. Teachers function as facilitators who create enabling environments, provide materials and guidance, and foster reflection. Workshops, exhibitions, artist interactions, and exposure visits are encouraged to enrich learning.

Through a good, effective art education programme, schools must aim to achieve:

- Joy in exploring and creating artwork
- Imagination and creativity
- Empathy and sensitivity
- Understanding of connections with other disciplines
- Sense of belonging

From NCF 2023

b Assessment Approach

Assessment in Arts Education aims to nurture students' creative abilities, artistic expression, critical thinking, and values such as curiosity, collaboration, and sensitivity, rather than focusing only on technical skills. In line with NCF-SE 2023, it follows a continuous, holistic, and competency-based approach, integrating assessment for learning, as learning, and of learning. Formative assessment is embedded in daily classroom processes through activities, discussion circles, teacher observations, peer and self-assessment, and students' art journals that promote reflection and creative exploration. Summative assessment at the secondary stage includes theory and practical components, where theory evaluates conceptual understanding of art forms through written or open-book examinations, while practical assessment focuses on demonstration of artistic skills in Visual Arts, Music, Dance, and Theatre, supported by portfolios, artefacts, performances, project work, and participation in artistic events. **Exact details of the assessment scheme in Arts Education are provided in the syllabus document of Arts Education.**

(vi) Education in Interdisciplinary Area

In alignment with the National Curriculum Framework for School Education 2023, which emphasises multidisciplinary learning, constitutional values, environmental consciousness, and the development of rational and ethical reasoning, CBSE introduces Education in Interdisciplinary Areas as a compulsory component at the Secondary Stage. Accordingly, "Individual in Society" in Class IX (2026-27 onwards) and "Environmental Education" in Class X (2027-28 onwards) shall be implemented for the same cohort of students as and when NCERT textbooks become available. The Pedagogical and Assessment approach shall be informed shortly, subsequent to the release of NCERT Syllabus.

(vii) Physical Education and Well Being

Physical Education and Well-being at the Secondary Stage promotes holistic development by integrating physical fitness, mental well-being, resilience, cooperation, and sportsmanship. In alignment with the Aims of School Education and the Learning Standards framework of NCFSE 2023, this curricular area is recognised as a core component of school education, with the same rigour and expectations as other disciplines.

The curriculum seeks to cultivate a lifelong love for physical activity and sports, while developing capacities for skilful participation, teamwork, leadership, discipline, and self-regulation. It integrates structured sports, indigenous games, athletics, and fitness practices, along with Yoga and mind-body wellness traditions that form an important part of India's knowledge heritage. Health education, nutrition awareness, and lifestyle choices are embedded to support informed and responsible living.

At the Secondary Stage, students are provided opportunities to deepen engagement in chosen sports or physical activities, building competence, strategic thinking, and collaborative skills. Physical Education contributes directly to the development of perseverance, empathy, cooperation, and respect for diversity.

a Pedagogical Approach

Pedagogy is activity-based, experiential, and developmentally appropriate. It includes structured skill development sessions, team-based games, fitness training, Yoga practices, and reflective discussions on health and well-being. Learning experiences are inclusive and adaptable to diverse abilities, ensuring active participation of all students. Emphasis is placed on practice, feedback, self improvement, and safe engagement.

A good physical education programme is therefore considered important for everyone, regardless of the field of interest one wants to pursue in life. Physical Education in schools must aim to achieve:

- *Appreciation for physical activity and sports*
- *Capacities for skilful engagement in physical activity or sports*
- *Resilience*
- *Empathy and cooperation*

From NCF 2023

b Assessment Approach

Assessment in Physical Education and Well-being is designed to be continuous, comprehensive, competency-based, and learner-centric, focusing not only on physical performance but also on conceptual understanding, participation, effort, reflection, values, and social behaviour. Aligned with the principles of assessment for learning, as learning, and of learning recommended in NEP 2020, formative assessment is integrated into daily teaching-learning processes through oral responses, concept checks, wellness diaries, peer and self-assessment, and case-study discussions that promote reflection and critical thinking. Summative assessment at the end of a unit or term includes pen-and-paper tests to assess conceptual clarity, project work involving inquiry and community-based learning, and practical demonstrations to evaluate fitness parameters and sports skills using defined rubrics.

Exact details of the assessment scheme in Physical Education and Well-being are provided in the syllabus document of Physical Education and Well-being.

(viii) Vocational Education

The subject Vocational Education at the Secondary Stage deepens the vocational exposure provided during the Middle Stage and progressively develops productive capacities, work ethics, and respect for the dignity of labour. In alignment with NEP 2020 and NCFSE 2023, vocational education is conceived as education through work, integrating knowledge, skills, values, and attitudes. As structured in the Grade 8 framework Kaushal Bodh, learning continues across three broad Forms of Work e.g.

Work with Life Forms, Work with Machines and Materials and Work in Human Services.

In Classes IX and X, this structure is extended with greater depth and responsibility. Students undertake longer-duration, context-based projects requiring planning, execution, documentation, reflection, and presentation. Emphasis is placed on application of tools and processes, integration of learning from other subjects, ecological and gender sensitivity, and understanding the relevance of skills in the world of work.

a Pedagogical Approach

Pedagogy remains project-based, experiential, and community-linked. Students engage with real-life contexts, resource persons, and local enterprises. Learning emphasises collaboration, problem solving, creativity, and reflection, with teachers acting as facilitators to ensure safety, inclusion, and equitable participation.

b Assessment Approach

Assessment prioritises demonstration of competencies and work-related values over theoretical recall. Portfolios, teacher observations, presentations, and practical tasks form the core of evaluation, with greater weightage to practical components as compared to theoretical assessment. Continuous feedback and reflection support growth and confidence. By the end of Class X, learners are expected to demonstrate competence in selected domains of work, appreciation for dignity of labour, and readiness for further academic or vocational pathways. **Details are given separately in the syllabus for Vocational Education.**

The approach to Vocational Education in NCF 2023 aims to achieve the following objectives:

- a. *Vocational capacities, knowledge, and relevant values will be developed for all students, and this will create the possibility of their joining the workforce after school if they choose to.*
- b. *Provide the possibility of learning range of vocations—ones that are aspirational, as also those that are most relevant locally and contextually (if different), also new and emerging vocations.*
- c. *Provide exposure to various types of work to all students establishing the dignity of work.*
- d. *Should be implementable with the current reality and resourcing of our schools, while providing a pathway to the future.*
- e. *Must value the work that many of the children of India already do in their homes and communities.*

From NCF 2023

02 - SCHEME OF STUDIES

2.1 Subjects to be offered:

Classes IX and X constitute a composite course. Students, therefore, should take only those subjects in Class IX that they intend to continue in Class X. Subjects can be offered from the list of subjects given in Table XII ahead. The Scheme of Studies as per the NCF recommendations from 2026-27 till 2030-31 will be as follows:

Table 2

	Existing 2025-26		New 2026-27			
S. No.	Subjects in Class X	Nature	Subject in Class IX	Assessment in Class IX	Subjects in Class X	Assessment in Class X
1	Language 1	Compulsory with Board Exam in Class (X)	Language 1 at R1/R2 levels	School-based Internal Assessment (IA) & Annual Examination	Language 1	School-based Internal Assessment (IA) and compulsory Board Examination
2	Language 2		Language 2 at R1/R2 levels		Language 2	
3	Mathematics		Mathematics & Mathematics Advanced (optional)		Mathematics (Basic/Standard)	
4	Science		Science & Science Advanced (optional)		Science	
5	Social Science		Social Science		Social Science	
6	Skill-based or other Subject	Optional with School-based Assessment and compulsory Board Exam in Class (X)	Individuals in Society	School-based Internal Assessment	Skill-based or another Subject	Optional with School-based Assessment and compulsory Board Exam in Class (X)
7	Language 3		Language 3 (Optional up to 2028-29)		Language 3 (Optional up to 2029-30)	
8	Health and Physical Education (HPE)	Compulsory Subjects having only school-based assessment	Art Education	School-based Internal Assessment	Health and Physical Education	Compulsory Subjects having only school-based assessment
9	Work Experience(Subsumed in HPE)		Physical Education and Well-being		Work Experience (Subsumed in HPE)	
10	Art Education				Art Education	
11	----- -----		Vocational Education	School-based Internal Assessment (IA) & Annual Examination		
			Optional Subject	School-based IA & Annual Exam		
12			CT & AI (Class IX-X) as Modules* (compulsory)	School-based Assessment		
	Total Number of Subjects for Board Examination 2026: 07 [05 (compulsory) + 2 (optional)]			Maximum Possible Number of Subjects for Board Examination 2027: 07 [05 (compulsory)+ 2 (optional)]		

*CT & AI as a compulsory subject in session 2027-28

Legend					
Denotes	Modules	Compulsory subject with Annual/ Board Examination	Compulsory subject with school-based assessment	Optional subject	Maximum Possible number of subjects for Board Exam

Table 3

Session 2027-28			
Subjects in Class IX	Assessment	Subjects in Class X	Assessment
Language 1 at R1/R2 Level	School-based Internal Assessment (IA) & Annual Examination	Language 1 at R1/ R2 Level	School-based Internal Assessment (IA) and compulsory Board Examination
Language 2 at R1/ R2 level		Language 2 at R1/ R2 level	
Mathematics & Mathematics Advanced(optional)		Mathematics & Mathematics Advanced (optional)	
Science & Science Advanced(optional)		Science & Science Advanced(optional)	
Social Science		Social Science	
Language 3 (Optional up to 2028-29)		Language 3 (Optional up to 2029-30)	
Individuals in Society	School-based IA	Environmental Education	School-based IA
CT & AI	School-based Internal Assessment (IA) & Annual Examination	Art Education	
Art Education	Assessment scheme – same as 2026-27	Physical Education and Well-being	
Physical Education and Well-being		Vocational Education	School-based Internal Assessment (IA) and compulsory Board Examination
Vocational Education	Assessment scheme – same as 2026-27	Optional Subject	
Optional Subject	School-based Internal Assessment (IA) & Annual Examination		
Maximum Possible Number of Subjects for Board Examination 2028: 08 [06 (Compulsory, including maximum two advanced level papers) + 2 (optional)]			

Legend				
Denotes	compulsory subject with Annual/ Board exam	Compulsory subject with school-based assessment	Optional subject	Maximum Possible Number of subjects for Board Examination

Table 4

Session 2028-29			
Subjects in Class IX	Assessment	Subjects in Class X	Assessment
Language 1 at R1/R2 Level	School-based Internal Assessment (IA) & Annual Examination	Language 1 at R1/ R2 Level	School-based Internal Assessment (IA) and compulsory Board Examination
Language 2 at R1/ R2 level		Language 2 at R1/ R2 level	
Mathematics & Mathematics Advanced (optional)		Mathematics & Mathematics Advanced (optional)	
Science & Science Advanced (optional)		Science & Science Advanced(optional)	
Social Science		Social Science	
Individuals in Society	School-based IA	Environmental Education	School-based IA
CT & AI	School-based Internal Assessment (IA) & Annual Examination	CT & AI	School-based Internal Assessment (IA) and compulsory Board Examination
Language 3 (Optional up to 2028-29)		Language 3 (Optional up to 2029-30)	
Art Education	Assessment scheme – same as in 2026-27	Art Education	School-based Internal Assessment
Physical Education and Well-being		Physical Education and Well-being	
Vocational Education	School-based Internal Assessment (IA) & Annual Examination	Vocational Education	School-based Internal Assessment (IA) and compulsory Board Examination
Optional Subject		Optional Subject	
Maximum Possible Number of Subjects for Board Examination 2029: 09 [(07 Compulsory, including maximum two advanced level papers with 3+1 hrs examinations) + 2 (optional)]			

Legend				
Denotes	Compulsory subject with Annual/ Board Examination	Compulsory subject with school-based assessment	Optional Subject	Maximum Possible Number of subjects for Board Examination

Table 5

Session 2029-30			
Subject in Class IX	Assessment	Subjects in Class X	Assessment
Language 1 at R1/ R2 Level	School-based Internal Assessment (IA) & Annual Examination	Language 1 at R1/R2 Level	School-based Internal Assessment (IA) and compulsory Board Examination
Language 2 at R1/R2 level		Language 2 at R1/R2 level	
Language 3 at R3 Level		Mathematics & Mathematics Advanced(optional)	
Mathematics & Mathematics Advanced(optional)	Assessment scheme as in 2027-28	Science & Science Advanced (optional)	
Science & Science Advanced (optional)		Social Science	
Social Science		Environmental Education	Assessment scheme as in 2027-28
Individuals in Society	Assessment scheme as in 2026-27	CT & AI	School-based Internal Assessment (IA) and compulsory Board Examination
CT&AI		Language 3 (Optional up to 2029-30)	
Art Education		Art Education	School-based Internal Assessment (IA)
Physical Education and Well-being		Physical Education and Well-being	
Vocational Education		Vocational Education	Assessment scheme as in 2027-28
		Optional Subject	School-based Internal Assessment (IA) and compulsory Board Exam
Optional Subject	School-based Internal Assessment (IA) & Annual Examination		
Maximum Possible Number of Subjects for Board Examination 2030: 09 [(07 Compulsory, including maximum two advanced level papers with 3+1 hrs examinations) + 2 (optional)]			

Legend				
Denotes	Compulsory subject with Annual/ Board Examination	Compulsory subject with school-based assessment	Optional Subject	Maximum Possible Number of subjects for Board Examination

Table 6

Session 2030-31			
Subject in Class IX	Assessment	Subjects in Class X	Assessment
Language 1 at R1/R2 Level	School-based Internal	Language 1 at R1/ R2 Level	School-based Internal Assessment (IA) and compulsory Board Examination
Language 2 at R1/R2 level	Assessment (IA) & Annual Examination	Language 2 at R1/ R2 level	
Language 3 at R3 Level	School -based Internal assessment	Language 3 at R3 Level	School -based Internal assessment
Mathematics & Mathematics Advanced (optional)	School-based Internal Assessment (IA) & Annual Examination	Mathematics & Mathematics Advanced (optional)	School-based Internal Assessment (IA) and compulsory Board Examination
Science & Science Advanced (optional)		Science & Science Advanced (optional)	
Social Science		Social Science	
Individuals in Society	Assessment scheme as in 2026-27	Environmental Education	Assessment scheme as in 2027-28
CT&AI	Assessment scheme as in 2027-28	CT&AI	Assessment scheme as in 2028-29
Art Education	Assessment scheme as in 2026-27	Art Education	Assessment scheme as in 2026-27
Physical Education and Well-being		Physical Education and Well-being	
Vocational Education		Vocational Education	
Optional Subject	School-based Internal Assessment (IA) & Annual Examination	Optional Subject	School-based Internal Assessment (IA) and compulsory Board Examination
Maximum possible Number of Subjects for Board Examination 2031: 8 [(07 Compulsory, including maximum two advanced level papers with 3+1 hrs examinations) + 1 (optional)]			

Legend				
Denotes	Compulsory subject with Annual/ Board Examination	Compulsory subject with school-based assessment	Optional Subject	Maximum Possible Number of Subjects for Board Examination

Instructions

- i. The external examination conducted by CBSE at the end of Class X shall be based on the prescribed syllabus and the competencies for Class X for the respective academic session.
- ii. All candidates shall be required to appear in both components of assessment, namely, the Internal Assessment and the External/Annual Examination conducted by the School or the Board, as applicable. No candidate shall be declared successful unless he/she has appeared in and completed both components of assessment in accordance with the prescribed Scheme of Examination.
- iii. Schools situated in foreign countries may offer one compulsory language native to India in lieu of the requirement of two Indian languages applicable to schools located in India.
- iv. **Special Case:** While it is desirable that the same scheme of language is adopted, under exceptional circumstances, for students returning from foreign schools where the 3rd language studied by a student till class VIII or class IX is not available in the domestic school, such students may be exempted, on a case-by-case basis, as per approved norms, at the request of the school. However, such students will be required to study the total number of subjects as stipulated in the Scheme of Studies.
- v. **Subjects at two levels:** From the academic session 2026–27, the Subjects Mathematics and Science and their assessments are being offered at two levels:

1 Mathematics and Science

The subjects Mathematics and Science as given in the tables 2 to 6 at the preceding pages, refer to the standard Mathematics and Standard Science Course. These will cover the common prescribed syllabus, will be compulsory and will be studied by all students.

2 Mathematics Advanced and Science Advanced:

will be optional, and meant for students who wish to study additional topics beyond the common syllabus. The details are as follows:

Subject	Nature	Syllabus	Assessment
Mathematics	Compulsory (to be studied by all students)	Common standard Content	80 marks (School-based Annual in Class IX of 2026-27 onwards /Board Examination in Class X of 2027-28 onwards); 3hrs duration
Science	Compulsory (to be studied by all students)	Common standard Content	80 marks (School-based Annual in Class IX of 2026-27 onwards /Board Examination in Class X of 2027-28 onwards);3hrs duration
Paper	Nature	Syllabus	Assessment
Mathematics Advanced	Optional	Additional Content	25 marks (Board Examination in Class X of 2027-28 and onwards);1 hr duration; all HOTS questions
Science Advanced	Optional	Additional Content	25(Board Examination in Class X of 2027-28 and onwards);1 hr duration; all HOTS questions

1. All students (whether opting for Advanced or not) will appear in a common final examination (Board in class X/ school-based annual examination in Class IX of 80 marks, 3 hours). In addition, students opting for the Advanced level will take an additional examination of 25 marks (1 hour) at a higher level, based on the prescribed content.
 2. Thus, the examination in Mathematics and Science will be offered at two levels—Standard and Advanced at class IX (2026-27 onwards) and Mathematics Advanced and Science Advanced at class X (2027-28 onwards). Students can choose **none/one/both** subject/s at viz., Advanced Level, (none; Maths Advanced/Science Advanced; Maths Advanced and Science Advanced) .
 3. A candidate securing 50 % and above marks for the optional Advanced Examination shall have the following recorded in the marksheet: **The Advanced Level has been successfully cleared.** (This text is tentative and may vary). **However, the marks obtained in the Advanced Examination shall not be added to the overall aggregate or total score. In case a candidate secures less than the prescribed criteria, no reference to the Advanced Level shall be reflected in the marksheet.**
 4. This two-level structure will not apply to the internal assessments of 20 marks in Mathematics and Science conducted at the school level in Class X.
 5. From the academic session 2026–27, the scheme of two-levels , i.e. Mathematics Basic and Mathematics Standard examination, will be discontinued. **However, students of Class-X in 2026–27 will only continue under the existing scheme and may opt for Mathematics Basic, as applicable for the academic year 2025-26.**
- vi. If a student fails in any one of the three compulsory subjects (i.e., Science, Mathematics and Social Science) and passes in the optional subject (if offered as 11th optional subject), then that subject will be replaced by the optional subject and the result of Class X Board examination will be computed accordingly provided that students have cleared three languages as stipulated.
- vii. Introduction of Computational Thinking and Artificial Intelligence (CT & AI):
From the academic session 2026–27, schools are directed to introduce **Computational Thinking and Artificial Intelligence** for students of Classes III to VIII in a developmental, age-appropriate, and competency-based manner, in alignment with the National Education Policy (NEP) 2020 and the National Curriculum Framework for School Education (NCFSE 2023). Computational Thinking will serve as the foundational skill, with CT integrated across subjects in Classes III–V, and advanced CT, along with foundational AI literacy, introduced in Classes VI–VIII through worksheets, projects, and classroom activities. The focus will be on strengthening core competencies such as logical reasoning, pattern recognition, data interpretation, algorithmic thinking, creativity, collaboration, and ethical awareness. The approach will remain low-tech and activity-driven, without reliance on specific platforms, devices, or additional instructional time, as competencies will be embedded within existing subject periods. Detailed class-wise competencies, learning outcomes, pedagogical guidelines, assessment suggestions, and teacher training modules will be provided by the Board, ensuring curriculum continuity and a smooth transition to advanced CT, programming, and AI learning in Classes IX–XII. Computational Thinking and Artificial Intelligence will be introduced in classes IX–XII as modules (to be provided by NCERT) in the Academic Session 2027-28. CT & AI will be introduced as a subject in the session 2027-28 (details will be informed in due course).

- viii. Board is extending several exemptions/concessions to candidates with disabilities as stipulated in the Clause 17(i) of the RPwD Act, 2016. Exemptions/concessions extended to Persons with Benchmark Disabilities for Class X & XII Examinations conducted by the Board and the Standard Operating Procedure for availing these concessions are available on:

https://www.cbse.gov.in/cbsenew/Examination_Circular/2019/5_CIRCULAR.pdf

Schools and candidates may also refer to the circulars issued by the Board from time to time on this matter.

ix. **Scheme of Studies for Children with Special Needs for classes IX-X**

Candidates with disabilities as defined in the Rights of Persons with Disabilities Act, 2016 have the option of studying one compulsory language instead two/ three.

This NCFSE 2023 is in consonance with the provisions of the Rights of Persons with Disabilities (RPWD) Act 2016 and endorses all its recommendations regarding school education. NCFSE 2023 further clarifies that-

“The idea of accommodations is different from modifications. While modification is about altering or changing the difficulty levels of the content or the expectations of learning of the student, accommodation is about making changes to assist a student to work with the conditions of disability and be able to demonstrate their learning achievement on the same standards. With accommodations, neither what is being taught changes nor does the grading criteria for students with disabilities.” NCF-SE 2023, Part B, Chapter 4, p. 184

Illustrative pedagogical accommodations: Teaching strategies will require a Universal Design in their planning and structure for equitable access. This is an important accommodation that will help meet learning challenges that students face. Allowing students to use word processors with or without spellcheck (through the use of assistive devices to practise spelling, grammar, and computing), creating a system of peer support, and organising special educator support in the classroom whenever necessary would make for an inclusive pedagogy.

Illustrative assessment accommodations: This typically involves changing or reorganising the order of tasks or questions for assessment, making assessment question papers or worksheets with large font print for ease of reading, allowing extended time for completion, organising for a scribe or writer or reading assistant, allowing the use of word processing software on a computer, organising a distraction-free room, allowing for the use of a calculator or a tablet, permitting more frequent breaks in the course of the assessment, and providing alternative furniture.

From NCF 2023

Scheme of Studies for Children with Special Needs (CwSN) for Classes IX–X (w.e.f. 2026-27 till 2030-31)

The scheme of studies for CwSN shall be similar to the scheme prescribed for all students in Tables 2 to 6 (depending upon the academic session). However, in accordance with Clause 17(i) of the RPwD Act, 2016 and the provisions of NCFSE 2023, CwSN shall be required to study only one compulsory language. All other subjects, whether compulsory (with Board examination or school-based assessment) or optional, may be replaced by any of the optional subjects listed in Table 7, as per the choice and comfort level of the CwSN student. However, CwSN students are free to retain as many subjects from the standard scheme of studies as they feel comfortable with; alternatively, they may replace any number of subjects, or even all subjects except the one compulsory language, with optional subjects.

2.2 List of subjects offered at Secondary Level:

Table 7

S. No.	Name		Theory Marks	Time (h)	Internal Marks	Total Marks
1	Hindi R1	(ANYONE)	80	03	020	100
	Hindi R2		80	03	020	100
2	English R1	(ANYONE)	80	03	020	100
	English R2		80	03	020	100
3	Urdu R1	(ANYONE)	80	03	020	100
	Urdu R2		80	03	020	100
4	Punjabi		80	03	020	100
5	Bengali		80	03	020	100
6	Tamil		80	03	020	100
7	Telugu	(ANYONE)	80	03	020	100
	Telugu Telangana		80	03	020	100
8	Sindhi		80	03	020	100
9	Marathi		80	03	020	100
10	Gujarati		80	03	020	100
11	Manipuri		80	03	020	100
12	Malayalam		80	03	020	100
13	Odia		80	03	020	100
14	Assamese		80	03	020	100
15	Kannada R1/Kannada R2(anyone)		80	03	020	100
16	Arabic		80	03	020	100
17	Tibetan		80	03	020	100
18	French		80	03	020	100
19	German		80	03	020	100
20	Russian		80	03	020	100
21	Persian		80	03	020	100
22	Nepali		80	03	020	100
23	Limboo		80	03	020	100
24	Lepcha		80	03	020	100
25	Bhoti		80	03	020	100
26	Bodo		80	03	020	100
27	Kok Borok		80	03	020	100
28	Tangkhul		80	03	020	100
29	Japanese		80	03	020	100
30	Bhutia		80	03	020	100
31	Spanish		80	03	020	100
32	Kashmiri		80	03	020	100

33	Mizo	80	03	020	100	
34	Bahasa Melayu	80	03	020	100	
35	Sanskrit	80	03	020	100	
36	Rai	80	03	020	100	
37	Gurung	80	03	020	100	
38	Tamang	80	03	020	100	
39	Sherpa	80	03	020	100	
40	Thai	80	03	020	100	
41	Dogri	80	03	020	100	
42	Konkani	80	03	020	100	
43	Maithili	80	03	020	100	
44	Santhali	80	03	020	100	
45	Mathematics	80	03	020	100	
	Mathematics- Advanced*	25	01	-	*	
46	Science	80	03	020	100	
	Science Advanced*	25	01	-	*	
47	Social Science	80	03	020	100	
OPTIONAL SUBJECTS (as on March 2026)**						
48	Home Science	70	03	030	100	
49	Painting	30	02	70	100	
50	National Cadet Corps (NCC)	70	03	30	100	
51	Computer Applications***	50	02	50	100	
52	Elements of Business or	Any One	70	03	30	100
	Elements of Book Keeping & Accountancy					
53	Retail	50	02	50	100	
54	Information Technology***	50	02	50	100	
55	Introduction to Financial Markets	50	02	50	100	
56	Introduction to Tourism	50	02	50	100	
57	Beauty & Wellness	50	02	50	100	
58	Front Office Operations	50	02	50	100	
59	Marketing and Sales	50	02	50	100	

* Please refer to point v at page number 16 to 17 above.

** This is a tentative list and may be reviewed basis feedback and data.

***Out of the two subjects with codes 165 and 402, only one subject can be offered. The curriculum and the study material for the optional electives is available on the CBSE academic website "<https://cbseacademic.nic.in>" under the tab 'Optional Subjects'.

2.3 Instructional Time

Instructional time shall be as per the subjects selected. Schools must ensure that minimum number of hours are spent on each subject as specified in the curriculum. The time duration for the subjects has been clearly indicated in the syllabus of each subject. However, it is expected that schools will create innovative Timetables (such as, teaching-learning only 2 or 3 subjects per day etc.) to ensure that the burden of the bag and homework are substantially reduced and the classroom transaction are based on experiential processes. Schools may also think of introducing bag-less day and same may be incorporated in the time tables. The time table must also include the mandatory periods for compulsory areas including Physical Education and Well Being, Art Education and Vocational Education.

03 - STRUCTURE OF ASSESSMENT SCHEME

The assessment structure for Classes IX and X comprises two mandatory components:

- a) Board (External) Examination for class X conducted by CBSE (80 Marks for subjects or Marks mentioned in the syllabus of the subject) and; Annual Examination conducted by the school for class IX (80 Marks for major subjects or Marks mentioned in the syllabus of the subject)
- b) Internal Assessment (20 Marks for major subjects or Marks mentioned in the syllabus of the subject) conducted by schools for classes IX and X both.

The final result of the student shall be determined by combining performance in both the External Examination and the Internal Assessment. Students are required to appear in and complete both components of assessment.

To be declared successful in a subject, a student must secure a minimum of 33% marks separately in external and internal assessments, calculated on the combined total of Internal Assessment and External Examination marks, as per the prescribed scheme.

Subjects assessed entirely through internal assessment shall follow the specific guidelines notified separately, along with their curriculum.

3.1 Nature of Question Papers

In alignment with the Board's shift toward competency-based and learning outcome-oriented assessment,

Board Examination question papers are designed to assess application, analysis, and evaluation. Presently, approximately 50% of the questions are competency-focused—such as case-based, source-based, integrated, data interpretation, situational, and application-oriented. Remaining items include select-response (MCQs) and constructed-response (short- and long-answer) questions. This structure may be reviewed periodically.

The papers incorporate real-life contexts, diagrams, passages, etc. to promote higher-order thinking skills and problem-solving abilities. They are structured into sections (e.g., Section A for objective/ MCQs; B and C for short answers; D for long answers; and E for case studies in certain subjects), with internal choices provided where appropriate to ensure fairness and flexibility.

Sample question papers and marking schemes are released in advance on cbseacademic.nic.in to support transparency and effective preparation. Overall, the examination design reflects a balanced, skill-oriented approach aligned with competencies.

3.2 Board Examination for (Class X) and Annual Examination (Class IX):

The Board Examination in each subject will cover entire syllabus of Class X. Grades corresponding to the marks shall be on the basis of 9-point grading system. Grades will be awarded in each scholastic subject. For awarding the grades, the Board will put all the passed students in a rank order and will award the grades as follows:

Table 8
Class X (External Board)

Grade	Octile
A-1	Top 1/8th of the passed candidates
A-2	Next 1/8th of the passed candidates
B-1	Next 1/8th of the passed candidates
B-2	Next 1/8th of the passed candidates
C-1	Next 1/8th of the passed candidates
C-2	Next 1/8th of the passed candidates
D-1	Next 1/8th of the passed candidates
D-2	Next 1/8th of the passed candidates
E*	Essential Repeat

Notes: -

- Minor variations in proportion of candidates to adjust ties will be made.
- In case of a tie, all the students getting the same score, will get the same grade. If the number of students at a score point need to be divided into two segments, the smaller segment will go with the larger.
- Method of grading will be used in subjects where the number of candidates who have passed is more than 500.
- In respect of subjects where total number of candidates passing a subject is less than 500, the grading would be adopted on the pattern of grading and distribution in other similar subjects.

For Class IX:

The assessment scheme will be similar to the class X Board examination. However, the grading in class IX will be as follows:

Table 9
Class IX (School-Based)

Grading Scale for Scholastic Areas (Class IX) (School will award grades as per the following grading scale)	
MARKS RANGE	GRADE
91-100	A1
81-90	A2
71-80	B1
61-70	B2
51-60	C1
41-50	C2
33-40	D

Absolute grading in class IX is used keeping in view the number of students appearing from any particular school as against positional grading used for class X.

3.3 Internal Assessment:

The year-end examination shall be supplemented by a robust system of Internal Assessment (IA) designed in alignment with the Learning Standards articulated in NCFSE 2023. Internal Assessment shall assess students in diverse ways, at different points of time, and across a broad range of curricular objectives, with explicit focus on the development of Competencies rather than rote memorisation. It shall provide multiple opportunities for learners to demonstrate attainment of identified Competencies, and the best performance of the student across the prescribed Internal Assessment components shall be considered while awarding the final Internal Assessment credit, in accordance with the specified weightage norms.

Internal Assessment serves a dual purpose:

- To provide a comprehensive picture of learners' progress towards Curricular Aims, Goals, and Competencies; and
- To inform classroom instruction, enabling timely remediation, enrichment, and differentiated support.

Assessment shall be conducted as, for, and of learning, and shall promote reflection, self-regulation, and continuous improvement. All Internal Assessment tools shall explicitly map to identified Competencies and Learning Outcomes.

3.3.1 Periodic Assessment (25 percent of overall weightage for Internal Assessment)

Periodic Assessment shall assess learning progress at regular intervals and provide structured feedback to both teachers and learners. Three periodic assessments shall be conducted in each subject during the academic year, of which the average of the best two shall be considered for final submission. However, unlike traditional examination patterns, at least one periodic assessment shall be competency-based and

application-oriented, including case analysis, data interpretation, problem-solving tasks, open-ended questions, or interdisciplinary contexts. Periodic assessments shall:

- a) Evaluate conceptual understanding, application, reasoning, and analytical abilities.
- b) Include higher-order thinking skills consistent with Stage-appropriate Competencies
- c) Be followed by structured feedback and documented remedial measures where required.

3.3.2 Multiple Assessment (25 percent of overall weightage for Internal Assessment):

Multiple Assessment shall provide opportunities to evaluate diverse aspects of learning through varied modes such as observation, oral presentations, discussions, quizzes, experiments, projects, fieldwork, collaborative tasks, concept mapping, and reflective exercises. Teachers shall ensure that:

- Assessment tasks are mapped to clearly defined Competencies.
- Simple, transparent rubrics are developed and shared with students in advance.
- Students are provided opportunities for self and peer assessment to strengthen metacognitive capacities.
- Recording procedures remain manageable and meaningful.

Multiple Assessment shall promote inclusive practices by allowing varied modes of expression in accordance with Universal Design for Learning (UDL) principles

3.3.3 Portfolio (25 percent of overall weightage for Internal Assessment):

The Portfolio shall form an integral component of Internal Assessment and align with the philosophy of the **Holistic Progress Card (HPC)** envisioned in NCFSE 2023.

A portfolio shall be a curated collection of student work demonstrating progress towards identified Competencies over time. It may include written work, projects, reflections, art-integrated tasks, experimental records, presentations, and evidence of interdisciplinary learning. The portfolio shall:

- i. Encourage student reflection on strengths, areas for improvement, and strategies for growth.
- ii. Document both process and product of learning.
- iii. Contain a limited number of thoughtfully selected artefacts to avoid undue burden.
- iv. Be assessed using clearly defined rubrics shared in advance.

The emphasis shall be on quality of engagement and growth rather than volume of compilation.

Assessing Portfolios

Students' portfolio can be effectively evaluated using a simple scoring rubric. The criteria – to be used in determining the quality of a particular student's portfolio needs to be carefully developed and shared with students. The key elements of the particular criteria need to be specified as well. Suggested below are some elements to judge student's portfolio:

Elements to judge student's portfolio

- Organization – Neatness, Creativity and Visual Appeal
- Completion of guided work focused on specific curricular objectives
- Evidences of student's growth
- Inclusion of all relevant work (completeness)

3.3.4 Subject Enrichment Activities (25 percent of overall weightage for Internal Assessment):

Subject Enrichment Activities shall aim to deepen conceptual understanding and strengthen discipline-specific skills through inquiry, exploration, and application.

In Languages, activities shall focus on listening, speaking, argumentation, analytical writing, and communicative competence.

In Science and Mathematics, activities shall promote investigation, hypothesis formulation, experimentation, modelling, and data analysis.

In Social Science, enrichment shall include civic inquiry, case studies, ethical reasoning, and project-based exploration of socio-economic and environmental issues.

Such activities shall move beyond confirmatory tasks and promote inquiry-driven and experiential learning consistent with NCFSE principles.

3.3.5 Inclusive and Ethical Assessment Practices

All Internal Assessments shall adhere to principles of fairness, inclusivity, and equity. Necessary accommodations shall be provided to students with special educational needs in accordance with applicable guidelines. Assessment shall respect student dignity and confidentiality and promote a supportive learning environment.

3.4 Development of Competencies Through Student Enrichment Activities:

In the recent past the Board has been organizing various activities for promoting various 21st century skills. Following are some such activities introduced with the intention of enhancement of the skills and values.

S. No.	Student Enrichment Activity	Skills/ Values to be Enhanced
1.	Story Telling Competition	Thinking Skills: Creative, Analytical, Evaluative Communication Skills, Linguistic Skills
2.	Reading Week, Budding Authors	
3.	Aryabhata Ganit Challenge	Reasoning Abilities, Problem Solving Skills, Critical thinking, Analytical thinking, Ability to manipulate precise and intricate ideas, Ability to construct logical arguments
4.	CBSE Heritage India Quiz	Values of respect for diversity and tolerance, Awareness about preserving Indian heritage and monuments, Critical thinking skills, Appreciation for rich heritage and diversity of the country
5.	Science Exhibition	Critical and Creative Thinking Skills, Problem Solving Skills, Scientific Temperament, Connecting Science to day-to-day life
6.	Science Challenge	
7.	Expression Series	Creative Thinking Skills Communication Skills

8.	Eco-Club Activities	Awareness about Environmental Conservation and Protection
9.	Swacchata Abhiyan	
10.	Ek Bharat Shrestha Bharat	Spirit of Patriotism and Unity Creative Skills
11.	Rashtriya Ekta Diwas	
12.	Fit India School Week	Healthy lifestyle
13.	CBSE Games	
14.	International Day of Yoga	
15.	Matri Bhasha Diwas	Awareness of Linguistic and Cultural traditions, Values of Tolerance and Dialogue, Communication Skills
17.	The Constitution Day	Importance of Constitution, its history, structure and implications to citizens, orientation to composite culture and diversity of our nation awareness of Fundamental Rights and Duties as enshrined in the Indian Constitution.
18.	Art Integrated Project	Application of art-based enquiry, investigation and exploration, critical thinking and creativity for a deeper understanding of the concepts/ topics, promotes experiential learning as it enables to derive meaning and understanding directly from the learning, enables students to see the multi-disciplinary linkages between subjects, topics, and real life.

Schools are encouraged to ensure that their students participate in these activities of the Board for making the students future-ready and also for becoming a holistic learner.

04 SCHOOL - LEVEL READLINESS AND PEDAGOGICAL PRACTICES

4.1 School Curriculum Committee

The Board mandates that all schools must constitute a School Curriculum Committee comprising teachers from each area. The School Curriculum Committee would define activities for pedagogical practices, evolve a plan of assessment and mechanism of feedback and reflection and ensure its implementation. The committee would also ensure that the textbooks/ reference materials are age appropriate, incorporate inclusive principles, gender sensitive, have valid content and do not contain any material which may hurt the sentiments of any community. The committee will then send the list of books to the principal to take action as per para 2.4.7 (b) of the Affiliation Byelaws, 2018. The committee would also ensure that the reference materials reflect conformity with the underlying principles of the Constitution of India and are compliant with NEP-2020. Issues of gender, social, cultural and regional disparities must be taken care of in the curriculum transaction.

4.2 Pedagogical Leadership

All Principals have a crucial role to play in the evolution of the teaching learning ecosystem as the Head and pedagogical leader of their schools. In the role of school pedagogical leader, the principal is expected to undertake the following:

- i. Lead, guide and support the teaching and learning processes in the school by focusing on class-room specific requirements for transacting the curriculum, so that both teachers and students perform at their optimal best.
- ii. Direct the entire focus of all school activities towards the students' learning and acquiring of necessary competencies. Every activity taken up by the school, therefore, should be mapped for the educational competencies, and for life skills, values, etc., being acquired by the students.
- iii. Prepare Annual Pedagogical Plan of the school by designing and developing annual plan for the school by giving equal importance to all areas.
- iv. Promote innovative pedagogy, with special focus on integrating art, sports and ICT (Information and Communication Technology) with education, and use of active and experiential learning methods in the classrooms.
- v. Ensure joyful learning at all levels through use of such innovative pedagogy.
- vi. Develop school specific resources for teaching and learning, in the form of lesson plans, e-content, use of mathematics and science kits developed by NCERT, etc.
- vii. Ensure proper in-house training of teachers in the school to enable them to unleash their own unique capabilities and creativity in their classrooms.
- viii. To be up to date with all new ideas and tools, etc. being used in education at the global level and constantly innovate the pedagogy of the school.
- ix. To make efforts to learn from the best practices of other schools, by arranging for discussions with Principals of such schools, or through observation visits of teachers to other schools.

The Board has not laid down the structure or format of the annual pedagogical plan as the Board respects educational autonomy of every school and expects each school to prepare its own unique and innovative annual plan. This plan must be an implementable one with realistic timelines that should include administrative inputs and detailed pedagogical aspects.

4.3 Pedagogical Practices of Teachers

The pedagogical practices should be learner centric. Teachers are expected to ensure such an atmosphere for students where they feel free to ask questions. They would promote active learning among students with a focus on reflections, connecting with the world around them, creating and constructing knowledge. The role of a teacher should be that of a facilitator who would encourage collaborative learning and development of multiple skills through the generous use of resources via diverse approaches for transacting the curriculum.

Teachers should follow inclusive principles and not label children as 'slow learners' or 'bright students', or 'problem children'. They should instead attend to the individual difference of students by diagnosing and modifying their pedagogic planning. As far as possible, Arts should be integrated in teaching, especially while teaching the concept which students find difficult to understand.

4.3.1 Competency Based Learning

In view of the evolving demands of the 21st century, education must move beyond content transmission towards the development of clearly articulated competencies. As envisaged in NCFSE 2023, curriculum design is anchored in a coherent progression from Aims of Education to Curricular Goals, Competencies, and Learning Outcomes, ensuring alignment between what is intended, taught, and assessed. Competency-based education places the learner's demonstrated understanding, application, reasoning, and performance at the centre of the learning process. Learning Outcomes describe what students are expected to know, understand, and be able to do at the end of a stage or course of study. The focus, therefore, shifts from mere coverage of syllabus content to meaningful attainment of stage-appropriate capacities.

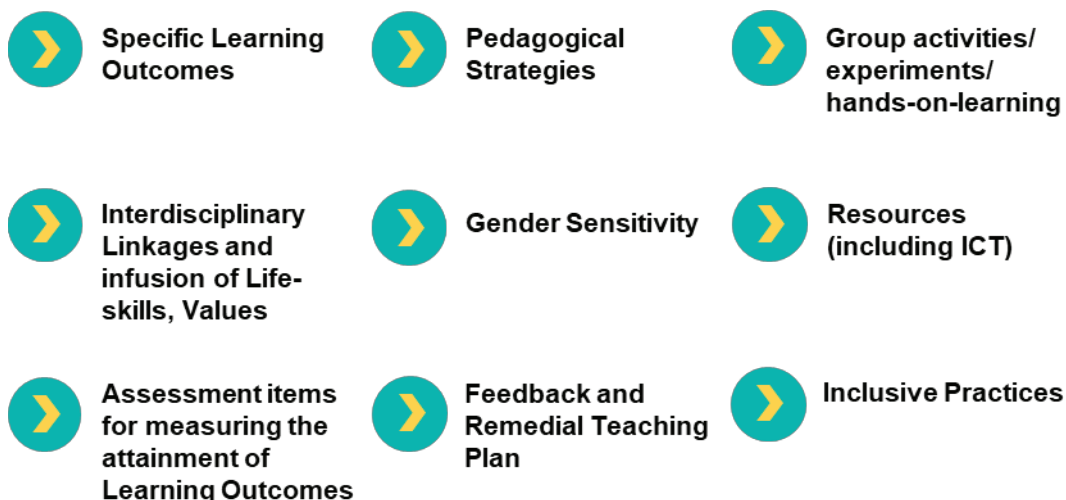
Assessment, in this approach, is integrated with teaching-learning processes and is designed to evaluate conceptual understanding, analytical ability, problem-solving, and application in real-life contexts rather than rote memorisation. Continuous and formative assessment practices enable teachers to monitor learner progress and provide timely academic support.

Experiential, inquiry-based, discussion-oriented, and activity-based pedagogies are central to competency-based learning. Such approaches foster critical thinking, creativity, collaboration, ethical reasoning, and reflective learning. Teachers are expected to design engaging and contextually relevant learning experiences that extend beyond textbooks and encourage exploration and deeper understanding.

Schools are required to systematically track the attainment of competencies by each learner, using appropriate assessment tools and feedback mechanisms, and to implement targeted interventions where needed. The objective is to ensure equitable learning progression and uphold the commitment that no learner is left behind.

Lesson/ Unit Plan

Specific Lesson Plans for the topics are to be prepared by the teachers. These plans may have the following parts:



4.3.2 Special Emphasis on Integrating Arts in Education

All disciplines being pursued by students at all stages require creative thinking and problem-solving abilities. Therefore, when Art is integrated with education, it helps the child apply art-based enquiry, investigation and exploration, critical thinking and creativity for a deeper understanding of the concepts/topics. Secondly, Art Integrated learning is a strong contender for experiential learning, as it enables the student to derive meaning and understanding, directly from the learning experience. Thirdly, this kind of integration not only makes the teaching and learning process joyful, it also has a positive impact on the development of certain life skills, such as communication skills, reflection and enquiry skills, un-conditioning of the mind leading to higher confidence levels and self-esteem, appreciation for aesthetics and creativity, etc. Fourthly, this kind of integration broadens the mind of the student, and enables him/her to see the multi-disciplinary links between subjects, topics, and real life. Schools are, thus, required to take up the integration of Art with the teaching learning process.

It must be understood that Art Education and Art Integrated Education may be mutually exclusive, but they build upon each other and strengthen each other. Art Education is not only relevant for developing creativity and appreciation of art among students, but is also necessary for inculcating art-based enquiry skills in the students. Art Education is a necessary precursor for the adoption of Art Integrated learning.

4.3.3 Art Integrated Pedagogy

While preparing its annual pedagogical plan under the leadership of the principal of the school, the school must plan out in detail the Art Education to be imparted at various levels, and how that Art can be integrated with classroom learning of various subjects. The focus must be on mutually reinforcing Art as a subject and Art as a tool for learning, with efforts towards seamless integration. Team teaching (combination of subject teachers and Art teachers) would also strengthen the integration.

For implementing this in classrooms, the subject teacher picks the topic/ concept/idea that she wants to teach by integrating Art. The teacher can do this jointly with the Art teacher too. Then, the subject teacher collaborates with the Art teacher to align the pedagogy. Next, the teacher teaches the topic/concept/idea ensuring active learning and ensuring that both the subject and Art are integrated well and there is learning in both areas. Finally, the teacher prepares a rubric to assess the student in both the areas – that is, the topic taught and the Art used.

4.4 School Culture and Processes

In accordance with the holistic understanding of curriculum articulated in NCFSE 2023, the overall learning experience of students is shaped not only by content and pedagogy, but equally by the school environment, practices, and culture. Schools must therefore function as vibrant, caring, inclusive, and safe communities where every learner feels respected, valued, and supported.

A nurturing school culture promotes cognitive, emotional, and physical i.e. holistic well-being. Schools are expected to create environments that are free from fear, discrimination, humiliation, and aggression. In this context, schools shall adopt measures consistent with the Board's guidelines on promoting emotionally safe spaces, including initiatives such as "No-Anger Zone" practices, and implement the School Health Manuals issued by the Board. Structured attention to mental health, counselling, and socio-emotional learning should form part of school processes.

Time-table design should reflect developmental needs, ensuring adequate rest, balanced academic engagement, and opportunities for physical activity, arts, and reflection. Health and nutrition awareness must be actively promoted. Schools should discourage the availability of unhealthy food within and around campus and encourage healthy dietary habits through structured awareness programmes and activities, in line with CBSE advisories. Consistent with NCF-2023, the classroom must be an interactive and inquiry-oriented space. Teachers are encouraged to draw upon learners lived experiences, local contexts, and everyday observations to design meaningful activities. Discussion, presentation, collaborative tasks,

and reflection should be integral to classroom practice to develop communication skills, critical thinking, and reasoning capacities.

Peer learning is recognised as a powerful pedagogical tool. Flexible seating arrangements and collaborative group structures may be adopted to encourage dialogue and teamwork. Classrooms must be inclusive and responsive to individual differences, including the needs of children with disabilities, consistent with the principles of equity and Universal Design for Learning.

Strong partnerships with families and communities are essential. Regular communication with parents, constructive feedback on student progress, and timely academic support or remedial interventions should be integral to school processes. Schools must uphold dignity and confidentiality, ensuring that no child is treated differently on the basis of socio-economic background, gender, caste, religion, or disability.

Through such inclusive, health-promoting, and value-oriented practices, the school environment becomes a lived embodiment of the aims of education — fostering rational thought, well-being, democratic participation, and responsible citizenship.

Creating Cross-Curricular Linkages

Creating cross-curricular linkages are vital to learning as they help to connect prior knowledge with new information. For example, Mathematical data handling and interpretation can be effectively applied in geography and science. Children can write better-framed answers in history, geography and science when they have learnt how to write explanations/ short descriptions in a language. Similarly, Life Skills like empathy, problem solving and interpersonal communications can be easily integrated with the study of literature and other areas. Universal Values, Life Skills and Constitutional Values with emphasis on realization of Fundamental Duties may be incorporated depending upon context in almost all the subjects.

4.5 21st Century Skills

There is an increased awareness among the educators of the need to integrate what are called as 21st Century skills in educational systems. There are three key 21st century skills;

There are three major 21st century skills i.e. Learning Skills, Literacy Skills and Life Skills.

Learning Skills include:

Critical Thinking

Creativity

Communication

Collaboration

Literacy Skills include:

Information Literacy

Media Literacy

Technology Literacy

Life Skills include:

Flexibility

Leadership

Initiative

Productivity

Self-awareness

The need of the hour is that schools must focus on enhancing the skills required for a successful adult life in 21st Century. It is important that the students are able to think scientifically, mathematically or artistically to face the real-life challenges in an information and technology driven world and enhance their inherent potential. CBSE has published a handbook on 21st century skills available at its website. Schools may further refer to it.

4.6 Inclusive Education

Inclusive approach in education is a prerequisite for ensuring full participation of all students with equal opportunity in all areas without any discrimination. Inclusive attitude in all staff and faculty members is crucial for successful inclusive education. Therefore, all the members of teaching and non-teaching staff should be sensitized on the issues of inclusive education. Students without disabilities should also be sensitized.

Schools must organize these sensitization programmes with the support of experts from respective field of disabilities. Capacity Building Programmes on Inclusive Education may be organized in collaboration with the CBSE- Centres of Excellence. Board has made the appointment of special educator mandatory to all the schools affiliated to the CBSE. Special Educators must possess the qualification as prescribed by the Rehabilitation Council of India (CBSE Circular No. 31/2015). CBSE has published a handbook on Inclusive Education which is available at its website.

5.0 ROLE OF THE TEACHER IN TRANSACTING THE SECONDARY CURRICULUM

In alignment with the National Curriculum Framework-2023, teachers are not merely transmitters of content but facilitators of deep understanding, inquiry, ethical reasoning, creativity, collaboration, and holistic development. Teachers must feel accountable for the academic progress, well-being, and character formation of their students and act with utmost honesty, integrity, and professional commitment.

Teachers are required to engage in continuous self-assessment of their subject knowledge, pedagogical practices, and assessment strategies, and strive to keep themselves updated. They shall regularly refer to the CBSE Academic website for circulars, guidelines, sample papers, assessment frameworks, and other academic resources. Participation in a minimum of 50 hours of structured annual capacity-building programmes at national, regional, or school levels is mandatory. Teachers are expected to collaborate with colleagues, school leadership, and parents in the best interests of learners and contribute actively to school-level academic planning and reform implementation.

The successful implementation of the Secondary Curriculum depends fundamentally on the professionalism, reflective practice, and ethical commitment of teachers.

In transacting the curriculum at the Secondary Stage (Classes IX–XII), teachers are expected to:

- i. **Set High Expectations and Promote Learner Agency** - Set challenging yet achievable expectations that motivate students to strive for excellence. Encourage learners to reflect on their own progress, identify strengths and areas of improvement, and take responsibility for their learning.
- ii. **Align Teaching with Curricular Aims and Competencies** - Carefully study and internalise the Curricular Aims, Goals, Competencies, and Learning Outcomes articulated in NCF-FS 2022 and NCFSE. Lesson planning and classroom processes must be aligned to competency development rather than mere content coverage.
- iii. **Adopt Competency-Based and Experiential Pedagogy** - Design learning experiences that emphasise conceptual clarity, application, critical thinking, creativity, communication, collaboration, and problem-solving.

Teachers shall incorporate:

- a) Experiential and inquiry-based learning
- b) Discussion, debate, and reflective dialogue
- c) Art-integrated and interdisciplinary approaches
- d) Real-life applications and local contextual examples
- e) Learnings from SAFAL (Structured Assessment for Analysing Learning) reports to understand school-level strengths and weaknesses and plan targeted remediation based on competency-level performance data.
- f) Indian Knowledge Systems where appropriate
- g) Classroom strategies such as structured group work, case-based discussions, problem-solving tasks, simulations, and project-based learning should be used regularly, even in large classrooms.
- h) Contribute to the preparation of the Holistic Progress Card (HPC).

- iv. **Address Learner Diversity through Inclusive Practices**-Analyse the needs of students and innovate or adapt pedagogy accordingly. Ensure inclusive practices for students of diverse socio-economic, linguistic, and ability backgrounds, including Children with Special Needs. Provide multiple opportunities and varied modes of expression (oral, written, visual, digital) to ensure equitable participation.
- v. **Promote Physical Education and Well-being** - Teachers must recognise Physical Education and Well-being as integral to holistic development.

They should:

- a) Encourage active participation in physical activities, sports, yoga, and indigenous games.
- b) Reinforce awareness about nutrition, hygiene, mental health, and lifestyle choices.
- c) Coordinate with Physical Education teachers to monitor student participation and fitness progression.
- d) Integrate health awareness themes within subject teaching where appropriate (e.g., stress management, digital wellness, environmental health).

- vi. **Support Mental Health and Counselling Initiatives** - Teachers play a frontline role in safeguarding students' emotional well-being.

They must:

- a) Create emotionally safe and non-threatening classroom environments.
- b) Identify early signs of stress, anxiety, bullying, or distress and refer students to school counsellors when necessary.
- c) Promote open communication and empathetic listening.
- d) Support examination stress management and resilience-building activities.
- e) Participate in orientation programmes on child protection and psychosocial well-being.
- f) Adhere strictly to statutory provisions including the RTE Act, POCSO Act, CBSE Affiliation Bye-Laws, and relevant guidelines of NCPCR. Treat every student with dignity and fairness.

- vii. **Demonstrate Constitutional Values and Ethical Conduct** - Lead by example by demonstrating constitutional values, empathy, integrity, environmental responsibility, gender sensitivity, and democratic attitudes. Teachers play a critical role in nurturing responsible and informed citizens.
- viii. **Engage in Systematic Academic Planning** - Assist the Principal in formulating the Annual Pedagogic Plan. Prepare well-structured lesson plans aligned with instructional time norms and CBSE directions regarding experiential, joyful, art-integrated, and competency-based pedagogy. Plan homework and enrichment tasks meaningfully to consolidate and extend understanding rather than promote rote repetition.
- ix. **Implement Competency-Focused Assessment Practices** - Study CBSE exemplar question papers, and competency guidelines to design balanced formative and summative assessments.

Teachers shall:

- a) Incorporate case-based, source-based, and application-oriented questions
- b) Conduct regular formative assessments to gauge conceptual understanding
- c) Use assessment data to identify learning gaps and plan remediation
- d) Maintain evidence of student progress through portfolios and project work
- e) Contribute to the preparation of the Holistic Progress Card
- f) Assessment shall be conducted as, for, and of learning, promoting reflection and continuous improvement.

- x. **Provide Constructive and Timely Feedback** - Offer specific, actionable feedback that guides learners toward improvement. Encourage students and parents to engage meaningfully with feedback to strengthen the home-school partnership in learning.
- xi. **Use Effective Classroom Management Strategies** - Adopt structured group roles, collaborative tasks, and clear classroom routines to ensure engagement and discipline. Encourage student responsibility and active participation.
- xii. **Integrate Technology Judiciously** - Use digital resources such as DIKSHA modules, virtual simulations, educational videos, and online assessments where feasible. Technology shall be used to enhance learning outcomes and accessibility, not as an end in itself.
- xiii. **Maintain Professional Discipline and Commitment** - Maintain high standards of attendance, punctuality, preparedness, and professional conduct. Participate actively in school-level initiatives and duties assigned by CBSE from time to time.
- xiv. **Use resources available at DIKSHA, NISHTHA modules, NCERT, CBSE Academic website, SWAYAM courses, IIT PAL etc.**

5.1 Values Education and Life Skills

In accordance with the vision of NCFSE 2023, education must foster the development of ethical, constitutional, and human values alongside knowledge and capacities. Values are not to be treated as a separate subject, but as dispositions to be cultivated through curriculum content, pedagogy, school culture, and everyday practices.

Schools shall promote Constitutional values such as justice, liberty, equality, fraternity, respect for diversity, and democratic participation. Universal human values including honesty, responsibility, compassion, empathy, cooperation, respect for elders and all living beings, cleanliness, hygiene, and environmental sensitivity should be embedded across curricular areas and school activities.

NCFSE 2023 emphasises the development of Values and Dispositions, Capacities, and Knowledge in an integrated manner. Capacities often referred to as “21st century skills” — such as critical thinking, problem-solving, communication, collaboration, creativity, ethical reasoning, digital literacy, and environmental awareness — must be developed across subjects through meaningful and experiential learning.

Life skills are best cultivated through participatory pedagogies including discussion, debate, group projects, reflective writing, community engagement, sports, arts, and vocational experiences. The school environment itself should model inclusivity, respect, discipline, and care, so that students learn values through lived experience rather than instruction alone.

Assessment of values and life skills should be qualitative, formative, and observation-based, focusing on students’ participation, responsibility, collaboration, and conduct within the school community. The Holistic Progress Card (HPC) framework envisaged in NCFSE 2023 may be used to document growth in these areas rather than relying solely on numerical grading.

Parents and communities are important partners in nurturing disciplined behaviour and positive dispositions. Regular communication between schools and families should support the holistic development of learners. Thus, Values Education and Life Skills are integral to the broader aims of school education — fostering rational thought, well-being, democratic participation, economic participation, and cultural rootedness — and must be reflected in both curriculum design and school culture.

5.2 Rules Regarding Admission and Examination

Regarding eligibility for Admission, Eligibility for Examination, Scheme of Examination and related information, please see the Examination Bye-Laws of CBSE available on www.cbse.nic.in.

5.3 Introduction of National Curriculum Framework for Foundational Stage-2022

NCF-FS 2022 was introduced in the Session 2023-24 in those CBSE schools which offer education at foundational stage to students in the age group of 3-8 years. Schools offering foundational or preparatory education are mandatorily required to adhere to the recommendations regarding curriculum, pedagogy,

assessment and other areas described in detail in the NCFFS-2022. All schools must necessarily adopt 5+3+3+4 structure.

Teacher's qualifications remain same as per the existing National Council of Teachers Education's notification no 62-1/2012/NCTE(N&S) dated November 12,2014 and its subsequent amendments.

Schools are advised to go through the NCF-FS-2022 document available at https://ncert.nic.in/pdf/NCF_for_Foundational_Stage_20_October_2022.pdf for its implementation.

The NCF-FS includes many examples and illustrations which play a critical role in its implementation. They help to clarify abstract concepts, reinforce learning, and make new ideas more accessible to practicing teachers. Myriad examples are aptly incorporated to enhance understanding, foster engagement, and elaborate concrete ways concepts can be implemented in day-to-day teaching. So, it is critical that teachers look at these illustrations and contextualize them according to the needs and contexts of children.

5.4 Academic Guidelines

Major academic highlights of NCFFS-2022 for the benefit of schools are reproduced as hereunder:

a) Curricular Goals and Learning

NCF-FS-2022 identifies five key domains of development viz., Physical Development, Socio Emotional and Ethical Development, Cognitive Development, Language and

Literacy Development, and Cultural Development, and Positive Learning Habits. Illustrative Curricular Goals, Competencies, and Learning Outcomes for the foundational stage in all these domains are given in NCF-FS-2022. Teachers should adapt the same in their curriculum to be designed by schools. The curriculum followed by schools should make specific choices for content and materials based on the Learning Outcomes, the principles, and guidelines of NCF along with considerations for the local context. Schools will follow their curriculum based on NCF-FS-2022.

For the Foundational Stage, it would be appropriate to develop activity books and other handbooks for Teachers, that would guide them through the sequence planned in the syllabus. The syllabus should include broad guidelines for assessments that check for the achievement of Learning Outcomes.

b) Organisation of Content

The selected content should be empirically engaging (e.g., engaging the child's senses) and/or relevant to their experience. It should be based on the child's experiences and reflect the child's socio-cultural and geographical context. Furthermore, content should introduce natural and human environments, the social and physical world, people, places, and living and non-living things. To accommodate the varied interests of individual children, the content should be diverse and inclusive. Special care should be taken to preclude the promotion of stereotypes.

Textbooks might be inappropriate for children of ages 3 to 6, activity books can guide Teachers to sequence activities and learning experiences. Textbooks can be introduced in class 1 and they must allow for the children's active participation. Workbooks and textbooks ought to be complementary to one another. Audio-visual materials including flashcards, cardboard-and-sandpaper, shapes of alphabets, games, and puzzles should adequately supplement textbooks.

When foundational stage children actively engage their hands and employ various senses, they learn more effectively. It is, thus, important to go beyond textbooks and use a range of Teaching Learning Material (TLM) at this Stage, from basic playthings to specific manipulatives for counting and numeracy. The majority of the TLM needed for the Foundational Stage can be constructed with readily available low-cost materials. For example, cardboards, straws, packaging material, old clothing, bottle caps, seeds, and pebbles (for counting), match sticks (without chemicals), discarded paper, coconut shells, and egg cartons (for sorting). Teachers can bring leftover fabric to create puppets, soft cloth balls, and other playthings. Young children can find making basic toys, puzzles, and board games to be particularly engaging activities that allow them to use all of their developmental domains.

The language content should contain a fair mixture of narratives, poetry, and information on local, natural and social contexts. Content on both flora and fauna as well as social and cultural issues allows youngsters to grasp the world around them while stories and poems develop young children's linguistic and imaginative abilities. Schools will aim to ensure the availability of teachers so that at least two or preferably three languages are taught to children on a regular basis.

Reading and writing should be initially developed through R1 (language in which a child first learns the concept of reading and writing) which is preferably L1 (mother tongue/ home language / familiar language) whenever possible, via early exposure to oral language development, meaning-making activities, and print materials. Understanding of phonemes and graphemes and the correspondence between them (decoding) will be developed through games and interactive exercises. The aim should be to achieve literacy skills in R1 by Grade 3.

Mathematical content can represent engagement with the surrounding environment, much like language can. Counting and other mathematical tasks can be combined with interactions with the natural and social settings.

The content of art learning experiences should be derived from the school's local environment and designed as activities centred on specific learning outcomes.

Schools may also make use of the Jadui Pitara (Collection of teaching-learning material) prepared by NCERT for the teaching-learning process for the Foundational Years. Jadui Pitara is available at DIKSHA portal. Further, it is recommended that all related Teaching-Learning material for Foundational Stage being released by NCERT be used for teaching-learning purposes.

c) Pedagogical Practices

CBSE advocates experiential, activity based and joyful learning. As part of its conceptual, operational, and transactional approach to curriculum structure, pedagogy, time and content organisation, and the overall experience of the child, NCF-FS2022 emphasises the significance of "play" as the cornerstone of these concepts. Play, in addition to sports and games, also includes singing songs, conversations, toys, stories, music, puzzles, rhymes, art and craft, painting, clay moulding, dancing, etc. Different children learn at different paces, and in different ways. So, it's crucial to avoid pressurising students to adopt a certain learning style. Children should be allowed to play with anything that engages them, is safe and easily available. In early education, experiential learning is essential. Projects give kids the chance to hone a variety of abilities, especially those that require peer collaboration.

Stories stimulate learning in children, and helps them build their own vocabulary. Stories not only introduce children to the world outside of their immediate experience but also to a wealth of resources for language learning and developing, helping youngsters acquire much more than just words. Stories help develop curiosity, imagination and intellect, promote emotional and social growth, making them an effective tool for children's overall development.

Schools may use thematic approach at this stage as a variety of curriculum areas are connected and integrated within a theme. Children are assisted in making meaningful connections through a theme and exploring different themes or elements within the theme as opposed to learning different skills at different times or learning distinct subjects.

Each of the aforementioned strategies has unique merits. A single, particular strategy for teaching and learning is not recommended. Depending on their environment and needs, teachers and schools are left to choose the best method for creating learning content and transaction of teaching learning.

d) Assessment

Overall approach in these years as in all higher classes is also competency focussed assessment using a variety of techniques. However, assessment should not contribute to any additional burden for the child, should not overtly burden the teacher and care must be taken not to label the child. Teachers should try to provide each child individual care and attention and keep observing what they are doing.

The stipulated learning outcomes may not be achieved in a linear fashion for all students. Children take their time and have their own ups and downs during their journey towards achieving these learning objectives. Teachers, thus, need to be very patient provide adequate space and time to each child as per her/ his need and not be overbearing. Some of the strategies that can be employed to assess progress of children may be guided observation, storytelling etc. Tools of assessment may include anecdotal records, checklists, event sampling and analysis of artefacts and workbooks. Teachers should analyse evidence from multiple sources taken over a period of time to assess the extent to which children have demonstrated understanding and acquisition of skills.

There should be no ranking of students at this stage as each child is unique. A teacher can sometimes accomplish a range of distinct curricular objectives and competences just by telling a story, having a conversation, or playing a game. Therefore, the teacher should have the freedom to conduct activities as she / he seems fit in the context of their classrooms.

More details can be found in the format of Holistic Progress Card for foundational stage developed by CBSE.

e) Identification of Developmental Delays

In order to ensure holistic and inclusive education, it is important to ascertain provisional cases of developmental delay in children significantly lagging in achieving developmental milestones in physical, cognitive, communication, social-emotional, behavioural, - or a combination of domains. NCFFS-2022 emphasizes the importance of early identification and intervention to ensure individual children receive timely and appropriate help. Though schools and Teachers are not supposed to confirm developmental delay or disability and should refer the perceptible cases to authorized medical professionals for diagnose, however, they can take the following steps to identify provisional cases for referring to clinical diagnosis:

Screening: Schools often conduct universal developmental screening to identify children who may be at risk for developmental delays. These screenings can be done by teachers, school psychologists, or other professionals using standardized assessment tools.

Teacher observations: Teachers spend a significant amount of time with their students and are well-positioned to observe developmental delays. Teachers can use checklists or rating scales developed by World Health Organisation to track their students' developmental progress and identify areas where children may need additional support. NCERT's PRASHAST is a checklist that enables the identification of children at risk. It comprises two parts - for use by regular teachers for first-level screening, and for use by special educators and others for second-level screening. It is a safeguard against unscientific diagnosis and needless labelling of children. It is aligned with the Rights of Persons with Disabilities Act (RPWD) Act 2016

Parental concerns: Parents are often the first to notice developmental delays in their children. School staff should listen to parents' concerns and take appropriate action to assess and address any developmental concerns

Standardized testing: Schools may administer standardized tests to assess academic skills, cognitive abilities, or social-emotional development. If a student performs significantly below their peers on these assessments, it may indicate a developmental delay.

The framework also encourages teachers to work closely with parents and caregivers to support children's learning and development. It emphasizes the importance of building strong partnerships between schools and families to create a supportive and collaborative learning environment for children.

Schools may make use of practical ideas and Sample Individual Education Programmes given in the framework to identify and support children with developmental delays.

f) Use of Technology

Technology can be used to enable equitable access to a diverse range of content and material in diverse forms, spaces, and formats that is contextual for children of varying backgrounds including Divyang (CWSN) children.

Technology can enhance the learning experience and create new opportunities. It empowers students to be more creative, connected and collaborative with their peers and teachers. Using technology gives the opportunity to develop student's digital citizenship skills. As use of digital devices is bound to increase with passage of time, it is important for children to learn from their initial years to use digital devices with responsibility. Technology should also provide an enjoyable experience for the learner and feed the child's innate curiosity.

Schools must also use technology in Capacity Building of Teachers, parents, and the community.

g) The Learning Environment

A welcoming, compassionate environment where collaboration, inquiry, dialogue, and reflection are commonplace is a prerequisite for effective teaching and learning. Teachers require surroundings that are resource-rich, inspiring, and that offer ongoing chances for professional development and connection.

Access to safe infrastructure viz., potable water, clean and well-maintained restrooms with running water, arts and crafts supplies, furniture to set up learning corners, and a variety of children's books and learning resources must be available to enable a conducive learning environment.

h) Organisation of Time in the School

The National Curriculum Framework for Foundational Stage 2022 highlights the importance of careful planning and organisation of time by allotting adequate and equitable time to all domains to achieve holistic education of children. Each activity may be planned to keep in mind the attention span of the child. There may be a balance between child-initiated and Teacher-guided activities, group (whole group or small group) and individual or pair activities, and alternating activities (e.g., quieter activity after physical activity, group activity after individual activity, indoor activity after outdoor activity). Art and Craft, Outdoor Play, and Free Play must have adequate time and focus during the day. Frequent breaks and transitions may also be provided to allow children to regain their energy and interest.

To achieve this, the curriculum framework recommends a balanced distribution of time across different areas of learning, such as language, mathematics, environmental studies, arts, and physical education. Illustrative examples are provided for schools to help in formulating their own schedules.

Similarly, the NCFFS advocates the need for the preparation of an annual calendar detailing all important school events prior to the commencement of the school academic year. Events of the school e.g., duration of the school term, vacations, annual day, sports day, other school celebrations, exhibitions/field trips, parent-teacher meetings, teacher professional development programs, and school meetings may be a part of this calendar.

i) Culture of the Institution

Fundamentally, if children are loved and cared for, they will learn. Teachers should be kind and compassionate. The school should be a safe space for all children. Children learn from their parents (the mother being the first teacher), the teacher in the classroom and the environment around. Therefore, it is vital that the school works seamlessly with the parents and the community to provide maximum learning opportunities for all children.

j) Teacher Orientation and Continuous Capacity Building

Through a variety of channels, teachers must consistently engage in their professional growth. The content must address the difficulties teachers confront, be thorough and complete, relevant to the classroom. It is necessary to provide platforms for peer learning with mentoring and assistance to teachers. Schools are required to fulfil the mandate given by CBSE regarding annual minimum teacher training hours.

Guidelines on National Curriculum Framework for School Education -2023

The National Curriculum Framework for School Education (NCFSE) serves as the guiding framework for the 5+3+3+4 schooling model proposed in the National Education Policy 2020 (NEP 2020). The framework is organized into five parts, covering broad aims, cross-cutting themes, subject-specific guidelines, school culture, and requirements for an effective schooling ecosystem. It was developed with a comprehensive approach covering all four stages of schooling, namely the Foundational Stage, Preparatory Stage, Middle Stage, and Secondary Stage.

Schools are advised to follow the following guidelines for implementing NCFSE-2023:

01 Ensure Comprehensive Coverage

Implement the framework to address learning standards, content selection, pedagogy, and assessments for each stage of schooling.

02 Facilitate Practical Implementation:

Provide guidance that is understandable and applicable to teachers and parents to facilitate practical changes in educational practices.

03 Ensure Clear Learning Standards:

Follow the specific learning standards for each subject to provide a clear direction for educators and stakeholders, emphasizing competency development as provided for different stages in the NCFSE-2023.

04 Focus on Holistic Development:

Foster not only knowledge but also fundamental capacities such as critical thinking, creativity, and values essential for holistic growth

05 Empower Teachers and Schools:

Design the curriculum to empower teachers and institutions, fostering creativity and engagement in the teaching-learning process.

06 Encourage Diverse Pedagogical Approaches:

Encourage a variety of pedagogical methods tailored to different age groups and contexts, including experiential, play-based, and inquiry-based approaches.

07 Integrate Cultural Values:

Root the curriculum in Indian knowledge and values, integrating contributions from ancient to contemporary times across various subjects.

08 Promote Multidisciplinary Education

Foster multidisciplinary learning to cultivate an integrated perspective and holistic understanding among students.

09 Ensure Equity and Inclusion

Guided by principles of equity and inclusion, ensure access to quality education for all learners.

10 Emphasize Art, Physical Education, and Well-being:

Renew emphasis on Art Education and Physical Education, incorporating specific learning standards and recommended time allocations.

11 Prioritize Environmental Education:

Recognize environmental challenges by emphasizing environmental education across all stages of schooling.

12 Integrate Skill (Vocational) Education:

Integrate Skill education with specific standards, content, pedagogy, and assessments.

13 Foster Multilingualism

Emphasize multilingualism, expecting proficiency in at least three languages, including Indian languages. Refer to CBSE advisory No: Acad-84/2023 dated July 21, 2023, for detailed guidelines.

14 Enhance Mathematical and Scientific Literacy:

Emphasize conceptual understanding and procedural fluency in Mathematics, alongside the development of scientific inquiry skills.

15 Adopt Interdisciplinary Learning:

Encourage an interdisciplinary approach in Social Science education, exploring themes across human societies and natural environments.

16 Provide Flexibility in Secondary Stage:

Offer flexibility and choice in the Secondary Stage, allowing students to select subjects aligned with their interests and aspirations.

17 Introduce Interdisciplinary Areas of Study:

Introduce separate interdisciplinary areas of study in the Secondary Stage to address contemporary challenges using knowledge from multiple disciplines.

Further, in line with the NCFSE 2023, it is imperative for schools to reassess and transform their approach to assessments. Here are some guidelines to facilitate this transformation across different stages of schooling:

FOUNDATIONAL STAGE:

- Ensure assessment methods are aligned with children's natural learning experiences, avoiding undue pressure.
- Assessment tools should seamlessly integrate with learning experiences, avoiding the use of traditional tests and exams.
- Recognize and accommodate the diversity in children's learning styles and expressions, allowing teachers the flexibility to design various assessment methods effectively.
- Facilitate systematic recording and documentation of children's progress through evidence collection.
- While teachers should have autonomy in selecting assessment tools, systematic recordkeeping is crucial for professional responsibilities.
- Prioritize observation of children and analysis of their created artifacts as primary assessment methods.

Preparatory Stage:

- Establish a robust system of formative assessment to track individual student progress as formal learning commences across various subjects.
- Help students understand the competencies they are expected to achieve, facilitating their understanding.
- Introduce formative oral and written assessments, alongside observation and artifact analysis, to assess conceptual understanding and creativity.
- Conduct comprehensive summative assessments at the end of each year to ensure readiness for the next grade, providing support options during breaks between grades.

Middle Stage:

- Maintain a competency-based assessment approach, covering all dimensions of learning, particularly with the introduction of complex concepts.
- Shift emphasis towards conceptual understanding and higher-order capacities, utilizing various assessment techniques like projects, debates, and presentations.
- Focus regular assessments on testing conceptual understanding and higher-order capacities, encouraging creativity through appropriate questions.
- Conduct yearly comprehensive summative assessments, offering support options to ensure readiness for the next grade.

Secondary Stage:

- Emphasize regular formative assessments to facilitate meaningful learning and constructive feedback, especially considering the greater subject depth.
- Continue utilizing classroom assessments, with self-assessment playing a significant role in student learning.
- Design assessments to evaluate competencies using diverse methods such as case-based questions, simulations, and essay-type questions, fostering creativity.
- Utilize a variety of assessment methods, including written tests, practical tests, projects, and open-book tests, with comprehensive summative assessments conducted at the end of each year or term, often in the form of board examinations.

Additionally, schools are required to implement Holistic Progress Cards (HPCs) as formal communication tools between schools and families, providing comprehensive reporting of students' progress based on competencies and learning outcomes achieved. HPCs should focus on individual progress and interests, providing disaggregated reporting to avoid comparisons with peers. Detailed guidelines and prototypes of HPC have been provided by CBSE for Foundational and Preparatory Stage.





CENTRAL BOARD OF SECONDARY EDUCATION

ACADEMIC UNIT, INTEGRATED OFFICE COMPLEX,
SECTOR 23, PHASE-I, DWARKA, NEW DELHI

CBSE | DEPARTMENT OF SKILL EDUCATION

CURRICULUM FOR SESSION 2026-2027

EMPLOYABILITY SKILLS

(COMMON FOR ALL SKILL COURSES)

CLASS IX

UNIT NO.	UNIT NAME
UNIT 1	Communication Skills - I
UNIT 2	Self- Management Skills - I
UNIT 3	Information and Communication Technology Skills - I
UNIT 4	Entrepreneurial Skills- I
UNIT 5	Green Skills - I

UNIT 1: COMMUNICATION SKILLS – I

LEARNING OUTCOMES	THEORY	PRACTICAL
1. Demonstrate knowledge of various methods of communication	1. Methods of communication - Verbal - Non-verbal - Visual	1. Writing pros and cons of written, verbal and non-verbal communication 2. Listing do's and don'ts for avoiding common body language mistakes
2. Identify elements of communication cycle	1. Meaning of communication 2. Importance of communication skills 3. Elements of communication cycle– - sender, - ideas, - encoding, - communication channel, - receiver, - decoding, and - feedback	1. Draw a diagram of communication cycle 2. Role plays on communication process related to the sector/job role
3. Identify the factors affecting our perspectives in communication	1. Perspectives in communication 2. Factors affecting perspectives in communication - Visual perception - Language - Past experience - Prejudices - Feelings - Environment	1. Group discussion on factors affecting perspectives in communication 2. Sharing of experiences on factors affecting perspectives 3. Sharing experiences on factors affecting communication at workplace

LEARNING OUTCOMES	THEORY	PRACTICAL
4. Demonstrate the knowledge of basic writing skills	1. Writing skills related to the following: - Phrases - Kinds of sentences - Parts of sentence - Parts of speech - Use of articles - Construction of a paragraph	1. Demonstration and practice of writing sentences and paragraphs on topics related to the subject

UNIT 2: SELF-MANAGEMENT SKILLS – I

LEARNING OUTCOMES	THEORY	PRACTICAL
1. Describe the meaning and importance of self-management	1. Meaning of self-management 2. Positive results of self-management 3. Self-management skills	1. Identification of self-management skills 2. Strength and weakness analysis
2. Identify the factors that helps in building self-confidence	1. Factors that help in building self-confidence – social, cultural, and physical factors 2. Self-confidence building tips - getting rid of the negative thoughts, thinking positively, staying happy with small things, staying clean, hygienic and smart, chatting with positive people, etc.	1. Role play exercises on building self-confidence 2. Use of positive metaphors/ words 3. Positive stroking on wakeup and before going bed 4. Helping others and working for community

UNIT 3: INFORMATION AND COMMUNICATION TECHNOLOGY SKILLS – I

LEARNING OUTCOMES	THEORY	PRACTICAL
1. Describe the role of Information and Communication Technology (ICT) in day-to-day life and workplace	1. Introduction to ICT 2. Role and importance of ICT in personal life and at workplace 3. ICT in our daily life (examples) 4. ICT tools - Mobile, tab, radio, TV, email, etc.	1. Discussion on the role and importance of ICT in personal life and at workplace. 2. Preparing posters / collages for showing the role of ICT at workplace
2. Identify components of basic computer system and their functions	1. Computer system - Central Processing Unit (CPU), memory, motherboard, storage devices 2. Hardware and software of a computer system	1. Connecting the cables and peripherals to the Central Processing Unit 2. Starting and shutting down a computer

LEARNING OUTCOMES	THEORY	PRACTICAL
	3. Role and functions of Random Access Memory (RAM) and Read Only Memory (ROM) 4. Role and functions of Central Processing Unit 5. Procedure for starting and shutting down a computer	3. Group discussion on the various aspects of hardware and software
3. Demonstrate use of various components and peripherals of computer system	1. Peripherals devices and their uses – mouse, keyboard, scanner, webcam, etc. of a computer system	1. Identification of various parts and peripherals of a computer 2. Demonstration and practice on the use of mouse 3. Demonstration and practice on the use of keyboard 4. Demonstration of the uses of printers, webcams, scanner and other peripheral devices 5. Drawing diagram of computer system and labelling it
4. Demonstrate basic computer skills	1. Primary operations on a computer system – input, process, storage, output, communication networking, etc.	1. Identification of the various input and output units and explanation of their purposes

UNIT 4: ENTREPRENEURIAL SKILLS- I

LEARNING OUTCOMES	THEORY	PRACTICAL
1. Identify various types of business activities	1. Types of businesses – service, manufacturing, hybrid 2. Types of businesses found in our community Business activities around us	1. Prepare posters of business activities found in cities/villages, using pictures 2. Discuss the various types of activities, generally adopted by small businesses in a local community 3. Best out of waste 4. Costing of the product made out of waste 5. Selling of items made from waste materials 6. Prepare list of businesses that provides goods and services in exchange for money
2. Demonstrate the knowledge of distinguishing characteristics of entrepreneurship	1. Meaning of entrepreneurship development 2. Distinguishing characteristics of entrepreneurship	1. Prepare charts showing advantages of entrepreneurship over wages 2. Group discussions on role and features of entrepreneurship

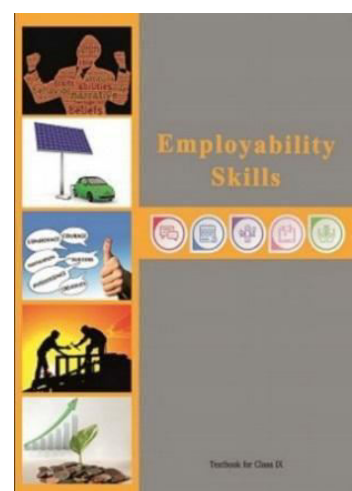
LEARNING OUTCOMES	THEORY	PRACTICAL
	3. Role and rewards of entrepreneurship	3. Lectures/presentations by entrepreneurs on their experiences and success stories 4. Identify core skills of successful entrepreneur

UNIT 5: GREEN SKILLS – I

LEARNING OUTCOMES	THEORY	PRACTICAL
1. Demonstrated the knowledge of the factors =influencing natural resource conservation	1. Introduction to environment, 2. Relationship between society and environment, ecosystem and factors causing imbalance 3. Natural resource conservation 4. Environment protection and conservation	1. Group discussion on hazards of deteriorating environment 2. Prepare posters showing environment conservation 3. Discussion on various factors that influence our environment
2. Describe the importance of green economy and green skills	1. Definition of green economy 2. Importance of green economy	1. Discussion on the benefits of green skills and importance of green economy 2. Prepare a Poster showing the importance of green economy with the help of newspaper/ magazine cuttings

Suggested Textbook:

❖ Employability Skills for class IX by NCERT



The textbook can be downloaded using any of the following links:

<http://psscive.ac.in/publications/textbooks>

<https://cbseacademic.nic.in/skill-education-books.html>

ENGLISH

Class IX (2026-27)

Introduction

At the secondary stage, language learning strengthens the learners' abilities to use language meaningfully for comprehension, expression, interpretation, and critical engagement with texts. Pedagogical processes emphasise dialogic reading, reflective writing, listening, and speaking activities, and contextual use of language through discussion, interpretation, and creative expression. Assessment focuses on understanding, interpretation, communicative clarity, articulation of ideas, and the ability to analyse and respond to texts in multiple modes, rather than only on recall-based written responses.

As per NCF-SE 2023, language education at the Secondary Stage must specifically aim to achieve:

- (a) **Oracy and literacy:** Oracy and literacy are fundamental to school education.
 - Attaining oracy means students develop fluency in expression and understanding of spoken language.
 - Literacy means that all students demonstrate fluent and critical reading, writing, and comprehension capacities in the language.
- (b) **Effective communication skills:** Students may develop their language capacities to think critically, identify real-world problems, analyse them, make rational arguments, work out solutions and communicate well in a variety of situations for effective democratic, social, and cultural participation.
- (c) **Literary and creative capacities:** Language teaching in schools must aim at building capacities in students towards an appreciation of the literary aspects of language. It may also allow for an exploration of—how to be creative and imaginative in their spoken and written expressions across cultures.
- (d) **Appreciation and engagement in culture:** Learning a language is learning a culture. Thus, language plays an important role in the immersion and participation in culture. Students must be allowed to understand and appreciate the rich linguistic cultures of India.
- (f) **Linkages with the Indian Knowledge System:** Along with the development of skills and competence, other aspects such as emotional intelligence, social feeling, national pride, connections of art, social concerns, and natural science are addressed through content, context and pedagogy with the focus on fundamentals of literature and life (critical thinking), such as emotion, perception, feeling, sound, language, thought, memory, metaphor, aesthetics, environment, self, society, culture, civilisation, etc.

Language Learning Approach

Experiential, activity and discussion-based approaches are recommended to promote the culture of self-learning and reduce dependence on the teacher. The teaching of language will be enhanced through innovative and experiential methods. Thus, the teaching of language will also be based on the experiential-learning pedagogy. The shift requires that students' contexts and experiences become part of the pedagogical processes.

Experiential learning includes any type of activity that comprises learning by doing, i.e., experimenting, exploring, sharing personal narratives, observing, cooperative learning, and above all, self-learning and self-assessment. Students need to have mastery in the 21st century skills, such as effective communication, critical thinking, creativity, collaboration, etc.

There are diverse learning situations and contexts in India. Language education plays a crucial role in keeping students rooted to their country, as it allows individuals to connect with their culture, heritage and society.

Learning Standards

Learning standards enable teachers to plan their content, pedagogy, and assessment towards achieving specific competencies. These must be seen as enabling guidelines for teachers and school leaders, not as constraining demands on them. By the end of the secondary stage, we would expect every student must have gained the whole range of skills and competencies. It is at this stage that using the language of students turns out to be more productive. Students use language to interpret, understand, address issues, and gain knowledge that will help them to become autonomous learners.

As per NCF-SE 2023, students will develop linguistic proficiency for academic use in R1 and R2 by the end of the secondary stage ensuring that a higher level of familiarity, understanding, and interpretation of literature is achieved.

Curricular Goals and Competencies-Secondary Stage

Curricular Goals (CGs) are specific statements derived from the broader Aims of Education that give clear direction to curriculum development and implementation. Competencies are the specific, observable, and systematically assessable learning achievements that students must attain by the end of the stage.

Language R1

Curricular Goal (CG)	Competency (C)
CG-1: Uses language for effective communication through writing various forms (essays, letters, articles, discussions, interviews, public speeches) and for new media (email, audio, and visual material).	C-1.1: Uses language appropriate to social context, expresses agreement and disagreement with reasons, and arrives at conclusions through discussion and debate. C-1.2: Writes in different styles (narrative, descriptive, expository, persuasive) from their own experiences and experiences of others. C-1.3: Writes for real-life situations (invitations, speeches, condolence messages, notices, creative slogans, advertisements) and for school newsletter/magazine/journal. C-1.4: Scripts to inform and communicate ideas effectively with the use of technology.
CG-2: Develops an appreciation of the aesthetics in different genres (humour, suspense, tragedy) through analysis of style (narrative, descriptive, expository, persuasive) and employs these elements in their writing.	C-2.1: Describes characteristics of works of literature from different time periods (such as early, medieval, contemporary). C-2.2: Analyses a literary text by close reading, critiquing form and style, and interpreting possible meanings. C-2.3: Composes literary texts by using appropriate literary devices.
CG-3: Uses language to develop reasoning and argumentation skills by engaging with a variety of audio and written material.	C-3.1: Analyses and evaluates the different audio and written material. C-3.2: Argues with proper rationale by carefully evaluating premises.
CG-4: Appreciates literary and cultural heritage in and related to the language and the richness of Indian languages.	C-4.1: Recognises the multilingual nature of Indian society and richness of its literary work through reading texts and watching content of different genres. C-4.2: Appreciates the richness of culture and heritage in the different works of regional language literature and their connections. C-4.3: Shows an understanding of the role of language in the formation of our identities and culture. C-4.4: Demonstrates a basic knowledge of the commonalities among some of the major Indian languages, such as their common phonetic and scientifically arranged alphabets and scripts, common grammatical structures, origins and

Curricular Goal (CG)	Competency (C)
	sources of vocabularies from Sanskrit and other classical languages. C-4.5: Demonstrates a basic knowledge of which languages are spoken in which geographical areas, a sense of the nature and structure of tribal languages, and becomes familiar with a few useful words and phrases and works of literature from a few Indian languages from across the country.

Language R2

Curricular Goal (CG)	Competency (C)
CG-1: Uses language for effective communication through various oral activities (discussions, interviews, public speeches) and writing activities (essays, letters, articles), including new media (email, audio, and visual material).	C-1.1: Uses language appropriate to social context, expresses agreement and disagreement with reasons, and arrives at conclusions through discussion and debate. C-1.2: Writes in different styles (narrative, descriptive, expository, persuasive) from their own experiences and experiences of others. C-1.3: Writes for real-life situations (invitations, speeches, condolence messages, notices, creative slogans, advertisements) and for school newsletter/magazine/journal. C-1.4: Scripts to inform and communicate ideas effectively with the use of technology.
CG-2: Uses language to develop reasoning and argumentation skills by engaging with a variety of audio and written material.	C-2.1: Analyses and evaluates different audio and written material. C-2.2: Argues with proper rationale by carefully evaluating premises.
CG-3: Develops an appreciation of the aesthetics in different genres (humour, suspense, tragedy) through an analysis of style (narrative, descriptive, expository, persuasive) and employs these elements in their writing.	C-3.1: Describes characteristics of works of literature from different time periods (such as early, medieval, contemporary). C-3.2: Analyses a literary text by close reading, critiquing form and style, and interpreting possible meanings. C-3.3: Composes literary texts using appropriate literary devices.

FOCUS AREAS OF THE SYLLABUS

The syllabus aims to develop students' ability to use language effectively for communication, reasoning and creative expression. The curriculum focuses on strengthening Listening, Speaking, Reading and Writing skills while fostering literary appreciation and critical thinking. Students engage with a variety of texts and activities that promote analytical thinking, creativity, collaboration and real-life application of language skills.

Reading

By the end of the secondary stage, students should be able to:

- Read and comprehend a variety of literary and non-literary texts with understanding.
- Identify main ideas, supporting details and key information in written texts.
- Analyse, interpret and evaluate ideas presented in different texts.
- Distinguish between facts and opinions and identify cause–effect relationships.
- Infer meanings and draw conclusions from textual evidence.
- Understand the author's perspective, tone and style of writing.
- Interpret information presented in different forms such as diagrams, charts and tables.
- Connect ideas from the text with personal experiences and social contexts.
- Develop critical reading skills through close reading and discussion.
- Read independently and engage with texts from diverse cultures and contexts.

Writing

By the end of the secondary stage, students should be able to

- Write clearly and coherently using appropriate grammar, vocabulary and organisation.
- Write in different styles such as narrative, descriptive, expository and persuasive.
- Present ideas with a clear beginning, middle and conclusion.
- Describe experiences, events and observations in a logical manner.
- Express opinions and viewpoints with appropriate reasoning and examples.
- Write for real-life purposes such as notices, invitations, advertisements, speeches and messages.
- Gather ideas from different sources and organise them effectively in writing.
- Write reports, articles and pieces for school magazines, newsletters and journals.
- Use technology and digital tools to present ideas through written and visual formats.
- Review, edit and improve written work through feedback and self-assessment.

Listening & Speaking

Listening

By the end of the secondary stage, students should be able to

- Listen attentively to conversations, discussions and audio material.
- Identify the main ideas and important details in spoken texts.
- Analyse and interpret information presented through speeches, discussions and media sources.
- Distinguish between key points and supporting information.
- Understand instructions, explanations and viewpoints expressed by others.
- Note important details and organise information appropriately.

Speaking

By the end of the secondary stage, students should be able to

- Express ideas clearly and confidently in different situations.
- Present opinions, viewpoints and arguments with logical reasoning.
- Participate actively in discussions, debates and conversations.
- Communicate effectively in formal and informal contexts.
- Present ideas through speeches, presentations and oral reports.
- Respond appropriately to questions and viewpoints of others.
- Interact respectfully with others during discussions and collaborative activities.

Structures (Grammar) & Vocabulary

By the end of the secondary stage, students should be able to

- use the **sequence of tenses** correctly in different contexts of communication.
- identify and apply **modal auxiliaries** to express ability, obligation, permission, possibility, and advice.
- transform and use **reported speech** in extended texts including statements, questions, commands, and requests.
- construct sentences using **Conditional Clauses (Type 1)** to express real and possible situations.
- apply the rules of **subject–verb concord** to ensure grammatical accuracy in sentences.
- use appropriate **determiners** to provide clarity and precision in communication.
- identify and construct **clauses**, including **noun clauses** and **relative clauses**, to create complex and meaningful sentences.
- expand vocabulary through contextual reading and writing;
- understand meanings of unfamiliar words through context and reference tools such as dictionaries;
- use appropriate words and expressions to communicate ideas clearly;
- apply vocabulary effectively in speaking and writing tasks.

Grammar and vocabulary learning will be reinforced through editing tasks, sentence transformation, contextual exercises and communicative activities to promote accuracy and fluency in language use.

Literature — Prose & Poetry

By the end of the course, students should be able to:

- Read and appreciate a variety of literary texts from different genres.
- Analyse characters, themes and ideas presented in literary works.
- Interpret events, conflicts and relationships in stories and poems.
- Recognise the influence of context, culture and background on literary texts.
- Identify literary devices such as simile, metaphor, imagery, repetition and symbolism.
- Interpret meanings beyond the literal level through critical reading.
- Evaluate characters' actions and motivations.
- Express personal responses and interpretations through discussion and creative activities.
- Develop an appreciation of the aesthetic and cultural aspects of literature.

Pedagogy of Language

Pedagogy, at the secondary stage, should take into consideration the knowledge and capacities that students will bring from the previous stages of schooling. The pedagogy may encourage more self-study and exploration with a focus on becoming fluent in the methods of inquiry specific to the Curricular Area. At this stage, students can be reasonably expected to become independent learners and the pedagogy in the classroom may reflect this expectation.

Classroom interactions may be a judicious mix of more direct instruction from the teacher with discussion, seminars for discussion, exploration and discovery, and opportunities for students to prepare individual and group projects and present key concepts of the discipline.

Depending on the matter of study, context, and stage of the student, these effective pedagogical approaches would be of a wide range, including pedagogy that is more experiential, integrated, inquiry-driven, discovery-oriented, discussion-based, project-based, arts-based, sports-based, and activity-based. Effective pedagogy, therefore, encourages conceptual understanding, active discovery, questioning and debating, and independent learning. It gives serious consideration to student experiences and student voices, acknowledges and accommodates student diversity, builds on students' previous knowledge, uses a range of teaching techniques, and gives timely feedback on the work done. Classroom processes must encourage active learning with an emphasis on dialogue and building relationships based on mutual respect.

At this stage, the following may become part of the pedagogical process.

a) **Oral presentations:**

- I. Students must be given opportunities for sharing their ideas freely and listening to others' points of view. They must also ask questions, argue for their own views, and accept others' views with proper justification.
- II. Students must be taught focused dialogue and conversation which require organising their thoughts for better clarity, the art of raising relevant questions, brainstorming, and thinking aloud, active participation, and skills of literary appreciation.
- III. Teachers must use methods, such as role play, group discussion, debate, open house dialogue, and interviews to allow students to ask questions and learn to respond impromptu. Club-based activities, assembly gatherings, and celebrations in schools can be used as platforms to practise these methods and may not be seen as a separate exercise.
- IV. Teachers must also find ways to teach students how to work on their listening skills (by paying attention to details and summarising) and use the same in day-to-day life.

b) **Developing reading skills:**

- I. **Literary language skills:** Students can be encouraged to participate in group activities in critically analysing a literary text in the class and participate in the activities of the school literature club, poetry house, and fiction-reading groups.
- II. **Critical reading skills:** The teacher may focus on enabling students to make meaning of a variety of texts, move from initial impressions to a closer reading of the text by asking questions related to the effect of words and ideas expressed, and how the effect of the language used in a text is working for specific purposes.
- III. **Exposure to reading multicultural texts:** Activities such as the comparison of literary works of two different writers can be done effectively by inquiring into the author's voice, cultural background, and context of the work, and talking about other similar works in the genre. Projects, plays, folk music performances, and posters are important ways in which students in this stage can be introduced to texts from a different era. Multicultural texts may be available in libraries for students to read in their free time.

c) **Developing writing skills:**

- I. **Functional language writing skills:** Students may be given enough opportunity to practise writing reports, essays, notes, applications, letters to editors, advertisements, and notices. They can also be encouraged to write in magazines, newsletters, newspapers, and blogs.

II. **Literary language writing skills:**

- i. Students must be guided towards independent and creative writing in this stage. They must be taught capacities for analysing literature and connecting it to its historical and socio-economical aspects rather than reading it in isolation, enabling the writing of a critical review.
- ii. Teachers must ensure students practise writing poems, stories, or plays with literary devices (e.g., similes, metaphors, hyperbole, irony, puns, and oxymorons).
- iii. Teaching them to identify voice and style of a writer taking cues from the material they read will help them find their own voice.

Assessment

In alignment with NCF-SE 2023, assessment moves beyond measuring recall to evaluating students' ability to interpret ideas, communicate effectively, think critically, and engage meaningfully with texts and contexts. Assessments should be based on observations, portfolios, and projects and should not just focus on capacities and skills, but also values and dispositions.

Assessments need to be visualised as an ongoing process which teachers integrate within the teaching-learning process using formal and informal ways to elicit reliable evidence about student learning. Assessment may not become an intimidating process that involves the labelling and segregation of students.

The 'assessment culture' must change, so that assessment is conducted increasingly as learning and for learning. There must also be periodic assessment of learning to ensure readiness for the next phase of learning and to arrange suitable support for students when this readiness is not achieved.

Assessment should emphasize a balanced approach integrating three dimensions:

Assessment of Learning; Assessment for Learning; Assessment as Learning

Assessments could be formative or summative, and both are important for improving teaching and learning.

a) Formative Assessment

- I. Formative assessments at secondary stage will continue to be competency-based, covering all dimensions of learning. Therefore, various formative assessment techniques, such as projects, debates, presentations, discussions, experiments, investigations, role plays, journals, and portfolios, should be used to assess learning.
- II. Regular assessments comprising MCQs and constructed responses (e.g., short answer and long answer), with the aim to test conceptual understanding and higher-order capacities rather than merely rote learning.
- III. Classroom and Self-assessment will play a key role in student learning at this stage.

- IV. Assessments can be designed using case-based questions, simulations, and essay-type questions to enable the assessment of competencies in order to continually replan and revise the teaching-learning process.

b) Summative Assessment

Summative examinations, including certification examinations, continue to be relevant as they serve as a necessary test to understand students' achievement of competencies and learning standards.

- I. At the end of each year (or term), there will be a comprehensive summative assessment, which in relevant cases, would be the Board examinations.
- II. Assessment may measure the achievement of competencies and learning standards leading to the attainment of Curricular Goals. The connection between the competencies or Learning Outcomes and the assessment should be clear and precise.
- III. Appropriate forms of assessments may be chosen in alignment with the competencies and learning standards to be assessed.
- IV. Assessments should be constructive, developmental, and learning focused.

Forms of Assessment

There are several forms of assessment that can be used across both formative and summative assessments.

(a) Written Tests: Forms of written tests include:

- I. **Objective Type Questions:** These include Multiple Choice Questions (MCQs), filling in blanks, matching, sorting lists based on select criteria, picking the odd one out, labelling a diagram, solving a crossword, unscrambling a word, solving riddles and word grids that require a very short or one-word answer.
- II. **Constructed Response Questions:** These are questions that require students to frame and write answers. They can be close ended (requiring one correct and short answer) or open-ended (requiring a short or long essay with multiple correct/alternate answers).
It is important to have clear and detailed scoring guides/marketing schemes for such questions to avoid subjectivity in assessment.
- III. **Graphic Organisers:** These visual representations of ideas and concepts help students organise their learning and assimilate new knowledge.

(b) Oral Tests: The most common forms are reading aloud, responding to questions, recitation, and debates and discussions. Other forms, include group discussions, presentations, and extempore talks.

- I. **Reading Aloud:** Reading assessments could include reading aloud a passage, a poem, or any other form of writing. Word recognition, fluency,

and voice modulation skills could be assessed along with comprehension by asking students to summarise or talk about what they have read.

- II. **Listening and Responding:** Students listen to a text and respond either orally or on a worksheet.
- III. **Recitation:** This helps the teacher assess the spoken language with a specific focus on pronunciation, intonation and comprehension by observing students' expressions and actions.
- IV. **Debates and Discussions:** Students' fluency of language as well as proficiency in making strong arguments using knowledge and reasoning to persuade and convince the audience can be assessed while also developing an ability to understand and respect others' viewpoints and opinions. Teachers can also include other parameters, such as diction deportment, ability to take criticism positively, and manage their emotions and body language during public speaking. Sharing parameters before setting the task helps students focus on developing these skills which serves as good learning opportunities as well.

Practical Tests

These require students to demonstrate specific skills and applications of their new learning. These include :

- I. **Projects:** Projects are longer, structured activities completed by individual students or groups of students that result in a product. For example, a model, a substantial report, or a collection of artefacts. While doing projects, students investigate, explore, and respond to complex questions, real-world challenges, and problems. Projects help assess collaboration, communication, perseverance, creativity, and problem solving along with assessing subject-specific knowledge and skills.
- II. **Portfolios:** A student portfolio is a purposeful collection of student work that tells a story about a student's efforts, progress, and achievement in one or more subjects over a period of time. It could be a collection of the student's day-to-day work or a selection of the student's best pieces of work. Portfolios may include writing samples, laboratory reports, journals, artwork, short surveys and research papers, projects, photos, worksheets, tests and map work, Teacher's qualitative comments on the students' work, peer feedback, and the students' own reflections on their learnings.

It becomes a cumulative record of performance from which emerges a clear picture of what students know, can do and how they have progressed over the period.

III. Multiple Assessment

These include a range of activities like quizzes, worksheets, oral presentations, class discussions, etc.

IV. Periodic Pen and Paper Assessment

Prescribed Textbook- Kaveri: Textbook of English for Grade 9

The textbook has been developed based on common curricular goals rather than rigid differentiation between R1 & R2. The textbook content, learning outcomes, and assessment remain aligned with the common competency framework envisaged for R1 and R2 at the secondary stage, and therefore, the same textbooks can be transacted flexibly in accordance with the learner profile and institutional context.

Question Paper Design- R1 & R2

ENGLISH LANGUAGE – SYLLABUS CLASS – IX (2026-27) R1

SUBJECT CODE –

Section		Weightage
A	Reading Skills	20 Marks
B	Writing Skills and Grammar	30 Marks
C	Language through Literature	30 Marks
D	Internal Assessment	20 Marks

Section A – Reading Skills

I. Reading Comprehension through Unseen Passage – 20 Marks (10+10)

- Descriptive/ Discursive Passage – 400-450 words – 10 Marks
- Case Based Passage (With verbal/visual inputs – statistical data/chart etc.) – 200-250 words – 10 Marks

Total Length of the two passages to be 600-700 words.

Question types to be included: Selected and constructed responses (MCQ's, Objective type, VSAQs, SAQs)

Section B – Writing Skills and Grammar – 30 Marks (10+20)

II. Grammar – 10 Marks (04+03+03)

- Sequence of Tenses in different contexts of communication
 - Modal Auxiliaries and their functions in expressing ability, obligation, permission, possibility and advice
 - Reported Speech in extended texts including
 - statements
 - questions
 - commands and requests
 - Conditional Clause – Type 1
 - Subject–Verb Concord
 - Determiners
 - Clauses – Noun Clause, Relative Clause
3. Editing/Omitting (Selected responses – MCQs) – 04 Marks
 4. Sentence Rearrangement – 03 Marks
 5. Sentence Transformation – 03 Marks

III. Writing Skills – 20 Marks (03+05+05+07)

6. Writing a Notice, Informal Invitation (Word Limit – Up to 50 words) – 3 Marks
7. Writing a Letter to Editor, Formal E-mail on a given issue for presenting views and suggestions –(Word Limit – 120-150 words) – 5 Marks
8. Writing a Factual Description, Magazine Article (Word Limit – 120-150 words) – 5 Marks
9. Writing Descriptive, Narrative Essay (Word Limit – 200-250 words) – 7 Marks

For questions 6 to 9 attempt any one as per the internal choice provided. The internal choice could comprise both same or different topics.

Section C – Language through Literature – 30 Marks (10 + 10 + 05 + 05)

IV. Extract Based Questions – 5x2 = 10 Marks

10. One extract out of two, from Drama / Prose.
11. One extract out of two, from poetry.

Types of questions to be included – Selected and constructed responses (MCQs, Objective Type Questions, VSAQs)

V. Constructed Responses (Short & Long Answer Questions)

12. Five out of Six Questions to be answered in 40-50 words. 5x2 = 10 Marks

13. One out of two Questions assessing extrapolation beyond the text and across the texts to be answered in about 120-150 words. 5 Marks
14. One out of two Questions assessing theme / plot/ character to be answered in about 120-150 words. 5 Marks

INTERNAL ASSESSMENT 20 MARKS	
Periodic Pen and Paper Tests	05 Marks
Multiple Assessment (Quizzes/ Oral Discussions/Presentations etc.)	05 marks
Portfolio	05 Marks
Subject Enrichment projects (ALS/ Art / IKS / Tech Integrated)	05 Marks

ENGLISH LANGUAGE – SYLLABUS CLASS – IX (2026-27) R2**SUBJECT CODE –**

Section		Weightage
A	Reading Skills	20 Marks
B	Writing Skills and Grammar	30 Marks
C	Language through Literature	30 Marks
D	Internal Assessment	20 Marks

Section A – Reading Skills**I. Reading Comprehension through Unseen Passage – 20 Marks (12 + 8)**

- Factual/ Literary Passage – 400-450 Words – 12 Marks
- Case Based Passage (With verbal inputs) – 200-250 Words – 8 Marks

Total Length of the two passages to be 600-700 words.

(Question types to be included: Selected and constructed responses (MCQ's, Objective type, VSAQs, SAQs)

Section B – Writing Skills and Grammar – 30 Marks (10+20)**II. Grammar – 10 Marks (04+03+03)**

- Sequence of Tenses in different contexts of communication
- Modal Auxiliaries and their functions in expressing ability, obligation, permission, possibility and advice
- Reported Speech in extended texts including
 - statements
 - questions
 - commands and requests
- Conditional Clause – Type 1
- Subject–Verb Concord
- Determiners
- Clauses – Noun Clause, Relative Clause

3. Paragraph Completion (Selected responses: Fill ups with options) – 04 Marks

4. Sentence Rearrangement – 03 Marks

5. Sentence Transformation – 03 Marks

III. Writing Skills – 20 Marks (04+05+05+06)

6. Writing a Notice, Creating a Poster (Word Limit – Up to 50 words) – 4 Marks
7. Writing a Letter to the Editor, Formal E-mail on a given issue for presenting views and suggestions (Word Limit – 120-150 words) – 5 Marks
8. Writing a Speech, Magazine Article based on visual or verbal cues (Word Limit – 120-150 words) -5 Marks
9. Writing a Narrative Essay (Word Limit – 150-180 words) – 6 Marks

For questions 6 to 9 attempt any one as per the internal choice provided. The internal choice could comprise both same or different topics.

Section C – Language through Literature – 30 Marks (15 + 10 + 05)

IV. Extract-Based Questions – 5x3 = 15 Marks

10. One extract out of two, from Prose.
11. One extract out of two, from Drama.
12. One extract out of two, from Poetry.

Types of questions to be included – Selected and constructed responses (MCQs, Objective type questions, VSAQs)

V. Constructed Responses (Short & Long Answer Questions)

13. Five out of Seven Questions to be answered in 40-50 words 5x2 = 10 Marks
14. One out of two Questions to be answered in 120-150 words to assess extrapolation beyond the text and across the texts; theme / plot/ character. 5 Marks

INTERNAL ASSESSMENT 20 MARKS	
Periodic 'Pen and Paper Tests	05 Marks
Multiple Assessment (Quizzes/ Oral Discussions/Presentations etc.)	05 marks
Portfolio	05 Marks
Subject Enrichment projects (ALS/ Art / IKS / Tech Integrated)	05 Marks

हिंदी पाठ्यक्रम (2026-27)

कक्षा-नवीं (आर -1)

भाषा किसी भी ज्ञान-क्षेत्र की आधारशिला है। हम प्रकृति और समाज को बहुत हद तक अपनी भाषा के ढाँचे के माध्यम से ही समझते और विश्लेषित करते हैं। इस कार्य को करने में भाषा का साहित्य हमारी विशेष सहायता करता है। माध्यमिक स्तर पर प्रवेश करने वाले विद्यार्थी सामान्य भाषा-ज्ञान से विशिष्ट अनुशासनात्मक अध्ययन की ओर बढ़ते हैं।

राष्ट्रीय शिक्षा नीति 2020 और विद्यालयी शिक्षा हेतु राष्ट्रीय पाठ्यचर्या की रूपरेखा 2023 की दृष्टि के अनुरूप यह पाठ्यक्रम हिंदी को केवल एक विषय नहीं बल्कि अनुभवों, मूल्यों, बहुसांस्कृतिकता, सृजनात्मकता और संवाद की एक समृद्ध प्रक्रिया के रूप में प्रस्तुत करता है। यह ज्ञान के संग्रह तक सीमित नहीं रहता बल्कि विद्यार्थियों को सोचने, कल्पना करने, विश्लेषण करने और अभिव्यक्ति के लिए प्रेरित करता है। पाठ्यक्रम का लक्ष्य विद्यार्थियों की चेतना को इस दिशा की ओर ले जाना है कि हिंदी भाषा के माध्यम से यथार्थ को अर्थात् जो भी घटित हो रहा है, उसे समझा जाए और उसमें अपनी आकांक्षाओं का चित्र रचा जाए। इस पाठ्यक्रम का केंद्रीय उद्देश्य पाठों का पठन-पाठन मात्र नहीं बल्कि उनके माध्यम से विद्यार्थियों में गहन पाठानुभूति, संवेदनशील अभिव्यक्ति, तार्किक विश्लेषण, संदर्भ-आधारित लेखन तथा भाषिक एवं सांस्कृतिक विविधता की समझ को विकसित करना है। हिंदी भाषा के सीखने-सिखाने के माध्यम से विद्यार्थियों में भाषा, संस्कृति का समावेशी दृष्टिकोण पैदा करना, जीवन के विविध संदर्भों को समझना, विविधता के प्रति सकारात्मकता का बोध पैदा करना- यह सब आवश्यक रूप से अपेक्षित है।

नवीं कक्षा में प्रवेश करने वाले विद्यार्थी की भाषा-शैली और विचार-बोध का एक ऐसा आधार बन चुका होता है कि अब उसे उसके भाषिक दायरे के विस्तार और वैचारिक समृद्धि के लिए आवश्यक संसाधन मुहैया कराए जाने की आवश्यकता होती है। माध्यमिक स्तर तक आते-आते विद्यार्थी किशोरावस्था में प्रवेश कर चुके होते हैं और उनमें सुनने, बोलने, पढ़ने, लिखने एवं समझने के साथ-साथ आलोचनात्मक दृष्टि विकसित होने लगती है। उनमें भाषा के सौंदर्यात्मक पक्ष, कथात्मकता, गीतात्मकता, समाचार-पत्रों की समझ, शब्द-शक्तियों के बीच अंतर की समझ, राजनैतिक चेतना एवं सामाजिक चेतना का विकास हो जाता है। वे आस-पड़ोस की भाषा और आवश्यकता के अनुसार उपयुक्त भाषा-प्रयोग, शब्दों के सुविचारित प्रयोग, भाषा की नियमबद्ध प्रकृति आदि से परिचित हो जाते हैं। इतना ही नहीं, वे विभिन्न विधाओं और अभिव्यक्ति की अनेक शैलियों से भी परिचित हो चुके होते हैं। अब विद्यार्थियों का अध्ययन आस-पड़ोस, राज्य-देश की सीमा को लाँघते हुए वैश्विक क्षितिज तक फैल जाता है। इन विद्यार्थियों की दुनिया में समाचार, खेल, फिल्म तथा अन्य कलाओं के साथ-साथ पत्र-पत्रिकाएँ और अलग-अलग तरह की पुस्तकें भी प्रवेश पा चुकी होती हैं।

एनसीईआरटी के पाठ्यक्रम और पाठ्यपुस्तकों में आर1 और आर2 के संदर्भ एनसीसीएफ-एसई 2023 के परिप्रेक्ष्य पर आधारित सांकेतिक और प्रासंगिक हैं। इन संदर्भों का उद्देश्य माध्यमिक स्तर पर आर1 और आर2 के बीच किसी भी प्रकार का संरचनात्मक या योग्यता-आधारित अंतर दर्शाना नहीं है।

पाठ्यपुस्तक की विषयवस्तु, अधिगम परिणाम और मूल्यांकन माध्यमिक स्तर पर आर 1 और आर 2 के लिए परिकल्पित सामान्य योग्यता ढाँचे के अनुरूप हैं, इसलिए संदर्भ के अनुसार इन पाठ्यपुस्तकों का लचीले ढंग से उपयोग किया जा सकता है।

इस स्तर पर हिंदी का अध्ययन-अध्यापन साहित्यिक, सांस्कृतिक और व्यावहारिक भाषा के रूप में कुछ इस तरह से हो कि माध्यमिक स्तर तक पहुँचते-पहुँचते यह विद्यार्थियों की पहचान, आत्मविश्वास और विमर्श की भाषा बन सके। आवश्यकता इस बात की है कि विद्यार्थी भाषा के लिखित प्रयोग के साथ-साथ सहज और स्वाभाविक मौखिक अभिव्यक्ति में भी सक्षम हो सकें। वे हिंदी की प्रकृति के अनुसार वर्तनी और उच्चारण के आपसी संबंधों को समझ सकें ताकि उनकी लिखित और मौखिक भाषा में समानता एवं स्पष्टता हो।

CG-1: लेखन के विभिन्न रूपों (निबंध, पत्र, लेख, चर्चा, साक्षात्कार, सार्वजनिक भाषण) और नव मीडिया (ईमेल, श्रव्य और दृश्य सामग्री) के माध्यम से प्रभावी संप्रेषण के लिए भाषा का उपयोग करना।

दक्षताएँ	सीखने के संकेत बिंदु/गतिविधियाँ
C-3.1-विभिन्न श्रव्य और लिखित सामग्री का विश्लेषण और मूल्यांकन करना।	- विभिन्न प्रकार की श्रव्य और लिखित सामग्री में विवरणों का अवलोकन और विश्लेषण करके उन्हें व्यवस्थित रूप से लिखते हैं। - किसी एक विषय पर विभिन्न स्रोतों से प्राप्त सामग्री का विश्लेषण करके उसकी विश्वसनीयता की जाँच करते हैं।
C-3.2-रचना में परिवेश का सावधानीपूर्वक मूल्यांकन करके उचित तर्कों के साथ चर्चा-परिचर्चा करना।	पाठ्यवस्तु को पढ़ते और सुनते समय स्वयं के पूर्वग्रहों को पहचानते हैं और साक्ष्यों का मूल्यांकन करके पाठ्यवस्तु/श्रव्य-सामग्री की विश्वसनीयता का निर्धारण करते हैं।

पाठ्यचर्या CG-4: भारतीय भाषाई विविधता से जुड़ी साहित्यिक और सांस्कृतिक विरासत की सराहना करना।

दक्षताएँ	सीखने के संकेत बिंदु/गतिविधियाँ
C-4.1-पाठ को पढ़ते हुए विभिन्न शैलियों की सामग्री के अवलोकन के माध्यम से भारतीय समाज और साहित्यिक विविधता की बहुभाषी प्रकृति की पहचान करना।	भारतीय समाज की बहुभाषी प्रकृति को पहचानने के लिए विभिन्न क्षेत्रीय भाषाओं के चलचित्र और वृत्तचित्र देखते हैं और उनके बारे में अपने विचार साझा करते हैं।
C-4.2-भारतीय भाषाओं की विभिन्न साहित्यिक रचनाओं में निहित संस्कृति एवं विरासत की विविधता और उनके आपसी संबंधों की सराहना करना।	- पढ़ी गई साहित्यिक रचनाओं को विषयों, पात्रों और परिस्थितियों के आधार पर अपने व्यक्तिगत अनुभवों/जीवन से जोड़ते हैं। - विभिन्न भारतीय भाषाओं के साहित्य की विशिष्टता और साहित्य जगत में उनके योगदान की सराहना करते हैं।
C-4.3-हमारी संस्कृति और पहचान के निर्माण में भाषा की भूमिका को समझते हुए अभिव्यक्त करना।	- भाषा में निहित सांस्कृतिक परंपराओं से प्रभावित कहावतों/पहेलियों/मुहावरों के उदाहरण साझा करते हैं। - लिखने और बोलने में सांस्कृतिक परंपराओं से प्रभावित अपनी भाषा की शब्दावली का संदर्भों के अनुसार उपयुक्त उपयोग करते हैं।

हिंदी पाठ्यक्रम - आर -1 (2026 - 27)			
कक्षा - नवीं			
खंड			भारांक
क	अपठित बोध		14
ख	व्यावहारिक व्याकरण		16

ग	पाठ्यपुस्तक		30
घ	रचनात्मक लेखन		20
• भारांक - 80 (वार्षिक परीक्षा) +20 (आंतरिक परीक्षा)			
खंड -क (अपठित बोध)		उपभार	कुल भार
विषयवस्तु			
1	अपठित गद्यांश व काव्यांश पर बोध, चिंतन, विश्लेषण, सराहना आदि पर बहुविकल्पीय, अतिलघूत्तरात्मक एवं लघूत्तरात्मक प्रश्न		14
अ	एक अपठित गद्यांश लगभग 200 शब्दों का । इसके आधार पर एक अंकीय तीन बहुविकल्पी प्रश्न (1x3=3) पूछे जाएँगे, अतिलघूत्तरात्मक एवं लघूत्तरात्मक प्रश्न (2x2=4) पूछे जाएँगे ।	7	
ब	एक अपठित काव्यांश लगभग 80-100 शब्दों का । इसके आधार पर एक अंकीय तीन बहुविकल्पी प्रश्न (1x3=3) पूछे जाएँगे, अतिलघूत्तरात्मक एवं लघूत्तरात्मक प्रश्न (2x2=4) पूछे जाएँगे	7	
खंड -ख (व्यावहारिक व्याकरण)			
2	व्याकरण के लिए निर्धारित विषयों पर विषयवस्तु का बोध, भाषिक बिंदु /संरचना आदि पर अतिलघूत्तरात्मक एवं लघूत्तरात्मक प्रश्न (1X16 = 16) कुल 20 प्रश्न पूछे जाएँगे, जिनमें से केवल 16 प्रश्नों के उत्तर देने होंगे 		16
(i)	शब्द -निर्माण उपसर्ग - 2 अंक ,प्रत्यय - 2 अंक (5 प्रश्नों में से 4 प्रश्न करने होंगे)	4	
(ii)	संज्ञा, सर्वनाम,विशेषण,क्रिया (5 प्रश्नों में से 4 प्रश्न करने होंगे)	4	
(iii)	अर्थ की दृष्टि से वाक्य-भेद - 4 अंक (5 प्रश्नों में से 4 प्रश्न करने होंगे)	4	

	(iv)	अलंकार - 4 अंक शब्दालंकार : अनुप्रास, यमक, श्लेष (5 प्रश्नों में से 4 प्रश्न करने होंगे)	4	
3		खंड -ग (पाठ्यपुस्तक)		30
4		खंड -घ (रचनात्मक लेखन)		20
		लेखन		
	(i)	विभिन्न विषयों और संदर्भों पर विद्यार्थियों के तर्कसंगत विचार प्रकट करने की क्षमता को परखने के लिए संकेत-बिंदुओं पर आधारित समसामायिक एवं व्यावहारिक जीवन से जुड़े हुए तीन विषयों में से किसी एक विषय पर लगभग 120 शब्दों में अनुच्छेद लेखन ।	5	
	(ii)	अभिव्यक्ति की क्षमता पर केंद्रित अनौपचारिक दो विषयों में से किसी एक विषय पर लगभग 100 शब्दों में पत्र लेखन । (विकल्प सहित)	5	
	(iii)	दिए गए विषय / परिस्थिति के आधार पर लगभग 80 शब्दों में संवाद लेखन । (विकल्प सहित)	5	
	(iv)	दिए गए विषय / शीर्षक के आधार पर लगभग 80 शब्दों में सूचना लेखन । (विकल्प सहित)	5	

राष्ट्रीय शैक्षिक अनुसंधान केंद्र द्वारा राष्ट्रीय पाठ्यचर्या की रूपरेखा 2023 के आधार पर जारी की गई पाठ्यपुस्तक के आधार पर साहित्य से संबंधित अध्ययन किया जाए।

हिंदी पाठ्यक्रम (2026-27)

कक्षा-नवीं (आर -2)

राष्ट्रीय पाठ्यचर्या की रूपरेखा 2023 के अनुरूप द्वितीय भाषा के रूप में हिंदी आर 2 के रूप में पढ़ाई जाएगी। रोचक ढंग से इस भाषा का अध्ययन-अध्यापन पूर्णतः स्तरानुकूल रहेगा जिससे सभी

शिक्षार्थी लाभान्वित हो सकें तथा भारतीय भाषाओं के साथ सुरुचिपूर्ण ढंग से सामंजस्य स्थापित कर सकें ।

एनसीईआरटी द्वारा जारी पाठ्यचर्या के लक्ष्यों एवं दक्षताओं को प्रमुख रूप से ध्यान में रखते हुए शिक्षण बिंदुओं का कार्यान्वयन किया जाएगा।

भाषा किसी भी ज्ञान-क्षेत्र की आधारशिला है। हम प्रकृति और समाज को बहुत हद तक अपनी भाषा के ढाँचे के माध्यम से ही समझते और विश्लेषित करते हैं। इस कार्य को करने में भाषा का साहित्य हमारी विशेष सहायता करता है। माध्यमिक स्तर पर प्रवेश करने वाले विद्यार्थी सामान्य भाषा-ज्ञान से विशिष्ट अनुशासनात्मक अध्ययन की ओर बढ़ते हैं।

राष्ट्रीय शिक्षा नीति 2020 और विद्यालयी शिक्षा हेतु राष्ट्रीय पाठ्यचर्या की रूपरेखा 2023 की दृष्टि के अनुरूप यह पाठ्यक्रम हिंदी को केवल एक विषय नहीं बल्कि अनुभवों, मूल्यों, बहूसांस्कृतिकता, सृजनात्मकता और संवाद की एक समृद्ध प्रक्रिया के रूप में प्रस्तुत करता है। यह ज्ञान के संग्रह तक सीमित नहीं रहता बल्कि विद्यार्थियों को सोचने, कल्पना करने, विश्लेषण करने और अभिव्यक्ति के लिए प्रेरित करता है। पाठ्यक्रम का लक्ष्य विद्यार्थियों की चेतना को इस दिशा की ओर ले जाना है कि हिंदी भाषा के माध्यम से यथार्थ को अर्थात् जो भी घटित हो रहा है, उसे समझा जाए और उसमें अपनी आकांक्षाओं का चित्र रचा जाए। इस पाठ्यक्रम का केंद्रीय उद्देश्य पाठों का पठन-पाठन मात्र नहीं बल्कि उनके माध्यम से विद्यार्थियों में गहन पाठानुभूति, संवेदनशील अभिव्यक्ति, तार्किक विश्लेषण, संदर्भ-आधारित लेखन तथा भाषिक एवं सांस्कृतिक विविधता की समझ को विकसित करना है। हिंदी भाषा के सीखने-सिखाने के माध्यम से विद्यार्थियों में भाषा, संस्कृति का समावेशी दृष्टिकोण पैदा करना, जीवन के विविध संदर्भों को समझना, विविधता के प्रति सकारात्मकता का बोध पैदा करना- यह सब आवश्यक रूप से अपेक्षित है।

नवीं कक्षा में प्रवेश करने वाले विद्यार्थी की भाषा-शैली और विचार-बोध का एक ऐसा आधार बन चुका होता है कि अब उसे उसके भाषिक दायरे के विस्तार और वैचारिक समृद्धि के लिए आवश्यक संसाधन मुहैया कराए जाने की आवश्यकता होती है। माध्यमिक स्तर तक आते-आते विद्यार्थी किशोरावस्था में प्रवेश कर चुके होते हैं और उनमें सुनने, बोलने, पढ़ने, लिखने एवं समझने के साथ-साथ आलोचनात्मक दृष्टि विकसित होने लगती है। उनमें भाषा के सौंदर्यात्मक पक्ष, कथात्मकता, गीतात्मकता, समाचार-पत्रों की समझ, शब्द-शक्तियों के बीच अंतर की समझ, राजनैतिक चेतना एवं सामाजिक चेतना का विकास हो जाता है। वे आस-पड़ोस की भाषा और आवश्यकता के अनुसार उपयुक्त भाषा-प्रयोग, शब्दों के सुविचारित प्रयोग, भाषा की नियमबद्ध प्रकृति आदि से परिचित हो जाते हैं। इतना ही नहीं, वे विभिन्न विधाओं और अभिव्यक्ति की अनेक शैलियों से भी परिचित हो चुके होते हैं। अब विद्यार्थियों का अध्ययन आस-पड़ोस, राज्य-देश की सीमा को लाँघते हुए वैश्विक क्षितिज तक फैल जाता है। इन विद्यार्थियों की दुनिया में समाचार, खेल, फिल्म तथा अन्य कलाओं के साथ-साथ पत्र-पत्रिकाएँ और अलग-अलग तरह की पुस्तकें भी प्रवेश पा चुकी होती हैं।

एनसीईआरटी के पाठ्यक्रम और पाठ्यपुस्तकों में आर 1 और आर 2 के संदर्भ एनसीसीएफ-एसई 2023 के परिप्रेक्ष्य पर आधारित सांकेतिक और प्रासंगिक हैं। इन संदर्भों का उद्देश्य माध्यमिक

स्तर पर आर1 और आर2 के बीच किसी भी प्रकार का संरचनात्मक या योग्यता-आधारित अंतर दर्शाना नहीं है।

पाठ्यपुस्तक की विषयवस्तु, अधिगम परिणाम और मूल्यांकन माध्यमिक स्तर पर आर1 और आर2 के लिए परिकल्पित सामान्य योग्यता ढाँचे के अनुरूप हैं, इसलिए संदर्भ के अनुसार इन पाठ्यपुस्तकों का लचीले ढंग से उपयोग किया जा सकता है।

इस स्तर पर हिंदी का अध्ययन-अध्यापन साहित्यिक, सांस्कृतिक और व्यावहारिक भाषा के रूप में कुछ इस तरह से हो कि माध्यमिक स्तर तक पहुँचते-पहुँचते यह विद्यार्थियों की पहचान, आत्मविश्वास और विमर्श की भाषा बन सके। आवश्यकता इस बात की है कि विद्यार्थी भाषा के लिखित प्रयोग के साथ-साथ सहज और स्वाभाविक मौखिक अभिव्यक्ति में भी सक्षम हो सकें। वे हिंदी की प्रकृति के अनुसार वर्तनी और उच्चारण के आपसी संबंधों को समझ सकें ताकि उनकी लिखित और मौखिक भाषा में समानता एवं स्पष्टता हो।

CG-1: लेखन के विभिन्न रूपों (निबंध, पत्र, लेख, चर्चा, साक्षात्कार, सार्वजनिक भाषण) और नव मीडिया (ईमेल, श्रव्य और दृश्य सामग्री) के माध्यम से प्रभावी संप्रेषण के लिए भाषा का उपयोग करना।

दक्षताएँ	सीखने के संकेत बिंदु/गतिविधियाँ
C-3.1-विभिन्न श्रव्य और लिखित सामग्री का विश्लेषण और मूल्यांकन करना।	- विभिन्न प्रकार की श्रव्य और लिखित सामग्री में विवरणों का अवलोकन और विश्लेषण करके उन्हें व्यवस्थित रूप से लिखते हैं। - किसी एक विषय पर विभिन्न स्रोतों से प्राप्त सामग्री का विश्लेषण करके उसकी विश्वसनीयता की जाँच करते हैं।
C-3.2-रचना में परिवेश का सावधानीपूर्वक मूल्यांकन करके उचित तर्कों के साथ चर्चा-परिचर्चा करना।	पाठ्यवस्तु को पढ़ते और सुनते समय स्वयं के पूर्वग्रहों को पहचानते हैं और साक्ष्यों का मूल्यांकन करके पाठ्यवस्तु/श्रव्य-सामग्री की विश्वसनीयता का निर्धारण करते हैं।

पाठ्यचर्या CG-4: भारतीय भाषाई विविधता से जुड़ी साहित्यिक और सांस्कृतिक विरासत की सराहना करना।

दक्षताएँ	सीखने के संकेत बिंदु/गतिविधियाँ
C-4.1-पाठ को पढ़ते हुए विभिन्न शैलियों की सामग्री के अवलोकन के माध्यम से भारतीय समाज और साहित्यिक विविधता की बहुभाषी प्रकृति की पहचान करना।	भारतीय समाज की बहुभाषी प्रकृति को पहचानने के लिए विभिन्न क्षेत्रीय भाषाओं के चलचित्र और वृत्तचित्र देखते हैं और उनके बारे में अपने विचार साझा करते हैं।
C-4.2-भारतीय भाषाओं की विभिन्न साहित्यिक रचनाओं में निहित संस्कृति एवं विरासत की विविधता और उनके आपसी संबंधों की सराहना करना।	- पढ़ी गई साहित्यिक रचनाओं को विषयों, पात्रों और परिस्थितियों के आधार पर अपने व्यक्तिगत अनुभवों/जीवन से जोड़ते हैं। - विभिन्न भारतीय भाषाओं के साहित्य की विशिष्टता और साहित्य जगत में उनके योगदान की सराहना करते हैं।
C-4.3-हमारी संस्कृति और पहचान के निर्माण में भाषा की भूमिका को समझते हुए अभिव्यक्त करना।	- भाषा में निहित सांस्कृतिक परंपराओं से प्रभावित कहावतों/पहेलियों/मुहावरों के उदाहरण साझा करते हैं। - लिखने और बोलने में सांस्कृतिक परंपराओं से प्रभावित अपनी भाषा की शब्दावली का संदर्भों के अनुसार उपयुक्त उपयोग करते हैं।

हिंदी पाठ्यक्रम - आर - 2 (2026 - 27)			
कक्षा - नवीं			
खंड			भारांक
क	अपठित बोध		14
ख	व्यावहारिक व्याकरण		16
ग	पाठ्यपुस्तक		30
घ	रचनात्मक लेखन		20
भारांक - 80 (वार्षिक परीक्षा) +20 (आंतरिक परीक्षा)			

खंड -क (अपठित बोध)		उपभार	कुल भार
विषयवस्तु			
1	अपठित गद्यांश पर बोध, चिंतन, विश्लेषण, सराहना आदि पर बहुविकल्पीय, अतिलघूत्तरात्मक एवं लघूत्तरात्मक प्रश्न		14
	दो अपठित गद्यांश लगभग 200 शब्दों के। एक अंकीय तीन बहुविकल्पी प्रश्न (1×3=3) पूछे जाएँगे अतिलघूत्तरात्मक एवं लघूत्तरात्मक प्रश्न (2×2=4) पूछे जाएँगे ।	7+7=14	16
खंड -ख (व्यावहारिक व्याकरण)			
2	व्याकरण के लिए निर्धारित विषयों पर विषयवस्तु का बोध, भाषिक बिंदु /संरचना आदि पर अतिलघूत्तरात्मक एवं लघूत्तरात्मक प्रश्न (1×16 = 16) कुल 20 प्रश्न पूछे जाएँगे, जिनमें से केवल 16 प्रश्नों के उत्तर देने होंगे ।		
(i)	(क) शब्द भंडार समानार्थी शब्द - 2 अंक (पाठ्यपुस्तक के आधार पर) (3 प्रश्नों में से 2 प्रश्न करने होंगे) (ख) मुहावरे -2 अंक (पाठ्यपुस्तक के आधार पर) (3 प्रश्नों में से 2 प्रश्न करने होंगे)	4	
(ii)	शब्द -निर्माण उपसर्ग - 2 अंक ,प्रत्यय -2 अंक (5 प्रश्नों में से 4 प्रश्न करने होंगे)	4	
(iii)	विराम चिह्न - 2 अंक (3 प्रश्नों में से 2 प्रश्न करने होंगे)	2	
(iv)	संज्ञा -2 अंक सर्वनाम -2 अंक निपात -2 अंक (7 प्रश्नों में से 6 प्रश्न करने होंगे)	6	
3	खंड -ग (पाठ्यपुस्तक)		30

4	खंड -घ (रचनात्मक लेखन)			20
	लेखन			
	(i)	विभिन्न विषयों और संदर्भों पर विद्यार्थियों के तर्कसंगत विचार प्रकट करने की क्षमता को परखने के लिए संकेत-बिंदुओं पर आधारित समसामायिक एवं व्यावहारिक जीवन से जुड़े हुए तीन विषयों में से किसी एक विषय पर लगभग 100 शब्दों में अनुच्छेद लेखन ।	5	
	(ii)	अभिव्यक्ति की क्षमता पर केंद्रित अनौपचारिक दो विषयों में से किसी एक विषय पर लगभग 100 शब्दों में पत्र लेखन । (विकल्प सहित)	5	
	(iii)	दिए गए विषय / परिस्थिति के आधार पर लगभग 80 शब्दों में संवाद लेखन । (विकल्प सहित)	5	
	(iv)	किसी दृश्य /घटना के चित्र पर आधारित लगभग 80 शब्दों में लेखन । (बिना किसी विकल्प के)	5	

राष्ट्रीय शैक्षिक अनुसंधान केंद्र द्वारा राष्ट्रीय पाठ्यचर्या की रूपरेखा 2023 के आधार पर जारी की गई पाठ्यपुस्तक के आधार पर साहित्य से संबंधित अध्ययन किया जाए।

Mathematics

Class IX (2026 – 27)

Introduction:

The Mathematics curriculum for the Secondary stage has been redesigned in alignment with the National Education Policy 2020 and the National Curriculum Framework for School Education (NCF – SE) 2023, prioritizing deep conceptual understanding and logical reasoning. The revised syllabus places strong emphasis on developing core mathematical competencies, including problem-solving, visualisation, mathematical modelling, mathematical communication, computational thinking, and data analytics. The syllabus integrates Indian Knowledge System with contemporary mathematical knowledge, highlighting the rich contributions of Indian mathematicians to foster a sense of pride and historical context. A deliberate shift from rote learning to competency-based education ensures that students build deep conceptual understanding and logical reasoning rather than mere procedural fluency. Greater emphasis has been laid on the integration of real-life applications and experiential learning, encouraging students to connect mathematical concepts with everyday situations and cross-disciplinary contexts. Greater emphasis has been laid on competency based learning outcomes encouraging students to connect mathematical concepts with everyday situations and inter-disciplinary contexts. Continuous and holistic assessment through projects, activities, and investigations forms an integral part of the learning process, moving beyond summative examinations.

At the secondary stage, the curriculum focuses on developing essential global mathematical competencies, including mathematical representation through quantities and relations, mathematical modelling and algorithm building, and effective mathematical communication. The study of the number system, algebra, geometry, mensuration, statistics and probability is designed to build a strong foundation for higher education while enhancing functional life skills. The curriculum thus aims to build rich mathematical learning frameworks not only for higher academic pursuits but also for the practical demands of life in a rapidly changing, data-driven world.

Objectives: The broad objectives of teaching Mathematics at the secondary stage are to help the learners to:

- develop logical thinking, critical reasoning, and a structured approach to problem-solving;
- build the ability to recognise, analyse, and solve diverse problems with confidence and adaptability;
- communicate mathematical ideas effectively using appropriate language, symbols, and representations;
- appreciate the beauty, history, and real-life relevance of Mathematics as a discipline;
- connect mathematical concepts to fields such as Science, Technology, Engineering, and Economics;
- engage in both collaborative and independent mathematical exploration and learning;
- develop habits of precision, accuracy, and logical consistency in mathematical work;
- build confidence to explore, experiment, and grow in mathematical understanding without fear of failure.

Curricular Goals (CGs) and Competencies (Cs) from the NCF-SE 2023

CG-1: Understands numbers (natural, whole, integer, rational, irrational, and real), ways of representing numbers, relationships amongst numbers, and number sets.

C-1.1 Develops understanding of numbers, including the set of real numbers and its properties.

CG-2: Builds deductive and inductive logic to prove theorems related to numbers and their relationships (such as ‘2 is an irrational number’, a recursion relation for *Virahanka* numbers, a formula for the sum of the first n square numbers).

C-2.1 Understanding of powers (radical powers) and exponents.

CG-3: Discovers and proves algebraic identities and models real-life situations in the form of equations to solve them.

C-3.1 States and proves remainder theorem, factor theorem, and division algorithm.

C-3.2 Models and solves contextualised problems using equations (for example, simultaneous linear equations in two variables or single polynomial equations), and draws conclusions about a situation being modelled.

C-3.3 Learns Brahmagupta’s quadratic formula (in both symbolic and poetic form) and its derivation, and uses it to solve some of the poetic puzzles of Bhaskara as well as modern-day problems.

CG-4: Analyses characteristics and properties of two-dimensional geometric shapes, and develops mathematical arguments to explain geometric relationships.

C-4.1 Describes relationships including congruence of two-dimensional geometric shapes (such as lines, angles, triangles) to make and test conjectures and solve problems.

C-4.2 Proves theorems using Euclid’s axioms and postulates for triangles and quadrilaterals, and applies them to solve geometric problems.

C-4.3 Proves theorems about the geometry of a circle, including its chords, subtended angles, inscribed polygons, and area in terms of π .

C-4.4 Understands the irrationality of π , the best approximations to be discovered over human history, and the first exact formula (infinite series) for π given by Madhava.

C-4.5 Specifies locations and describes spatial relationships using coordinate geometry, for example, plotting a pair of linear equations and graphically finding the solution, or finding the area of triangle with given coordinates as vertices.

C-4.6 Understands the definitions of the basic trigonometric functions, their history and motivation (including the introduction of the sin and cos functions by Aryabhata using chords), and their utility across the sciences.

CG-5: Derives and uses formulae to calculate areas of plane figures, surface area, and volumes of solid objects.

C-5.1 Visualises, represents, and calculates the area of a triangle using Heron’s formula and its generalisation to cyclic quadrilaterals given by Brahmagupta’s formula.

C-5.2 Visualises and uses mathematical thinking to discover formulae to calculate surface areas and volumes of solid objects (cubes, cuboids, spheres, hemispheres, right circular cylinders or cones, and their combinations).

CG-6: Analyses and interprets data using statistical concepts (such as measures of central tendency, standard deviations) and probability.

C-6.1 Applies measures of central tendencies, such as mean, median, and mode.

C-6.2 Applies concepts from probability to solve problems on the likelihood of everyday events.

CG-7: Begins to perceive and appreciate the axiomatic and deductive structure of Mathematics.

C-7.1 Proves mathematical statements and carries out geometric constructions using stated assumptions, axioms, postulates, definitions, and mathematics vocabulary.

C-7.2 Visualises and appreciates geometric proofs for algebraic identities and other 'proofs without words'.

C-7.3 Proves theorems using Euclid's axioms and postulates for angles, triangles, quadrilaterals, circles, area-related theorems for triangles, and parallelograms.

C-7.4 Constructs different geometrical shapes like bisectors of line segments, angles and their bisectors, triangles, and other polygons, satisfying given constraints.

CG-8: Builds skills, such as visualisation, optimisation, representation, and mathematical modelling along with their application in daily life.

C-8.1 Models daily-life phenomena and uses representations, such as graphs, tables, and equations to draw conclusions.

C-8.2 Uses two-dimensional representations of three-dimensional objects to visualise and solve problems, such as those involving surface area and volume.

C-8.3 Employs optimisation strategies to maximise desired quantities (such as area, volume, or other output) under given constraints.

CG-9: Develops computational thinking, i.e., deals with complex problems and is able to break them down into a series of simple problems that can then be solved by suitable procedures/algorithms.

C-9.1 Decomposes a problem into sub-problems.

C-9.2 Describes and analyses a sequence of instructions being followed.

C-9.3 Analyses similarities and differences among problems to make one solution or procedure work for multiple problems.

C-9.4 Engages in algorithmic problem-solving to design such solutions.

CG-10: Knows and appreciates important contributions of mathematicians from India and around the world.

C-10.1 Recognises the important contributions made by mathematicians (Indian and others) in the field of Mathematics (such as the evolution of numbers, geometry, and algebra).

C-10.2 Recognises modern contributions to Mathematics made in both India and abroad, and understands the next frontiers and next major open questions in the field of Mathematics.

CG-11: Explores connections of Mathematics with other subjects.

C-11.1 Applies mathematical knowledge and tools to analyse problems or situations in multiple subjects across Science, Social Science, Visual Arts, Music, Vocational Education, and Sports.

COURSE STRUCTURE CLASS – IX

Units	Unit Name	Chapter Name	Marks
I	Number System	Number System	07
II	Algebra	- Introduction to Polynomials - Sequences and Progressions - Exploring Algebraic Identities - Linear Equations in Two Variables	20
III	Coordinate Geometry	Coordinate Geometry	04
IV	Geometry	- Introduction to Euclid's Geometry: Axioms and Postulates - Lines and Angles - Triangles – Congruence Theorems 4-gons (Quadrilaterals) - Circles	25
V	Mensuration	- Area and Perimeter - Surface Area and Volume	14
VI	Statistics and Probability	- Statistics - Introduction to Probability	10
	Total		80

Chapter Name	Key Concepts	Relevant CGs	Competencies
	Unit 1: Number System		No. of periods : 12
Number System	- Introduction to rational numbers - Representation of rational numbers on the number line - Density of rational numbers and its proof - Finding rational numbers between any two rational numbers - Decimal representation of rational numbers - Introduction to irrational numbers - Proof of irrationality of $\sqrt{2}$ and $\sqrt{3}$ - The square root spiral	CG-1, C-1.1, CG-9	The student will be able to: - Understand the concept of a rational number. - Represent rational numbers on the number line. - Understand the properties of rational numbers. - Explain the concept of density of rational numbers. - Compute decimal representation of rational numbers. - Understand the concept of irrational numbers. - Prove the irrationality. - Construct the square root spiral. - Apply computational thinking to represent rational and irrational

			numbers through algorithms and visual models, generate decimal expansions systematically, and reason about numbers using step-by-step logical procedures.
	UNIT II: ALGEBRA		No. of periods : 66
Introduction to Polynomials	- Algebraic expressions - Definition of a polynomial. - Degree of a polynomial - Introduction to linear polynomials and applications - Exploring linear patterns - Modelling linear growth and linear decay - Linear relationships - Visualising linear relationships - Slope and y-intercept of a line $y = ax + b$	CG-3, C-3.2, CG-9	The student will be able to: - Understand the meaning of an algebraic expression. - Define a polynomial. - Identify the degree, terms and coefficients of terms in a polynomial. - Model linear growth and decay using linear polynomials. - Explain and identify patterns in linear relationships. - Identify the slope and y-intercept of a linear equation in two variables. - Graph a linear equation in two variables. - Use computational thinking to identify patterns, construct linear expressions, and systematically represent and analyse linear relationships using equations and graphs.
Sequences and Progressions	- Introduction to sequences - Explicit or general rule of a sequence - Recursive rule of a sequence - Arithmetic Progressions (AP): nth term, visualising an AP, and practical contexts leading to Aps - Sum of the first n natural numbers - Geometric Progressions (GP): nth term, visualising a GP, and practical contexts leading to GPs - Applications of GP in fractals - Tower of Hanoi puzzle	CG-11, C-8.1, CG-9	The student will be able to: - Understand the concept of a sequence of numbers. - Identify the pattern in a sequence and predict the next few terms. - Determine the recursive and explicit rules for different sequences. - Obtain the terms of sequence given its recursive and explicit rule. - Identify Arithmetic Progressions (AP). - Determine the nth term of an AP. - Visualise an AP graphically. - Identify Geometric Progressions (GP). - Determine the nth term of a GP. - Visualise a GP graphically. - Analyse attributes of fractals using GP. - Solve the Tower of Hanoi puzzle. - Use computational thinking to identify patterns, write step-by-step rules, and model patterns in sequences and progressions.

Exploring Algebraic Identities	• Revisiting algebraic identities • Visualising identities using geometrical models • Factorisation of algebraic expressions using identities • More identities and their applications • Visualising factorisation of quadratic expressions through algebra tiles and without using algebra tiles • Finding new identities • Simplifying rational expressions	CG-7, C-7.2, CG-9	The student will be able to: • Visualise algebraic identities using geometric models. • Determine the factors of algebraic expressions using identities. • Interpret factors of quadratic expressions through geometric models. • Find simplified versions of rational expressions. • Use computational thinking strategies, such as decomposition and step-by-step procedures to visualise algebraic identities, factor expressions, and simplify rational expressions.
Linear Equations in Two Variables	• Introduction to linear equations in two variables through practical examples • Solution of linear equation in two variables: graphical representation • Slope-intercept form of linear equation in two variables • Drawing graphs of linear equations when x and y assume only certain values • Pair of linear equations in two variables • Graphical method for solving a pair of linear equations in two variables • Nature of solutions: consistency and inconsistency • Algebraic methods of solving a pair of linear equations: substitution and elimination method	CG-3, C-3.2, C-8.1, CG-9	The student will be able to: • Understand the concept of a linear equation in two variables. • Graph a pair of linear equations. • Solve a pair of linear equations graphically. • Solve a pair of linear equations through the methods of substitution and elimination. • Determine the nature of solutions of a pair of linear equations. • Model and solve contextualised problems using a pair of linear equations and draw conclusions. • Model daily-life phenomena using representations, such as graphs, tables, and equations. • Use computational thinking to systematically represent, solve, and interpret pairs of linear equations through graphs, tables, and step-by-step procedures.

	UNIT III: COORDINATE GEOMETRY		No. of periods : 6
Coordinate Geometry	- Brief history of coordinate geometry - The 2-D Cartesian coordinate system - Distance between two points in the 2-D plane - Midpoint of the line-segment between two points in the 2-D plane	CG-4, C-4.5, CG-9	The student will be able to: - Specify locations and the position of one point relative to another point using coordinates. - Represent a floor plan on a grid using coordinates. - Compute the distance between two points using coordinates. - Determine whether three points lie in a straight line using coordinates. - Compute the position of the midpoint of a line segment using coordinates. - Check whether a triangle is right-angled using coordinates. - Apply computational thinking to model situations on the coordinate plane and verify geometric properties through systematic reasoning.
	UNIT IV: GEOMETRY		No. of periods : 69
Introduction to Euclid's Geometry: Axioms and Postulates	- History of geometry - Constructing a square with a given side as described in the Baudhayana's Sulbasutras - Discovering Euclid's definitions - Axioms: Axioms of measurement and rules for geometric objects	CG-7, C-7.1, C-7.3	The student will be able to: - Describe how geometry grew from the practical needs ancient civilisations. - Describe contributions of India, Egypt and Greece to the development of geometric ideas. - Understand the role of definitions, axioms, and postulates. - Explain that there are elements of plane geometry (point, line, surface) for which we have an intuitive sense. - State the 5 postulates of Euclidean geometry. - Define parallelism of straight lines. - Explain the construction of a square as given in the Sulbasutras. - Justify simple constructions using the axioms.
Lines and Angles	- Rays and angles - Measures of angles - Intersecting lines and angles - Pairs of angles - Theorems and examples on intersecting lines - Theorems and examples on parallel lines	CG-7, C-7.1, C-7.3, CG-9	The student will be able to: - Explain the notion of an angle. - Explain the notion of a ray. - Explain that angles are formed between two rays with a common starting point. - State that a straight angle equals two right angles and measures 180° while a right angle measures 90°.

			• Classify angles as acute, right, obtuse, or reflex. • Define parallelism. • State and apply the linear pair theorem and its converse. • Follow proof by contradiction in geometry. • Prove that vertically opposite angles are equal. • Identify corresponding, alternate, and interior angles. • Explain transitivity of parallelism. • Explain why a triangle must have at least two acute angles; why it cannot have two obtuse angles, or all three angles less than 60° • Apply computational thinking to analyse geometric ideas by breaking constructions into ordered steps, using axioms and postulates as rules, and justifying geometric results through logical step-by-step reasoning.
Triangles: Congruence Theorems	• Practical applications of triangles • Proofs of conditions of congruence of triangles • Theorems on triangles • Propositions and their converse • Problems based on applications of theorems on triangles	CG-4, C 4.1, C-7.3	The student will be able to: • Explain that a triangle is rigid, unlike a quadrilateral. • Identify uses of triangle rigidity. • Explain why triangles give strength and stability to structures. • Describe what it means for two triangles to be congruent. • Identify correspondence between the vertices, sides, and angles of two congruent triangles. • Use the SAS congruence axiom. • Use the SSS congruence condition. • Use the ASA congruence condition. • Use the RHS congruence condition. • Use the AAS congruence condition. • Prove the basic properties of isosceles triangles. • Explain the notion of a proposition. • Explain the notion of converse of a proposition. • Identify the converse of a given proposition. • Explain that not all converses are true; use counter examples to show that some converses are false. • Explain why SSA is not, in general, a valid congruence condition.

			- Identify the situations where SSA is a valid congruence condition. - Justify the role of diagram accuracy.
4-gons (Quadrilaterals)	- Properties of parallelograms - Important theorems related to parallelograms and their proof - Midpoint theorem and its applications - Understanding the notion of central symmetry in the context of parallelograms	CG-4, C-4.2, C-7.3	The student will be able to: - Frame a precise definition of a 4-gon. - Prove various characterisations of a parallelogram. - Prove the midpoint theorem. - Prove a converse of the midpoint theorem. - Prove that the medians of a triangle are concurrent and each median is divided in the ratio 2:1 at the point of concurrence. - Prove that the 4-gon formed by joining the midpoints of a given 4-gon is a parallelogram. - Find the coordinates of the midpoint of a line segment given its end points and find the coordinates of the fourth vertex of a parallelogram given the other three. - Understand reflection and rotation symmetries of 4-gons. - Understand how any 4-gon can tile a plane. - Practice forming logical converses of statements and asking questions guided by converses of theorems. - Engage in drawing, measurement and paper manipulation activities to discover geometric patterns involving triangles and 4-gons.
Circles	- Practical applications and uses of circles - Definitions related to a circle — centre, diameter, and radius - Chords and the angles they subtend - Midpoints and perpendicular bisectors of chords - Distance of chords from the centre - Subtended angles by an arc - Cyclicity of points	CG-4, C-7.3, CG-9	The student will be able to: - State the definition of a circle. - Explain the meanings of the terms 'chord', 'diameter', 'radius', 'arc', 'segment', and 'sector'. - Explain why there exists a unique circle through three non-collinear points. - Construct the circumcircle and circumcentre of a triangle. - Describe the location of the circumcentre for acute, obtuse, and right-angled triangles. - Explain what 'angle subtended by an arc at the centre' means. - Explain why 'equal chords subtend equal angles at the centre'.

			• Explain why ‘chords that subtend equal angles at the centre are equal’. • Explain why ‘the line from the centre of a circle to the midpoint of a chord is perpendicular to the chord’. • Explain why ‘a perpendicular from the centre to a chord bisects the chord’. • State the relationship between length of a chord and its distance from the centre of the circle. • Explain why ‘equal chords are equidistant from the centre (and conversely)’. • Explain why ‘among unequal chords, the longer chord is closer to the centre’. • Explain why ‘the diameter is the longest chord’. • Explain why ‘the angle subtended by an arc at the centre is double the angle subtended by the arc at any point on the remaining part of the circle’. • Explain why ‘angles in the same segment of a circle are equal’. • Explain why ‘the angle in a semicircle is a right angle’. • Determine when four given points are concyclic. • Explain why ‘a quadrilateral with supplementary opposite angles is cyclic, and conversely’. • Explain how circular wheels have influenced transport, farming, building, and technology. • Identify cultural motifs involving circles, for example, the Dharmachakra, Ashoka Chakra, Sudarshan Chakra. • Use computational thinking to break down circle-related problems, apply geometric rules step-by-step, and verify properties of figures, such as chords, angles, and cyclic quadrilaterals through systematic reasoning.
	UNIT V: MENSURATION		No. of periods : 27
Mensuration : Area and Perimeter	• Perimeter of shapes • Perimeter of a circle: Introduction to Pi and its irrationality • Length of an arc	CG-5, C-5.1, CG-9	The student will be able to: • Define perimeter as the length around the boundary of any shape. • Explain that the circumference-to-diameter ratio is constant for all circles.

	- Area of shapes: rectangles, parallelograms, and triangles - Heron's formula - Squaring a rectangle: Proof from Baudhayana's Sulbasutras - Area of a circle: derivation - Area of the sector of a circle - Brahmagupta's formula for area of a cyclic 4-gon - Heron's formula as a special case of Brahmagupta's formula		- List historical approximations to π (from Archimedes, Aryabhata, and Zu Chongzhi). - Compute the circumference of a circle and the length of an arc. - Apply ideas of circle perimeter and arc-length to real-world contexts. - Explain why a median of a triangle divides it into two triangles of equal area. - Use Heron's formula to compute the area of a triangle from its sides. - Explain the classical problem of 'squaring' a given shape. - Explain how ancient civilisations approximated the area of a circle. - Compute the area of a circle using the formula. - Explain and use the formula for area of a sector of a circle. - Solve problems on areas of sectors and segments of circles. - State Brahmagupta's formula for the area of a cyclic quadrilateral in terms of its sides. - Explain why Heron's formula is a 'special case' of Brahmagupta's formula. - Explain the notion of 'special case' and 'generalisation' in mathematics. - Use computational thinking to break down shapes, apply step-by-step methods to calculate perimeter and area, recognise patterns across formulae, and understand generalisation and special cases in geometry.
Mensuration : Surface Area and Volume	Surface areas and volumes of spheres (including hemispheres) and right circular cones	CG-5, C-5.1, CG-9	The student will be able to: - Recognise cuboids and cubes in real-life situations. - Compute the surface area and volume of a cuboid. - Explain how a cube is a 'special case' of a cuboid. - Describe a right circular cylinder using its radius and height. - Compute the surface area and volume of a cylinder. - Recognise cones in daily life, and describe them using radius and height.

			• Compute the surface area and volume of a cone. • Recognise a pyramid, and identify its base and apex. • Compute the surface area and volume of a pyramid. • Recognise spheres in real-life situations. • Compute the surface area and volume of a sphere. • Use computational thinking to systematically calculate, and compare surface areas and volumes of 3-D shapes by varying dimensions and analysing patterns.
	UNIT VI: STATISTICS AND PROBABILITY		No. of periods : 24
Statistics	• Graphical representation of data • Measures of central tendency	CG-6, C-6.1, CG-9	The student will be able to: • Collect, organise, visualise and interpret data to answer a statistical investigative question. • Compute and apply weighted average in different settings. • Read and interpret stacked bar graphs and 100% stacked bar graphs. • Apply computational thinking strategies to analyse real-life data, create appropriate graphical representations, and interpret mean, median and mode for decision-making.
Introduction to Probability	• Concept of probability and randomness • The probability scale • Empirical probability: analysing statistical data and performing experiments • Theoretical probability: sample space and events • Representing probability through tree diagrams and tables	CG-6, C-6.2, CG-9	The student will be able to: • Understand the concept of randomness. • Describe the likelihood of an event using the probability scale. • Estimate the empirical probability of the occurrence of an event by analysing statistical data. • Define theoretical probability of an event. • Apply the definition of theoretical probability to compute the probability of an event. • Compute probability of events with the help of tree diagrams and tables. • Use computational thinking strategies, such as pattern recognition and simulation, to model random experiments and estimate probabilities.

MATHEMATICS QUESTION PAPER DESIGN
CLASS – IX (2026-27)

Time: 3 Hrs.

Max. Marks: 80

S. No.	Typology of Questions	Total Marks	% Weightage (approx.)
1	Remembering: Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers. Understanding: Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas	43	54
2	Applying: Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	19	24
3	Analysing: Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations Evaluating: Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. Creating: Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions	18	22
	Total	80	100

INTERNAL ASSESSMENT	20 MARKS
Pen Paper Test and Multiple Assessment (5+5)	10 Marks
Portfolio	05 Marks
Lab Practical (Lab activities to be done from the prescribed books)	05 Marks

Prescribed Books:

1. Mathematics - Textbook for class IX - NCERT Publication
2. Guidelines for Mathematics Laboratory in Schools, class IX - CBSE Publication
3. Laboratory Manual - Mathematics, secondary stage - NCERT Publication
4. Mathematics exemplar problems for class IX, NCERT publication

ODIA
SUBJECT CODE
013 CLASS-IX
(2026-27)

Time: 3 Hrs

Max Marks: 80

The question paper will be divided into four sections.

SECTION –A	Unseen Prose Passage	10 Marks
SECTION –B	Writing	12 Marks
SECTION –C	Grammar	10Marks
SECTION –D	Literature (Prose, Poetry, Non-Detailed)	48 Marks

Prescribed Books:

Sahitya Dhara (Class-IX)-2023 (Revised Edition) Published by- Board of Secondary Education, Odisha.

Madhyamika Byakarana (Class IX) – 2023 (Revised Edition) Published by – Board of Secondary Education, Odisha.

Course Content- 2026-27

1.	Reading	Comprehension from an Unseen Prose Passage (130 to 150 words)	
2.	Writing	Essay(Contemporary Issues) Official Letter	
3	Grammar	1. Sandhi(Swara,Byanjana, Bisarga) 2. Samasa (Tatpuruṣa,Dwandwa, Dwigu, Karmadharaya, Bahubrihi, Abyeibhaba) 3. Taddhita 4. Kṛdanta	
4.	Literature Poetry 1.Bande Utkala Janani 2. Kaha Mukha Anai Banchibi 3.Padma 4.He Mora Kalama	Prose 9. Jatiya Jibana 10.Bhasa O Jatiyata 11.Bamanara Hata O Akasara Chandra 12.Prakṛta Bandhu 13.Samuha Drusti	Short Story 16.Budha Sankhari 17..Pataka Uttolana 18.Laxmira Abhisara One-Act-Play 19.Dalabehera 20.Durapahada

	5. Manisha Bhai 6. Gopa Prayana 7. Paikabadhura Udbodhana		
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Activities/Guidelines for Internal Assessment

Marks: 20

Periodic Tests (5 Marks)- 3 Periodic Tests: - Average marks of best 2 Tests will be taken for final submission of marks.

Portfolio (5 Marks):

- Organization – Neatness and visual appeal
- Completion of guided work focused on specific curricular objectives
- Evidences of student's growth
- Inclusion of all relevant contents.

Subject Enrichment Activities (Any One)

(5 Marks)

- Quiz
- Books & Authors Chart
- Art Integrated Activities

Multiple Assessments- (Any One)

(5 Marks)

- Listening and Speaking skills
- Individual or Group work
- Class Room Activity, Field work
- Audio Visual Representation
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BLUE PRINT

S.L No	Section	Very Short Answer (1Mark)	Short Answer-I (2Marks)	Long Answer-I (4/5Marks)	Long Answer-II (6Marks)	Total Marks
1.	A. Reading	-----	Q.1 (5x2)	-----	-----	10
2.	B. Writing	-----	-----	-----	Q.2 (1x6) Q.3 (1x6)	12
3.	C. Grammar	Q.4 (3x1) Q.5 (3x1) Q.6 (2x1) Q.7 (2x1)	-----	-----	-----	10
4.	D. Literature	Q.10 (10x1) Q.13 (10x1)	Q.9 (3x2) Q.12 (3x2) Q.14 (3x2)	Q.8 (1x5) Q.11 (1x5)	-----	48
Total Marks/Qs		30 /6 Qs	28 /4Qs	10 /2Qs	12 /2Qs	80/14Qs

Design of Question Paper

SECTION	DETAILS	Question No	Details Of QS.	Total Marks
Section –A Reading	Comprehension from Unseen Prose Passage (130 to 150 Words)	Q.No-1	5 Out of 5	5x2=10
Section – B Writing	Essay (Contemporary Issues)	Q.No-2	1 Out of 3	1x6=6
	Official Letter	Q.No-3	1 Out of 2	1x6=6
Section – C Grammar	Sandhi(Swara,Byanjana , Bisarga)	Q.No-4	3 Out of 4	3x1=3
	Samasa (Tatpuruṣa, Dvandwa, Dwigu, Karmadharaya, Bahubrihi, Ayaibhaba)	Q.No-5	3 Out of 4	3x1=3
	Taddhita	Q.No-6	2 Out of 3	2x1=2
	Krudanta	Q.No-7	2 Out of 3	2x1=2
Section – D Literature	Explanation From Prose	Q.No-8	1 Out of 2	1x5=5
	Short Answer Type Questions From Prose	Q. No-9	3 Out of 5	3x2=6
	MCQ From Prose	Q.No-10	10 Out of 10	10x1=10
	Explanation From Poetry	Q.No-11	1 Out of 2	1x5=5
	Short Answer Type Questions From Poetry	Q.No-12	3 Out of 5	3x2=6
	MCQ From Poetry	Q.No-13	10 Out of 10	10x1=10
	Short Answer Type Questions From Non- Detailed	Q.No-14	3 Out of 5	3x2=6
				80 Marks

ODIA
CLASS-X (2026-27)

Time: 3 Hrs

Max Marks: 80

The question paper will be divided into four sections.

SECTION –A	Unseen Prose Passage	10 Marks
SECTION –B	Writing	12 Marks
SECTION –C	Grammar	10Marks
SECTION –D	Literature (Prose, Poetry, Non-Detailed)	48 Marks

Prescribed Books:

Sahitya Sindhu (Class-X)-2024 (Revised Edition) Published by Board of Secondary Education, Odisha.

Madhyamika Byakarana (Class X) – 2024 (Revised Edition) Published by – Board of Secondary Education, Odisha.

Course Content-2026-27

1.	Reading	Comprehension From an Unseen Prose Passage.(130 to 150 words)	
2.	Writing	Essay(Contemporary Issues) Letter to the Editor of a Newspaper	
3.	Grammar	1.Chhanda (Bhagabatabani, Natabani, Bangalashree,Ramakeri) 2. Transformation of Sentences (Simple, Compound, Complex) 3. Idioms 4. Correction of Common Errors in Words	
4.	Literature Poetry 1.Bande Utkala Janani 2. Bhimanka Singhanada Radi 3. Raghabanka Lanka Jatranukula 4. Chilikare Sayantana Drushya 5. Mangale Aila Usha 6. Jaga Bandhanahara 7..Sarabamsaha Mati	Prose 9. Janmabhumi 10. Sabhyata O Bigyana 11.Matrubhasha O Lokashikshya 12.Narenru Vivekananda	Short Story 14..Katha 15..Kalara Kapola Tale 16.Bela, Aswattha O Batabrukshya One-Act-Play 17.Falgu 18.Konarka

Activities/Guidelines for Internal Assessment

Marks: 20

Periodic Tests (5 Marks)- 3 Periodic Tests: - Average marks of best 2 Tests will be taken for final submission of marks.

Portfolio (5 Marks):

- Organization – Neatness and visual appeal
- Completion of guided work focused on specific curricular objectives
- Evidences of student's growth
- Inclusion of all relevant works(completeness)

Subject Enrichment Activities-(Any One)

(5 Marks)

- Quiz
- Book Review.
- Art Integrated Activities

Multiple Assessments-(Any One)

(5 Marks)

- Listening and Speaking skills
- Individual or Group Work
- Class Room Activity, Field Work
- Audio Visual Representation

BLUE PRINT

S.L No	Section	Very Short Answer (1Mark)	Short Answer-I (2Marks)	Long Answer-I (4/5Marks)	Long Answer-II (6Marks)	Total Marks
1.	A. Reading	-----	Q.1 (5x2)	-----	-----	10
2.	B. Writing	-----	-----	-----	Q.2 (1x6) Q.3 (1x6)	12
3.	C. Grammar	Q.5 (2x1) Q.6 (2x1) Q.7 (2x1)	-----	Q.4 (1x4)	-----	10
4.	D. Literature	Q.10 (10x1) Q.13 (10x1) Q.14 (6x1)	Q.9 (3x2) Q.12 (3x2)	Q.8 (1x5) Q.11 (1x5)	-----	48
Total Marks/Qs		32 /6 Qs	22 /3Qs	14 /3Qs	12 /2Qs	80/14Qs

Design of Question Paper

SECTION	DETAILS	Question No	Details Of Q.	Total Marks
Section –A Reading	Comprehension from Unseen Prose Passage (130 to 150 Words)	Q.No-1	5 Out of 5	5x2=10
Section – B Writing	Essay (Contemporary Issues)	Q.No-2	1 Out of 3	1x6=6
	Letter to the Editor of a Newspaper	Q.No-3	1 Out of 2	1x6=6
Section – C Grammar	Chhanda (Bhagabatabani, Natabani, Bangalashree, Ramakeri)	Q.No-4	1 Out of 2	1x4=4
	Transformation of Sentences (simple, compound, complex)	Q.No-5	2 Out of 3	2x1=2
	Idioms	Q.No-6	2 Out of 3	2x1=2
	Correction of Common Errors in Words	Q.No-7	2 Out of 3	2x1=2
Section – D Literature	Explanation From Prose	Q.No-8	1 Out of 2	1x5=5
	Short Answer Type Questions From Prose	Q. No-9	3 Out of 5	3x2=6
	MCQ From Prose	Q.No-10	10 Out of 10	10x1=10
	Explanation From Poetry	Q.No-11	1 Out of 2	1x5=5
	Short Answer Type Questions From Poetry	Q.No-12	3 Out of 5	3x2=6
	MCQ From Poetry	Q.No-13	10 Out of 10	10x1=10
	Short Answer Type Questions From Non-Detailed	Q.No-14	6 Out of 8	6x1=6
				80 Marks

Physical Education and Well-being

Grade 9

Session 2026-27

Max. Marks: 100

Time: 3:00 Hours

Theory: 20 Marks, Practical: 80 Marks

Introduction

Physical Education and Well-being is an essential component of holistic education that promotes balanced development of physical, mental, emotional, and social dimensions of learners. In the present era of rapid technological advancement, academic pressure and sedentary lifestyles, the subject plays a critical role in nurturing healthy habits, physical literacy, emotional resilience, and positive social behaviour among students. It prepares learners not only for physical fitness but also for meaningful participation in society as confident, responsible, and ethical individuals.

The scope of Physical Education and Well-being extends beyond sports and physical exercise. It encompasses fitness management, movement skills, emotional regulation, teamwork, leadership, value-based living and holistic well-being. Structured physical activities, games, and reflective practices develop essential life skills, such as self-discipline, perseverance, cooperation, empathy, decision-making, and critical thinking. These skills contribute to the overall well-being, and support lifelong engagement in healthy and active lifestyles.

With increasing societal emphasis on excellence in holistic health, fitness and sports, Physical Education and Well-being addresses contemporary challenges, such as lifestyle-related diseases, mental stress, social inequality, and exclusion. The subject promotes values of fairness, inclusivity, gender equality, respect for diversity, ethical conduct, and social responsibility. It encourages students to develop self-awareness, regulate emotions, and build healthy relationships, thereby contributing to personal and social well-being.

Nature of the Subject

Physical Education and Well-being is a dynamic, experiential, and value-oriented subject that plays a vital role in the holistic development of learners. It recognises movement as a powerful medium for learning and self-expression.

The subject is interdisciplinary, drawing on knowledge from the biological sciences, psychology, sociology, health sciences, technology, and environmental studies. Learners explore how physical activity influences body systems, mental processes, behaviour and social interactions, connecting theory with practice through active participation, observation and reflection.

Physical Education and Well-being is an inclusive and learner-centric subject, catering to diverse abilities, interests, genders, and cultural backgrounds. It promotes equity, accessibility, and participation for all, including children with disabilities and special needs. Through games and sports, students learn ethical behaviour, fair play, discipline, perseverance, humility in success, and grace in defeat, while also developing confidence, self-esteem, and emotional intelligence essential for personal and academic success.

Physical Education serves as a vehicle for character building, providing opportunities for self-regulation, goal setting, critical thinking, and problem-solving in real-life situations. The pedagogy is learner-centric and inclusive, with learning taking place through direct participation, inquiry, discussion, and reflection. Activity based learning, project work, discovery-oriented approaches, and collaborative practices enable students to connect theoretical knowledge with real-life experiences.

Nature of Knowledge in this Subject

Knowledge in Physical Education and Well-being is experiential, applied, interdisciplinary, and transformative. Unlike purely theoretical subjects, collaboration in Physical Education is based on learning through movement, practice, thinking about one's actions, and learning with others. Knowledge is constructed through doing, observing, analysing, and reflecting on physical activity experiences, thereby enabling learners to internalise concepts meaningfully and apply them in real-life contexts.

The knowledge acquired is dynamic and evolving, and is continuously influenced by advancements in sports science, health research, digital technologies, and changing societal needs. The nature of knowledge encompasses four interconnected dimensions:

- **Conceptual Knowledge:** This includes understanding the principles of health, physical fitness, movement, wellness, nutrition, behaviour, and human body systems. Learners gain insights into growth and development, physiological responses to exercise, injury prevention, mental well-being, and the relationship between physical activity and overall health. Conceptual knowledge provides the scientific and theoretical foundation necessary for informed decision-making regarding lifestyle and fitness.

- **Practical Knowledge:** Practical knowledge is developed through hands-on participation and skill acquisition. It involves learning and refining motor skills, sport-specific techniques, movement patterns, game rules and strategies, and safe practices during physical activity. Students also acquire essential life skills, such as First Aid, Basic Life Support (BLS), Cardiopulmonary Resuscitation (CPR), and safety protocols, enabling them to respond responsibly in emergencies and promote a safe supporting environment.

Reflective Knowledge: Reflective knowledge enables learners to evaluate their physical, emotional, and behavioural responses during and after physical activities. Through self-assessment, fitness tracking and reflective journals, students analyse their strengths, limitations, habits, and attitudes. This dimension also fosters awareness of ethical conduct, fair play, inclusivity, respect, discipline and value formation, supporting character development and emotional intelligence.

- **Social Knowledge:** Social knowledge focuses on understanding the role of physical activity like sports in society. Learners explore how sports contribute to nation-building, cultural identity, community engagement, and global harmony. This includes the responsible and meaningful use of leisure time, the promotion of gender equity and equality, the inclusion of persons with disabilities, accountability, affordability, and the appreciation of diversity. Students also learn about teamwork, leadership, cooperation, and citizenship through shared physical experiences.

Knowledge of Physical Education and Well-being empowers learners to develop lifelong healthy behaviours, ethical values, social responsibility, and self-confidence. It supports holistic growth by integrating physical competence with mental awareness, emotional balance, and social sensitivity, preparing students to lead active, healthy, and purposeful lives in a rapidly changing world.

Physical Education and Well-being Grade 9 (Session 2026-27)

Max. Marks: 100

Time: 3:00 Hours

Theory: 20 Marks, Practical: 80 Marks

Curricular Goals	Competencies	
Learning Standard 1		
CG-1 Demonstrates a high level of competence in the understanding of movement concepts, strategies, and principles, while engaging and performing in physical activities, including sports and dance.	C1.1	Exhibits proficiency in all movement and motor skills required to participate and excel in at least one sport, yoga or any other physical activity (team, dual, individual).
	C1.2	Explains the role of rhythmic drills to improve their game.
	C1.3	Exhibits the ability to use complex movement concepts and principles to develop and refine their games or sports skills.
	C1.4	Exhibits and explains the manipulation of space and equipment in the context of a game.
	C1.5	Applies knowledge and understanding of movements, and skills to develop a physical activity plan for themselves, follow a routine and assess independently.
CG-2 Exhibits sensitivity and learns to manipulate their personal and social behaviour towards themselves and others.	C2.1	Reflects upon their and others' behaviour before, during and after the physical activity in the long term. This may include different but related behaviours, including emotional state of mind, physical fitness, fatigue, fair play, biases, and personal interests.
	C2.2	Articulates the importance of emotional and mental support to others, as well as, improving performance and encouraging others to perform by analysing the behaviour of student when someone is emotionally or physically hurt, and how their support may improve others' performance.
	C2.3	Modifies and creates new games and rules that are more inclusive in nature.
	C2.4	Creates and applies safety rules, protocols for physical activity, and visualises how they can be applied outside the field as well.
	C2.5	Demonstrates fairness and responsible behaviour in tough contexts and situations.
	C2.6	Exhibits modesty after an exceptional performance, accepts defeat gracefully and enjoys the game.
CG-3 Demonstrates social sensitivity and mental engagement in physical activity and game situations.	C3.1	Designs and uses multiple strategies in a game and can make new strategic moves in challenging game situations (for example, a student's plan A and B, both failed and strategise a plan C during the game).
	C3.2	Understands and deals with their and others' emotions, and the thinking process during the game.
	C3.3	Demonstrates calmness and courage in difficult situations, and is able to calm their teammates.
	C3.4	Regulates the intensity in different situations.

CG-4 Plans personal physical fitness goals independently and monitors them.	C4.1	Sets multiple physical activity and fitness goals, such as improving multiple shots or their overall match performance.
	C4.2	Assesses their progress in terms of efforts, processes, and outcomes.
	C4.3	Prepares, plans, and schedules their exercises and warm-ups in consultation with their teacher to get maximum benefits.
CG-5 Learns about the value of physical activity for health, enjoyment, challenge, expression, and social interaction.	C5.1	Illustrates the role of physical education for positive social interaction, while discussing physical activity throughout history and culture.
	C5.2	Examines the role of physical activity in improving self-confidence and self-esteem.
	C5.3	Appreciates the aesthetic appeal of a performance, such as someone's classy straight drive, a beautiful free kick, an effortless smashing of the ball, a well-placed drop shot, or a speedy smash.
	C5.4	Expresses self through dance, gymnastics, or any physical activity.
CG-6 Assesses their growth and development.	C6.1	Examines the role of different factors which affect growth and development, such as heredity, immediate environment, diet, diseases, state of mind and physical activity.
	C6.2	Analyses the relationship of nutrition, physical activity, and mental health with skeletal health, muscles, strength, endurance, flexibility and agility.
	C6.3	Classifies the common injuries of bones and muscles, and describes the protocol for seeking medical help for themselves and others when needed like providing first-aid in such situations.
	C6.4	Outlines and challenges the societal beliefs and taboos associated with different aspects of growth, and development in the adolescent age.
CG-7 Learns about tournaments at the international, national, state, district, and block levels.	C7.1	Charts the various tournaments at international, national, state, district and block levels.
	C7.2	Describes the participation criteria and rules of tournaments.
	C7.3	Summarises the support or organisational structures to participate in tournaments.
	C7.4	Explains the different forms and procedures for participating in tournaments.

Learning Standard 2

CG-1 Demonstrates competence in the understanding	C1.1	Exhibits all movements and motor skills required to participate and play in at least one sport, yoga or any other physical activity (team, dual, individual).
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of movement concepts, strategies and principles, while engaging in and performing physical activities, including sports.	C1.2	Exhibits the ability to use complex movement concepts and principles to develop and refine one's game and sports skills.
	C1.3	Applies knowledge and understanding of movements, and skills to develop their own physical activity plan, follows a routine and assesses independently.
CG-2 Exhibits sensitivity and learns to regulate their personal and social behaviour towards themselves and others.	C2.1	Reflects upon their and others' behaviour before, during, and after the physical activity. This may include different but related behaviours, including emotional state of mind, physical fitness, fatigue, fair play, biases, and personal interests.
	C2.2	Articulates the importance of a team member's support to improve performance in the game, by analysing the behaviour of students when someone is emotionally or physically hurt, and how their support may enhance the performance of others.
	C2.3	Modifies and creates new games and rules that are more inclusive in nature.
	C2.4	Creates and applies safety rules and protocols for physical activity and visualises how they can be applied outside the field as well.
	C2.5	Demonstrates fairness and responsible behaviour in tough contexts and situations.
	C2.6	Exhibits modesty after an exceptional performance, accepts defeat gracefully, and enjoys the game.
CG-3 Demonstrates social sensitivity and mental engagement in physical activity and game situations.	C3.1	Designs and executes multiple strategies for the game.
	C3.2	Understands and deals with their and others' emotions, and the thinking process during the game.
	C3.3	Demonstrates calmness and courage in difficult situations, and can calm their teammates.
CG-4 Learns to connect physical activity with health, enjoyment, challenge, expression, and social interaction.	C4.1	Discusses activities that bring personal satisfaction
	C4.2	Identifies diverse cultures with special reference to dance, physical activity, local games and spaces to interact.
CG-5 Learns about tournaments at the international, national, state, district and block levels.	C5.1	Charts the various tournaments at international, national, state, district and block levels.
	C5.2	Describes the participation criteria and rules of the tournament.
	C5.3	Summarises the support structure or organisational structure to participate in tournaments.
	C5.4	Explains the different forms and procedures for participating in tournaments.

Development of Competencies and Learning Outcomes

Content organisation and learning outcomes for developing competencies in Grade 9.

Units T: Theory P: Practical	Unit Outline/Key Concepts	Learning Outcomes
Unit 1 Development of Physical Culture in India 4 Hours (T: 4 hrs)	• Definition, Meaning, Aims and Objectives of Physical Education • History and Culture of Physical Education and Sports in India • Introduction to Physical Literacy • Career Prospects	Competencies developed in this unit: C5.1, C5.3, C6.1, C6.2, C4.1, C4.3 Students will be able to: • Explain the meaning and evolution of Physical Education. • Appreciate traditional games and their cultural value. • Identify diverse careers in physical education and sports.
Unit 2 Health, Fitness and Wellness 6 Hours (T: 2 hrs, P: 4 hrs)	• Meaning and Difference Between Health, Physical Fitness and Wellness • Components of Health-related Fitness • Components of Skills-related Fitness • Dimensions of Wellness. • First-Aid, Basic Life Skills (BLS) and CPR	Competencies developed in this unit: C6.1, C6.2, C1.1, C2.1, C2.4 Students will be able to: • Differentiate between health, fitness, and wellness. • Identify health-related and skills-related fitness components. • Adopt daily routines promoting hygiene and wellness. • Demonstrate First-Aid and CPR.
Unit 3 Sciences and Sports 10 Hours (T: 6 hrs, P: 4 hrs)	• Introduction to Body Systems • Skeletal System: Types of Bones, Major Joints, and Functions in Movement • Muscular System: Voluntary and Involuntary Muscles • Introduction to Circulatory and Respiratory Systems during Exercise • Growth and Development	Competencies developed in this unit: C6.1, C6.2, C1.3, C6.3 Students will be able to: • Describe body systems involved in movement. • Relate exercise to physiological changes. • Demonstrate understanding of growth and development stages.
Unit 4 Technology Integration 4 Hours (T: 1 hrs, P: 3 hrs)	• Digital Literacy: Do's and Don'ts, Data Handling and Interpreting Results • Application of Technology in Sports • Wearables in Sports Competitions, Trainings and Projects	Competencies developed in this unit: C1.5, C1.3, C3.1 Students will be able to: • Use technology to assess fitness and performance. • Interpret data for performance enhancement.

Unit 5 Sports for All 6 Hours (T: 3 hrs, P: 3 hrs)	• Meaning of Inclusiveness in Physical Education and Sports. • Introduction to Disability and Types (intellectual, physical, sensory) • Disability Etiquette and STEP Model • Women's Participation in Sports • Master Athlete • Community Sports and Khelo India Movement and Fit India	Competencies developed in this unit: C2.3, C2.1, C2.2, C5.1 Students will be able to: • Describe the concept of inclusivity in sports. • Show sensitivity to disabilities and gender equality. • Participate in community sports programmes.
Unit 6 Olympic Movement 6 Hours (T: 2 hrs, P: 4 hrs)	• Olympism: Concept and Olympic Values (Excellence, Friendship and Respect) • Olympic Value Education: Joy of Effort, Fair Play, Respect for Others, Pursuit of Excellence, Balance Among Body, Will and Mind • Ancient and Modern Olympics. • Olympics: Symbols, Motto, Flag, Oath, and Anthem	Competencies developed in this unit: C5.1, C2.5, C2.6 Students will be able to: • Explain the evolution of the Olympic Movement. • Apply Olympic values in daily life and sports.
Unit 7 Yoga 14 Hours (T: 3 hrs, P: 11 hrs)	• Yoga for Holistic Health and Well-being • Yoga for Health • Adolescent Age and Hormonal Balance • Yoga for Personal Excellence • Memory and Concentration	Competencies developed in this unit: C1.1, C6.2, C2.2, C3.3, C5.2 Students will be able to: • Demonstrate selected yoga asanas and pranayama. • Understand yoga's role in holistic health and well-being.

	• Willpower and Self-Confidence/ Self-Esteem • Leadership and Responsibility • Creativity and Critical Thinking	• Explain yogic practices related to emotional well-being. • Practice yoga and meditation for self-development. • Exhibit improved focus and confidence.
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Unit 8 Sports 40 Hours (P: 40 hrs)	• Hockey • Basketball • Judo • Wrestling • Kalaripayattu • Thang Ta • Gatka • Malkambh • Swimming • Archery • Taekwondo • Cricket • Gymnastic • Yogasana	Competencies developed in this unit: C1.1, C1.3 Students will be able to: Demonstrate fundamental skills of the given sports.
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Assessment

Assessment in Physical Education and Well-being is continuous, comprehensive, competency-based, and learner-centric. It focuses on assessing not only physical performance but also conceptual understanding, effort, participation, reflection, values, and social behaviour. Assessment practices align with the principles of assessment for learning, assessment as learning, and assessment of learning, as recommended by the NEP 2020.

Formative Assessment

Formative assessment is integrated into daily teaching-learning processes to provide regular feedback and support students' growth.

- **Classroom oral responses and concept checks:** Short question answer sessions, quizzes, and discussions are conducted after lessons to assess the understanding of concepts related to health, fitness, body systems, wellness, and sports ethics.
- **Reflection journal or wellness diary:** Students can maintain a wellness diary to document daily physical activity, sleep patterns, posture, hydration, nutritional habits, and emotional states. This will help them assess their self-awareness, consistency, and reflective abilities.
- **Peer and self-assessment:** After games and physical activity sessions, students can assess themselves and their peers based on their participation, cooperation, effort, fair play, and teamwork. This will encourage the values of responsibility, empathy, and honest reflection among them.
- **Case study and discussion-based assessment:** Students can participate in discussions and case studies, such as — How traditional games promote mental health and social well-being?, allowing assessment of critical thinking, communication skills, and application of concepts among them.

Summative Assessment

Summative assessment evaluates the overall learning outcomes at the end of a unit or term. It can be done in three ways:

- **Pen and paper test:** to assess the conceptual clarity related to definitions, principles, terminology, and factual knowledge, comparison of various practices, its benefits and impact on their holistic health and well-being. Application of practices in real-life situations related to wellness, lifestyle choices, injury prevention or ethical behaviour.
- **Project work:** to assess inquiry, research, creativity, collaboration, application of concepts, interdisciplinary learning, and community-based learning. Projects may include field visits, interviews, surveys, reports, presentations, or digital submissions.
- **Demonstration:** Physical education is about health, fitness, well-being and developing basic and advanced skills in sports and games. Measurement of fitness parameters and demonstration of various skills is an important part of physical education and well-being competencies. Summative assessment of practical demonstration can be done through the rubrics defined in the textbook at the end of each unit.

Textbook

The NCF-SE 2023 aligned new textbook of Physical Education and Well-being for Grade 9 developed by the NCERT.

**Physical Education and Well-being
Grade 9
Session 2026-27**

Max. Marks: 100

**Time: 3:00 Hours
Theory: 20 Marks, Practical: 80 Marks**

Assessment Criteria

Theory (20 Marks)	Project & Sports File (40 marks)	Practical-Skill Based (40 Marks)
Every unit contains 2 marks (MCQs/Objective/Short Answer) 2 Marks × 8 Units= 16 Marks Viva= 4 Marks	1. Prepare a report of visit to any one of the following: - Open tournament/ competition (of any game/sports mentioned in CBSE Games) - Gymnasium/ Fitness Centre - Stadium - Sports Institution (5 marks) 2. The student will prepare a file on the sports/ game chosen by him/ her covering following aspects: - History of the game/sports (200 words) - Terminology of the game/sports (any 5) - Fundamental skills of the game/ sports (any 5) - Rules of the game/ sport (any 5) - Ground/ Court/ Field specification - Common injuries of the game/ sports (any 3) - Indian sports personalities/ awardees of the game/ sports (any 5) - Name of national/ international tournaments/ competitions of the game/ sports (any 3) (30 marks) 3. Sports Participation - Intramural/Extramural (5 Marks)	1. Fundamental Skills 5 skills @ 6 marks each = 30 Marks (Any 5 fundamental skills to be demonstrated at the time of practical) 2. Advanced Skill 1 skill @10 marks = 10 Marks (Any skill to be demonstrated at the time of practical) Note:(of any game/ sports mentioned in CBSE Games)

संस्कृतम्
कक्षा - नवमी (2026-27)
पाठ्यक्रमः परीक्षानिर्देशाश्च

भाष्यते व्यवहारादिषु प्रयुज्यते इति भाषा । मानवः स्वमनसि विद्यमानान्विचारान् भावनाः अनुभूतिं च अर्थयुक्तैः ध्वनिभिः लिखितसङ्केतैः च व्यक्तीकरोति सा भाषा । भाषा अभिप्रायप्रकटनस्य साधनम् । वस्तुतः लोके द्वयोः मनुष्ययोः मध्ये परस्परम् अवबोधनाय, भावग्रहणाय, भावविनिमयाय च भाषया विना न अन्यत् स्पष्टतमं सरलतमं च साधनं विद्यते । लोके बहव्यः भाषाः सन्ति यासु संस्कृतभाषा प्राचीनतमा समृद्धा च अस्ति । संस्कृतभाषायाम् एव सन्ति ऋग्यजुस्सामाथर्वाः इति चत्वारः वेदाः, शिक्षा, व्याकरणं, निरुक्तं, ज्योतिषं, छन्दः कल्पः चेति षडङ्गानि, चतुर्दशविद्याः, विज्ञानम्, आयुर्वेदः, योगशास्त्रादयः ग्रन्थाः । अतः संस्कृतं केवलं भाषा न अपितु किञ्चन जीवनदर्शनम् इति वर्तते । इयं विद्या (भाषा) भारतीयानां प्रतिष्ठात्मिका कामधेनुः समस्तज्ञानप्रदात्री, ऐक्यप्रदात्री, धर्मार्थकाममोक्षप्रदात्री च अस्ति । सृष्टेः आदितः अद्यावधि यत् शिक्षणं ज्ञानविज्ञानं च अस्ति तत् सर्वम् अस्यां भाषायामेव सन्निहितम् अस्ति । अतिसूक्ष्मभावनां प्रकटयितुं स्पष्टीकर्तुं संस्कृतं विना नैव अन्यत्र विद्यते सामर्थ्यम् । भारतीयं सर्वस्वं विश्वस्य समग्रं तत्त्वं च अस्यां भाषायाम् अस्ति ।

संस्कृतस्य भाषावैज्ञानिकत्वम् – ऐतिहासिक-वर्णनात्मक-तुलनात्मकाध्ययन-द्वारा भाषायाः प्रकृतेः विकासोत्पत्तेः संरचनायाः अध्ययनपूर्वकं सर्वेषां विषयाणां सैद्धान्तिकः निर्णयः भाषाविज्ञानेन क्रियते । भाषाविज्ञान-नामकशास्त्रे शब्दानाम् उत्पत्तिः, वाक्यानां संरचना इत्यादीनां विषयाणां विचारः क्रियते । भाषाविज्ञानस्य सम्बन्धः सर्वेषां मानवानां भाषाभिः सह अस्ति । एवं भाषाविज्ञाने ध्वनेः, ध्वनि-उच्चारणोपयोगिनां स्वरयन्त्रमुखजिह्वादि-अङ्गानां प्रकृति-प्रत्ययादीनां, संज्ञासर्वनाम-क्रिया-विशेषणादीनां नामाख्यातोपसर्जननिपातानां पदपदार्थविषयकानां विकारादीनां विकारमूलककारकाणाम् अन्येषां विविधविषयाणाञ्च अध्ययनं क्रियते । भाषाविज्ञाने संस्कृतभाषा-विषयक-वर्णोत्पत्ति-सिद्धान्तस्य अतीव वैज्ञानिकं निरूपणं कृतं वर्तते ।

राष्ट्रियशिक्षानीतौ (२०२०) इत्यत्र भाषा मानवसशक्तीकरणस्य आधारः साधनं वा अङ्गीकृतं वर्तते । भारतस्य परमविशिष्टस्य गतज्ञानवैभवस्य पुनः प्रतिष्ठापनमपि राष्ट्रियशिक्षानीतेः २०२० इत्यस्याः लक्ष्यमस्ति । एतदर्थं संस्कृतभाषयाः शिक्षणस्य महत्त्वम् इतोऽप्यधिकं भवति । प्रायः सर्वासु भाषासु संस्कृतपरकशब्दाः उपलभ्यन्ते । संस्कृतभाषा भारतीयभाषाणां जननी इति कथ्यते । सर्वासु भारतीयभाषासु संस्कृतभाषा अन्तर्लीना अस्ति इति सर्वे अङ्गीकुर्वन्ति ।

भारतदेशः बहुभाषी देशोऽस्ति । अस्मिन् देशे अनेकतायाम् एकतावर्धिनी भाषेयं सामाजिकसमरसतायै जीवनविकासाय च आवश्यकी वर्तते । संस्कृतस्य सांस्कृतिकं महत्त्वं वर्णयन्तः विद्वांसः कथयन्ति “भारतस्य प्रतिष्ठे द्वे संस्कृतं संस्कृतिस्तथा, संस्कृतिमूलं संस्कृतम्, साहित्यं संस्कृतिवाहकञ्च इति ।” एषा संस्कृतिः न केवलं भारतस्य अपि तु विश्वस्य मुकुटायमाना अस्ति । उक्तं च -

सत्यमहिंसादिगुणैः श्रेष्ठा विश्वबन्धुत्वशिक्षिका ।

विश्वशान्तिः सुखधात्री भारतीया हि संस्कृतिः ॥

संस्कृते संस्कृतिर्ज्ञेया संस्कृते सकलाः कलाः ।

संस्कृते सकलं ज्ञानं संस्कृते किन्न विद्यते ॥

एवं संस्कृतभाषा परिनिष्ठिता, दोषरहिता, सरला, गभीरा, यथार्था वैज्ञानिकी च भाषा अस्ति । सम्प्रति युगेऽस्मिन् प्रमुखैः उद्देश्यैः संस्कृतभाषा शिक्षणीया अस्ति ।

शिक्षणोद्देश्यानि –

भाषायाः प्रभावपूर्णसम्प्रेषणाय विविधानां मौखिकलेखनाभ्यासानां नवमाध्यमानां च प्रयोगः करणीयः भविष्यति ।

यथा - चर्चा भाषणानि सन्दर्शनानि निबन्धाः पत्रलेखनं विद्युन्मानपत्रं (email) दृश्यश्रव्यमाध्यमानि च इत्यादयः वर्तन्ते ।

- वसुधैव-कुटुम्बकम् इति भावनाविकासः ।
- भारतीयभाषाणां संरक्षणम् ।
- संस्कृतभाषया सम्प्रेषणकौशलविकासः ।
- परस्परं संस्कृतसम्भाषणेन भावविनिमयः ।
- संस्कृत-भाषया एव संस्कृत-शिक्षणम् ।
- श्रवण-भाषण-पठन-लेखनेति चतुर्णां भाषिक-कौशलानां विकासः ।
- बौद्धिकविकासपुरस्सरम् आध्यात्मिकनैतिकज्ञानम् ।
- निर्णयात्मिकायाः बुद्धेः विकासः ।
- तार्किकचिन्तनेन सह निर्भीकवक्तृत्वकौशलस्य विकासः ।
- मानसिकविकासानन्दानुभूतिः रसानुभूतिश्च ।
- भारतीयसंस्कृतेः संरक्षणं ज्ञानवर्धनञ्च ।
- आत्मानुशासनसंस्थापनार्थं शिक्षणम् ।
- सर्जनात्मकचिन्तनकौशलस्य विकासः ।
- सामाजिकचेतनायाः विकासः ।
- भाषाशिक्षणकौशलानि वर्धनाय नैपुण्यप्राप्तिः ।
- परस्परं वार्तालापमाध्यमेन भावविनिमयः ।
- संस्कृतसाहित्यस्य अध्ययनेन ज्ञानानन्दस्य अनुभूतिः ।
- मानवजीवनस्य विकासपूर्वकं कल्याणम् ।
- संस्कृतभाषया छात्राणां सर्वविधविकासः ।

शिक्षणप्रविधयः -

- संस्कृतमाध्यमेन सम्भाषणविधिना शनैः शनैः संस्कृतशिक्षणं सम्भविष्यति । गतिवर्धनाय संस्कृताध्यापकैः धैर्येण स्वकीयाध्यापन-कार्यक्रमाणां नियोजनम् । रुचिकरभाषाभ्यासेन भाषिकोपलब्धिः । भाषिकाभ्यासाय वार्तालाप-कथाश्रवण-वादविवाद-संवादादि-वर्णनपरकाभिः प्रतियोगिताभिः भाषाशिक्षणं कारयितुं शक्यते ।
- विभिन्नप्रामाणिकसंस्थानां कार्यक्रमाः साहित्यसामग्र्यश्च प्रयुज्य उत्तमशिक्षणं कर्तुं शक्यते ।
- संस्कृतभाषया उपलब्ध-दृश्य-श्रव्य-सामग्री-माध्यमेन भाषाभ्यासः ।
- आवश्यकतानुगुणं नवदृश्य-श्रव्य-सामग्री-निर्माण-माध्यमेन भाषायाः शिक्षणम् ।
- विभिन्नपाठ्यसामग्रीद्वारा शिक्षकः स्वकीयं शिक्षणकार्यं रुचिकरं कर्तुं शक्नोति ।
- भाषाशिक्षकः छात्रान् स्नेहपूर्वकम् (आत्मीयभावेन) पाठयेत् ।
- अद्यतनपूर्वकं साहित्यकोश-शब्दकोश-सन्दर्भग्रन्थानां सहायतया छात्राणां तत्परतां रुचिवर्धनं च ।
- प्राचीनार्वाचीनयोर्मध्ये समन्वयस्थापनद्वारा नूतनशिक्षणविधिभिश्च संस्कृतशिक्षणम् ।

कौशलानि-

- श्रवणकौशलम् – भावाधिग्रहणाय ध्वन्यात्मकं भाषायाः प्रथमं कौशलम् इदम् । अस्य साधनानि- गुरुमुखम्, आकाशवाणी, दूरवाणी, परिवारसदस्याः, समाजः, कक्षाः, ध्वनिमुद्रणयन्त्रम्, दूरदर्शनम् इत्यादीनि ।

- भाषणकौशलम्- भावाभिव्यक्तये ध्वन्यात्मकं भाषायाः इदं द्वितीयं कौशलम् । वाग्-रूपं भावप्रकटनम् एव भाषणम्, परिसरप्रभावेण आधारेण वा भाषणशक्तिः जायते ।
- पठनकौशलम् – भावाधिग्रहणाय लिप्यात्मकं भाषायाः तृतीयं कौशलम् इदम् । (अर्थग्रहणपूर्वकं स्पष्टरूप-वाचनम् इत्यर्थः)
- लेखनकौशलम्- भावाभिव्यक्तये लिप्यात्मकं भाषायाः चतुर्थं कौशलम् इदम् । (ध्वनिरूपे विद्यमानं भाषांशं लिपिरूपे अवतारणं लेखनम् इति उच्यते)
- ज्ञानात्मक-अवबोधनात्मक-अनुप्रयोगात्मक-विश्लेषणात्मक-संश्लेषणात्मक-मूल्याङ्कनात्मक-लक्षिताधिगमनविशेषाः ।

संस्कृतम्

कक्षा - नवमी (2026-27)

आहत्याङ्काः – 80+20

वार्षिकमूल्याङ्कनाय निर्मिते प्रश्नपत्रे चत्वारः खण्डाः भविष्यन्ति –

‘क’ खण्डः	अपठितावबोधनम्	10 अङ्काः
‘ख’ खण्डः	रचनात्मककार्यम्	15 अङ्काः
‘ग’ खण्डः	अनुप्रयुक्तव्याकरणम्	25 अङ्काः
‘घ’ खण्डः	पठितावबोधनम्	30 अङ्काः

खण्डानुसारं विषयाः मूल्यभारः च

क्र. सं.	विषयाः	प्रश्नप्रकाराः	मूल्यभारः
‘क’ खण्डः अपठितावबोधनम्			
			10 अङ्काः
1.	एकः गद्यांशः (80-100 शब्दपरिमितः)	अति-लघूत्तरात्मकौ दीर्घोत्तरात्मकौ शीर्षकम् (लघूत्तरात्मकः) भाषिककार्यम् (बहुविकल्पात्मकाः)	2×1=2 2×2=4 1×1=1 3×1=3
		पूर्णभारः	10 अङ्काः
‘ख’ खण्डः रचनात्मककार्यम्			
			15 अङ्काः
2.	सङ्केताधारितम् औपचारिकम् अथवा अनौपचारिकं पत्रलेखनम् (मञ्जूषायाः सहायतया रिक्तस्थानपूर्तिमाध्यमेन पूर्णं पत्रं लेखनीयम्)	निबन्धात्मकः	10×½=5
3.	चित्रवर्णनम् अथवा अनुच्छेदलेखनम्	निबन्धात्मकः	5
4.	संवादपूर्तिः / कथापूर्तिः	निबन्धात्मकः	10×½=5

	(मञ्जूषायाः सहायतया रिक्तस्थानपूर्तिमाध्यमेन पूर्णः संवादः / कथा लेखनीया)		
		पूर्णभारः	15 अङ्काः
‘ग’ खण्डः अनुप्रयुक्तव्याकरणम्			
			25 अङ्काः
5.	सन्धयः	लघूत्तरात्मकाः.	3×1=3
6.	कारक-उपपदविभक्तयः	बहुविकल्पात्मकाः	3×1=3
7.	शब्दरूपाणि	बहुविकल्पात्मकाः.	3×1=3
8.	धातुरूपाणि	बहुविकल्पात्मकाः.	3×1=3
9.	प्रत्ययाः	बहुविकल्पात्मकाः	3×1=3
10.	समासः	बहुविकल्पात्मकाः	3×1=3
11.	सङ्ख्या – १-१०० (१-४ केवलं प्रथमा-विभक्तौ)	लघूत्तरात्मकाः	3×1=3
12.	उच्चारणस्थानानि	लघूत्तरात्मकाः	4×½=2
13.	अव्ययानि	लघूत्तरात्मकाः	4×½=2
		पूर्णभारः	25 अङ्काः
‘घ’ खण्डः पठितावबोधनम्			
			30 अङ्काः
14.	गद्यांशः	अति-लघूत्तरात्मकौ दीर्घोत्तरात्मकौ लघूत्तरात्मकौ (भाषिककार्यम्)	2×½=1 2×1=2 2×1=2
15.	पद्यांशः	अति-लघूत्तरात्मकौ दीर्घोत्तरात्मकौ लघूत्तरात्मकौ (भाषिककार्यम्)	2×½=1 2×1=2 2×1=2
16.	नाट्यांशः	अति-लघूत्तरात्मकौ दीर्घोत्तरात्मकौ लघूत्तरात्मकौ (भाषिककार्यम्)	2×½=1 2×1=2 2×1=2
17.	प्रश्ननिर्माणम्	दीर्घोत्तरात्मकः	5×1=5
18.	अन्वयः अथवा भावार्थः	दीर्घोत्तरात्मकः	4×1=4
19.	पाठाधारित-कथापूर्तिः (मञ्जूषापदसहायतया रिक्तस्थानपूर्तिः)	निबन्धात्मकः	6×½=3
20.	प्रसङ्गानुकूलम् अर्थचयनम्	बहुविकल्पात्मकाः	3×1=3
		पूर्णभारः	30 अङ्काः

सम्पूर्णभारः 80 अङ्काः

प्रश्नपत्र-प्रारूपम् / संरचना
संस्कृतम्
कक्षा - नवमी (2026-27)

प्रश्नप्रकारः	प्रश्नानां सङ्ख्या	विभाग-सङ्ख्या	प्रतिप्रश्नम् अङ्कभारः	आहत्याङ्काः
अति-लघूत्तरात्मकाः 1 अङ्कः	2=2	1	1	2
अति-लघूत्तरात्मकाः ½ अङ्कः	2+2+2=6	3	½	3
बहुविकल्पात्मकाः 1 अङ्कः	3+3+3+3+3+3+3=21	7	1	21
लघूत्तरात्मकाः ½ अङ्कः	4+4=8	2	½	4
लघूत्तरात्मकाः 1 अङ्कः	1+3+3+2+2+2=13	6	1	13
दीर्घोत्तरात्मकाः 1 अङ्कः	2+2+2+5+4=15	5	1	15
दीर्घोत्तरात्मकाः 2 अङ्कौ	2=2	1	2	4
निबन्धात्मकाः 3 अङ्काः	1=1	1	3	3
निबन्धात्मकाः 5 अङ्काः	1+1+1=3	3	5	15
			आहत्याङ्काः	80

संस्कृतम्
कक्षा-नवमी (2026-27)
वार्षिकं मूल्याङ्कनम्

‘क’ खण्डः अपठितावबोधनम्		(10 अङ्काः)
1. एकः अपठितः गद्यांशः 80-100 शब्दपरिमितः गद्यांशः, सरलकथा वर्णनं वा ➤ एकपदेन पूर्णवाक्येन च अवबोधनात्मकं कार्यम् (2+4) ➤ शीर्षकलेखनम् (1) ➤ अनुच्छेदाधारितं भाषिकं कार्यम् (3) भाषिककार्याय तत्त्वानि - ✓ वाक्ये कर्तृ-क्रियापदचयनम् ✓ कर्तृ-क्रिया-अन्वितिः ✓ विशेषण-विशेष्यचयनम् ✓ पर्याय-विलोमपदचयनम् ✓ सर्वनामस्थाने संज्ञाप्रयोगः		10

‘ख’ खण्डः रचनात्मककार्यम् (15 अङ्काः)	
2. सङ्केताधारितम् औपचारिकम् अथवा अनौपचारिकं पत्रलेखनम् (मञ्जूषायाः सहायतया रिक्तस्थानपूर्तिमाध्यमेन पूर्णं पत्रं लेखनीयम्)	5
3. चित्राधारितं वर्णनम् अथवा अनुच्छेदलेखनम् (मञ्जूषायाः सहायतया चित्रवर्णनम् अनुच्छेदलेखनं वा करणीयम्)	5
4. संवादपूर्तिः / कथापूर्तिः (कथा छात्रस्तरानुगुणम् एव भवेत् ।) (मञ्जूषायाः सहायतया रिक्तस्थानपूर्तिमाध्यमेन पूर्णः संवादः / कथा लेखनीया ।)	5
‘ग’ खण्डः अनुप्रयुक्तव्याकरणम् (25 अङ्काः)	
5. सन्धिकार्यम् (1+1+1) ➤ स्वरसन्धिः - दीर्घः, गुणः, वृद्धिः, यण्, अयादि, पूर्वरूपम् ➤ व्यञ्जनसन्धिः -जश्त्वसन्धिः, ‘म्’ स्थाने अनुस्वारः, तुगागमः ➤ विसर्गसन्धिः - उत्त्वम्, विसर्गस्य सत्वम्, शत्वम्, षत्वम्, रत्वम्	3
6. कारक-उपपद-विभक्तयः ➤ द्वितीया - उभयतः, धिक्, परितः, समया, निकषा, प्रति, विना ➤ तृतीया - सह, साकम्, समम्, सार्धम्, विना, अलम्, सदृश, हीन ➤ चतुर्थी - रुच्, दा (यच्छ), नमः, कुप्, स्वस्ति ➤ पञ्चमी - विना, बहिः, भी, रक्ष्, ऋते ➤ षष्ठी - उपरि, अधः, पुरतः, पृष्ठतः, निर्धारणे ➤ सप्तमी- स्निह्, निपुणः, विश्वस्, पटु	3
7. शब्दरूपाणि ➤ पुँल्लिङ्गशब्दाः - बालकवत्, कविवत्, साधुवत्, पितृवत्, राजन्, भवत्, विद्वस्, गुणिन् ➤ स्त्रीलिङ्गशब्दाः - लतावत्, मतिवत्, नदीवत्, मातृवत्, धेनुवत् ➤ नपुंसकलिङ्गशब्दाः - फलवत्, वारि, जगत्, मनस्, चक्षुष् ➤ सर्वनामशब्दाः - तत्, इदम्, किम् (त्रिषु लिङ्गेषु), अस्मद्, युष्मद्	3
8. धातुरूपाणि ➤ परस्मैपदिनः - पठ्, गम्, वद्, भू, क्रीड्, नी, दृश्, शक्, ज्ञा, अस्, कृ, दा, क्री, श्रु, पा (पिब्) (पञ्चसु लकारेषु) ➤ आत्मनेपदिनः - सेव्, लभ्, रुच्, मुद्, वृध् (लट्-लृट्-लोट्-लकारेषु) ➤ उभयपदिनः - कृ, पच्, नी, कृष्, ह, भज् (केवलं लट्लकारे)	3
9. प्रत्ययाः ➤ क्त्वा, तुमुन्, ल्यप्, क्त, क्तवतु, शतृ, शानच्	3

10. समासः – तत्पुरुषः (विभक्ति-नञ्-उपपद-कर्मधारय)	3
11. सङ्ख्या – 1-100 (1-4 केवलं प्रथमा-विभक्तौ)	3
12. उच्चारणस्थानानि	2
13. अव्ययानि	2
➤ स्थानबोधकानि – अत्र, तत्र, अन्यत्र, सर्वत्र, यत्र, एकत्र, उभयत्र ➤ कालबोधकानि – यदा, तदा, सर्वदा, एकदा, पुरा, अधुना, अद्य, श्वः, ह्यः ➤ प्रश्नबोधकानि – किम्, कुत्र, कति, कदा, कुतः, कथम्, किमर्थम् ➤ अन्यानि – च, अपि, यदि, तर्हि, यथा, तथा, सम्यक्, एव, तु	
‘घ’ खण्डः पठितावबोधनम्	
(30 अङ्काः)	
14. गद्यांशम् अधिकृत्य अवबोधनात्मकं कार्यम् प्रश्नप्रकाराः – एकपदेन पूर्णवाक्येन च प्रश्नोत्तराणि भाषिककार्यम् –	5
➤ वाक्ये कर्तृ-क्रियापदचयनम् ➤ विशेषण-विशेष्यचयनम् ➤ पर्याय-विलोमपचयनम् ➤ सर्वनामस्थाने संज्ञाप्रयोगः	
15. पद्यांशम् अधिकृत्य अवबोधनात्मकं कार्यम् प्रश्नप्रकाराः – एकपदेन पूर्णवाक्येन च प्रश्नोत्तराणि भाषिककार्यम् –	5
➤ वाक्ये कर्तृ-क्रियापदचयनम् ➤ विशेषण-विशेष्यचयनम् ➤ पर्याय-विलोमपचयनम् ➤ सर्वनामस्थाने संज्ञाप्रयोगः	
16. नाट्यांशम् अधिकृत्य अवबोधनात्मकं कार्यम् प्रश्नप्रकाराः – एकपदेन पूर्णवाक्येन च प्रश्नोत्तराणि भाषिककार्यम् –	5
➤ वाक्ये कर्तृ-क्रियापदचयनम् ➤ विशेषण-विशेष्यचयनम् ➤ पर्याय-विलोमपचयनम् ➤ सर्वनामस्थाने संज्ञाप्रयोगः	
17. वाक्येषु रेखाङ्कितपदानि अधिकृत्य उचितप्रश्ननिर्माणम्	5
18. अन्वयः अथवा भावार्थः (रिक्तस्थानपूर्तिः)	4
19. पाठाधारित-कथापूर्तिः (मञ्जूषापदसहायतया रिक्तस्थानपूर्तिः)	3
20. प्रसङ्गानुकूलम् अर्थचयनम्	3

परीक्षायै निर्धारिताः पाठाः – शीघ्रमेव सूचयिष्यन्ते

निर्धारितपाठ्यपुस्तकम् –

1. पाठ्यपुस्तकम् - शीघ्रमेव सूचयिष्यते
(प्रकाशनम् – रा.शै.अनु.प्र.परि. द्वारा)

अवधेयम् -

- * अनुप्रयुक्तव्याकरणस्य अंशानां चयनं यथासम्भवं 'पाठ्यपुस्तकात् करणीयम्।
- * पुस्तकपाठादिसहितं पूर्णः पाठ्यक्रमः शीघ्रमेव सूचयिष्यते।

नवमी

आन्तरिक-मूल्याङ्कनम् - 20 अङ्काः

उद्देश्यानि

- ❖ छात्राणां सृजनात्मकक्षमतायाः विकासः।
- ❖ श्रवण-भाषण-पठन-लेखनकौशलानां विकासः।
- ❖ चिन्तनक्षमतायाः आत्मविश्वासस्य च संवर्धनम्।

क्र. सं.	गतिविधयः	उदाहरणानि	अङ्काः	निर्देशाः	मूल्याङ्कनविन्दवः
1.	आवधिक-परीक्षा: (पीरियोडिक् - असैस्मैट)	लिखितपरीक्षा	05	विद्यालयेन समये समये लिखितपरीक्षाणाम् आयोजनं करणीयं भवति।	परीक्षासु यत्र विद्यार्थिनः श्रेष्ठाः अङ्काः स्युः तयोः द्वयोः परीक्षयोः एव अधिभारः ग्रहीतव्यः। अपि च आवधिकपरीक्षासु अपि प्रश्नेषु आन्तरिकविकल्पाः देयाः। मूल्याङ्कनसमये यदि छात्रः सर्वान् प्रश्नान् उत्तरति तर्हि छात्रहिताय यत्र अधिकाः अङ्काः सन्ति तेषाम् एव मूल्याङ्कनं करणीयम्।

2	बहुविधमूल्याङ्कनम्	❖ कक्षायां पाठितस्य पाठस्य लघुमूल्याङ्कनम् ❖ निर्गतपत्राणि ❖ प्रश्नोत्तरी ❖ मौखिकी परीक्षा ❖ प्रतियोगिताः ❖ प्रश्नमञ्चस्यायोजनम्	05	कक्षायां पाठित-पाठस्य विषयस्य वा बहुविधं मूल्याङ्कनम् अपेक्षितम् अस्ति । अनेन विद्यार्थिनां विविधकौशलानां मूल्याङ्कनं भवेत् ।	❖ मौलिकता ❖ विषयसम्बद्धता ❖ शुद्धता ❖ समयबद्धता ❖ प्रस्तुतीकरणम्
3.	निवेशसूचिका (पोर्टफोलियो)	❖ कक्षाकार्यम् ❖ सामूहिक-मूल्याङ्कनम् ❖ स्वमूल्याङ्कनम् ❖ विद्यार्थिनः विषयगताः उपलब्धयः	05	विद्यार्थिभिः कक्षायां कृतानां कार्याणाम् उपलब्धीनां च संरक्षणं संयोजनं च सञ्चिकायां पत्रावल्यां वा करणीयम् । एतेन समग्रं मूल्याङ्कनं प्रमाणिकत्वेन भवितुं शक्नोति ।	❖ सुलेखः ❖ तथ्यात्मकता ❖ प्रामाणिकता ❖ समयबद्धता
4.	भाषा-संवर्धनाय गतिविधयः (क) श्रवण-भाषण-कौशलम्	❖ कथा ❖ संवादः/ वार्तालापः ❖ भाषणम् ❖ नाटकम् ❖ वार्ताः ❖ आशुभाषणम् ❖ संस्कृतगीतानि ❖ श्लोकोच्चारणम् ❖ प्रहेलिकाः	05	❖ छात्राः कामपि कथां श्रावयितुं शक्नुवन्ति । ❖ शिक्षकः कमपि विषयं सूचयित्वा परस्परं संवादं कारयितुं शक्नोति । ❖ दूरदर्शने वार्तावली इत्याख्यः संस्कृत-कार्यक्रमः प्रसारितः भवति तं द्रष्टुं छात्राः प्रेरणीयाः । ❖ श्रवण-कौशल-मूल्याङ्कनाय शिक्षकः स्वयम् अपि कथां श्रावयित्वा ततः सम्बद्ध-प्रश्नान् प्रष्टुं शक्नोति ।	❖ उच्चारणम् ❖ शुद्धता ❖ समयबद्धता ❖ प्रस्तुतीकरणम् (आरोहावरोह-गतियति-प्रयोगः)
	(ख) लेखनकौशलम्	❖ विविधविषयान् आधृत्य मौलिकलेखनम् यथा- देशः, माता, पिता, गुरुः, विद्या पर्यावरणम्, योगः, समयस्य सदुपयोगः,		❖ छात्राः यथाशक्यं कक्षायामेव लेखनकार्यं कुर्युः । ❖ टिप्पणी- पुस्तिकायाः निर्माणम् । ❖ वैयक्तिकपरीक्षणम् ।	❖ विषय-सम्बद्धता ❖ शुद्धता (विशेषतः पञ्चमवर्णस्यप्रयोगः) ❖ समयबद्धता ❖ सुलेखः ❖ प्रस्तुतीकरणम्

		शिक्षा, अनुशासनम् इत्यादयः । ❖ शैक्षिकभ्रमणस्य संस्कृतेन प्रतिवेदनलेखनम् । ❖ दैनन्दिनीलेखनम् । ❖ सङ्केताधारितं कथालेखनम् । ❖ भित्तिपत्रिकायाः निर्माणम् । ❖ श्रुतलेखः । ❖ सूक्तिलेखनम् ।			
	अवधातव्यम् –उपर्युक्त-गतिविधयः उदाहरणरूपेण प्रदत्ताः सन्ति । एतदतिरिच्य एतादृशाः अन्यगतिविधयः अपि भवितुमर्हन्ति ।				

Science at Advanced Level (Optional)

Grade 9

2026-27

**Academic Unit,
Central Board of Secondary Education**

Integrated Office Complex, Sector-23, Phase - 1, Dwarka,
New Delhi - 110077



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Measurement- The Foundation of Science

1.1 Introduction: What is Measurement?

Measurement is the process of comparing an unknown quantity with a known standard quantity of the same kind. Physics is based on measurement. Whether we measure the length of a classroom, the mass of a bag, or the time taken by a runner, accurate measurement is essential

Examples

- A tailor measures cloth in meters.
- A doctor measures body temperature in degree Celsius.
- A shopkeeper measures rice in kilograms.

Without proper units, these measurements would have no meaning.

Activity 1.1 Measuring the area of the classroom floor

Materials: Take three sticks of length $l_1:l_2:l_3 = 1:2:3$

Procedure:

1. Divide students in 3 groups and hand over one stick to each group.
2. Each group will measure the length and width of the classroom taking stick as one unit.

	Stick 1	Stick 2	Stick 3
Length of wall	 units*	 units	 units
Breadth of wall	 units	 units	 units
Area of floor	 units ²	 units ²	 units ²

**the unit refers to length of the stick used for measurement*

3. Compare the length, breadth and area measured by different groups and try to generate conclusions between unit chosen and numerical values obtained by all the three groups.

This activity demonstrates that the numerical value of a quantity is inversely proportional to the size of the unit used. Thus, when a larger unit (longer stick) is used to measure the classroom floor, the numerical value obtained is smaller, and

when a smaller unit is used, the numerical value is larger.

In measurement, the physical quantity remains constant even when the unit changes.

Hence,

$$Q = n_1 u_1 = n_2 u_2$$

Therefore,

$$n_2 = n_1 (u_1 / u_2)$$

Activity 1.2: Let's play an estimation game

Procedure:

1. Estimate the length of the blackboard without measuring.
2. Then measure its length using a meter scale.
3. Compare the estimated and measured values. Now, calculate the inaccuracy (error) in the measurement.

1.2 Different Systems of Units

In earlier times, different regions/places used their own units of measurement, which often led to confusion and errors.

(a) CGS System

- Length: centimeter (cm)
- Mass: gram (g)
- Time: second (s)

It is mainly used in laboratory and scientific calculations.

(b) FPS System

- Length: foot (ft)
- Mass: pound (lb)
- Time: second (s)

Commonly used in the United States.

(c) MKS System

- Length: meter (m)
- Mass: kilogram (kg)
- Time: second (s)

This system later developed into the SI (**International System of Units or Système International d'Unités**) system.

Example

- The height of a person is largely measured in centimeters in India, while in some countries it is measured in feet and inches.

1.3. Need for a Common System of Units

Different systems of units caused difficulties in communication, trade, and scientific research.

Problems Without a Common System

- Confusion in international trade
- Errors in scientific calculations
- Difficulty in sharing scientific data

Example

If a scientist in India measures length in meters and another in the USA measures in feet, comparison becomes difficult unless a common unit is used.

Hence, a universal system of units was required.

Activity 1.3: Let us Compare

Materials: Ruler marked in cm and inches

Procedure:

1. Measure the length of a book using both cm and inches.
2. Compare the values and find the relation between them.

1.4. International System of Units (SI)

The International System of Units (SI) is the modern and universally accepted system of measurement.

SI Base Units

Physical Quantity	SI Unit	Symbol
Length	Meter	m
Mass	Kilogram	kg
Time	Second	s
Temperature	Kelvin	K
Electric Current	Ampere	A

Luminous Intensity	Candela	Cd
Amount of substance	Mole	mol

Advantages of SI Units

- Internationally accepted
- Easy to use and understand
- Based on the decimal system

Examples

- Speed of vehicles is measured in m/s or km/h
- Medicines are measured in milligrams (mg)

1.5 Conversion of Units between different Systems

Sometimes, we need to convert a measurement from one unit to another to ensure comprehension across different systems.

During unit conversion, the numerical value and the unit may change, but the magnitude of the physical quantity remains the same.

Basic Conversions

- **1 km = 1000 m**
- **1 m = 100 cm**
- **1 kg = 1000 g**
- **1 hour = 3600 s**

Examples

Q. Convert 9 km/hr into m/s.

$$\text{Answer: } 9 \text{ km/hr} = \frac{9 \times 1000 \text{ m}}{3600 \text{ s}} = \frac{5}{2} \text{ m/s}$$

Q. Convert 1 N into gcm/s².

$$\text{Answer: } 1 \text{ kg m/s}^2 = 1000\text{g} \times 100 \text{ cm/s}^2 = 10^5 \text{ gcm/s}^2 = 10^5 \text{ dyne.}$$

Quick Check

1. Name any two systems of units.
2. Why is SI system preferred over other systems?
3. Convert 250 N into gcm/s².
4. Convert 1000 kg/L into kg/m³.

Check Your Understanding

1. Which of the following is not an SI unit?
 - a) Meter
 - b) Kilogram
 - c) Second
 - d) foot
2. The SI unit of mass is:
 - a) Gram
 - b) Kilogram
 - c) Pound
 - d) tonne
3. Name the system of units used internationally.
4. Why is a common system of units necessary?
5. Why is measurement necessary in physics?
6. Why was there a need for a common system of units?
7. Explain the relation: $\text{Magnitude} = \text{Numerical value} \times \text{Unit}$
8. Why does the same classroom floor give different numerical values when measured with sticks of different lengths?

Answer questions 9 to 11 that are based on Activity 1.1 (Measuring Classroom Floor)

Suppose:

Stick Length	Length of Wall	Breadth of Wall
1 unit	30 units	20 units
2 units	15 units	10 units
3 units	10 units	6.6 units

9. Why are numerical values different?
10. Is the actual size of the classroom different? Why or Why not?
11. What conclusion can you draw about units and measurement from this activity?
12. Fill in the blanks
 - a. Measurement is the process of comparing an unknown quantity with a _____ quantity.
 - b. The SI unit of mass is _____.

- c. In CGS system, the unit of length is _____.
- d. 1 km = _____ m.
- e. The modern internationally accepted system of units is called _____.

13. Match the following:

Column A	Column B
CGS	Kelvin
FPS	Pound
SI	International system
MKS	Meter-Kilogram-Second

- 14. What problems might occur if every country used its own system of units for measurement?
- 15. A scientist measures length in feet and another in meters. What difficulties may it lead to?
- 16. If 1 meter was defined differently in different countries, what would happen to international trade?
- 17. A shopkeeper sells rice using kilograms. A foreign customer asks for rice in pounds.
 - a. Why is unit conversion necessary here?
 - b. If 1 kg = 2.2 pounds, how many pounds are there in 5 kg?

Understanding Motion Through Experience

Reflect on the following:

- Why do we feel pushed backward when a bus suddenly starts moving?
- Can an object be at rest for one observer but moving for another?
- How do athletes decide the best angle to throw a ball so that it travels the maximum distance?
- Can we measure motion using simple tools available in the classroom?

Discuss your ideas with classmates before beginning the activities.

2.1 What is Motion?

An object is said to be in motion if its position changes with time with respect to a reference point. Motion can be slow or fast, straight or curved, uniform or non-uniform. Understanding motion becomes easier when we observe it directly and measure it ourselves.

Activity 2.1: Let's observe

Materials: Notebook, stopwatch (mobile timer), measuring tape

Steps:

1. Mark two points 5 meters apart in the classroom corridor or playground.
2. Ask one student to walk normally from one point to another while another student measures the time taken using a stopwatch.
3. Repeat the experiment with the student running.
4. Record the distance and time in a table.

Observation: - Compare the time taken for walking and running. - Which motion is faster? How can you calculate speed?

Can motion be described using measurable quantities such as distance and time?

2.2 Frame of Reference

A frame of reference that is at rest or moving with constant velocity is called an inertial frame. Newton's laws hold without modification in such frames. A frame that is accelerating is called a non-inertial frame, and we will see in later sections that special corrections (pseudo forces) become necessary in such frames.

To describe the state of motion of an object, we must specify a reference point. Without it, we cannot say whether an object is moving or at rest.

Activity 2.2: Motion is Relative

Materials: Two students as props

Steps:

1. Let one student stand still while another walks past him.
2. Ask each student to describe the motion of the other student.
3. Now let both students walk in the same direction with the same speed and describe the motion again.

Discussion: - When both students walk together at the same speed, they appear at rest relative to each other but moving relative to the classroom.

2.3. Scalars and Vectors

Physical quantities are of two types: -

Scalars: Quantities having magnitude only (distance, time, mass, speed and work)

Vectors: Quantities having both magnitude and direction (displacement, velocity, force).

Activity 2.3: Direction Matters

Materials: Chalk, measuring tape

Steps:

1. Draw a straight 5-metre line on the ground and mark the starting point as A and the end as B.
2. Walk from A to B and note the distance covered.
3. Next walk from A to B and then back to A.
4. Compare the distance travelled and displacement.

Observation: - Distance changes but displacement becomes zero when returning to the starting point.

2.4 Vector Addition (Graphical Method)

Vectors are physical quantities that have both magnitude and direction, such as displacement, velocity, and force. When two or more vectors act together, we combine them to find a single vector called the **resultant**. This process is known as **vector addition**. Vectors can be added graphically using methods like the **triangle method** or the **parallelogram method**.

Activity 2.4: Graphical Addition of Displacements

Materials: Graph paper, ruler, pencil

Steps:

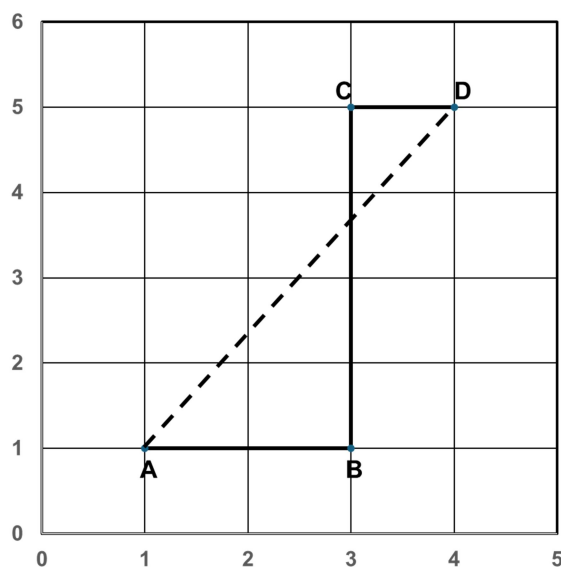
1. On graph paper, draw a vector representing 4 units towards the east.
2. From the head (end) of this vector, draw another vector representing 3 units towards the north.
3. Now join the tail (starting point) of the first vector to the head of the second vector.

Observation:

The line joining the starting point to the final point represents the **resultant displacement**.

This is how two vectors can be combined graphically to find a resultant vector, and how both magnitude and direction are important in describing motion.

Practice Question:



Points A at (1,1), B at (3,1), C at (3,5) and D at (4,5) (All the values mentioned in the graph are in km) represent Sita's House, bus stop, traffic signal and school respectively. In the morning Sita travels from A to B on foot, then B to D via C in the school bus. (All the values mentioned in graph are in km) Then calculate:

- (a) Distance traveled by Sita on foot,
- (b) Distance traveled by Sita by the school bus,
- (c) Total displacement of Sita from her house to the school.

2.5. Equations of Motion

When an object moves with constant acceleration, its motion can be described using equations which are given as:

$$V = u + at$$

$$S = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

where, u is initial velocity, v is final velocity, a is acceleration, and s is displacement.

Activity 2.5: Observing Accelerated Motion Using a Toy Car

Materials: Toy car (or small wheeled object), smooth floor, measuring tape, stopwatch (mobile timer), chalk/tape

Steps:

1. Mark a straight line on the floor and label the starting point as O.
2. Place the toy car at point O and give it a gentle push so that it moves forward.
3. Use a stopwatch and note the position of the car at equal time intervals (every 1 second).
4. Mark these positions on the floor using chalk or tape.
5. Measure the distance from the starting point to each marked position and record it in a table.

Observation: The distance travelled in successive intervals increases, showing acceleration.

Conclusion:

The motion is **accelerated motion**, as the velocity increases with time.

4th equation of motion distance travelled in the n^{th} second

From the **second equation of motion**:

$$s = ut + \frac{1}{2}at^2$$

where,

u = initial velocity

a = acceleration

t = time

s = displacement in time t

Distance travelled in n seconds

$$s_n = u(n) + \frac{1}{2}an^2$$

Distance travelled in (1) second

$$s_{n-1} = u(n-1) + \frac{1}{2}a(n-1)^2$$

Distance travelled in the n^{th} second

$$\text{distance in } n^{th} \text{ second} = s_n - s_{n-1} = \left[\frac{1}{2}an^2 \right] - \left[u(n-1) + \frac{1}{2}a(n-1)^2 \right]$$

Solving:

$$= un + \frac{1}{2}an^2 - un + u - \frac{1}{2}a(n^2 - 2n + 1) = u + \frac{1}{2}a[2n - 1]$$

Final Formula

$$s_n = u + \frac{a}{2}(2n - 1)$$

This is the distance travelled in the n^{th} second, often called the fourth equation of motion. Here n must be a positive integer representing the n th second of motion. The formula gives the displacement specifically during that one-second interval, not a cumulative displacement.

2.6 Reflect and Discuss

- Why is specifying a reference frame necessary to describe motion?
- How do direction and magnitude together describe displacement?
- Which daily activities around you involve accelerated motion?

2.7 Project-Based Learning

Design a simple experiment using everyday materials to measure the speed of a moving object (using a bicycle, or a walking student). Present your method, observations, calculations, and conclusions to the class.

Check Your Understanding

1. Define a frame of reference in your own words.
2. Give two real-life examples where motion depends on the observer.
3. Why does a person sitting in a moving train appear at rest to another passenger?
4. Classify the following as scalar or vector quantities: speed, velocity, displacement, distance, acceleration and mass.

5. Explain the difference between distance and displacement with an activity diagram.
6. Give two everyday examples of vector quantities.
7. Draw two vectors of 4 units east and 3 units north and find the resultant using the triangle method.
8. Explain how vector subtraction is performed graphically.
9. Draw two opposite vectors of equal magnitude. Calculate its resultant.
10. A body starts from rest and accelerates at 4 m/s^2 . Find the distance travelled in the 6th second.
11. A car with initial velocity 8 m/s accelerates at 2 m/s^2 . Find the distance covered in the 5th second.

Newton's Laws of Motion

3.1 Limitations of Newton's Laws in Accelerating Frames

Activity 3.1: Let us observe

Consider the following situations:

- A passenger standing in a bus that suddenly accelerates forward feels pushed backward, even though no one is actually pushing.
- When a vehicle takes a sharp turn, passengers feel pushed outward.

Why does this happen? Is there really a force pushing the passenger backward or outward? Can these effects be explained only by the usual forces like gravity or friction?



Understanding the Limitations

According to Newton's First Law of Motion, a body continues to remain at rest or in uniform motion in a straight line unless acted upon by an external force. This law is strictly valid only in a non-accelerating frame.

However, when the frame itself is accelerating, objects seem to move without any visible external force acting on them.

To maintain consistency with Newton's laws, let us examine an additional concept.

Pseudo Force (Fictitious Force)

A force which does not arise due to physical contact or interaction (unlike gravitational, frictional, or tension forces). A pseudo force (also called a fictitious force) is an apparent force that is observed only when motion is described from an accelerating frame of reference.

Now understanding the scenario: What does a passenger fall backwards when a bus starts suddenly?

Observer 1: Standing on the road (inertial frame)

- Sees the bus accelerate forward
- Sees the passenger trying to remain at rest (inertia)

Explanation uses only real physics:

- No backward force exists
- Passenger's body just resists motion

This follows Newton's First Law of Motion perfectly.

Observer 2: Inside the accelerating bus (non-inertial frame)

- Sees the passenger "move backward"
- But doesn't see any real force causing it

To make Newton's Laws of Motion still work, we **introduce the concept of pseudo force**: From the ground (an inertial frame), no force pushes the passenger backward — the bus simply accelerates away from under them. But if we describe the situation from inside the accelerating bus (a non-inertial frame), we must add a pseudo force of magnitude $m \cdot a$ directed backward to make Newton's First Law appear valid within that frame. This force has no physical source and no reaction pair.

When a frame accelerates forward, it exerts an influence on objects inside it. From within that accelerating frame, we introduce an imaginary force acting in the opposite direction to explain the observed motion. Thus, in an accelerating frame:

- The frame accelerates in one direction.
- An apparent force (pseudo force) is considered to act on the body in the opposite direction.

This ensures that Newton's First Law still appears valid within that frame.

Definition:

A pseudo force is an apparent force observed only in an accelerating frame of reference.

It is always opposite to the acceleration of the frame and does not arise due to any physical interaction.

Formula

$$F_{pseudo} = -ma_{frame}$$

where:

- m = mass of the object
- a_{frame} = acceleration of the frame
- The negative sign indicates that the pseudo force acts opposite to the acceleration of the frame.

Quick Check

1. In which type of reference frame are Newton's laws valid?
2. Define pseudo force and write its formula.
3. A lift accelerates upward at 4.5 m s^{-2} . Calculate the pseudo force experienced by a 60 kg person inside the lift.
4. Why does pseudo force disappear in an inertial frame?

3.2 Gravitation

Orbital Motion: Why the Earth and Moon Do Not Fall Despite Gravity?

Concept of Centripetal and Centrifugal forces

The Sun and the Earth both have mass, so they attract each other with a gravitational force. According to Newton's law of gravitation, the force between them is equal in magnitude and opposite in direction. However, because the Sun's mass is much greater than the Earth's mass, the Earth experiences a much larger acceleration as compared to the Sun. That is why the Earth appears to revolve around the Sun.

The Sun's gravitational pull on the Earth provides the centripetal force needed to keep the Earth in its orbit.

Earth is revolving around the Sun and it is moving with very high tangential velocity. So, due to its inertia, it should tend to continue moving in a straight line. On the other hand, the gravitational force of the sun is continuously attracting it towards the centre of the sun. This changes its direction of motion. As a result of these two aspects, the Earth does not move in a straight line but follows a fixed curved path called an orbit.

Let us think: Imagine the Earth suddenly slows down. Take a moment to picture what would happen if its forward (tangential) speed decreases, but the Sun's gravitational pull remains just as strong as before. Would the balance still exist? How would this change affect the Earth's path? Think about why slowing down would cause the Earth to drift closer to the Sun instead of continuing smoothly along its usual orbit.

Try to get the answer with the help of the following activity.

Activity 3.2:

Steps:

1. Tie the ring/bob securely to one end of the thread of length approx. 1 m.
2. Hold the other end of the thread firmly with your finger.
3. Swing the ring/bob in a horizontal circle at a steady speed.

4. Observe how the bob moves in a circular path.
5. Now slowly reduce the speed of rotation.
6. Continue decreasing the speed further and observe what happens to the circular motion.

Observation:

At an appropriate speed, the thread provides the centripetal force that pulls the stone/ bob inward, keeping it in a circular path. At the same time, due to its inertia, the stone tends to move in a straight line along the tangent. The balance between this outward tendency and the inward centripetal force results in circular motion.

When the speed decreases, the **required centripetal force also decreases**. However, the tension in the thread may reduce to the point where it can no longer keep the stone moving in a circular path. As a result, the string may become slack, and the motion is no longer circular—the stone begins to move inward or fall.

Conclusion:

Circular motion requires a balance between inward pulling force (centripetal force) and tangential speed (which provides necessary centrifugal force). If speed decreases too much, the balance is disturbed, and the object can no longer continue in the same circular path.

Effect of Cross-Sectional Area (Air Resistance) on Falling Objects of Equal Mass

Let us imagine two objects with the same mass but different cross-sectional areas. These are dropped from the same height, an important question arises: *Will they reach the ground at the same time?*

Case 1: When Air Is Present

Both objects have the same mass, so the gravitational force acting on them is the same:

$$F = mg$$

Since mass (m) is the same, the force of gravity on both objects is equal. This means gravity pulls both objects downward equally.

However, another force also acts on the objects — **air resistance (air drag)**. This is an upward force that opposes motion.

Air resistance mainly depends on the **cross-sectional area** of the object (and shape, speed and density of air). The larger the cross-sectional area, the greater the air resistance.

Because of this:

- The object with a **larger cross-sectional area** experiences more air resistance.
- The object with a **smaller cross-sectional area** faces less opposition.
- Therefore, it has a greater net downward force and falls faster.

Conclusion:

In air, the object with the **smaller cross-sectional area** reaches the ground first.

Case 2: In a Vacuum (No Air)

Since there is no air in a vacuum, there is **no air resistance either**.

$$a = \frac{F}{m} = \frac{mg}{m} = g$$

Conclusion:

In a vacuum, both objects reach the ground at the **same time**, regardless of their shape or size.

Variation of acceleration due to Gravity with Altitude and Depth (without using Binomial Theorem)

- When we throw a ball upward, it comes back down.
- When we jump, we return to the ground.

This happens because the Earth pulls everything toward its centre due to gravity.

But why do astronauts float inside a spacecraft?

Does gravity disappear in space?

Is the value of gravity the same everywhere?

We know that as we go higher above the Earth's surface, we move farther away from the centre of the Earth. We know that gravitational force depends on distance. As distance increases, force decreases.

Astronauts in the International Space Station appear weightless.

So clearly, gravity decreases with height, but it does not become zero.

Now let us derive the expression for the acceleration due to gravity at point A, which is at a height of h from the surface of the earth.

Derivation – Acceleration Due to Gravity at Height

Let:

- Mass of object = m
- Radius of Earth = R
- Height above surface = h
- Distance from centre of Earth = $(R + h)$

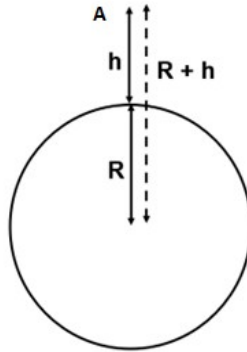


Fig: 3.1 Acceleration due to gravity at height h

The acceleration due to gravity at height h is:

$$g_h = \frac{GM}{(R+h)^2}$$

Where:

- G = Universal Gravitational Constant
- M = Mass of Earth

On Earth's surface:

$$g = \frac{GM}{R^2}$$

Dividing both equations:

$$\frac{g_h}{g} = \frac{R^2}{(R+h)^2}$$

This shows clearly that:

$$g_h < g$$

Example

Calculate acceleration due to gravity at a height of 800 km above Earth.

Given:

$$R = 6400 \text{ km}$$

$$h = 800 \text{ km}$$

$$g = 9.8 \text{ m/s}^2$$

$$g_h = g \left(\frac{R^2}{(h)^2} \right) g_h = 9.8 \left(\frac{6400^2}{7200^2} \right) g_h = 9.8 \left(\frac{64}{72} \right)^2 g_h = 7.74 \text{ m/s}^2$$

Acceleration Due to Gravity Below the Surface of Earth

Now, consider a point **A** located at a depth **d** inside the Earth. Assuming the Earth has uniform density, let us determine the acceleration due to gravity at that interior point.

Let:

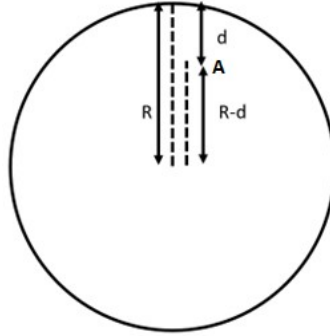


Fig: 3.2 Acceleration due to gravity at depth d

- Radius of Earth = R
- Depth below surface = d
- Distance from centre = $(R - d)$
- Density of Earth = ρ (uniform)

If density is uniform, then mass of the earth can be calculated by

$$\text{Mass of Earth} = M = \frac{4}{3} \pi R^3 \rho$$

At depth d , the object is at a distance $(R - d)$ from the centre, only the mass inside radius $(R - d)$ contributes to gravity. (This is By Newton's Shell theorem, the gravitational effect of a uniform spherical shell on a point inside it is exactly zero. Therefore, at depth d , only the sphere of radius $(R-d)$ centred at Earth's core contributes to gravity—the outer shell of thickness d has no net effect)

$$M_d = \frac{4}{3} \pi (R - d)^3 \rho$$

From Newton's Law of Gravitation

$$g_d = \frac{G M_d}{(d)^2}$$

Substitute M_d :

$$g_d = \frac{G \left(\frac{4}{3} \pi (R - d)^3 \rho \right)}{(d)^2}$$

$$g_d = \frac{4}{3} \pi G \rho (R - d)$$

Compare with gravity at earth's surface i.e.

At Earth's surface:

$$g = \frac{4}{3} \pi G \rho R$$

Dividing the two equations:

$$\frac{g_d}{g} = \frac{R - d}{R}$$

Therefore,

$$g_d = g \left(\frac{d}{R} \right)$$

We conclude from the above derivations that acceleration due to gravity is maximum at the Earth's surface and decreases as we go up/down. It will become zero at the centre of the earth.

Example:

At what depth does g become 1/10th of its surface value?

Given:

$$g_d = \frac{g}{10}$$

Using the formula:

$$g \left(\frac{d}{R} \right) = \frac{g}{10} \Rightarrow 1 - \frac{d}{R} = \frac{1}{10} \Rightarrow \frac{d}{R} = \frac{9}{10} \Rightarrow d = \frac{9R}{10}$$

Quick Check

1. Where does the acceleration due to gravity reach its maximum value—on the surface, above, or below the Earth?
2. What happens to g at the centre of the Earth?
3. Calculate g at a height of 400 km if R = 6400 km.
4. At what depth will g become half of its surface value?
5. Why does gravity decrease both above and below the surface of the earth?

3.3 Turning Forces (Moment of Force/Torque)

Activity 3.3: Let us observe

Look at the picture of a boy trying to enter his classroom. He pushes the door to open it.

Now, think carefully and answer the following questions:

- Where will the boy apply force to open the door easily?
 - (a) Near the handle
 - (b) Near the hinges
 - (c) At the centre of the door
- Why are door handles fixed far away from the hinges and not near them?



Now, reflect on the following points:

- The boy applies force in a straight direction, but the door rotates. Why does this happen?
- Even though the door is heavy, it rotates easily when pushed at the handle.
- How is it possible to rotate such a heavy object by applying force at just one end?

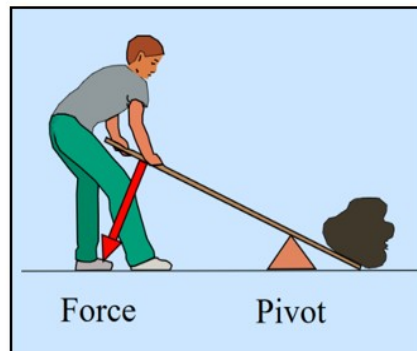
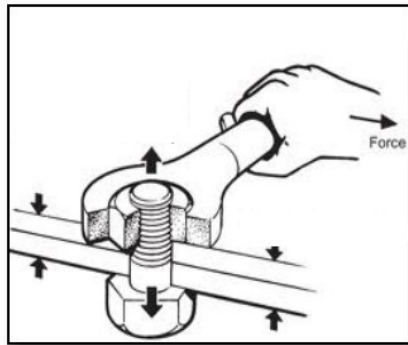


Fig: 3.3 Some examples of turning effects of forces in our daily life

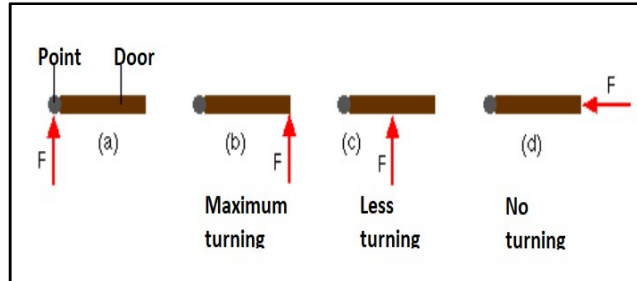
When we apply a force to an object and it starts to rotate, the force produces a turning effect.

This turning effect of a force is called the moment of force.

Moment of Force (Torque) $\tau = F \times d \times \sin \theta$, where F is the magnitude of the force, d is the distance from the pivot to the point of application, and θ is the angle between the force and the line joining the pivot to the point of application. Torque is maximum when $\theta = 90^\circ$ (force perpendicular to the lever arm) and zero when $\theta = 0^\circ$ or 180° (force directed toward or away from the pivot).

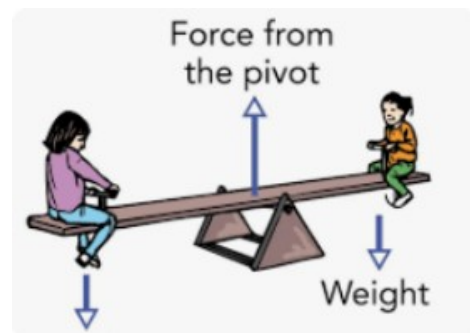
Since the turning effect of a force depends on both the magnitude of the force and the distance from the fixed point, its S.I. unit is newton-metre (Nm).

The angle at which force is applied to a door (and the resulting angle of the door itself) is crucial for controlling the turning, efficiency, and safety of the opening motion. The fundamental principle is that turning is maximized when the force is applied perpendicular (at a 90-degree angle) to the door surface, making it the most efficient way to open or close it.



Check Your Understanding

1. Why is it easier to open a door when you push at the handle rather than near the hinges?
2. A force is applied to a wrench at different angles. At which angle will the rotating force be maximum? What happens to the turning effect when the force is applied parallel to the wrench?
3. Two students apply the same force to open a gate. One pushes perpendicular to the gate at 20cm from the hinge. The other pushes perpendicular to the gate at 80 cm. Who produces greater torque? Justify
4. Is it possible for a force to act on a body and still produce zero turning about a given fixed point? Give a real-life example.
5. Two forces act on a rod pivoted at its centre:
 - I. 10 N downward at 0.5 m on the left
 - II. 10 N downward at 0.5 m on the right
 Will the rod rotate? Explain your reasoning
6. How can a mechanic loosen a tight bolt using a long spanner instead of applying a very large force? Explain using the torque formula.
7. A force of 20 N is applied to a door at 0.8 m from the hinge. Calculate the torque when the force is applied at (a) 90°, (b) 60° (c) 30° to the door surface.



The Geometry of Power- Advanced Simple Machines

4.1 Introduction

Welcome to the study of Mechanical Advantage. While simple machines such as levers and inclined planes form the foundational concepts of physics, the machines that shape our modern world—like cranes, trucks, and bicycles—apply these same principles in more advanced and integrated ways through systems of wheels, axles, and pulleys.

In this chapter, we will examine how the principles of geometry and force distribution allow a relatively small input force to be transformed into a much larger output force.

Activity 4.1:

- A truck driver turning a massive vehicle using only two hands.
- A crane lifting heavy concrete beams smoothly.
- A cyclist moving very fast by pedaling lightly.

Now think carefully:

- Is the driver extremely strong?
- Does the crane create extra force?
- Does the cyclist get “free” speed?

In all these cases, machines are helping us multiply force or increase speed.

This multiplication is called **Mechanical Advantage (MA)**.

4.2 Wheel and Axle – The Steering Mastery

Activity 4.2: Think and Answer

“Think about a steering wheel and axle (steering column) and their respective radius.”

- The steering wheel is large. The steering column connected to it is small. Why is this so?
- Why not make both of equal size?

A wheel and axle consist of:

- a large wheel
- a smaller axle fixed at the center

Both rotate together. When effort is applied on the wheel, torque increases at the axle.

The Mechanical Advantage is calculated using the formula:

$$M.A = \frac{\text{Radius of wheel}}{\text{Radius of Axle}}$$

Example

A driver needs to maneuver the truck on muddy ground, requiring a resistance force of 1,200 N to turn the steering axle. The steering wheel has a radius of 30cm, and the steering axle has a radius of 3cm.

- Calculate the Mechanical Advantage (MA) of the steering system.
- How much effort (E) must the driver apply to the rim of the steering wheel to turn the truck?

Solution:

$$\begin{aligned} \text{a) } M.A &= \frac{\text{Radius of wheel}}{\text{Radius of Axle}} \\ &= \frac{30 \text{ cm}}{3 \text{ cm}} = 10 \end{aligned}$$

$$\begin{aligned} \text{b) } \text{Effort (E)} &= \frac{\text{load}}{M.A} \\ &= \frac{1200N}{10} = 120N \end{aligned}$$

The driver needs to apply an effort of 120N to the rim of the steering wheel to turn the truck.

Note: In practice, some input work is lost to friction within the machine. The efficiency of a machine is defined as $\eta = (\text{useful output work} / \text{total input work}) \times 100\%$. A real machine always has $\eta < 100\%$. Mechanical Advantage as calculated here assumes an ideal (frictionless) machine.

Quick Check

In a mechanical watch, a single power source (a spring or motor) must move three different hands at three different speeds. This is achieved through a **Gear Train**, where the "output" of one gear becomes the "input" for the next. The seconds-to-minutes gear ratio is 60:1 and the minutes-to-hours ratio is 60:1;

- If the seconds gear is 2 mm, how large would the hour gear be in meters?
- Which of the three hands gear should be directly connected to the motor? Why?

4.3 Tension

Activity 4.3:

Hang a thread from an iron stand as shown in figure. Observe its natural length.

Now attach a small bob to the lower end of the thread. Notice how the thread stretches slightly.

Replace the small bob with a heavier bob. Does the stretch increase or decrease?

You will observe that the thread stretches more when a heavier bob is attached. This shows that a greater pulling force is acting on the thread.



Further,

Pass the thread over a pulley. Attach a weight to one side and observe.

Now attach equal weights (equal bobs) on both sides of the pulley. Does the rope move, or does it only stretch?

Replace one of the equal bobs with a heavier bob on the left side. Observe carefully the direction in which the system moves.

When both sides have equal weights, the system remains at rest because the forces are balanced. When one side is heavier, the system moves toward the heavier side.



Tension

Tension is the pulling force/ stretch force that travels through a stretched string, thread, rope, or cable. When you hang an object using a thread, the object pulls the thread downward because of its weight. In response, the thread pulls the object upward. This pulling force inside the thread is called tension. If the weight attached to the string increases, the tension in the string also increases.

It always acts along the length of the string and pulls away from the object to which it is attached.

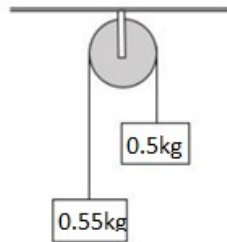
S.I unit of tension is Newton.

When the forces acting on an object are balanced (for example, the upward tension is equal to the downward weight), the object remains at rest or moves with constant speed. This state is called **equilibrium**. In a pulley system, if equal

weights are placed on both sides, the tensions balance and the system does not move. But if one side is heavier, the forces become unbalanced, and the system moves toward the heavier side. This is by Newton's First Law of Motion.

Let us Calculate: Tension and acceleration are produced when two unequal masses are connected over a pulley.

1. Do the setup of weights, string and simple pulley as shown.



2. Since $0.55 \text{ kg} > 0.5 \text{ kg}$, the 0.55 kg mass will move downward. The 0.5 kg mass will move upward. Both masses will move with the same acceleration because they are connected by the same string.
3. For 0.55 kg mass (moving downward):
 - a. Downward force = Weight = _____
 - b. Upward force = Tension (T)
4. Net force: $0.55g - T = 0.55a$
5. For 0.5 kg mass (moving upward):
 - a. Downward force = Weight = _____
 - b. Upward force = Tension (T)
6. Net force: $T - 0.5g = 0.5a$
7. Add both equations: _____
8. Acceleration of the system: _____
9. Find Tension: _____

Examples:

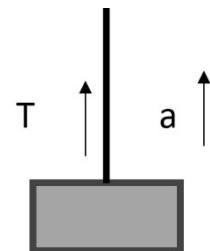
1. A 5 kg object is suspended stationary from a rope. Calculate the tension.

Ans: The weight of the object is: $T = m \times g = 5 \times 9.8 = 49 \text{ N}$

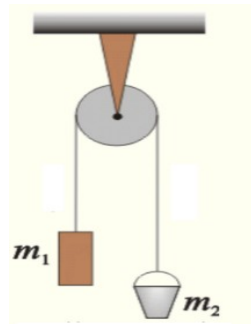
2. A 4 kg mass is lifted upward with an acceleration of 2 m/s^2 . Calculate the tension.

Ans: Using Newton's Second Law

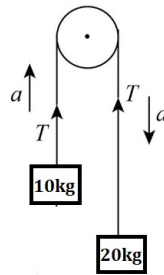
$$T - mg = ma \quad T = m(g + a) \quad T = 4(9.8 + 2) \quad T = 47.2 \text{ N}$$



Check Your Understanding :



1. Show the direction of weight and tension for both objects m_1 and m_2 .
2. An 8 kg mass hangs freely from a single fixed pulley. The system is at rest. Find the tension in the rope.
3. Observe the given diagram. Find out in which direction the rope will move? What will be the net downward force?



4. A 6 kg mass hangs freely from a single fixed pulley. The system is at rest. Find the tension in the rope.
5. Two objects having masses 2 kg and 6 kg are connected over a frictionless pulley with the help of rope. Find acceleration and tension in the rope.

Work and Energy

5.1 CONSERVATIVE AND NON-CONSERVATIVE FORCES

Recollect these common occurrences:

- A ball thrown upward comes back down to your hand.
- A stretched rubber band returns to its original shape.
- A sliding book on a table finally stops.

Now think carefully:

- Why does the ball come back?
- Why does the rubber band regain its shape?
- Why does the book stop moving?

In all these cases, forces are acting. But are all these forces the same?

Conservative Forces

- If the work done by the force doesn't depend on the path.
- Work done by the force on the closed path is always zero.
- For a conservative force, the work done by the force equals the decrease in potential energy: $W = -\Delta U = -(U_{\text{final}} - U_{\text{initial}}) = U_{\text{initial}} - U_{\text{final}}$. Equivalently, $\Delta U = U_{\text{final}} - U_{\text{initial}} = -W$.

Examples: Gravitational force (Earth pulling objects downward) and Spring force (stretched or compressed spring)

Non-Conservative Forces: If the work done by the force depends on the path taken.

Examples: Friction (solid and drag)

When you slide a book across a table, it eventually stops because friction converts its kinetic energy into heat. This lost energy cannot be fully recovered.

That is why friction is a non-conservative force.

Reflect on the following:

- If there were no friction, would a moving object ever stop?
- Why do pendulums slowly stop after some time?
- Why do machines require lubrication?

Quick Check

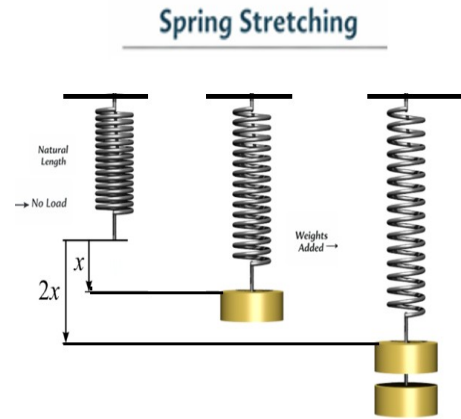
1. Define a conservative force with one example.
2. Why is gravitational force called a conservative force?
3. Why is friction called a non-conservative force?
4. What happens to energy when a non-conservative force acts on an object?
5. If there were no friction on Earth, how would motion be different? Explain.

5.2 Potential Energy of a Spring

Activity 5.2:

Collect the following items: A spring, a stand, a weight hanger, slotted weights, a ruler.

1. Suspend a spring vertically from a rigid support.
2. Attach a weight hanger to the free end of the spring and note the initial length of the spring.
3. Add a known weight to the hanger and measure the extension produced in the spring.
4. Increase the weight gradually and note the corresponding extension each time.
5. Repeat the experiment using springs made of different materials or thickness.



Observation:

- As more weight is added, the extension of the spring increases.

Different springs show different extensions for the same applied weight.

Conclusion:

The extension of a spring is directly proportional to the applied force (weight), provided the elastic limit is not exceeded. This relationship can be expressed as:

$$F = kx$$

where

F = applied force,

x = extension produced,

k = spring constant, which depends on the nature of the spring.

This law is called Hooke's law and is mathematically stated as $F = -kx$. The negative sign indicates the force is a restoring force acting against the direction of displacement (elongation or compression), aiming to return the spring to its original length.

Its unit is N m^{-1} . The spring is said to be stiff if k is large and soft if k is small.

Derivation

- The spring obeys Hooke's Law

$$F \propto x$$

$$F = kx$$

Prepare a graph between Force and extension in the spring with the help of data observed in the activity by taking

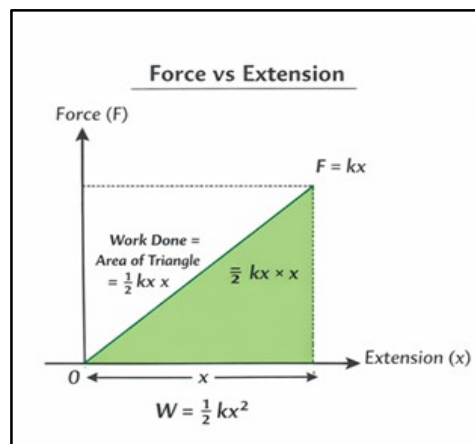
- X-axis → Extension (m or cm)
- Y-axis → Force (N)

Observation Table

These values give a straight-line graph passing through origin.

Sample Values for $k = 100 \text{ N/m}$

Force (F) in N	Extension (x) (in cm)	Extension (x) (in m)
0	0 cm	0 m
20	20 cm	0.2 m
40	40 cm	0.40 m
60	60 cm	0.60 m
80	80 cm	0.80 m
100	100 cm	1 m



Calculation of Average Force:

For a spring stretched from 0 to maximum force:

$$\text{Average Force} = \frac{F_{\text{initial}} + F_{\text{final}}}{2}$$

When the spring is stretched gradually from zero extension to a maximum extension x , the force acting on it does not remain constant.

- At the beginning, force = 0
- At extension x , force = kx

So, the average force (spring force changes linearly from 0 to maximum as extension increases.) acting on the spring is given by:

$$F_{average} = \frac{0 + kx}{2} = \frac{kx}{2}$$

Work done in stretching the spring = Average force $\times$ Extension

$$W = \frac{kx}{2} \times x = \frac{1}{2}kx^2$$

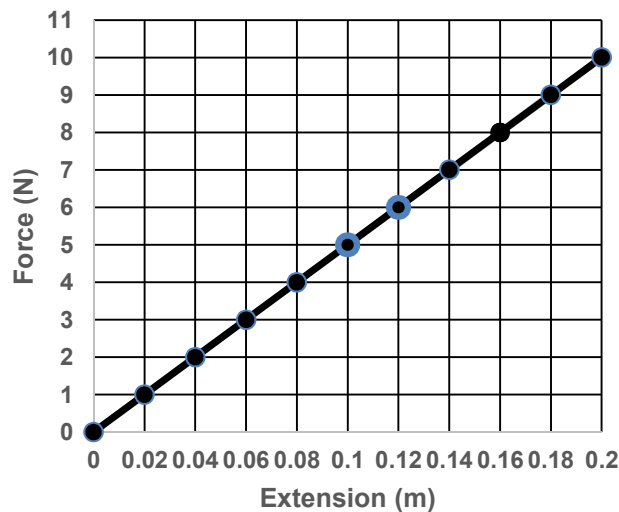
Conclusion

The work done in stretching the spring is stored in it as elastic potential energy.

$$U = \frac{1}{2}kx^2$$

Example: A spring obeys Hooke's law with a spring constant of 30 N m^{-1} . If a force of 100 N is applied to the spring, calculate the extension produced in the spring. The Force-extension graph of a spring of spring constant 100 N m^{-1} is given in figure:

- Using the graph, determine the work done in stretching the spring from 2 cm to 6 cm .
- If the spring is released from the stretched position of 6 cm , calculate the maximum speed of a body of mass 0.5 kg attached to the spring, assuming no loss of energy.



Solution:

- Work done = area under force-extension graph

$$W = \frac{1}{2}k(x_2^2 - x_1^2)$$

$$W = \frac{1}{2} \times 100 \times (0.06^2 - 0.02^2)$$

$$W = 50 \times (0.0036 - 0.0004)$$

$$W = 50 \times 0.0032 = 0.16 \text{ J}$$

(b) $k = 100 \text{ N/m}$, $x = 0.06 \text{ m}$. Elastic PE = $\frac{1}{2} \times 100 \times 0.06^2 = 0.18 \text{ J}$. At maximum speed, all PE converts to KE: $0.18 = \frac{1}{2} \times 0.5 \times v^2$, so $v^2 = 0.72$, $v \approx 0.85 \text{ m/s}$.

Check Your Understanding

- 1) Explain the conversion of potential energy to kinetic energy when a ball is thrown upward.
- 2) Why is gravitational potential energy considered a conservative force?
- 3) Calculate the potential energy of a 5 kg object kept on the top of a 30m high building. (Considering potential energy to be zero at the base of the building.)
- 4) What is the increment in its potential energy?
- 5) A 10 kg weight is hung from a 5 m wire, causing it to stretch by 1 mm. Calculate the energy stored.
- 6) Calculate the work done by an external force to lift a 2 m long rod from a horizontal to a vertical position.

Structure Of Atom

6.1 Discovery of Subatomic Particles

You have learnt about the development of models of the structure of the atom. You would recall that in 1803, Dalton proposed that atoms are the smallest indivisible particles of matter. However, this idea could not explain the results of several experiments. For example, it was observed that substances like glass or ebonite, when rubbed with silk or fur, acquire electric charge. This and many other experiments on electrical discharge through gases showed that atoms are not indivisible. They are made up of smaller particles called subatomic particles.

J. J. Thomson, in 1897, discovered the electron as a constituent of the atom and confirmed that the atom is not the smallest particle of matter. He proposed the so-called plum-pudding model of the atom, in which electrons are embedded in a sphere of positive charge. This model was later shown to be incorrect by Rutherford, as it could not explain the results of the gold foil experiment. Rutherford then proposed a model in which electrons revolve around a small, positively charged nucleus. However, this model could not explain the stability of the atom. Thereafter, another model was proposed by Niels Bohr.

Here, you will learn about the discovery of the subatomic particles—electron, proton, and neutron—which contribute to our understanding of atomic structure. Before discussing these exploration we must recall a basic principle: like charges repel each other, while unlike charges attract each other.

6.1.1 Discovery of Electron

In the late nineteenth century, many scientists, including Michael Faraday, William Crookes, and others, studied electrical discharge in partially evacuated tubes known as cathode ray discharge tubes. J.J Thomson carried out experiments by taking gases at low pressure in discharge tube which is a long glass tube in which two metal plates connected to oppositely charged poles of battery (Fig 1)

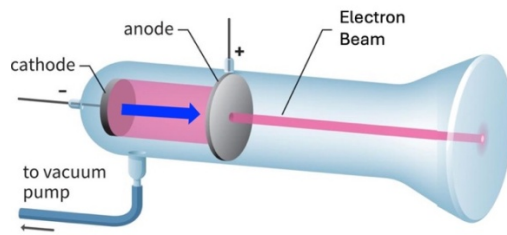


Fig. 6.1: A schematic representation of cathode ray tube showing the cathode rays going from the cathode to anode in a straight line

When a sufficiently high voltage is applied across the electrodes, rays are observed to travel from the negatively charged electrode (cathode) towards the positively charged electrode (anode). (Fig 2)

These are called cathode rays. The presence of these rays can be detected by allowing them to pass through a hole in the anode and strike at screen coated with a special material placed behind it. A bright spot is observed on the screen, indicating that the rays travel in straight lines.

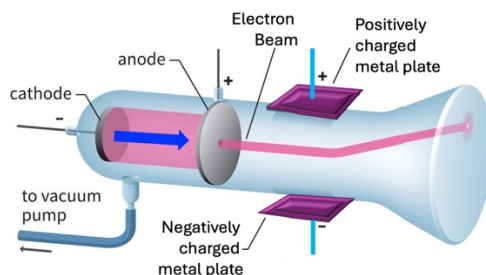


Fig.6.2: A schematic representation of the deflection of cathode rays to positive plate of the applied electric field.

Further to determine the nature of these rays, Thomson carried out experiments by applying electric and magnetic fields in the path of the rays. He observed that the rays were deflected towards the positively charged plate.

This showed that the particles in the rays carry negative charge on further experimentation. Thomson concluded that cathode rays consist of tiny negatively charged particles, later called electrons.

When these experiments were repeated using different gases (such as hydrogen, nitrogen, neon, etc.) and different electrode materials, it was found that the properties of cathode rays remained unchanged. This showed that electrons are present in all atoms.

The main characteristics of cathode rays are as follows:

- They originate from the cathode and move towards the anode.
- They are not visible themselves but produce bright spot when they strike certain materials.
- They travel in straight lines in the absence of external fields.
- They are deflected by electric and magnetic fields in such a way that indicates them to be negatively charged.
- Their properties do not depend on the nature of the gas or the electrode material.

Thus, electrons are a fundamental constituent of all atoms.

6.1.2 Discovery of Protons

After the discovery of the electron, it was realised that since electrons are negatively charged, atoms must also contain positive charge to maintain electrical neutrality.

Eugen Goldstein, in 1886, performed experiments using a discharge tube similar to that used for cathode rays, but with a cathode having holes in it (perforated cathode). When high voltage was applied, a faint glow was observed behind the cathode. The rays responsible for this glow passed through the holes (or canals) in the cathode and were therefore called canal rays.

Further studies showed that these rays were deflected towards the negatively charged plate in electric and magnetic fields, indicating that they consist of positively charged particles.

However, it is important to note that canal rays are not made up of a single type of particle. They consist of positively charged ions of the gas present in the tube. Therefore, their properties depend on the nature of the gas used.

When hydrogen gas was used in the discharge tube, the positively charged particles obtained were the lightest known and were identified as hydrogen ions (H^+). These particles were later recognised as protons. The proton was finally established as a fundamental particle by Rutherford in 1919.

The main characteristics of canal rays are:

- They are positively charged.
- Their behaviour in electric and magnetic fields is opposite to that of electrons.
- Their properties depend on the nature of the gas present.
- The lightest positive particle was obtained from hydrogen and is called the proton.

6.1.3 Discovery of Neutrons

Once electrons and protons were known, it appeared that the structure of the atom was understood. However, another problem arose when atomic masses were measured. The mass of atoms was found to be greater than the sum of the masses of their protons and electrons. For example, helium contains two protons, yet its mass is about four times that of hydrogen. This indicated the possibility of the presence of another particle contributing to the mass of the atom.

It was proposed that there must be a neutral particle present in the atom. This particle was discovered by James Chadwick in 1932. He bombarded a thin sheet of beryllium with alpha particles and observed the emission of powerful neutral

radiation. This radiation consisted of particles having no charge and a mass nearly equal to that of the proton. These particles were called neutrons.

Neutrons are present in the nuclei of almost all atoms. The most common isotope of hydrogen that does not contain a neutron is protium (${}_1\text{H}^1$) but its heavier isotopes Deuterium (${}_1\text{H}^2$) and Tritium (${}_1\text{H}^3$) contains neutrons.

Thus, the presence of neutrons explains the mass of atoms. For example, helium contains two protons and two neutrons, which accounts for its mass being approximately four times that of hydrogen.

Chadwick was awarded the Nobel Prize in Physics in 1935 for the discovery of the Subatomic particle neutron.

From these discoveries, it became clear that atoms are composed of three subatomic particles:

- Electrons (negative charge)
- Protons (positive charge)
- Neutrons (no charge)

These particles together determine the structure and properties of atoms.

Quick Check:

1. Why do cathode rays bend towards the positive plate?
2. What conclusion did Thomson draw from using different gases in discharge tubes?
3. Why are canal rays different from cathode rays in nature?
4. Why was the discovery of neutron necessary?
5. In a cathode ray experiment, it was observed that the rays bend towards a positively charged plate. What can we conclude about the nature of these rays?
6. In a discharge tube experiment, the gas is changed from hydrogen to neon, but the behaviour of cathode rays remains unchanged. What does this observation tell us about electrons?
7. If cathode rays were neutral instead of being negatively charged, how would their behaviour differ in an electric field?
8. In an experiment with canal rays, different gases are used and different masses of particles are observed. What conclusion can be drawn about the nature of canal rays?

9. Why did scientists feel the need to propose the existence of neutral particles even after discovering electrons and protons? Explain using the example of helium.
10. In Chadwick's experiment, the emitted particles were not deflected by electric or magnetic fields. What does this observation indicate about the nature of these particles?

6.2. Spectrum

When white light passes through a glass prism, what do we observe? We see a rainbow, that consists of a continuous spread of many colours from violet to red (VIBGYOR). Such a spread is called a **continuous spectrum** in which the colours are present without any gap.



Fig 6.3 Continuous Spectrum

Now, suppose we take a sodium vapour lamp, which you would have seen at street lights or in parks, and pass the 'yellow light' given out by it, through a prism. We find that we do not get all the colours but only a few bright coloured lines. Two of these are intense yellow lines. We may do a similar experiment with mercury vapour lamp and observe another set of distinct lines. Such a spectrum that contains distinct lines is called a **line spectrum**.



Fig 6.4 (a) Sodium vapour lamp



Fig 6.4 (b) Lines Spectrum of Sodium

Line spectrum means only specific radiation are emitted, not all. It is important to know that the line spectrum is characteristic of the element causing it. This fact is used to identify elements present in stars by studying their spectra. Even without going to the star, we can know what it is made of.

6.3 Line Spectrum of Hydrogen

Now, when the radiation from a discharge tube containing hydrogen gas in it is passed through a prism, it also gives line spectrum called **hydrogen atom spectrum**.

The Spectral lines for atomic hydrogen are:

Series	n_i	n_f
Lyman	1	2,3_ _ _ _ _
Balmer	2	3,4_ _ _ _ _
Paschen	3	4,5_ _ _ _ _
Brackett	4	5,6_ _ _ _ _
Pfund	5	6,7_ _ _ _ _

The energies of the distinct spectral lines observed in hydrogen atom spectrum could be expressed empirically in terms of mathematical expressions involving two sets of integers. This equation is known as Rydberg Equation.

$$\Delta E = R_E Z^2 \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right),$$

$$R_E = 109,677 \text{ cm}^{-1}$$

Where, R_E is the Rydberg constant expressed in terms of energy and Z is the atomic number. These empirical formulas worked very well but could not be explained until Bohr's model came.

6.4 Limitation of Rutherford Model of Atom

- Rutherford could not explain stability as the electron continuously loses energy when it moves around the nucleus.
- As the electron in the atom is allowed to have continuous energies, therefore the emitted radiation is expected to give a continuous set of radiation. However, we observe a line spectrum. Therefore, we say that Rutherford's model fails to explain the existence of line spectrum of hydrogen.

6.5 Bohr's model

Neils Bohr, a student of Rutherford, in 1913 proposed his model for an atom. He combined Rutherford's nuclear model with the new quantum idea introduced by Max Planck. He made two revolutionary assumptions which are as below:

- Electrons can move only in certain allowed circular orbits without radiating energy. That is, they have a fixed energy as long as they are in a given orbit.
- The radiation is emitted or absorbed only when an electron jumps from one allowed orbit to another,

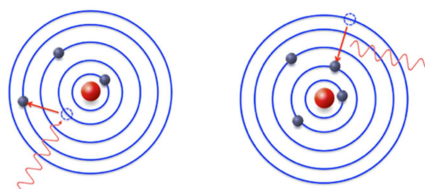


Fig 6.5:Energy change is electron jump

6.5.1 Achivement of Bohr Model

“When an electron jumps from an orbit of higher energy to that of a lower energy it releases energy in the form of radiation. The amount of energy released depends on the difference in the energies of the two levels. Since the orbits of only certain energies exist, only of fixed quantity energy differences are possible. Therefore, we get a line spectrum. Bohr’s model could explain the observed line spectrum of hydrogen fairly well.

6.5.2 Limitations of Bohr’s model

Bohr model was unable to explain:

- Finer details (that is closely spaced lines) of hydrogen atom spectrum observed by sophisticated spectroscopic techniques.
- The spectrum of atom other than hydrogen.
- The splitting of spectral lines in presence of magnetic field (Zeeman effect) or an electric field (Stark’s effect).

6.6 Check Your Understanding

1. The hydrogen spectrum consists of only a few sharp spectral lines instead of a continuous spectrum. What information does it provide about the energy of electrons in an atom.
2. Explain why would Rutherford’s model predict a continuous spectrum rather than a line spectrum.
3. A discharge tube filled with an unknown gas produces a line spectrum identical to hydrogen. What can you conclude about the gas? Give reason.
4. If electrons in an atom were allowed to have a continuous set of energy values, what kind of spectrum would you expect? Why is this not observed?
5. “Bohr’s model solved all problems of atomic structure.” Comment.
6. How does the concept of fixed energy levels explain the stability of atoms?

7. Why do different elements produce different line spectra? Give a conceptual explanation.
 8. Explain why Bohr's model works well for hydrogen but not for multi-electron atoms.
 9. State two limitations of Rutherford's model.
 10. Rutherford's model explained the structure of the atom but failed to explain atomic stability and spectra. Discuss.
 11. What was the main drawback of Rutherford's model regarding electron motion? What assumption was made by Bohr to overcome this problem.
 12. How does Bohr's model explain line spectrum of hydrogen?
 13. Outline the limitations of Bohr's model.
 14. Define line spectrum and continuous spectrum with one example each.
 15. Write two main postulates of Bohr's model.
 16. What is meant by fine structure in hydrogen spectrum?
 17. What is the significance of Rydberg equation?
-

Chemical Bonding

7.1 Octet Rule

You have learnt that the atoms having eight electrons in its valence shell are stable. The atoms other than hydrogen tends to form bonds until it is surrounded by eight valence electrons. They do so by gaining, losing or sharing electrons. It is called **Octet rule** and is quite useful in describing the formation of simple molecules. It is important to note that the octet rule is just a guiding principle and not a law. In case of hydrogen, the valence shell attains the electron configuration of helium, i.e., a total of two electrons.

7.1.1 Lewis Approach

Lewis Symbol :- The Valance electron of an atom in terms of dot is written around the atom.

For Example:

Fluorine (F=9) Electronic configuration=2,7

Valence electron=7

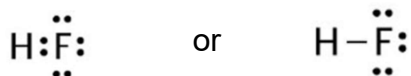
Hence is represented as:



Bonding in molecule:

Duing bonding the valance electrons are written around the atoms and then electrons are shared in such a way so as to complete the octet of each atom.

For Example the Lewis formula for Hydrogen Fluoride is



Here the pair of dots (representing electrons) placed between the symbols of the combining atoms represent the bonding electrons. The remaining dots represent the non-bonding electrons. As the name suggests, the non-bonding electrons do not contribute to the bonding. You may note that the hydrogen atom in this molecule has only two electrons (a duplet) around it. The line here indicates the bond between hydrogen and fluorine atom.

7.1.2 Exceptions of Octet Rule

Many stable molecules do not follow the octet rule. These are called exceptions to the octet rule. Let us discuss about these exceptions.

Molecules with incomplete octets

In case of some elements the valence shell has less than four valence electrons. In these cases, their atoms cannot form four bonds to complete the octet. Also, these do not have sufficient lone pairs that can complete the octet. As a result, the octet remains incomplete in such cases. For example, in case of lithium, beryllium and boron there are only 1, 2 and 3 valence electrons respectively. Therefore, these can form 1, 2 and 3 bonds respectively. In such cases the central atom would have 2, 4 and 6 electrons respectively on forming the molecule. These represent molecules which do not complete the octet and yet are stable. One common example is that of boron trifluoride. In this molecule, one boron atom makes bonds with three fluorine atoms and is represented as



The lines here indicate the bond between boron and fluorine atom.

Molecules with expanded octets

Another exception to the octet rule is observed in the formation of molecules having more than eight valence electrons around central atom. Such molecules are formed by the atoms of the elements having more than four electrons in their valence shell. For example, in case of sulfur hexafluoride one atom of sulphur combines with six atoms of fluorine. The Central sulphur atom has 12 electrons in its valence shell representing an expanded octet. We can represent its structure as



You will learn about the formation of such compounds in higher classes.

Molecules with odd number of electrons

Certain molecules have an odd number of electrons. For example, an atom of nitrogen (having 5 valence electrons) makes two bonds with an atom of oxygen (having six valence electrons) to form a molecule of NO. It has a total of 11 valence electrons, five from N and six from O atom. The Lewis structure for this molecule can be represented as



The two lines here indicate two bonds. Whenever there are odd number of electrons in a molecule then at least one atom would have an incomplete octet. Secondly in such a molecule there would always be an unpaired electron.

Quick Check

1. What is meant by the octet rule?
2. Why does hydrogen not follow the octet rule?
3. Give one example each of the molecule with
 - a) incomplete octet
 - b) expanded octet
 - c) an odd electron
4. Why can boron form compounds with only six electrons around it?
5. What is meant by a duplet configuration?
6. Why is NO considered an exception to the octet rule?
7. Draw the Lewis dot structure of BF_3 and explain why boron does not complete its octet.
8. Assertion: SF_6 violates the octet rule.
Reason: Sulphur can accommodate more than eight electrons.
 - A. Assertion and reason, both are correct and reason is the correct explanation of the assertion.
 - B. Assertion and reason, both are correct but reason is not the correct explanation of the assertion.
 - C. Assertion is correct but reason is a wrong statement.
 - D. Assertion is wrong but the reason is a correct statement.

7.2 Metallic Bonding

You all are familiar with metals like iron, copper, aluminium, and so on. They are hard, they can be beaten into sheets, drawn into wires, and they conduct electricity. You may be wondering how can we explain these properties of metals. We can explain these in terms of a simple model known as the electron sea model for metals. You have learnt about bonding in case of ionic and covalent compounds. In these, the atoms bind by transfer or sharing of electrons between specific atoms. The electron sea model, in fact, is a simple model for bonding in metals. It involves bonding between a very large number of atoms of the metal. Let us understand this model and learn how we can explain the properties of metals by using this model.

7.2.1 Electron Sea Model

A metal atom has a few electrons in its outermost shell. These outer electrons are not held very tightly by the nucleus. Because of this, when many metal atoms come together to form a solid, these outer electrons do not remain attached to any

one atom. Instead, they become delocalised and are free to move throughout the entire piece of metal.

You know that when an atom loses an electron it becomes a cation. In metals, the atoms can be thought of as forming positive metal ions arranged in a regular pattern. These ions form a kind of fixed structure. The free electrons move continuously and randomly in all directions around and between these ions. This collection of freely moving electrons is called a “sea of electrons”.

Thus, according to the electron sea model, a metal can be seen as a structure in which positive metal ions are fixed in place, and a “sea” of mobile electrons moves around them. This is why the model is called the electron sea model as shown in Fig.7.1.

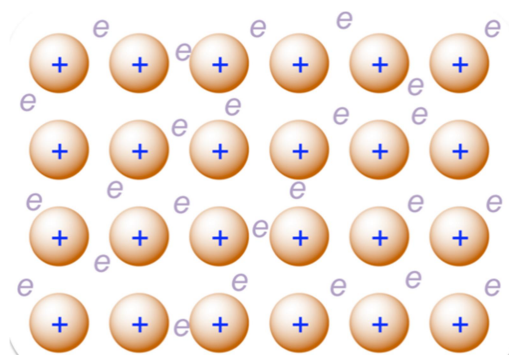


Fig. 7.1: Schematic representation of Electron sea model

These ions and electrons together form a stable structure. The attraction between the positive ions and the sea of electrons is what holds the metal together. This attraction is called **metallic bonding**. So, we can say that metallic bonding is the force of attraction between positive metal ions and the sea of electrons. It is important to note that unlike covalent bonds, metallic bonds are not localised. The electrons are shared by all the atoms collectively, forming a non-directional bond that can adjust to shifting positions of the metal ions.

7.2.1: Electron sea model and properties of metal

Now let us see how this simple electron sea model helps us to understand the properties of metals.

Electrical conductivity

Since electrons are free to move, when we apply an electric field across a metal, these electrons start moving in a particular direction. This movement of electrons is what we call electric current. That is why metals are good conductors of electricity.

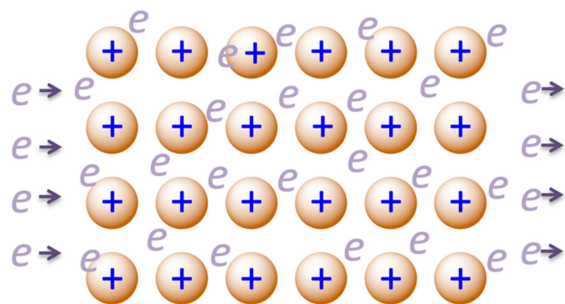


Fig.7.2: Schematic representation of electrical conduction by metals in terms of electron sea model

Thermal conductivity

When one part of a metal is heated, the electrons in that region gain energy and start moving faster. As they move, they transfer this energy to other parts of the metal. At the same time, the metal ions also vibrate more and help in passing the heat along. In this way, heat spreads quickly. This is why metals are good conductors of heat.

Malleability and Ductility

You know that malleability refers to the ability of metals to be beaten into thin sheets. In the electron sea model, the positive metal ions can slide over one another without breaking the structure. This is possible because the electrons are not fixed; they continue to move and hold the ions together. So, even when layers of the metal ions shift, the metal does not break.

Similarly, you know that ductility refers to the ability of metals to be drawn into wires. When we stretch a metal, these metal ions slide past each other without breaking the non-directional metallic bonds, allowing the metal to stretch into wires. The free electrons help maintain the attraction between ions even when the shape changes.

You must remember that the electron sea model gives a simple picture and explains many basic properties of metals. The electrons are not completely lost as in ionic bonding; rather, they are shared collectively by all atoms in the metal. You will learn more detailed models of metallic bonding in your higher classes.

Check Your Understanding

1. What is meant by the term “electron sea” in metals?
2. What type of particles are in a fixed position in a metal according to the Electron sea model?
3. Define metallic bonding.
4. Why are metallic bonds called non-directional?

5. Name two properties of metals explained by the electron sea model.
6. Explain how the electron sea model accounts for electrical conductivity in metals.
7. How does the electron sea model explain thermal conductivity in metals?
8. Why can metals be beaten into thin sheets? Explain using the Electron sea model.
9. What is meant by ductility? How is it explained by the electron sea model?
10. How is metallic bonding different from covalent bonding?
11. Explain the structure of a metal according to the electron sea model.
12. If electrons in a metal were not free to move, which property would be most affected? Explain.
13. Explain why metals do not break when hammered but instead change shape.
14. Copper is used for electrical wiring, while rubber is not. Explain using the electron sea model.
15. Why are metals generally good conductors of heat as compared to non-metals?
19. Assertion (A): Metals are good conductors of electricity.
Reason (R): Metals contain free electrons that can move under an electric field.
 - A. Assertion and reason, both are correct and reason is the correct explanation of the assertion.
 - B. Assertion and reason, both are correct but reason is not the correct explanation of the assertion.
 - C. Assertion is correct but reason is a wrong statement.
 - D. Assertion is wrong but the reason is a correct statement.
20. Assertion (A): Metallic bonds are non-directional.
Reason (R): Electrons in metals are localised between two atoms.
 - A. Assertion and reason, both are correct and reason is the correct explanation of the assertion.
 - B. Assertion and reason, both are correct but reason is not the correct explanation of the assertion.
 - C. Assertion is correct but reason is a wrong statement.
 - D. Assertion is wrong but the reason is a correct statement.
21. Assertion (A): Metals are malleable.
Reason (R): Layers of metal ions can slide while electrons continue to hold them together.

- A. Assertion and reason, both are correct and reason is the correct explanation of the assertion.
- B. Assertion and reason, both are correct but reason is not the correct explanation of the assertion.
- C. Assertion is correct but reason is a wrong statement.
- D. Assertion is wrong but the reason is a correct statement.

Mixtures And Separation Of Mixtures

8.1 Chromatography

Chromatography was first developed by the **Russian botanist Mikhail Tswett in 1906** while studying plant pigments. He used this technique to separate the different coloured constituents of chlorophyll. This method was named **chromatography** components of chlorophyll. The name chromatography comes from the Greek words chroma (colour) and graphein (to write). The technique is used to **separate the mixtures into components, purification of compounds and also to test the purity of compounds.**

Principle: The technique is based on the difference in the rates at which the components move through a stationary medium under the influence of moving phase..

Application: Today, chromatography is widely used in chemistry, biology, and medicine to **identify and separate different substances in a mixture.**

Column Chromatography

Modern method for the separation of mixtures into its components. The selective removal of the components may be due to adsorption or partition process.

When a mobile phase is allowed to move over a stationary phase, the components of the mixture move by varying distances over the stationary phase because of different adsorption tendencies. In this case the stationary phase can be held on a cylindrical column of solid . hence it is called column chromatography.

Principle: It is based on the fact that different compounds are adsorbed on an adsorbent to different degrees

Procedure: In this technique, a long glass tube having a stop cock near the bottom, called a column is used. First a plug of cotton or glass wool is placed at the bottom of the column. Then it is filled with a solid material such as silica gel or alumina, which acts as the **stationary phase** (fixed in a place). The mixture to be separated is placed at the top of silica gel in the column, and then a little amount of glass wool is placed above the mixture. After this a suitable liquid solvent is poured from above and allowed to flow through the column under the influence of gravity. This is called an eluent or the **mobile phase** (which moves). The solvent coming out from the column is collected in different fractions. In this way, the components of the mixture get separated and are collected separately. Column chromatography is widely used in chemistry laboratories to purify compounds as well as to separate them from the mixtures.

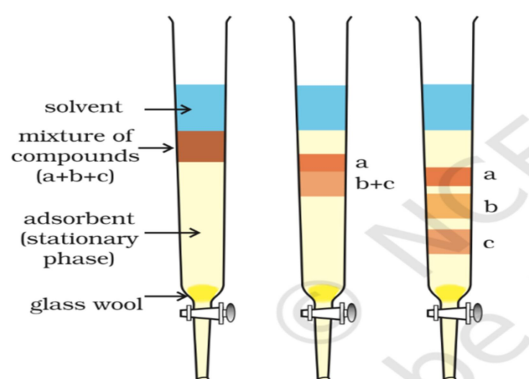


Fig 8.1: Column chromatography: Different stages of separation of components of a mixture.

Application: The method has been used:

- To separate blue and red dyes
- To separate and purify plant pigments

8.2.1 Fractional Distillation

This method is used for the purification of liquids which boil without decomposition and contain non volatile impurities.

Principle: Fractional Distillation is a technique to separate a mixture of two miscible liquids whose boiling points differ by less than 25°C shown in Fig. 8.2 (a).

In this process, the mixture of liquids is heated in a distillation flask which is fitted with a fractionating column before the condenser as shown in figure 8.2(b).

Fractionating Column: The fractionating column is a long tube provided with obstructions to the passage of vapours moving upwards and liquid moving downwards. It increases the cooling surface area.

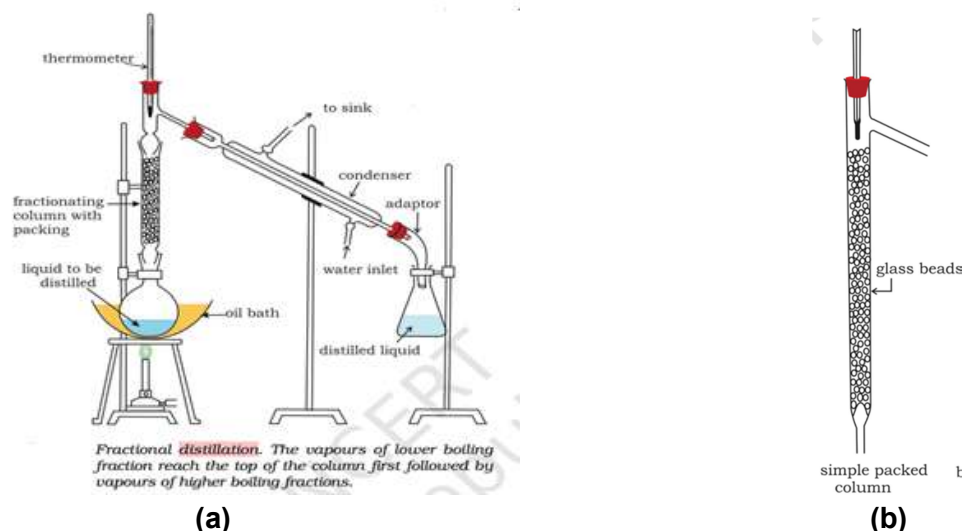


Fig 8.2: (a) Fractional distillation apparatus and (b) A sample fractional distillation column

Procedure: When the mixture is added to distillation flask and the flask is heated the vapours of more volatile liquid having low boiling point rises up in the fractionating column. Due to the obstruction in the fractionating column, some of the vapours condense and fall back in the column. Some of the condensing liquid in the fractionating column gets heat from the ascending vapours and revaporizes. As a result the vapours become richer in low boiling component. These rise up in the fractionating column and condense while passing through condenser and collected in the receiver. The same process will occur again and again. This repeated condensation and vaporization helps in better separation of the liquids. By carefully controlling the temperature, different liquids in the mixture can be separated one after another according to their increasing boiling points.

8.2.2 How is it different from simple distillation?

- In fractional distillation, a fractionating column is placed between the distillation flask and the condenser. The column provides many surfaces where repeated condensation and vaporization occur. This allows better separation of liquids whose boiling points are close to each other.
- Simple Distillation is used to separate miscible liquid which differ in boiling point by at least 25°C but in fractional distillation the boiling point differ by less than 25°C

8.2.3 Application

Crude oil is a complex mixture of many hydrocarbons with different boiling points. In a refinery, the crude oil is heated, and the vapours enter a tall fractionating column. As the vapours rise in the column, they cool and condense at different levels according to their boiling points. Different fractions are collected at different heights of the column as shown in the figure below along with the temperature range. The various important fractions used in our daily life or industry are:

- Petroleum gas (LPG, contains butane and propane)
- Petrol (gasoline)
- Kerosene
- Diesel
- Fuel oils
- Lubricating oil and heavy oils

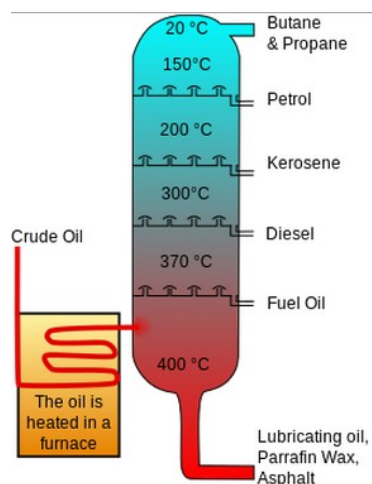


Fig 3: (a) Schematic representation of separation of different components of crude oil by fractional distillation

Questions

1. What is chromatography? Mention its two main phases.
2. Who discovered chromatography and in which year?
3. What is meant by stationary phase and mobile phase?
4. Name two common adsorbents used in column chromatography.
5. What is an eluent in column chromatography?
6. Why do different substances move at different speeds in column chromatography?
7. What is fractional distillation?
8. When is fractional distillation preferred over simple distillation?
9. What is the role of the fractionating column?
10. In column chromatography, a mixture of two compounds A and B is separated. A comes out first. What can you say about its interaction with the stationary phase?
11. A mixture of ethanol (b.p. 78°C) and water (b.p. 100°C) is to be separated. Which method will you use and why?
12. Explain why repeated condensation and vaporization improve separation in fractional distillation.
13. In a fractional distillation column, why does temperature decrease from bottom to top?
14. Why is simple distillation not suitable for separating liquids with close boiling points?
15. Assertion: In chromatography, separation occurs due to difference in boiling points.
Reason: Components move at different speeds in the column.
A. Assertion and reason, both are correct and reason is the correct explanation of the assertion.

- B. Assertion and reason, both are correct but reason is not the correct explanation of the assertion.
 - C. Assertion is correct but reason is a wrong statement.
 - D. Assertion is wrong but the reason is a correct statement.
16. Assertion: Fractional distillation gives better separation than simple distillation.
Reason: It involves repeated condensation and vaporization.
- A. Assertion and reason, both are correct and reason is the correct explanation of the assertion.
 - B. Assertion and reason, both are correct, but reason is not the correct explanation of the assertion.
 - C. Assertion is correct, but reason is a wrong statement.
 - D. Assertion is wrong, but the reason is a correct statement.
17. Difference in which property forms the basis for separating components in fractional distillation?
- A. Solubility
 - B. Boiling points
 - C. Particle size
 - D. Chemical reactivity
18. What is the main purpose of the "fractionating column" in fractional distillation?
- A. To heat the mixture faster.
 - B. To cool the vapours at fast rate.
 - C. To provide more surface area for vapours.
 - D. To let the vapours of two liquids mix properly
19. In column chromatography, the solid substance that is filled in the column is called the:
- A. Mobile phase
 - B. Solvent
 - C. Stationary phase
 - D. Mixture
20. That component of a mixture moves down the column at a faster rate which is
- A. most attracted to the stationary phase.
 - B. having the highest boiling point.
 - C. The one most soluble in the mobile phase (solvent)
 - D. The one with the largest particle

Microscope and Microscopy

9.1. What is a Microscope?

You have read in Grade 8 that a special instrument called the **microscope** (*micro* – small; + *skopion* - "means of viewing") is required to observe tiny living organisms or their parts which cannot be seen through naked eyes by magnifying them. With a microscope, you can see small specimens such as onion cells, cheek cells, bacteria and even dust particles etc. It helps doctors to see germs and study cells in living organisms.

What do we call the ability of a human eye to see two very close objects as separate and distinct? Imagine two tiny dots drawn on a piece of paper. As the dots are moved closer, there comes a point at which they can no longer appear as separate. When viewed from about 25 cm (the near point of the eye), two points separated by about 0.1 mm (100 μ m) can be observed as distinct, otherwise, they appear as a single point. This defines the **limit of resolution** of the human eye.

A cell is generally too tiny to be observed by an unaided eye. This raises an important question - how do cell biologists study the structure and functioning of cells, which are much smaller than the limit of resolution of the human eye?

When Robert Hooke observed 'cork' under the microscope developed by him in 1665. He examined thin slices of bark of an oak tree and observed tiny hexagonal box-like spaces just like the patterns of honeycomb and called them **cells**. Around the same time, Antony van Leeuwenhoek made tiny, powerful lenses and saw "animalcules" – what we now know as bacteria and protozoa. Those simple lenses opened the door to a completely new world.

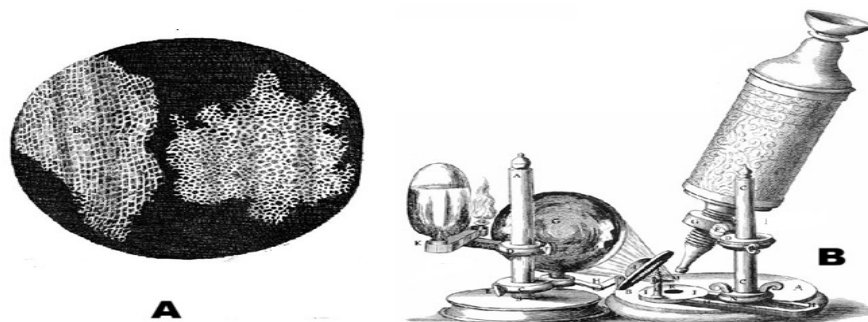


Figure 9.1: A. Drawings of Cork cells as published in the 'Micrographia'; B. Microscope developed by Robert Hooke,

Activity 9.1: Let us think and write:

If you could shrink yourself and travel inside a leaf, what would you see? Write 3 – 4 lines imagining that journey.

9.2. A Quick historical Journey of Microscopes

Let us walk through time and see how microscopes evolved:

- **13th–15th century:** Simple magnifying glasses used by spectacle makers.
- **1590 - Hans and Zacharias Janssen:** A Dutch father-and-son duo of spectacle makers developed an early compound microscope by combining two lenses within a single tube.
- **1665 – Robert Hooke:** Coined the term ‘cell’ for empty, hexagonal, box-like structures by examining the cork of an oak tree under the microscope developed by him. He published his findings in a book called “Micrographia”.
- **1670s – Antony van Leeuwenhoek:** He worked with a simple, single-lens microscope capable of magnifying up to about 300 times, which allowed him to observe tiny living organisms he called “animalcules,” including bacteria and protozoa. He was the first to study living microorganisms and is widely regarded as the ***Father of Microscopy***.
- **1878 Ernst Abbe:** Postulated a mathematical theory linking resolution to the wavelength.
- **19th–20th century:** Better lenses and illumination improved the compound light microscope.
- **1930s onwards: Electron microscopes** (TEM and SEM) were invented where viruses, cell organelles and cell surfaces could be observed.
- **1938 Ernst Ruska:** developed the first electron microscope, which operated on the principle using electrons as the illumination source (instead of light) that provides shorter wavelengths and thereby significantly enhancing the resolving power.
- **1953: Frits Zernike** received the Nobel Prize in Physics for inventing and demonstrating the phase-contrast microscope.

Activity 9.2: A Timeline Strip

Draw a horizontal line. Mark at least 5 important dates in microscopy and add a tiny sketch or symbol for each (e.g., cork cells, bacteria, electron beam etc.).

9.3. How Does a Microscope Work?

An important parameter in microscopy is the **resolution**, **contrast** and **magnification** of the object that is viewed under the lens, which makes it appear several times larger to the human eye. The operating principle varies with the type of microscope, which can be broadly classified by whether they use multiple lenses or electron beams. In each case, a system of lenses or electromagnetic fields is used to produce an enlarged, detailed image of a specimen that cannot be clearly seen with the naked eye.

9.3.1 Types of Light microscope

Light (Optical) microscopes rely on visible light and glass lenses to enlarge and view specimens.

Basic Classification -

- **A simple microscope** utilizes a single lens to magnify an object, similar to how a magnifying glass works. For example, dissecting microscope is used for 3D viewing of small objects.
- **Compound Microscope**: Most commonly used laboratory microscope utilizes at least two sets of lenses - the objective lens (near the specimen) and the eyepiece (ocular lens) - to achieve high magnification.
- **Advanced optical microscopes**

Beyond the standard compound microscope, a diverse family of advanced light microscopes exists—such as Phase-Contrast and Fluorescence, each using unique optical technique to reveal hidden cellular secrets that would otherwise remain invisible to the naked eyes. **Fluorescence microscopy** uses high-intensity light to excite specialized dyes in a specimen, causing specific cellular structures to glow brilliantly against a dark background like stars in the night sky. **Phase-Contrast** microscopy is used for viewing **living cells** in their natural state because it enhances contrast without the need for chemical stains that would otherwise kill the specimen.

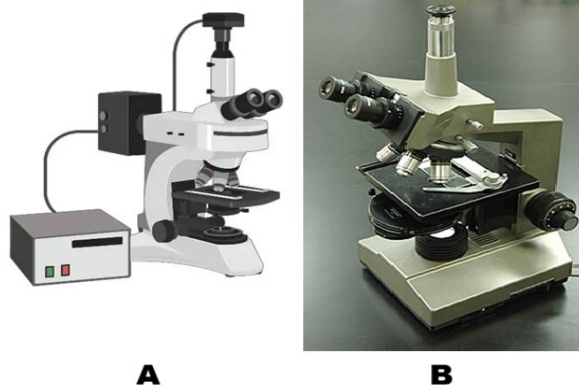


Figure 9.2: A. Fluorescence microscope; B. Phase contrast microscope

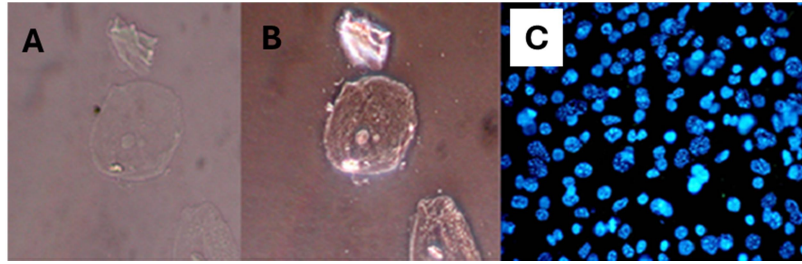


Figure 9.3: Cells imaged with – A. Traditional optical microscope (Mag. 40X) B. Phase-contrast microscope (Mag. 40X) and C. Fluorescence microscope (Mag. 20X)

9.3.2 Parts of a Compound microscope

Core Components and their Roles

1. **Light Source**; Provides illumination (LED or halogen lamp).
2. **Condenser Lens**: Focuses light onto the specimen to optimize numerical aperture and contrast.
3. **Specimen Stage**: Holds the slide containing the specimen.
4. **Objective Lens**: The primary magnifying lens (e.g., 4X, 10X, 40X, 100X). It forms an enlarged, inverted image of the specimen that is real in nature.
5. **Eyepiece (Ocular Lens)**: It enhances the magnification of the image already produced by the objective lens.

Activity 9.3: Let us examine a compound microscope

Key parts include eyepiece, objectives, nosepiece, stage with clips, coarse/ fine focus, condenser, iris diaphragm, illuminator, arm, and base

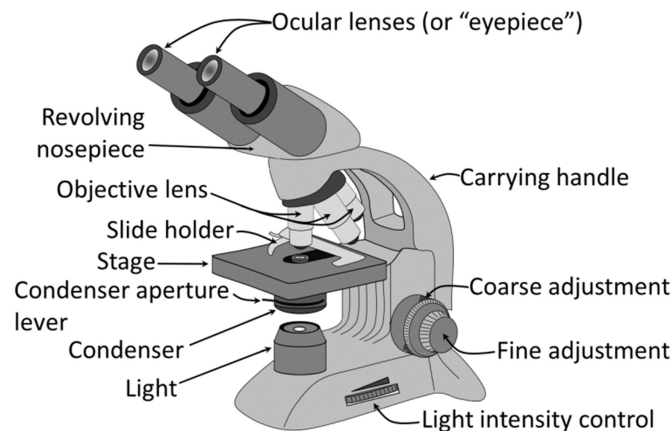


Figure 9.4: Light (compound) microscope

- **Objective lenses**: Main magnifying lenses (with different magnification power (X) – 4, 10, 15, 20, 40 etc.) close to the slide. These form a real, magnified image of the object.

- **Eyepiece (ocular lens):** Where you place your eye. It acts like a magnifying glass for the image formed by the objective. Together, these lenses produce a greatly enlarged image for your eye.
- **Body tube:** A hollow tube which has the eye piece and objective fitted on its two ends.
- **Revolving nosepiece:** Holds objectives and allows you to switch between them.
- **Stage and clips/ mechanical stage:** Platform to hold the slide in place.
- **Condenser Lens:** Consists of convex lens to focus and concentrate the light on specimen to optimize numerical aperture and contrast.
- **Substage diaphragm:** Controls the amount of light transmitted on specimen
- **Coarse adjustment knob:** Big knob for rough focusing (low power).
- **Fine adjustment knob:** Small knob for sharp focus (high power).
- **Arm and base:** Support; always hold microscope by the arm and support the base.
- **Light source/ mirror:** Provides light that passes through specimen/reflects light.

9.3.3 Light Microscope – working

Light changes direction when it passes through glass. You have earlier learnt in Grade 8 that a **convex lens** (converging lens) bends light rays to meet at a point. When we place a tiny object near such a lens, the lens forms a larger, inverted image. Light microscopes function by using refraction—the bending of light as it moves between different media due to changes in speed—along with reflection to direct and focus light rays. The objective lens, which has a short focal length, first creates a real and inverted image of the specimen placed just outside its focal point. This image then becomes the input for the eyepiece, which has a longer focal length and further enlarges it, producing the final upright, highly magnified virtual image.

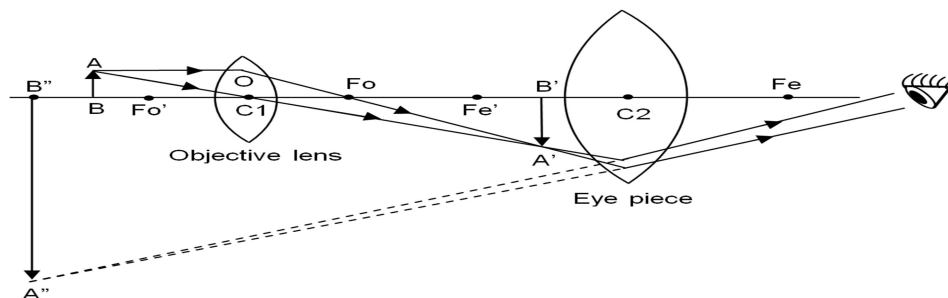


Figure 9.5: Ray diagram of compound microscope

9.4. Microscopy Skills

9.4.1 Slide Preparation and Focusing (temporary mount)

You have already learnt the method for preparing a temporary mount of an onion peel; using a similar approach, let us now create a few more temporary mounts.

Activity 9.4: Let us prepare, observe and compare leaf peels of monocot and dicot leaves:

Take peels from both upper and lower epidermis of a monocot leaf (*Rhoeo/ maize/ lily*) and a dicot leaf (*Bryophyllum/ petunia/ balsam*). Prepare their temporary mounts. Observe them under microscope, compare their structure and draw labelled diagrams. Record similarities and differences, if any.

Now correlate the points noted by you in activity 9.1 with your observations.

S. No.	Feature	Monocot leaf		Dicot leaf	
		Name of source plant.....		Name of source plant.....	
1.	Shape of epidermal cells				
2.	Pattern of epidermal cells				
3.	Shape of Guard cells				
4.	Distribution of stomata				
5.	Any other observation				

9.4.2 Permanent Slides

We have already learnt how to prepare temporary mounts. These are useful only for a short time because the drop of water slowly dries up and the living cells start shrinking, and dying. If you leave a temporary mount of an onion peel for a few hours, you will notice air bubbles, crystals of the dried stain, and distorted cell shapes instead of fresh, clear cells.

Now think, what if we want to keep a well prepared slide of onion cells or cheek cells safe so that many future batches of students in your school can observe it? For this purpose, biologists make **permanent mounts**. The slides stored carefully in slide boxes in your laboratory are usually permanent slides that have been prepared using a special technique and preserved for years.

In a **permanent mount**, the specimen is first fixed (to kill and preserve its structure), then stained, dehydrated, and finally sealed in a special mounting medium such as Canada balsam or DPX under a coverslip. This prevents the

specimen from drying, rotting, or being attacked by microorganisms. Once prepared properly, a permanent slide can be stored in the laboratory and used repeatedly without losing clarity of cells when seen under the microscope.

Activity 9.5: Let us observe permanent slides of leaf peel of a monocot and dicot leaf

Observe a permanent slide of leaf peel of monocot and dicot leaf and compare it with the temporary mount prepared by you.

Do you find any difference in the clarity of the slides? Notice the cell walls and guard cells in the fresh temporary mount and the stained permanent mount of the dicot peel? Does the clarity of cell walls and guard cell differ? Identify two common anatomical differences in leaf peels that remain consistent in temporary and permanent mount.

9.4.3 By what factor is the image larger than the actual object?

When you look at a diagram of a cell or a tiny insect in your book, it often appears huge on the page, now you know that it might be smaller than a grain of sand. Further, when you observed onion peel cells under the microscope you would have noticed the difference in the size of image when we switch from low power to high power objective lens.

How do you know *exactly* how many times bigger you are seeing the image? We can find out by finding the magnification of objective and eye piece. Magnification is represented by the symbol X, which is read as “times,” for example, 10X means “magnified ten times.”

Magnification of a microscope: $M = m_o \times m_e$
Where m_o = magnification of objective, m_e = magnification of eyepiece.

Example:

- 10X eyepiece and 40x objective $\rightarrow M = 10 \times 40 = 400$.
- Real size = image size / total magnification

Let us find out:

1. If a cell measures 5 mm on 100X image, calculate its actual size.
2. If you use a 15X eyepiece and 10X objective, what will be the total magnification?
3. If 4 cells fit across a 0.8 mm field of view, what will be the approximate size of one cell?

9.5. Types of Microscopes

All microscopes do the same basic function – they magnify small objects – but they do it in different ways and to different depths. Magnification and resolution are core concepts in microscopy that define the imaging capabilities of a microscope. Different microscopes have different magnification powers and resolution ranges; the size of the specimen and purpose of observation determines which microscope can be used to view the specimen effectively.

9.5.1 Magnification vs. Resolution – Big vs. Sharp image

Generally, students think: “More magnification is always better.” Not always true!

- **Magnification:** Magnification is the factor by which a microscope enlarges the image of a specimen relative to its actual size (e.g., 400x).
- **Resolution:** Resolution is the smallest distance between two very close points in a specimen to clearly distinguish them as separate and not merged into a single image. It is often expressed as a unit of length e.g. 0.2 μm for light microscopes. Higher resolution reveals fine details and gives a sharp image. **Resolving power** is the capacity of the microscope to clearly identify two very closely placed points as separate points. It is expressed as the reciprocal of resolution (smaller resolution means higher resolving power).

The **resolution** of human eye and some microscopes is given below:

Instrument	Resolution (in metre)
Human eye	$\sim 1 \times 10^{-4} \text{ m}$ ($\approx 0.1 \text{ mm}$)
Light microscope	$\sim 2 \times 10^{-7} \text{ m}$ ($\approx 0.2 \mu\text{m}$)
Electron microscope	$\sim 2 \times 10^{-10} \text{ m}$ ($\approx 0.2 \text{ nm}$)

Let's know more about the units of length used in microscopy:
1 cm = 10 mm
1 mm = 1,000 μm (micrometres)
1 μm = 1,000 nm (nanometres)

9.5.2 Light (Compound) Microscope

This is the microscope you generally use in school laboratories.

- It uses **visible light** and **glass lenses**.
- Its magnification is usually up to about 1000x.
- Its resolution (smallest detail you can see clearly) is about 0.2 μm .
- It can be used to observe living cells, like moving protozoa or cheek cells.

9.5.3. Electron Microscopes

- Electron microscopes operate with electron beams that have extremely short wavelengths (about 0.005 nm compared to 550 nm for visible light). These electrons are accelerated in a vacuum and directed using magnetic lenses.
- Electrons also behave like waves, but with a **much shorter wavelength** than visible light. A shorter wavelength gives better resolution.
- Electromagnets act as “lenses” to focus on the electron beam.
- Source of electron beam (Tungsten filament).

9.5.3.1 Transmission Electron Microscope (TEM)

It is much more powerful as compared to the light microscope because it has better magnification and resolution.

- It operates with a beam of **electrons** rather than light.
- Extremely thin slices of the specimen, about 50–90 nm thick, are prepared using an ultramicrotome equipped with a glass knife.
- Electrons pass through an ultra-thin slice of specimen.
- Heavy metal stains like uranyl acetate (for proteins/ nucleic acids) and lead citrate (for lipids/ carbohydrates) are used. These increase electron density *via* positive staining, providing contrast without dissolving in embedding resins.
- Internal details of cells – mitochondria, ribosomes, viruses etc. can be observed.
- Image produced is two – dimensional (2D).
- Resolution can be around 0.1 nm.

9.5.3.2 Scanning Electron Microscope (SEM)

- It operates with a beam of **electrons** rather than light.
- Unlike TEM's ultrathin sections (50-90 nm) cut by glass knives, SEM uses diamond knives for thicker sections or whole mounts.
- Heavy metal coatings provide conductivity for electrons.
- Electrons are reflected from the specimen.
- Electrons scan the surface of the specimen.
- Gives 3D-like images of surfaces – pollen grains, insect legs, microchips.
- Resolution can be around 1 – 20 nm.



Figure 9.6: A. Transmission Electron Microscope B. Scanning Electron Microscope

(Source: Wikimedia commons)

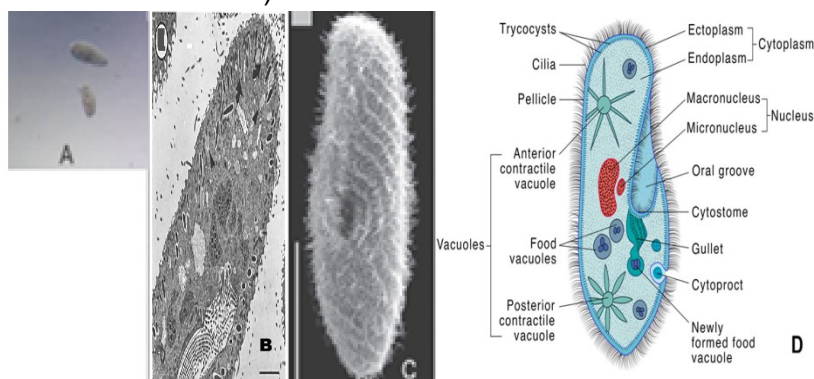


Figure 9.7: *Paramecium* as observed under - A. Light Microscope (Wikimedia commons); B. Transmission electron microscope (Source: Research Gate); C. Scanning electron microscope (Source: Research Gate) and D. Diagrammatic representation.

9.5.3.3 Let us compare Light microscope and Electron microscope (TEM and SEM)

The comparison between these three types of microscopes can be summarised as below:

S. No.	Feature	Light Microscope	Transmission Electron Microscope	Scanning Electron Microscope
1.	Illumination source	Visible light	Electron beam (broad)	Electron beam (focused, scanned)
2.	Types of lenses	Glass (convex, achromatic)	Electromagnetic coils (condenser, objective, projector)	Electromagnetic coils (condenser, scanning, objective)
3.	Thickness of section	Up to several mm - whole mounts; 5 - 10 μ m for tissue sections	Ultra-thin (<100 nm, typically 50-90 nm ultramicrotomy)	Surface only (no sectioning; samples 20 - 30 mm thick, coating 10 -100 nm)
4.	Staining	Basic dyes (e.g., methylene blue, eosin; light-absorbing)	Dense metal compounds, such as uranyl acetate and lead citrate.	Conductive coating (e.g., gold/ palladium; no traditional staining)
5.	Observing living cells	Yes (e.g., pond life, cheek cells)	No (vacuum kills cells)	No (vacuum and the coating kills cells)
6.	Resolution	$\sim 0.2 \mu$ m	~ 0.1 nm or better	~ 1 -10 nm
7.	Magnification	Up to 1,500x	Up to 50 million x	Up to 2 million x
8.	Sample	Minutes	Hours-days	Hours (dehydration,

	preparation time	(simple mounting)	(embedding, ultramicrotomy)	coating)
9.	Cost	Low (~₹10,000-50,000)	Very high (₹50 lakh+)	High (₹20-50 lakh)
10.	Vacuum required	No	Yes	Yes

Think

Why do you think electron microscopes are usually found in big research centres and not in normal school laboratories?

9.6. What is new in Microscopy? What are the limits?

9.6.1 New Developments

With advances in science and technology, digital microscopes are being developed that show a real time image directly on a screen. Thus, live images can be shared with all students at once. In Super-resolution microscopes details smaller than the normal limits of light can be observed. Explore these latest inventions through books, trusted websites, science magazines, and virtual lab simulations, and find out what new things could we discover by using an even better microscope! Your curiosity today may help design the microscopes of tomorrow.

9.6.2 Limitations

- With a light microscope, structures smaller than about $0.2\ \mu\text{m}$ cannot be resolved due to the diffraction limit of light.
- Electron microscopes are costly, need vacuum and very careful sample preparation; most samples have to be processed with chemicals and metal stains.

9.7. Where do we use Microscopes?

You might be surprised how often microscopes quietly support our lives.

- **Hospitals and Pathology laboratories:** Diagnosing diseases by checking blood, sputum, tissue biopsies (e.g., malaria parasites in blood).
- **Science laboratories:** Studying stomata, plant and animal tissues, plant diseases etc.
- **Industry:** Checking quality of metals, plastics, electronic chips using light and electron microscopes.
- **Police and forensics:** Examining fibres, hair, glass fragments, blood stains from crime scenes.
- **Environment:** Checking water samples for algae, protozoa and pollution indicators.

Snapshots

- Microscope (*micro* – small; + *skopion* - "means of viewing") is a special instrument required to observe tiny living organisms or their parts which cannot be seen through naked eyes.
- Different microscopes have varied magnification powers and resolution ranges; the size of the specimen and purpose of observation determines which microscope can be used to view the specimen effectively.
- Magnification is the factor by which a microscope enlarges a specimen's image relative to its actual size (e.g., 400 X).
- Resolution is the smallest distance between two very close points in a specimen to clearly distinguish them as separate and not merged into a single image. It is often expressed as a unit of length e.g. 0.2 μm for light microscopes.
- Light (Optical) microscopes rely on visible light and glass lenses to enlarge and view specimens.
- Light microscopes function by using refraction—the bending of light as it moves between different media due to changes in speed—along with reflection to direct and focus light rays.
- They can be broadly grouped according to the number of lenses used: simple microscopes have a single lens, while compound microscopes contain two or more lenses.
- Fluorescence microscopy uses high-intensity light to excite specialized dyes in a specimen, causing specific cellular structures to glow brilliantly against a dark background like stars in the night sky.
- Phase-contrast microscopy is a premier technique for observing living cells in their native state because it enhances contrast without requiring chemical stains that would compromise cell viability.
- For light microscopy, we can prepare temporary or permanent mount depending upon the short term or long-term storage requirement.
- Electron microscopes use electron beams (shorter wavelength $\sim 0.005\text{ nm}$ vs. light 550 nm) accelerated in vacuum, focused by magnetic lenses.
- Electron microscopes are classified as transmission (TEM) or scanning (SEM) based on how the electron beam interacts with the specimen—either passing through it or being reflected from its surface.
- TEM shows internal details of cells in 2D – mitochondria, ribosomes, viruses etc while SEM gives 3D-like images of surfaces.
- In addition to the study of cell and its organelles, microscopes are used for diagnosing diseases, for assessing the quality of metals, plastics, electronic chips, analysis of water samples and in forensics etc.

Check Your Understanding

1. A microscope has a 10X eyepiece and a 40X objective.
 - a) What is its total magnification?
 - b) At this setting, the field of view is 0.4 mm. If 4 cells fit across, estimate the size of one cell.
2.
 - a) You want to watch live protozoa moving in pond water. Which microscope (light, phase-contrast, TEM, SEM) is best and why?
 - b) Neha wants to study the 3D surface of a pollen grain. Which microscope should she choose and why?
3. Riya sees a sharp onion cell image at 100X, but when she switches to 400X, the image is big but very blurred. Name the concept causing this problem. Explain the reason.
4. Draw a ray diagram of a compound microscope.
5. Design a simple poster “How to take care of a microscope?” with three do’s and three don’ts.
6. At 40X total magnification, the field diameter is 4 mm. Predict the field diameter at 400X magnification (assume it is inversely proportional to magnification).
7. A student accidentally traps many air bubbles while placing the cover slip. How will this affect observation? Suggest two ways to avoid bubbles next time.
8. Compare TEM and SEM in terms of:
 - Type of image.
 - Best use (internal vs surface).
9. Plan a brief investigation using a school light microscope to compare the purity of three water samples (tap water, RO-purified water, and pond water). Outline the main steps and predict your expected observations.
10. Can we rely on electron microscopes for studying living cells? Explain the reason.
11. List two ways how microscopes are used in hospitals and one way they are used in industries that manufacture mobile phones.
12. Imagine you are Robert Hooke. Write a 5–6 lines diary entry about what you felt when you first saw “little boxes” (cells) in cork.
13. Ananya says, “If we add more and more lenses, we can see anything, even atoms, with a school microscope.” Use the idea of resolution to correct this statement.

14. Nishant wants to observe the effect of concentrated salt solution on cells of *Rhoeo* leaf and also wants to keep slides for future reference. Answer the following:
 - a) Which type of mount should be used for this purpose? Give reason.
 - b) Will the same slide be suitable for long-term storage? Elucidate the reason.
15. Why is it important to fix and dehydrate cheek cells before mounting in Canada Balsam for school laboratory storage? Predict the consequences if a student inadvertently skipped the fixation and dehydration steps before mounting the specimen in Canada Balsam.

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Engineering Life: Miracles in Biotechnology

10.1 Introduction to Biotechnology

For centuries, humans have relied on living organisms and their properties to improve the quality of life. Whether it is using bacteria to turn milk into curd, using yeast to make the bread we eat, or making the homemade probiotic drink, kanji. By influencing and modifying living organisms through innovation, humans have become engineers of life.



Figure 10.1: Miracles with Biotechnology

Biotechnology refers to the judicious use of living organisms, such as microbes, or their cellular components, to produce substances beneficial to humans. In the modern era, biotechnology has evolved from simple kitchen chemistry to sophisticated genetic engineering.

Human beings have been using biotechnology for a long time. Selective breeding and using the fermentation process for the production of cheese, beer and wine have been practiced since centuries. Today, microbes are not only used to make traditional fermented foods but are also widely exploited in industrial biotechnology for the production of valuable substances such as antibiotics, enzymes, improving the nutritional quality of food items, biofuels and the production of eco – friendly products.

As early as 1973, scientists observed that the genes from microbes can be taken out from one organism and can be inserted in different organism to get a desired altered gene. This branch of biotechnology is called **genetic modification/ genetic engineering/ recombinant DNA (rDNA) technology**, wherein the gene is modified to enhance the production of enzymes, antibiotics, vitamins, hormones (such as insulin), and other industrially significant substances. Thus, Biotechnology has led to advancements in many fields such as medicine, agriculture, animal science and environmental science.

Some common areas where Biotechnology has led to advancements are:

Category	Areas covered
Blue Biotechnology	Application of biotechnology for marine and freshwater organisms, which are used for increasing the seafood supply, regulation of water – borne diseases and developing new drugs.
Green Biotechnology	Improvement in the nutritional quality, quantity and production of eco – friendly products. Development of transgenic plants for better productivity and disease resistance.
Red Biotechnology	Medical Biotechnology, which is applied to manufacture pharmaceutical products such as insulin, enzymes, antibiotics, and vaccines

(Source: Biotechnology: textbook for class XI, NCERT Publication)

Activity 10.1: Observe Fermentation at Home

Aim: To understand microbial action in food.

Materials Required: Warm milk, a spoon of curd, one bowl

Procedure:

1. Pour warm milk into a bowl.
2. Add a spoonful of curd into it.
3. Leave it overnight in a warm place.

Observation: Milk turns into curd.

Conclusion: Microorganisms present in curd convert milk into curd.

Discuss with your parents. In what times or situations does curd take a long time to form? What conditions support the curdling of milk?

Quick Check

1. What is biotechnology?
2. Give two examples from your daily life demonstrating the use of biotechnology.
3. Why are microorganisms important in biotechnology?

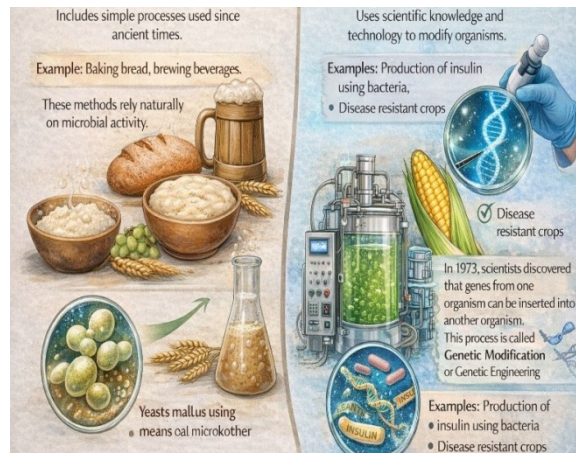


Figure 10.2: Biotechnology: Traditional vs Modern

10.2 Traditional vs Modern Biotechnology

Traditional biotechnology includes simple processes used since ancient times.

Example- Making wine, baking bread, brewing beverages. These methods rely on natural microbial activity.

Modern biotechnology uses scientific knowledge and technology to modify organisms. The process of transfer of genes from one organism to another involves a set of molecular techniques that allow scientists to deliberately modify the genetic material of an organism. Herein, specific genes can be “cut” from one organism and “inserted/ pasted” into another.

Examples: Production of insulin using bacteria, disease-resistant crops

Let us research

Activity 10.2: Traditional Biotechnology around you

- **Part A: Research on Fermented Foods:** Make a list of fermented foods used in your home or community. Identify the microorganism that may be responsible for it?
- **Part B: Preparing Probiotic Kanji**

Prepare **kanji**, a traditional fermented drink using **carrot and beetroot**.

- Place chopped carrot and beetroot pieces in a clean glass jar. Add water, salt, and a little mustard powder.
- Keep the jar in sunlight for **2–3 days**, stirring once daily.
- Observe the changes in **aroma, colour, and formation of bubbles**, which indicate microbial activity during fermentation.

Observation: Record your observations and results in the following table.

Day	Changes in Color	Changes in aroma	Presence of Bubbles/Froth	Possible Microbial Activity
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				
Day 7				

Conclusion:

Quick Check

Traditional Biotechnology	Modern Biotechnology
Uses natural microbial processes	Uses _____ techniques
Used since _____ times	Developed in _____ times
Example: Making curd and bread	Example: Production of _____ using bacteria
Has limited control over _____	Provides greater control over _____
Does not involve gene transfer	Involves _____ modification

10.3 Microbes as Tools in Biotechnology

Microorganisms such as bacteria, yeast and fungi are widely used in biotechnology. Why is the reason for this?

- Microbes are easy to grow. Bacteria can double their population in 20 minutes.
- They need basic nutrients (sugar, nitrogen) for their growth.
- They do not need much space, as millions of bacteria can be grown in a small space.
- Their DNA can easily be manipulated.
- Their DNA is self-replicating.

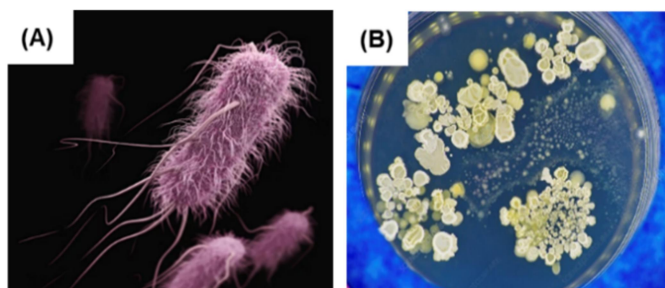


Figure 10.3: (A) Bacteria (B) Fungus

Let us observe

Activity 10.3: Fermentation at home

Mix 2 teaspoons of sugar in a bowl of warm water and add 1 teaspoon of dry yeast.

Cover it and wait for 15 minutes.

Observation: You will observe frothing and a pungent odour emerging.

Discussion: The froth is CO₂, and the smell is due to ethanol.

The yeast is "working" by breaking down sugar.

10.4 Applications of Biotechnology in Daily Life

A casual survey of everyday products reveals that biotechnology plays a key role in many of them. These innovations span diverse fields, transforming how we produce food, medicine, and more.

The following are the key areas involving the use of biotechnology.

1. Crop production and agriculture
2. Medicine and Health Care
3. Food processing
4. Bio-Enzymes: Revolutionizing Household Cleaning
5. Environmental protection

10.4.1 Crop production and agriculture

Genetic engineering of crop plants has enhanced traits like stress tolerance, insect resistance, viral resistance, productivity and nutritional value.

A gene is a segment of DNA that codes for specific proteins. Biotechnology now enables us to manipulate genes of interest to create recombinant DNA, producing genetically modified plants resistant to insect pests—like Bt cotton and Bt corn. Let's explore these examples further.

10.4.1.1 Pest-resistant crops

Bt toxin, a protein from the soil bacterium *Bacillus thuringiensis*, exhibits insecticidal properties. It targets larvae of moths, butterflies, and cotton bollworms but remains harmless to humans. The gene encoding this toxin is transferred to cotton, corn, potato, and tomato plants, creating transgenic varieties. These plants express the Bt toxin, which functions as a natural insecticide, protecting them from insect pests.



Figure 7: Genetically modified plant
e.g.: Bt cotton

These plants are engineered to be "self-protecting" against pests.

- **Source:** A soil bacterium called *Bacillus thuringiensis* (Bt) naturally produces a protein that is toxic for certain insects (like bollworms).
- **Process:** The "toxin gene" from this bacterium is identified, isolated and inserted into the DNA of cotton or corn plants.
- **Result:** The plant starts producing this protein in its leaves and stems. When a pest feeds on the plant, the toxin enters its gut and kills it. This reduces the need for harmful chemical pesticides.

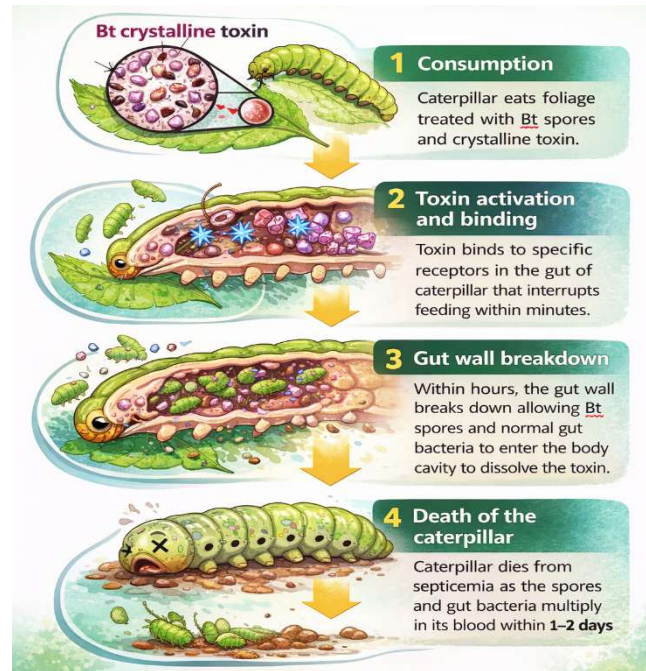


Figure 8: Action of *kurstaki* (Bt) on Caterpillars

10.4.1.2 Improving nutritional quality

Biotechnology has improved the nutritional content of key food crops. A prominent example is Golden Rice, genetically modified to produce high levels of beta-carotene, a precursor to vitamin A.

Golden Rice

- This bio-fortified crop helps fight malnutrition, especially Vitamin A Deficiency (VAD), which causes blindness in millions of children.
- **Problem:** Normal rice is a great source of energy but lacks Vitamin A.
- **Process:** Scientists inserted genes from maize (corn) and a soil bacterium into the rice plant. These genes allow the rice to produce beta-carotene, a precursor to Vitamin A.
- **Result:** The rice grains turn a golden-yellow colour because they are packed with beta-carotene, which our bodies convert into Vitamin A. It acts as a "medicinal food" for people in regions where rice is the main diet.



Figure 9: (A) Normal Rice and (B) Golden Rice

10.4.2 Medicine and Health Care

Making human insulin using bacteria is a brilliant piece of engineering. Instead of relying on animals, scientists "instruct" bacteria how to synthesize human insulin by giving them the right genetic instructions.

Steps:

DNA Isolation

Scientists have identified the specific human gene that contains the gene for making insulin. They use special biological "scissors" called **restriction enzymes** to cut this gene out of human DNA. This leaves "sticky ends" on the gene so it can attach to something else later.

Preparing the Plasmid

Bacteria have small, circular loops of DNA called **plasmids (extracellular DNA)**. Scientists take a plasmid and cut it open using the *same* restriction enzymes used for the human gene. This ensures the plasmid has matching "sticky ends" that fit the human insulin gene perfectly.

Combining the DNA (Ligation)

The human insulin gene is mixed with the cut bacterial plasmid. An enzyme called **DNA ligase** acts like biological glue, joining the two pieces together. This creates a **recombinant plasmid**—a modified DNA that now contains the human instructions for making insulin.

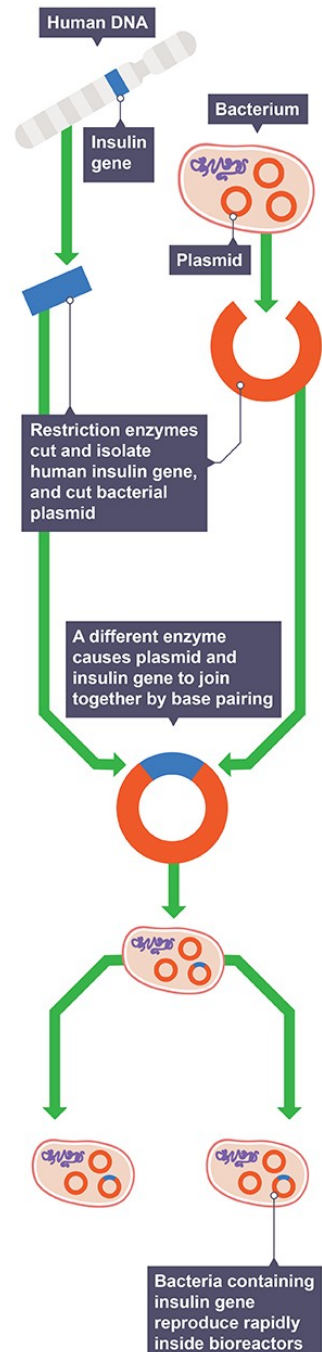
Creating the "Medicine Factory" (Transformation)

This recombinant plasmid is inserted back into a bacterium (usually *E. coli*). The bacterium is now "transformed" and ready to follow its new instructions.

Mass Production and Extraction

The engineered bacteria are placed into a large tank called a **fermenter**. As the bacteria replicate (multiply), they all carry the human insulin gene and begin to "express" it, meaning they start releasing human insulin protein in the culture medium.

Finally, the insulin is collected and purified to be safely used for diabetic patients.



10.4.3 Food processing

Biotechnology plays a key role in the large-scale production of fermented foods like yoghurt, cheese, probiotics, buttermilk, idli, dosa, and dhokla. These products gain improved taste, enhanced nutrition like probiotics for gut health, added vitamins, and longer shelf life (via controlled microbial action). Microorganisms like *Lactobacillus* and yeasts are carefully selected, fermented under optimized conditions, and preserved to produce these foods safely and on a large scale.

10.4.4 Bio-Enzymes: Revolutionizing Household Cleaning

Biotechnology enhances household products through bio-enzymes, natural proteins derived from microbes like bacteria and fungi. These enzymes, such as proteases, amylases, and lipases, power everyday cleaners like laundry detergents, dishwashing liquids, and stain removers by breaking down tough dirt, grease, fats, and proteins at low temperatures—saving energy and reducing harsh chemical use. For instance, in washing powders, bio-enzymes target food stains or grass marks effectively, while in drain openers, they dissolve organic clogs safely without damaging pipes. This makes cleaning eco-friendly, skin-safe, and highly efficient for routine chores.

10.4.5 Environmental protection

Biotechnology contributes to environmental protection through targeted applications like bioremediation and biofuels.

Bioremediation

Microbes, engineered bacteria, or fungi break down pollutants such as oil spills, heavy metals, and pesticides in soil and water. This natural process restores ecosystems without harsh chemicals—for example, *Pseudomonas* bacteria degrade hydrocarbons from industrial waste.

Biofuels

Microbial fermentation converts biomass into renewable fuels like ethanol, biodiesel, or biogas. These alternatives reduce fossil fuel use and greenhouse gas emissions—algae systems even capture CO₂ while growing, aiding cleaner energy and waste management.

10.5. Bioreactors: Powering Large-Scale Biotechnology Applications

Biotechnology's diverse applications—from medicine and agriculture to food production—rely on scalable tools like fermenters (bioreactors) for industrial efficiency.

Fermenters (Bioreactors)

Fermenters are large vessels (up to 100,000 liters) made up of glass or steel that are used to grow microorganisms so as to produce a desired product. Example- A small culture of bacteria or yeast (**inoculum**) is added to fermenters containing nutrient medium to get useful products on a large scale.

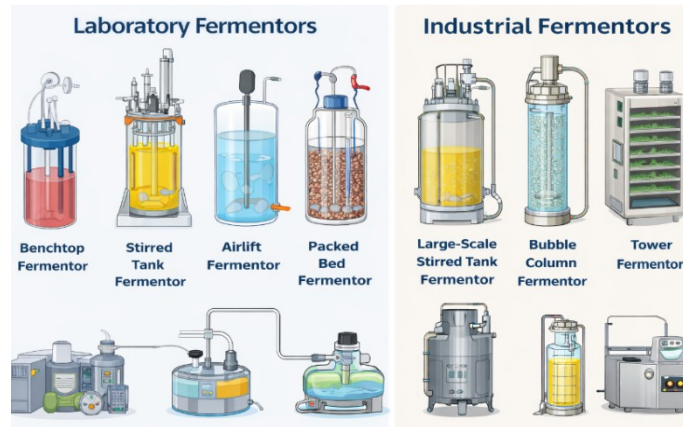


Figure 4: Fermenters in Laboratory and Industry

Fermenters must be **sterilized** before use so as to avoid the **contamination** of the rich nutrient culture.

10.5.1 Parts of fermenter-

- **Stirrer (Impeller)**- helps in agitation, i.e., mixes broth so that every cell gets the nutrients and oxygen.
- **Sparger**- Helps in aeration into the tank for the microbes to facilitate aerobic respiration.
- **Cooling Jacket**- Acts as a temperature control when microbes produce heat as they grow. The "cooling jacket" filled with cold water surrounds the tank to prevent the microbes from "cooking" themselves.
- **pH sensors**- Sensors monitor the change in pH. If the broth becomes too acidic, the system automatically adds a "base" to neutralize it.

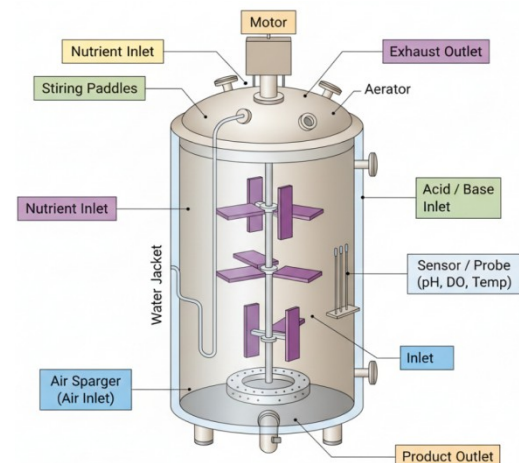


Figure 5: Parts of a fermenter

10.5.2 Fermentation Process

Preparation of Culture Medium



Sterilization of Medium and Equipment



Preparation of Pure Microbial Culture (Inoculum)



Growth of Microorganisms in a Fermenter (Under Controlled Conditions)



Extraction and Purification of Product



Treatment and Disposal of Waste Materials

Quick Check

1. Why is temperature control important in fermenters?
2. What happens if contamination occurs?
3. Explain sterilization and its importance in microbial growth.

10.5.3 Growth of Microorganisms in a Fermenter

Microbial growth does not occur at a constant rate. When nutrients are supplied in a fermenter, microbes pass through different phases of growth, which together form a growth curve.

The following are the phases of growth-

Lag Phase: The new inoculum is added to the nutrients in the fermenter, and the microbes adapt to the new environment. This phase is also called the **acclimatization phase**.

Log Phase: During this phase, microbial cells divide at their optimal rate, resulting in rapid population growth and maximum product formation. This phase is known as the **exponential phase**.

Stationary Phase: This phase is also known as the Survival Phase, wherein nutrients in the fermenters start depleting, and metabolic waste starts building up. Although new cells are being produced, an equal number of cells are dying.

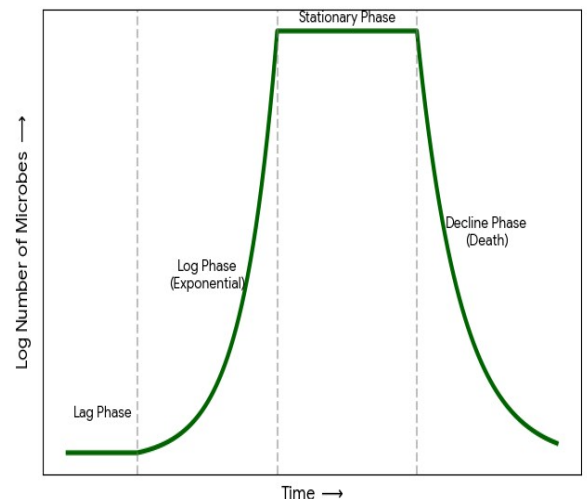


Figure 6: Microbial growth curve

Decline (Death) Phase or The End phase: The toxic waste levels become too high in the fermenter, and the population crashes.

To avoid the Decline (Death) Phase in a fermenter, engineers use a Continuous Culture system. Instead of a closed "batch," the environment is actively managed by:

- **Nutrient Replenishment:** Fresh nutrient medium is added continuously to ensure the microbes never run out of "fuel" for growth.
- **Waste Removal:** An equal volume of "spent" broth (containing toxic metabolic waste) is removed simultaneously. This prevents the buildup of toxins that would otherwise harm the population.
- **Steady State:** Nutrient replenishment and waste removal keep the microbes locked in the Log Phase, where they are most productive.
- **Automatic Buffering:** Sensors detect changes in pH and temperature. If acidic waste builds up, a base is automatically added to maintain a stable, life-supporting environment.

Let us explore like a scientist

Activity 5.4: Growth Simulation

The following table shows hypothetical data representing the growth of microorganisms in a fermenter.

Time (hours)	Number of Microorganisms
0	10
2	12
4	25
6	60
8	120
10	125
12	123
14	90

1. Using the above data, plot a graph using time (hours) on the X-axis and number of microorganisms on the Y-axis.
2. Identify and label the following growth phases on the graph:
 - Lag phase
 - Log phase
 - Stationary phase
 - Death phase

3. During which time period do microorganisms grow most rapidly?
4. Suggest one reason why the population decreases after a certain time.

10.6 Ethical Issues in Biotechnology

10.6.1 Safety: The risk of "Super-bugs" and ecological imbalance

When we try to engineer a microbe to kill a pest or to modify or extract proteins, we are actually introducing a new variable in the ecosystem. This may lead to unintended consequences and require biosafety measures.

Example-

- **Gene Flow:** Modifying genes could mix into the wild through cross-pollination in plants and lead to a risk that will be difficult to control. For example, a "weed-killer resistant" gene from a crop could transfer to a wild weed, creating a "super-weed" that no one can kill.
- **Targeting the Wrong Organisms:** A toxin meant to kill one specific pest might accidentally harm beneficial insects, like bees or butterflies, disrupting the entire food chain and food web.
- **Evolutionary Pressure:** Just as bacteria become resistant to antibiotics, pests can become resistant to the toxins in GM crops (like Bt Cotton), leading to the rise of "super-bugs" that are harder to control than ever before.

10.6.2 Equity: The Global "Biotech Divide"

Science is expensive. Because of the high cost of research and development, biotechnology is often regulated by a few powerful corporations and wealthy nations.

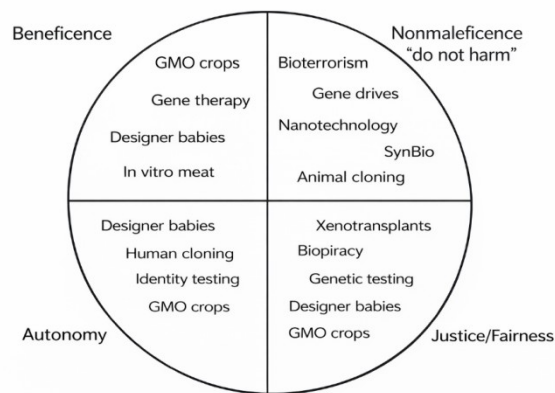
- **Patent Control:** Companies often "own" the seeds or the processes they create through patents. This can prevent poor farmers in developing countries from saving seeds for the next year, forcing them to buy new, expensive seeds every season.
- **Biopiracy:** This happens when researchers do unethical or unlawful appropriation or commercial exploitation of biological materials (such as medicinal plant extracts) that are native to a particular country or territory without providing fair financial compensation to the people or government of that country or territory.
- **Health Access:** Benefits of biotechnology may not reach the middle-income people, as the process and products developed are expensive and may only reach up to the top 1% of the global population, widening the gap between the rich and the poor.

Think and Discuss

There are four important ethical principles that help evaluate the impact of biotechnology on society. These principles act as guidelines to understand the benefits, risks and fairness related to emerging biotechnologies.

The figure shows different modern biotechnologies placed under four ethical principles:

- Beneficence (Doing Good)
- Non-maleficence (Do Not Harm)
- Autonomy (Freedom of Choice)
- Justice and Fairness



Each emerging biotechnology has been grouped under the principle where ethical concerns may arise. (*SynBio refers to Synthetic Biology.*)

Check Your Understanding

1. Define biotechnology. Explain how microorganisms act as "life's engineers" giving two examples.
2. Differentiate between traditional biotechnology and modern biotechnology using suitable examples.
3. Why are fermenters used instead of open containers for industrial production of useful substances? Give any two reasons.
4. Explain the importance of maintaining sterility inside a fermenter. What problems may arise if sterility is not maintained?
5. Study the diagram of a fermenter in the chapter and answer the questions.
 - A. Identify any two parts responsible for maintaining microbial growth.
 - B. What is the function of the stirrer in a fermenter?
 - C. Why is oxygen supply important in some fermenters?
6. The following data shows the number of microorganisms growing in a fermenter.

Time (hours)	Number of Microorganisms
0	20
2	30
4	70
6	140
8	145
10	140
12	90

Answer the following:

- a) During which time period does rapid microbial growth occur?
 - b) Identify the stationary phase from the data.
 - c) Suggest one reason why the microbial population decreases after a certain time.
7. Microbes are used in food production, medicine and environmental protection. Analyse how biotechnology helps improve human life using any three examples.
 8. A scientist wants to produce insulin using bacteria. Explain how modern biotechnology makes this possible. Why has traditional biotechnology not achieved this?
 9. Biotechnology has helped increase food production, but some people have ethical concerns regarding GM crops. Evaluate both advantages and concerns.
 10. Design a simple biotechnology product that can help solve an environmental problem in your community. Describe:
 - The microorganism or enzyme you would use
 - The problem it solves
 - How it benefits society
 11. Which of the following is an example of traditional biotechnology?
 - a) Production of insulin using bacteria
 - b) Preparation of curd from milk
 - c) Development of disease-resistant crops
 - d) Gene transfer between organisms
 12. Which microorganism is commonly used in bread making?
 - a) Bacteria
 - b) Virus
 - c) Yeast
 - d) Algae

13. Which of the following conditions is necessary for proper functioning of a fermenter?
- a) Contamination
 - b) Controlled temperature
 - c) Open environment
 - d) Absence of nutrients
14. Genetic engineering mainly involves:
- a) Mixing different foods
 - b) Transfer of genes between organisms
 - c) Increasing natural microbial growth
 - d) Removing microorganisms from food
15. During which phase do microorganisms show maximum growth?
- a) Lag phase
 - b) Log phase
 - c) Stationary phase
 - d) Death phase

Assertion (A): Sterility must be maintained inside a fermenter.

Reason (R): Contamination by unwanted microorganisms can reduce product quality.

- a) Both A and R are true and R is the correct explanation of A.
- b) Both A and R are true but R is not the correct explanation of A.
- c) A is true but R is false.
- d) A is false but R is true.

Assertion (A): Modern biotechnology allows production of insulin using bacteria

Reason (R): Modern biotechnology involves genetic modification techniques.

- a) Both A and R are true and R is the correct explanation of A.
- b) Both A and R are true but R is not the correct explanation of A.
- c) A is true but R is false.
- d) A is false but R is true.

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SCIENCE

Subject Code – 086

Classes IX (2026-27)

Introduction

Science is the study of the natural and physical world around us through a systematic process of observing, questioning, forming hypotheses, testing hypotheses through experiment, analysing evidence, and continuously revising our knowledge. It develops essential skills like curiosity, creativity, evidence-based thinking, and sound decision-making that help us lead rational and fulfilling lives. Learning Science provides valid knowledge about the world, and builds scientific values and capacities. It draws knowledge from Biology, Chemistry, Physics, Earth Science, Mathematics, Computational Sciences, and sometimes Social Science and Vocational Education to offer an interdisciplinary understanding of the role of science.

Science Education helps students to develop an understanding of the natural and physical world through systematic inquiry. Learning Science also develops important capacities, such as observation, questioning, analysis, inference, etc. This helps individuals to meaningfully participate in society and the world of work with a scientific temper, critical and evidence-based thinking, asking relevant questions, analysing practices and norms, and acting for necessary change.

Science Education aims to achieve:

- Scientific understanding of the natural and physical world;
- Capacities for scientific inquiry;
- Understanding the evolution of scientific knowledge;
- Interdisciplinary understanding between Science and other curricular areas;
- Understanding of the relationship between Science, Technology, and Society;
- Scientific temper, and
- Creativity.

Together, the NEP 2020 and NCF-SE 2023 envision science classrooms that encourage curiosity, creativity, collaboration and connection with the real world, ultimately nurturing not just future scientists, but responsible, informed and critically thinking citizens.

Learning standards (Curricular Goals and Competencies) describe what students should know, understand, and be able to do in Science. In Grades 9 – 10, Science is taught using an integrated approach that combines Biology, Chemistry, Physics, and Earth Science. This helps students understand the connections between disciplines and relate Science to their observations and experiences. At this stage, scientific inquiry skills are developed alongside conceptual understanding, with content selected both for disciplinary relevance and real-life usefulness. Students must deepen their understanding of the world, explore scientific questions through discussion and experimentation, and communicate their learning in various ways. It is important to note that the Curricular Goals are interdependent and not separate.

Learning standards are organised into four levels: broad curricular aims define the overall objectives for Science Learning by the end of each schooling stage; more specific Curricular Goals guide the design of the science curriculum for each stage and topic; Competencies

represent measurable scientific skills and knowledge-based on these goals, assessed at the end of each stage; and detailed Learning Outcomes (LOs) are granular milestones of learning and usually progress in a sequence leading to the attainment of a competency. These LOs enable teachers to plan their content, pedagogy, and assessments towards achieving specific competencies.

Curricular Goals (CGs) and Competencies (Cs)

CG 1 – Explores the world of matter, its interactions, and properties at the atomic level

C 1.1 – Describes classification of elements in the Periodic Table, and explains how compounds (including carbon compounds) are formed based on the atomic structure (Bohr's model) and properties (valency).

C 1.2 – Investigates the nature and properties of chemical substances (distillation, crystallisation, chromatography, centrifugation, types and properties of mixtures, solutions, colloids, and suspensions)

C 1.3 – Describes and represents chemical interactions and changes using symbols and chemical equations (acid and base, metal and non-metal, reversible and irreversible)

CG 2 – Explores the physical world around them, and understands scientific principles and laws based on observations and analysis

C 2.1 – Applies Newton's laws to explain the effect of forces (change in state of motion — displacement and direction, velocity and acceleration, uniform circular motion, acceleration due to gravity) and analyses graphical and mathematical representations of motion in one dimension

C 2.2 – Explains the relationship between mass and weight using universal law of gravitation, and connect it to the laws of motion

C 2.3 – Manipulates the position of object and properties of lenses (focus, centre of curvature) to observe image characteristics and correspondence with a ray diagram, and extends this understanding to a combination of lenses (telescope, microscope)

C 2.4 – Manipulates and analyses different characteristics of the circuit (current, voltage, resistance) and mathematises their relationship (Ohm's law), and applies it to everyday usage (electricity bill, short circuit, safety measures)

C 2.5 – Defines work in scientific terms, and represents the relationship between potential and kinetic energy (conservation of energy) in mathematical expressions

C 2.6 – Demonstrates the principle of mechanical advantage by constructing simple machines (system of levers and pulleys)

C 2.7 – Describes the origin and properties of sound (wavelength, frequency, amplitude) and differences in what we hear as it propagates through different instruments

C 2.8 – *Explores interconnected systems and phenomena that support and affect life on Earth (hydrosphere, biosphere, atmosphere, geosphere, cryosphere and their interrelationships, earth processes, hazards, etc.)

*Additional Competency for Earth Science

CG 3 – Explores the structure and function of the living world at the cellular level

C 3.1 – Explains the role of cellular components (nucleus, mitochondria, endoplasmic reticulum, vacuoles, chloroplast, cell wall), including the semi-permeability of cell membrane in making cell the structural basis of living organisms and functional basis of life processes

C 3.2 – Analyses similarities and differences in the life processes involved in nutrition (photosynthesis in plants; absorption of nutrients in fungi; digestion in animals), transport (transport of water in plants; circulation in animals), exchange of materials (respiration and excretion), and reproduction

C 3.3 – Describes the mechanisms of heredity (in terms of DNA, genes, chromosomes) and variation (as changes in the sequence of DNA)

CG 4 – Explores interconnectedness between organisms and their environment

C 4.1 – Applies the knowledge of cellular diversity in organisms along with the ecological role organisms play (autotrophic or heterotrophic nutrition) to classify them into five kingdoms

C 4.2 – Illustrates different levels of organisations of living organisms (from molecules to organisms)

C 4.3 – Analyses different levels of biological organisation from organisms to ecosystems and biomes along with interactions that take place at each level

C 4.4 – Analyses patterns of inheritance of traits in terms of Mendel's laws and its consequences at a population level (using models and/or simulations)

C 4.5 – Analyses evidences of biological evolution demonstrating the consequences of the process of natural selection in terms of changes—in allele frequency in population, structure, and function of organisms

CG 5 – Draws linkages between scientific knowledge and knowledge across other curricular areas

C 5.1 – Explores how literature and arts have influenced Science

C 5.2 – Examines a case study related to the use of Science in human life from the perspective of Social Sciences and Ethics (for example, Marie Curie, Jenner, treatment of patients with mental illnesses, the story of the atomic bomb, green revolution and GMOs, conservation of biodiversity)

C 5.3 – Applies scientific principles to explain phenomena in other subjects (sound pitch, octave, and amplitude in music; use of muscles in dance form and sports)

CG 6 – Understands and appreciates the contribution of India through history, and the present time to the overall field of Science, including the disciplines that constitute it

C 6.1 – Knows and explains the significant contributions of India to all matters (concepts, explanations, methods) that are studied within the curriculum in an integrated manner

CG 7 – Develops awareness of the most current discoveries, ideas, and frontiers in all areas of scientific knowledge in order to appreciate that Science is ever evolving, and that there are still many unanswered questions

C 7.1 – States concepts that represent the most current understanding of the matter being studied, ranging from mere familiarity to conceptual understanding of the matter as appropriate to the developmental stage of the students

C 7.2 – States questions related to matters in the curriculum for which current scientific understanding is well-recognised

CG 8 – Explores the nature of Science by doing Science

C 8.1 – Develops accurate and appropriate models (including geometric, mathematical, graphical) to represent real-life events and phenomena using scientific principles, and use these models to manipulate variables and predict results

C 8.2 – Designs and implements a plan for scientific inquiry (formulates hypotheses, makes predictions, identifies variables, accurately uses scientific instruments, represents data — primary and secondary—in multiple modes, draws inferences based on data, and understanding of scientific concepts, theories, laws and principles, and communicates findings using scientific terminology)

COURSE OUTLINE

CLASS IX (2026-27)

Cell

No. of Periods: 12

Key Concepts		Learning Outcomes
• Discovery of cell • Plant and animal cells • Prokaryotic and eukaryotic cells • Cell as a structural and functional unit of life; structure and function of key organelles (nucleus, mitochondria, chloroplast, endoplasmic reticulum, vacuoles, plasma membrane, cell wall) • Permeability of cell membranes • Cellular division and cancer • Recent advancement in cell biology	C-3.1	• Differentiate between plant and animal cell, prokaryote and eukaryote • Describe the structural and functional features of cells • Explain the role of cells in the structure and functions of organisms • Explain activities inside the cell and its interactions with the environment • Demonstrate osmosis in cells • Prepare slides to observe cell structure
	C-3.2	• Differentiate between diffusion and osmosis
	C-3.3	• Explain the role of cell division mitosis and meiosis in creating similarities and variations
	C-4.2	• Identify and describe the role of biomolecules in the structure and function of cell
	C-5.2	• Cite case study related to the use of science in human life, for example, Leigh Syndrome and mitochondrial dysfunction
	C-5.3	• Apply learning of a structure and function of muscles cells or joints in dance form and/or sports
	C-6.1	• Discuss significant contributions of India, for example, Professor Arun Kumar Sharma for his work on chromosomes and methods for its studies
	C-7.1	• Recognise that the cell is a structural unit of life and functional unit of life processes
	C-7.2	• Pose questions, such as — Can we create artificial cell which behaves exactly like a natural living cell?

	C-8.1	Exhibit creativity and design models using low cost or no-cost eco-friendly material to study structure and functions of cell and cell organelles
	C-8.2	- Carry out an experiment to understand the osmosis - Analyze result and present finding using scientific terms

Tissues

No. of Periods: 13

Key Concepts		Learning Outcomes
Tissues: Introduction and importance - Level of organisation in the living organisms - Plant and animal tissues - Types of plant tissues - Meristematic tissues (types and function of each) - Permanent tissues (types, structure and function of each) - Animal tissues - Overview (epithelial, connective, muscular and nervous tissues — types, structure and function of each) - Elementary idea of musculoskeletal system - Care of musculoskeletal system: injuries, postural care, nutrition and exercise	C-4.2	- Differentiate between plant and animal tissues; meristematic and permanent tissues; simple and complex tissues; parenchyma, collenchyma and sclerenchyma; xylem and phloem; striated smooth and cardiac muscles; - Different types of joints - Relate the structure of the different types of tissues with their functions - Explain the role of various types of tissues in plants and animals - Describe the level of organisation in a multicellular organism
	C-5.3	Establish the correlation between different tissues for fitness, for example, role of muscles, cartilage and bones in facilitating movement
	C-6.1	Explain the importance of yoga exercises for physical agility and in maintaining the correct posture
	C-6.1	Discuss significant contributions of India, for example, Professor Sipra Guha Mukherjee and Professor S.C. Maheshwari for their significant contribution in the plant cell and tissue culture research in India
	C-7.1	Discuss the techniques and medical recommendations in recovery from muscular injuries

	C-8.2	- Carry out an experiment to understand the growth in plant due to apical meristem - Represent data in multiple modes, including appropriate figures, tables, graphs, or digital formats, interpret and draw inferences from the data - Analyse results and present findings using scientific terms - Communicate findings and conclusions effectively, such as those from experiments, activities, or projects, both orally and in written form
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Reproduction

No. of Periods: 13

Key Concepts		Learning Outcomes
- Introduction to different forms of reproduction — sexual and asexual - Types of asexual reproduction with examples - Sexual reproduction in flowering plants (flower and its parts, pollination, fertilisation, seed dispersal) - Sexual reproduction in humans: male and female reproductive systems (structure and function, formation of gametes, sperm and egg, fertilisation, pregnancy and development of embryo, menstrual cycle) - Reproductive health and hygiene - Introduction to birth control methods and importance	C-2.8	Analyse the interactions between members of different groups of organisms, such as plants and pollinators
	C-3.2	- Compare asexual and sexual reproduction - Describe male and female reproductive organs in plants and animals - Differentiate between ovule and seed; ovary and fruit - Explain pollination and fertilisation
	C-3.3	Explain how variations are introduced by sexual reproduction
	C-4.3	Identify and explain the role of biotic and abiotic agents in seed dispersal and pollination
	C-5.1	Illustrate the structure of male and female reproductive units or systems in plants and animals
	C-5.2	Recognise the significance of contraceptive devices for population control and health including reproductive health
	C-6.1	Describe the contribution of India to the understanding of human anatomy
	C-6.1	Discuss significant contributions of India, for example, Professor Panchanan Maheshwari for

		laying the foundation of plant cell and tissue culture research in India
	C-7.1	• Recognise the importance of improvements in medical field for assisted reproductive technologies
	C-7.2	• Pose questions, such as — How do heavy metals harm reproductive organs? Can extreme heat affect fertility?

Diversity

No. of Periods: 12

Key Concepts		Learning Outcomes
- Importance of classification - Five kingdoms and their key features with examples - Major division of animals and plants - Binomial nomenclature - Acellular entities: viruses	C-4.1	- Distinguish organisms based on certain characteristics, such as number of cells present, cellular organisation and mode of nutrition - Classify various organisms in groups, such as five kingdoms, on the basis of their cellular organisation and ecological role - Describe the significance and rules of binomial nomenclature - Apply binomial nomenclature on some common organisms in their surroundings
	C-2.8	- Analyse the interactions between members of different groups of organisms, such as lichens - Discuss ecological role of diverse organisms
	C--7.1	Recognise three domains of classification of organisms on molecular basis

Exploring Mixtures and their Separation

No. of Periods: 12

Key Concepts		Learning Outcomes
- Homogeneous and heterogeneous mixtures; - Solutions, suspensions, colloids and their properties - Various ways to express concentration of solutions (mass by mass percentage of a solution,	C-1.2	- Differentiate between homogeneous and heterogeneous mixtures on the basis of their properties - Demonstrate separation techniques, such as crystallisation, distillation, paper chromatography, sublimation, centrifugation and coagulation - Classify mixtures as solutions, suspensions, or colloids based on their properties - Explain the scientific principles behind different

mass by volume percentage of a solution, volume by volume percentage of a solution) Separation techniques based on the physical properties of components, including crystallisation, distillation, paper chromatography, sublimation, centrifugation and coagulation		separation techniques - Apply the knowledge of homogeneous and heterogeneous mixtures in daily life - Define and calculate the concentration of solutions using mass by mass percentage, mass by volume percentage, volume by volume percentage - Analyse graphs of solubility and explain how the solubility of substances changes with temperature - Use scientific conventions and standard units to express concentrations - Handle common laboratory chemicals and apparatus safely - Relate separation techniques with practices observed in the local environment
	C-5.1	Draw labelled diagrams or flow charts of separation techniques
	C-5.2	Display awareness about the societal impact of chemistry in making life healthier, cleaner and sustainable
	C-5.3	Correlate the phenomenon used in centrifugation to the spinning dance
	C-6.1	- Describe the cultural practices, like traditional methods of distillation - Display awareness about the contributions of Indian scientists, such as Dilip Mahalanabis
	C-7.1	Demonstrate the use of small-scale or micro-scale experiments, such as crystallisation of copper sulfate, as an alternative to traditional methods
	C-7.2	Poses question, such as — Can we create artificial blood that works just as real blood for all patients?
	C-8.1	Exhibit creativity and work collaboratively in groups to create models of apparatus used for separating mixtures, such as a paperfuge and a distillation unit, using eco-friendly materials
	C-8.2	Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, and predict the results of an experiment or investigation based on their hypotheses

		• Accurately use scientific instruments, apparatus and chemicals to collect data • Analyse results and findings using scientific terms • Represent findings in multiple modes, including appropriate figures, tables, graphs, or digital formats, and interpret and draw inferences from the findings • Communicate findings and conclusions effectively, such as those from experiments, activities or projects, both orally and in written form
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Structure of an Atom

No. of Periods: 14

Key Concepts		Learning Outcomes
• Atoms are the basic units of elements • Atoms consist of subatomic particles • Atomic Models (Thomson's Model, Rutherford's Model, and Bohr's Model) • Distributions of electrons in elements (up to 18 elements) • Symbols • Valency as the combining capacity • Atomic number • Mass number • Isotopes • Isobars	C-1.1	• Differentiate between subatomic particles (electrons, protons, and neutrons) based on their charge, and position in the atom • Illustrate how electrons are distributed in different energy levels, such as K, L, M, N ... or by numbers $n = 1, 2, 3, 4 \dots$ • Explain valence electrons, valency, atomic number, atomic mass, isotopes, and isobars • Calculate the number of electrons, protons, and neutrons of an element using its atomic and mass numbers • Interpret data, such as atomic mass, maximum number of electrons in a shell, and valency to classify elements accurately • Use scientific conventions as per international standards, such as notations for electron, proton, neutron, unified atomic mass unit (u), and distribution of electrons in various shells, such as K, L, M, N ...
	C-1.3	• Recognise and accurately apply the chemical symbols for the first eighteen elements according to IUPAC
	C-5.1	• Draw labelled diagrams of various atomic models, such as Thomson's model, Rutherford's model and Bohr's model • Create and present a role play, stage play, or story of 'Journey Inside the Atom' to display awareness about the contributions of key scientists in the

		discovery and development of atomic structure
	C-5.2	• Display awareness about the role of Indian scientists and their contributions to atomic science for peaceful purposes and explore how their works influenced India's scientific development
	C-5.3	• Display awareness about the societal impact of science in making life healthier, like the use of various isotopes in medicines to treat different diseases, and atomic energy in power generation • Design and develop games that utilise atomic number, mass number, and subatomic particle clues to accurately predict and identify elements
	C-6.1	• Display awareness about the contributions of the ancient Indian philosopher, Acharya Kanad's idea of indivisible particles (Parmanu)
	C-7.1	• Describe the use of the atomic mass unit (u) to measure the mass of atoms as per IUPAC recommendations • Describe scientific discoveries that explain how the structure of the atom has evolved over time through various atomic models proposed by different scientists
	C-7.2	• Pose question, such as—is it possible to completely understand everything that happens inside an atom?
	C-8.1	• Exhibit creativity and work collaboratively in groups to design different models of atoms
	C-8.2	• Formulate hypotheses about scientific phenomena by applying prior knowledge and understanding of scientific concepts, and predict the results of data based on the hypotheses • Analyse results and present findings using scientific terms • Correlate the results and conclusions of different models of atomic structure • Represent data in multiple modes, including appropriate figures, tables, graphs or digital formats, and interpret and draw inferences from the data

		Communicate findings and conclusions effectively, such as those from experiments, activities or projects, both orally and in written form
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Atoms and Molecules

No. of Periods: 14

Key Concepts		Learning Outcomes
- Law of conservation of mass - Law of constant proportion - Dalton's Atomic theory - Molecules of elements, Molecules of covalent compounds and their properties - Ions, Ionic compounds and their properties - Writing chemical formulae - Molecular mass - Formula unit mass	C-1.1	- Differentiate between chemical species based on their properties or characteristics, such as atoms and molecules, elements and compounds, ionic and covalent compounds, cations and anions, formula unit mass and molecular mass - Plan and demonstrate activities to observe and verify the law of conservation of mass - Explain the Dalton's atomic theory, the law of conservation of mass, the law of constant proportions, and formation of ionic and covalent compounds - Calculate the charge on an ion, valency from the atomic number, the molecular and formula unit mass - Use scientific conventions, symbols, and valency to write the chemical formulae of simple compounds - Display awareness about the scientific discoveries, such as the contributions of Antoine Lavoisier, Joseph Proust, and John Dalton - Handle common laboratory chemicals and apparatus safely
	C-5.1	Draw diagrams of electron dot structures of atoms and molecules
	C-5.2	- Describe how atoms and molecules can lead to beneficial applications, such as medicine, energy and peaceful use of atomic science - Relate atomic bonding to social bonding
	C-5.3	Design educational games to write chemical formulae using symbols
	C-6.1	Display awareness about the contributions of Indian scientists in promoting the peaceful use of atomic energy and the traditional use of the red pigment 'cinnabar' obtained from rocks

	C-7.1	Describe the basic concepts that matter are made of particles; elements combine in fixed ratios to form compounds; the law of conservation of mass; and different types of bonding (ionic and covalent)
	C-7.2	Pose question, such as — Are there any chemical changes that do not obey the law of conservation of mass?
	C-8.1	Exhibit creativity and work collaboratively in groups to construct simple models of compounds
	C-8.2	- Formulate hypotheses about scientific phenomena by applying prior knowledge and understanding of scientific concepts and laws, and predict the results of data based on the hypotheses - Accurately use scientific instruments, apparatus and chemicals to collect data - Analyse results and findings using scientific terms - Represent data in multiple modes, including appropriate figures, tables, graphs or digital formats - Communicate findings and conclusions effectively, such as those from experiments, activities or projects, both orally and in written form

Earth as a System: Energy, Matter & Life

No. of Periods: 12

Key Concepts		Learning Outcomes
- Earth as interconnected system - Nature of solar energy: solar radiation, electromagnetic spectrum, and speed of light - Solar energy interaction with the Earth's Surface and differential heating of the Earth (the role of the atmosphere and the Earth's surface) - Differential warming of the Earth causes winds	C-2.8	- Explain the interconnectedness between different spheres of the Earth (biosphere, geosphere, hydrosphere, cryosphere and atmosphere) - Explain the nature of solar radiation • Explain that solar radiation is an electromagnetic waves having different Frequencies - Explain how heat from the Sun warms the Earth's surface differently based on the shape, latitude and tilt of the Earth - Explain the interaction of solar radiation with the Earth's surface and relate the differential heating of the Earth's surface with the atmospheric phenomena, such as air movement, evaporation, etc., and describe phenomena like mountain, valley, sea and land breezes

• Biogeochemical cycles (water cycle, carbon cycle, nitrogen cycle, oxygen cycle) • Human impact on Earth's system		• Describe how the latitude and tilt of the Earth, and absorption and reflection of solar radiation by different surfaces cause differential heating of the Earth's surface • Identify various components of the Earth that interact with solar energy • Explain the role of the atmosphere in influencing weather and climate on the Earth • Identify the reflectivity of different materials through reliable scientific sources, such as the internet and books • Describe how elements like carbon, nitrogen, oxygen and water are recycled between biotic and abiotic environments • Explain biogeochemical cycles, and the roles of biogeochemical cycles in circulating matter and energy continuously between the non-living environment (abiotic) and living (biotic) organisms, making nutrients available, and maintaining environmental balance
	C-6.1	• Reflect the changing nature of Earth's environment through our traditional knowledge
	C-7.2	• Pose questions, such as — What will happen if there is no differential heating of the Earth?
	C-8.1	• Draw flow charts, concept maps for biogeochemical cycles, differential heating of the Earth's surface and Electromagnetic spectrum
	C-8.2	• Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of differential heating of the Earth and biogeochemical cycle • Predict the results of an experiment or investigation based on their hypotheses • Communicate findings and conclusions effectively, such as those from experiments, activities or projects, both orally and in written form

Motion**No. of Periods: 13**

Key Concepts		Learning Outcomes
• Motion — displacement, velocity, acceleration • Graphical representation of motion for an object moving in a straight line in one direction (with constant velocity, and constant acceleration) • Kinematic equations for motion in a straight line with constant acceleration (by graphical method) • Elementary idea of uniform circular motion	C-2.1	• Differentiate between distance travelled and displacement, and speed and velocity for objects moving in a straight line • Define displacement, velocity, acceleration, and uniform circular motion • Express displacement, velocity, acceleration in appropriate SI units • Plot and interpret position-time graphs and velocity-time graphs to describe the motion of an object moving in a straight line in one direction (with constant velocity and constant acceleration) • Calculate average velocity from position-time graph, displacement and average acceleration from velocity-time graph • Derive kinematic equations for motion in a straight line with constant acceleration by graphical method • Calculate values of unknown physical quantities from the given physical quantities, using kinematic equations • Derive the expression of speed for uniform circular motion
	C-8.1	• Analyse real-life events and phenomena, and identify the key factors that influence their Behaviour.
	C-8.2	• Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, theories, laws, and principles • Predict about the outcome of an experiment or investigation based on their hypotheses • Identify the variables that are relevant to a scientific investigation and determine how to control or manipulate them • Accurately use scientific instruments and equipment to collect data • Represent data in multiple modes, including tables, graphs and visual representations, and interpret and draw inferences from the data • Communicate their findings using scientific terminology and effectively communicate their conclusions to others

Force and Laws of Motion**No. of Periods: 13**

Key Concepts		Learning Outcomes
• Force; balanced and unbalanced forces • Force of friction • Newton's first law of motion • Newton's second law of motion • Newton's third law of motion	C-2.1	• Explain that force has magnitude as well as direction • Identify situations in which balanced and unbalanced forces are acting on an object • Explain the role of friction on the motion of objects • Recognise that for an object moving with constant velocity, the net force is zero, whereas a change in velocity (acceleration) is caused by a force • State and explain Newton's first law of motion • State and explain Newton's second law in terms of mass and acceleration • Calculate force using mathematical expression of Newton's second law of motion • Define SI unit of force • State and explain Newton's third law of motion • Apply Newton's laws of motion to explain everyday life events
	C-8.1	• Analyse real-life events and phenomena, and identify the key factors that influence their behaviour • Develop a model to represent real-life event • Use models to manipulate variables and predict results
	C-8.2	• Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, theories, laws, and principles • Predict about the outcome of an experiment or investigation based on their hypotheses • Identify the variables that are relevant to a scientific investigation and determine how to control or manipulate them • Accurately use scientific instruments and equipment to collect data • Represent data in multiple modes, including tables, graphs and visual representations, and interpret and draw inferences from the data • Communicate their findings using scientific terminology and effectively communicate their conclusions to others

Work, Energy and Simple Machines**No. of Periods: 13**

Key Concepts		Learning Outcomes
• Concept of work; work done by a constant force • Work-Energy theorem • Mechanical energy, kinetic and potential energy, and conversion between potential energy and kinetic energy • Conservation of energy • Power • Simple machines and their mechanical advantage (pulley, inclined plane, lever)	C-2.5	• Define work done by a constant force and its SI unit • Calculate work done by a force using mathematical expression • State work-energy theorem • Explain the concept of energy and state its SI unit • Name forms of energy and identify their interconversion in surroundings (elementary idea) • Define kinetic energy of a moving object and derive its mathematical expression • Define potential energy for an object raised to a height and derive its mathematical expression • Calculate kinetic and potential energy using mathematical expressions • Explain conversion between potential energy and kinetic energy (for the case of an object under free fall) • State the law of conservation of energy • Define power and its unit • Calculate power using its mathematical expression
	C-2.6	• Identify different simple machines (pulley, inclined plane and lever) • Define mechanical advantage and calculate its value for simple machine • Demonstrate and explain mechanical advantage of simple machines their conclusions to others
	C-8.1	• Analyse real-life events and phenomena, and identify the key factors that influence their behaviour • Develop model to represent real-life event • Use models to manipulate variables and predict results
	C-8.2	• Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, theories, laws, and principles • Predict about the outcome of an experiment or investigation based on their hypotheses • Identify the variables that are relevant to a scientific

		investigation and determine how to control or manipulate them • Accurately use scientific instruments and equipment to collect data • Represent data in multiple modes, including tables, graphs and visual representations, and interpret and draw inferences from the data • Communicate their findings using scientific terminology and effectively communicate their conclusions to others
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Sound

No. of Periods: 11

Key Concepts		Learning Outcomes
• Production of sound • Propagation of sound (as a longitudinal wave through a medium) • Graphical representation of sound wave • Characteristics of sound wave (wavelength, frequency, time period, amplitude, intensity, speed) • Human perception of sound (pitch, loudness) • Propagation of sound in different media (solid, liquid) • Reflection of sound (echo, reverberation), echolocation	C-2.7	• Demonstrate the production of sound in multiple ways (through vibration of strings, membranes, air columns) using materials in surroundings • Explain that sound is produced by vibrations • Demonstrate that sound can travel through different mediums (air, solid and liquid) • Describe that sound needs a medium for propagation • Explain that sound travels as a longitudinal wave • Describe the characteristics of sound waves the (wavelength, frequency, time period, amplitude, intensity and speed) • Analyse graphs representing sound • Write relationship between time period and frequency of sound wave • Derive mathematical expression for speed of sound • Calculate speed of sound using its mathematical expression • Explain human perception of sound in terms of audible range, loudness and pitch of sound • Describe reflection of sound, and apply it to echo and reverberations in surroundings • Explain the use of sound waves for echolocation
	C-5.3	• Describe music in terms of characteristics of sound waves, such as loudness and pitch
	C-6.1	• Name historical buildings designed for echoes, such as whispering gallery of Gol Gumbaz

		• Display awareness about Sir C.V. Raman
	C-8.1	• Analyse real-life events and phenomena, and identify the key factors that influence their behaviour • Develop model to represent real-life event • Use models to manipulate variables and predict results
	C-8.2	• Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, theories, laws, and principles • Predict about the outcome of an experiment or investigation based on their hypotheses • Identify the variables that are relevant to a scientific investigation and determine how to control or manipulate them • Accurately use scientific instruments and equipment to collect data • Represent data in multiple modes, including tables, graphs and visual representations, and interpret and draw inferences from the data • Communicate their findings using scientific terminology and effectively communicate their conclusions to others

Practical will be announced shortly.

Assessment Structure	Marks
Annual Examination (03 hrs.)	80 Marks
Internal Assessment • Periodic Assessment - 05 marks + 05 marks • Subject Enrichment (Practical Work) - 05 marks • Portfolio - 05 marks	20 Marks
Total	100 Marks

PRESCRIBED BOOKS:

- Science-Textbook for class IX-NCERT Publication
- Assessment of Practical Skills in Science-Class IX - CBSE Publication
- Laboratory Manual-Science-Class IX, NCERT Publication
- Exemplar Problems Class IX – NCERT Publication

Social Science
Subject Code-087
Class - IX (2026-27)

RATIONALE

The purpose of the education system is to develop good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and creative imagination, with sound ethical moorings and values. It aims at producing engaged, productive and contributing citizens for building an equitable, inclusive and plural society as envisaged by our Constitution. [NEP 2020, pages 4-5]

Social Science is a compulsory subject at Secondary Stage Phase-I of school education. Social Science can play a unique role within the school curriculum to enable Knowledge, Capacities, and Values and Dispositions that underpin the purpose of education as committed to in NEP 2020.

The teaching and learning of Social Science at the secondary stage is aligned with the transformational vision of the National Curriculum Framework for School Education (NCF-SE) 2023 and the National Education Policy (NEP) 2020. The NCF-SE 2023 emphasises learning, i.e., competency-based, inquiry-oriented, and rooted in Indian Knowledge Systems (IKS) and lived realities. The deliberate reduction of content load with a focus on core concepts rather than memorisation, creates space for discussion, exploration, and deep understanding. The framework's call for interdisciplinarity encourages students to draw meaningful connections across disciplines and relate classroom learning to real-life contexts and experiences.

Furthermore, the NCF-SE 2023 envisions rootedness in India, in which learning is grounded in India's diverse heritage and intellectual traditions, while also being combined with a global outlook. Within this perspective, Social Science education engages students with India's historical experiences, democratic values, and patterns of economic and social development, geographical understanding alongside global processes and contemporary challenges. By integrating the aims of the NEP 2020, Social Science education seeks to transform learning into a process that builds knowledge, capacities, and values essential for personal growth, social harmony and national progress.

Social Science at the secondary stage is an integrated study of human society like its evolution, structures, and dynamics through the disciplines of History, Geography, Political Science, and Economics. It explores how societies function and transform over time through the interplay of historical, geographical, cultural, political, economic, and environmental forces. The subject goes beyond the factual understanding to include inquiry, interpretation, and analysis.

Students learn to source and validate information, interpret data and evidence, and construct logical explanations, thus fostering critical and reflective thinking. It also cultivates empathy, respect for diversity, and a sense of justice and responsibility — values that reflect India's intellectual traditions of reasoning, dialogue, and debate as pathways to truth and understanding.

AIMS & OBJECTIVE

As per NCF- 2023, the aims of teaching Social Science in school education can be summarised as follows:

- a. Develop disciplinary knowledge and understanding of how society functions through an interplay of historical, geographical, social, economic, and political factors.

This can be enabled through:

- i. an understanding of continuity and change in human civilisation, its causation and effect and its impact on modern life.
 - ii. an understanding of the interaction between nature and human beings, the spatial patterns arising out of this interaction and its effect on human life.
 - iii. an awareness and understanding of the diversity of people and their practices in different societies, regions and cultures within societies.
 - iv. an awareness of various social, political and economic institutions, their origin, functioning and transformations over time.
- b. Develop an understanding and appreciation for the methods of enquiry relevant to Social Science and deepen students' skills to engage with the key questions and issues confronting society.

These could be specifically seen as:

- i. Skills in sourcing evidence, interpreting them, checking through multiple sources and evidences and constructing a coherent narrative.
 - ii. Skills in recognizing spatial patterns, map-reading, interpretation and analysis of various interconnected concepts and processes.
 - iii. Skills of creative and analytical thinking to form informed opinions, demonstrate logical decision-making and incline towards a problem- solving attitude.
 - iv. Skills to collect, organize, analyse, represent, and present data and information on various historical, geographical, and socio-political issues.
 - v. Skills to question unsubstantiated ideas, biases, stereotypes, and assumptions to foster scientific temper and propose meaningful responses to contemporary concerns of society.
- c. Foster ethical, human, and Constitutional values:

As the NEP 2020 emphasises to foster a “democratic outlook and commitment to liberty and freedom; equality, justice, and fairness; embracing diversity, plurality, and inclusion; humaneness and fraternal spirit; social responsibility and the spirit of service; ethics of integrity and honesty; scientific temper and commitment to rational and public dialogue; peace; social action through Constitutional means; unity and integrity of the nation, and a true rootedness and pride in India with a forward-looking spirit to continuously improve as a nation.

NOTE-Refer to NCF-2023-Page no-320-323

In alignment with the NEP 2020, Social Science education seeks to develop responsible human beings capable of rational thought and action, possessing compassion, empathy, courage, resilience, scientific temper, and creative imagination — qualities that prepare them to contribute meaningfully to the nation and humanity.

Studying Social Science is essential for developing informed, empathetic, and active citizens. It enables learners to situate themselves within broader social, cultural and environmental contexts, and to recognise their role in shaping them. Through this subject, students understand the origins of democratic values, Constitutional principles, and India's civilisational ethos of unity in diversity. They also develop awareness of pressing issues such as inequality, conflict, environmental degradation and economic challenges, and learn to respond to them with evidence-based reasoning and ethical reflection. Social Science thus, bridges knowledge and action, encouraging learners to think critically about society and participate responsibly and effectively in it.

CURRICULAR GOALS-CG

As per NCF 2023 - At the Secondary Stage, students will go into details to understand India's past and appreciate its complexity, diversity, and unity brought about by cultural integration and the sharing of knowledge traditions across geographical and linguistic boundaries. NCF 2023 Page no -154

- CG-1 Understands and analyses the important phases in Indian history and draws insights to understand present-day India
- CG -2 Analyses the important phases in world history and draw insight to understand the present-day world
- CG-3 Understands the idea of a nation and the emergence of the modern Indian Nation
- CG -4 Develops an understanding of the inter-relationship between human beings and their physical environment and how that influences the livelihoods, cultural diversity, and biodiversity of the region
- CG -5 Understand the Indian Constitution and explores the essence of Indian democracy and the characteristics of a democratic government.
- CG -6 Understand and analyse social, cultural, and political life in India over time – as well as the underlying historical Indian ethos and philosophy of unity in diversity – and recognises challenges faced in these areas in the past and present and the efforts (being) made to address them
- CG -7 Develop an understanding of the inter-relationship between human beings and their physical environment and how that influences the livelihoods, cultural diversity, and biodiversity of the region
- CG -8 Evaluate the economic development of a country in terms of its impact on the lives of its people and nature
- CG-9 Understand and appreciate the contribution of India through history and present times, to the overall field of Social Science, and the disciplines that constitute it

COMPETENCIES

Competencies are specific learning achievements that are observable and can be assessed systematically. In NCF, Competencies are directly derived from a Curricular Goal and are

expected to be attained by the end of a Stage. The following competencies need to be developed in students to achieve the curricular goals at secondary stage.

- CG-1.1 Explains the historical events and processes using different types of sources with specific examples from Indian history
- CG-1.2 Explains and analyses the chronology of human life on the Indian subcontinent, from prehistory to its civilisational beginnings and beyond, and its relations with other civilisations over time, such as those in Mesopotamia, Greece, Central Asia, China, Southeast Asia, Arabia, and Eastern Africa
- CG-1.3 Traces aspects of continuity and change in different phases of history across the Indian subcontinent (including cultural trends, social and religious trends and reforms, and economic and political transformations)
- CG-1.4 Explains the growth of new indigenous ideas across India in Mathematics, Philosophy, Science and Technology, Medicine, Architecture, Agriculture, Literature and Art, and Social Science (such as zero and the Indian number system, *ahimsa*, the six systems of Indian philosophy, Ayurveda, yoga, the 22 *shrutis* of Indian music, horticulture, use of herbs and spices, etymology, meters, and grammar) and how they affected the course of the Indian history
- C-2.1 Explains historical events and processes with different types of sources with specific examples from India and world history.
- C-2.3 Traces aspects of continuity and change in different phases of world history (including cultural trends, social and religious reforms, and economic and political transformations)
- C-2.4 Explains the growth of new ideas and practices across the world (including humanism, mercantilism, industrialisation, scientific developments and explorations, imperialism, colonialism, the rise of the new nation states across the world, and various technologies including the most current) and how they affected the course of world history.
- C-2.5 Recognises the various practices that arose, such as those in C- 2.4, and came to be condemned later on (such as racism, slavery, colonial invasions, conquests, and plunder, genocides, exclusion of women from democratic and other institutions), all of which have also impacted the course of world history and have left unhealed wounds.
- C 3.1 Analyses the meaning of nation and how the concept evolved over time across the world and in the specific context of India, including its roots in the rich civilisational history of the Indian subcontinent
- C3.2 Identifies and analyses important phases of the Indian national freedom struggle against British colonial rule, with special reference to the movement led by Mahatma Gandhi and other important figures as well as those that led to independence, and understands the specific Indian concepts, values, and methods (such as Swaraj, Swadeshi, passive resistance, fight for dharma self- sacrifice, *ahimsa*) that played a part in achieving Independence.
- C-4.1 Locates physiographic regions of India and the climatic zones of the world on a globe/map.
- C-4.2 Explains important geographical concepts, characteristics of key landforms, their origin, and other physical factors of a region
- C-4.3 Draws inter- linkages between various components of the physical environment, such as climate and relief, climate and vegetation, vegetation, and wildlife.
- C-4.4 Analyses and evaluates the inter- relationship between the natural environment and human beings and their cultures across regions and, in the case of India, the special environmental ethos that resulted in practices of nature conservation

- C-4.5 Critically evaluates the impact of human interventions on the environment, including climate change, pollution, shortages of natural resources (particularly water), and loss of biodiversity; identifies practices that have led to these environmental crises and the measures that must be taken to reverse them.
- C-4.6 Develops sensitivity towards the judicious use of natural resources (by individuals, societies, and nations) and suggests measures for their conservation
- C-5.1 Understands that the Indian Constitution draws from the great cultural heritage and common aspirations of the Indian nation, and recalls India's early experiments with democracy (assemblies in *Mahajanapadas*, kingdoms and empires at several levels of the society, guilds *sanghas* and *ganas*, village councils and committees, *Uthiramerur* inscriptions)
- C-5.2 Appreciates fundamental Constitutional values and identify their significance for the prosperity of the Indian nation.
- C-5.3 Explains that fundamental rights are the most basic human rights, and they flourish when people also perform their fundamental duties
- C-5.4 Analyses the basic features of a democracy and democratic government – and its history in India and across the world – and compares this form of government with other forms of government.
- C-5.5- Analyses the critical role of non-state and non-market participants in the functioning of a democratic government and society, such as the media, civil society, socio-religious institutions, and community institutions
- C-6.1 Understands how the Indian ethos and the cultural integration across India did not attempt uniformity, but respected and promoted a rich diversity in Indian society, and how this harmonisation and unity in diversity, with a historical respect for all cultures, women have counted among India's great strengths by promoting peaceful coexistence
- C-6.2 Understands that despite C-6.1, forms of inequality, injustice, and discrimination have occurred in different sections of society at different times (due to internal as well as outside forces such as colonisation), leading to political, social, and cultural efforts, struggles, movements, and mechanisms at various levels towards equity, inclusion, justice, and harmony, with varying outcomes and degrees of success.
- C 6.3 Analyses aspects of differential treatment or discrimination that may exist in the Indian society, based on, socio-cultural background, region, language spoken, and what individuals and societies can do to eradicate such differential treatment
- C 6.4 Understands that a progressive society and nation, such as India is one that recognises not only its civilisational strengths but also its socio-economic, cultural and political challenges, and continuously makes efforts to address those challenges to become ever more prosperous, inclusive, just, and harmonious
- C-7.1 Defines key features of the economy, such as, production, distribution, demand, supply, trade, and commerce, and factors that influence these aspects (including technology)
- C-7.2 Evaluates the importance of the three sectors of production (primary, secondary, and tertiary) in any country's economy, especially India
- C-7.3 Distinguishes between 'unorganised' and 'organised' sectors of the economy and their role in production for the local market in small, medium, and large-scale production centres (industries), and recognises the special importance of the so-called 'unorganised' sector in

Indian economy and its connections with the self-organising features of Indian society

- C-7.4 Traces the beginning and importance of large- scale trade and commerce (including e- commerce) between one country and another - the key items of trade in the beginning, and the changes from time to time.
- C-8.1 Gathers, comprehends and analyses data related to income, capital, poverty, and employment in one's locality, region and at the national level. Markets.
- C- 8.2 Understands and analyses the concepts and practices of the range of economic systems — from free market to entirely state-controlled markets.
- C-8.3 Understands these features in the context of ancient India, with its thriving trade, both internal and external, and its well- established trade practices and networks, business conventions, and diverse industries, all of which made India one of the world's leading economies up to the colonial period
- C-8.4 Describes India's recent path towards again becoming one of the three largest economies of the world, and how individuals can contribute to this economic progress.
- C-8.5 Appreciates the connections between economic development and the environment, and the broader indicators of societal wellbeing beyond GDP growth and income.
- C – 9.1 Knows and explains the significant contributions of India to all matters (concepts, explanations, methods) studied within the curriculum, in an integrated manner

Pedagogy for teaching geography should integrate experiential, visual, and analytical approaches to make learning more meaningful and connected to the real world. Effective geography teaching goes beyond textbooks- it involves helping students observe, analyse, and interpret the Earth's surface and human-environment relationships. The use of three-dimensional models enables students to visualise complex geographical processes, such as mountain formation, river systems, and soil profiles, thus making abstract concepts tangible. Field observation is an essential pedagogical tool that promotes experiential learning; by directly engaging with local landscapes, students develop geographical inquiry skills, observation techniques, and data collection abilities. Incorporating Bhuvan images, India's indigenous satellite imagery and mapping platform allow learners to explore their own regions using real-time geospatial data and satellite views, linking classroom knowledge to local realities. Map reading is another fundamental component, as it cultivates spatial awareness, orientation, and the ability to interpret symbols, scales, and coordinates. Likewise, photo interpretation — analysing aerial and satellite photographs — helps students understand the land-use patterns, vegetation cover, urbanisation, and environmental changes. When combined, these methods foster critical thinking, spatial reasoning, and a deeper appreciation of the dynamic Earth systems that geography seeks to explain.

For understanding the past and India's rich heritage, teachers are expected to engage students in the following ways. Firstly, they are expected to analyse inscriptions or edicts (for example, Ashoka's edicts, and Gupta records) to understand how rulers communicated policies, messages, and ethical guidelines to their subjects. Secondly, they are to encourage students to read excerpts or chapters from Indian literary sources that throw light on the social, cultural, and political life of people. Thirdly, they are expected to conduct research and present examples of forts, temples, mosques, and palaces to illustrate cultural, architectural, and political developments in the Indian history. Finally, the teachers should explore and discuss the works of artists and philosophers of the Renaissance period, highlighting their contributions and influence.

Students should be made to locate the extent of various important empires on a world map. They are also expected to investigate and explain the key Indian ideas that shaped the thinking of Western philosophers, scientists, and artists. Finally, students should be encouraged to use a world map to trace India's trade and cultural exchanges with other civilisations, and analyse their patterns and impact.

Transaction of political concepts requires connecting students with evidence, inquiry, and real-world reasoning. Document-based inquiry helps learners explore authentic sources, such as Vedic texts, constitutional excerpts, and letters from national leaders to interpret historical contexts and moral reasoning. Case-based pedagogy, using landmark judgments, maps, and data analysis, builds decision-making and analytical skills, encouraging students to apply theory to practice. Evidence-based learning engages learners with real datasets from Census, NITI Aayog, or UNDP reports to develop data literacy and link concepts like equality and representation with measurable realities. Further, multimedia and experiential approaches use podcasts, documentaries, and archival materials to connect abstract political ideas with real experiences, sharpening students' interpretive and critical listening skills. Visual and graphic organiser-based pedagogy-through charts, tables, and concept maps — supports comprehension, memory, and summarisation by converting complex ideas into structured visuals. Together, these pedagogies transform classrooms into laboratories of civic thinking, empathy, and inquiry. They nurture students as reflective citizens who can interpret evidence, question assumptions, and engage meaningfully with India's democratic processes.

The pedagogy for teaching Economics needs to be interactive, experiential, and inquiry-driven, enabling students to relate economic concepts to real-life situations. Teachers can use role-play activities — such as running a lemonade stall or simulating the circular flow of income with students acting as households, firms, banks, and the government to make ideas like production, income, and expenditure tangible. Class discussions on familiar issues, such as rising vegetable prices during monsoons, help students link classroom learning with everyday experiences and develop critical thinking. Engaging classroom activities and games, like preparing a classroom budget, allow students to understand scarcity, choice, and opportunity cost in a fun and participatory way. The use of visual tools — including maps, pie charts, and graphs — can help students analyse data on GDP, trade, and sectoral trends. The case studies on topics like pollution as an externality, public goods like street lights, or successful entrepreneurs encourage application and deeper reflection. Surveys and field visits to local shopkeepers or MSMEs further bridge theory and practice by exposing students to real market dynamics. Incorporating current resources, such as newspaper articles or the Union Budget fosters analytical skills and awareness of contemporary economic issues. Through this diverse, hands-on approach, learners will move beyond memorisation to active understanding, making Economics relevant, engaging, and empowering

COURSE OUTLINE

Class IX-2026-27

Part 1

S. No.	Theme (time allocation in instructional hours)	Outline/Concepts	Learning Outcomes and Competencies Students will be able to:
1.	Understanding Social Science (4 Hours)	• Meaning, scope and relevance of Social Science • Understanding Social Science from an Indian perspective	• Explain the relevance of studying Social Science to understand society, environment, economy, and governance in our lives. • Explain the meaning and scope of Geography, History, Political Science, and Economics as disciplines and recognise their interconnections. • Appreciate diversity, inclusivity, sustainability, and equity as guiding values when studying society and making decisions.
2.	Shaping of the Earth's Surface (8 Hours)	• Theory of plate tectonics • Interior of the Earth • Role of weathering and erosion; agents of gradation — river, waves and currents, wind, glaciers, and underground water • Landforms and disasters: earthquakes, landslides, avalanches, Glacial Lake Outburst Flood (GLOF) and duststorms	C4.2 • Describe the concept of plate tectonics and analyse its relevance in understanding Earth's dynamics. • Locate major tectonic plates on a world map. • Explain processes of weathering and erosion with suitable examples. • Identify the prominent agents of gradation operating in a given region. • Describe major landforms and explain the processes involved in their formation. • Explain the causes of natural disasters and propose strategies for their mitigation.
3.	Atmosphere and Climate (7 Hours)	• Structure and composition; elements of weather and climate • Seasons of India and monsoons • Climate change • Floods • Carbon footprint	C4.3, C4.4, C4.5 • Explain the different atmospheric layers and represent them using sketches and diagrams. • Observe and analyse local winds and their impact. • Understand the impact of the Indian monsoon on life, agriculture, and livelihoods across different regions.

			• Explain the causes and effects of climate change. • Represent climatic data (temperature, rainfall, etc.) through appropriate graphs, charts, or diagrams. • Analyse how climate change influences the frequency and intensity of natural disasters.
4.	Early Humans and Beginning of Civilisation (9 Hours)	• Cultural development from 2 million years ago • Early human history, periodisation: Archaeological ages • Who are human ancestors? • Palaeolithic hunter-gatherers and use of stone tools	C1.2, C2.1, C2.2, C2.3 • Describe how prehistoric time divisions are organised. • Explain how humans lived before the invention of writing • Understand the beginning of the settled life with development of agriculture, and domestication of plants and animals. • Explore the factors of urban development and transformation through time.
		• Mesolithic transition to food production: Mesolithic sites and tools • Neolithic and the beginning of farming: Neolithic revolution domestication of plants and animals • Harappan and contemporary cultures • Mesopotamian, egyptian, and chinese civilisation	• Appreciate the diversity of crafts and trade, and their role the establishment of prosperous economy. • Understand the diversity of food habits. • Describe the social, political, and religious structures of the civilisations of Egypt and Mesopotamia.
5.	State and Society (upto 1000 CE) (9 Hours)	• Vedic Age — geography; texts; rituals; political institutions, and social order • Administrative structure of early empires • Quest for knowledge — educational heritage, institutions, knowledge traditions, and cultural practices	C1.3, C2.3, C3.1, C1.4 • Explain various facets of Vedic society and polity. • Appreciate the achievements of Indian empires and their cultural legacy. • Understand the knowledge traditions and practices of India. • Understand the foundations of the Indian social and political institutions and their continuity.

		• Traders and trade routes, guilds and merchants, crafts and industries	
6.	Democracy (9 Hours)	• Meaning features and types of democracy • Roots of democracy in India • Challenges to democracy in India • Democratic systems in the world	C5.1, C5.2 • Understand the features of democracy. • Appreciate early democratic traditions in India and how they influenced modern democracy. • Differentiate between parliamentary and presidential systems. • Identify examples of both systems across countries, such as India, USA, France, Russia, and Canada.
7.	Elections (9 Hours)	• Factors of importance of elections • Electoral systems • Delimitation Commission • Election Commission of India and its role • Constituency, electoral rolls, enumerators • Party system in India	C5.2, C5.3, C5.4, C5.5, C6.2, C6.3, C6.4, C9.1 • Identify factors highlighting importance of elections in a democracy. • Categorise three types of electoral systems and list examples. • Identify the major laws that govern the conduct of elections in India. • Describe the main provisions of the Representation of the People Acts. • Define the concept of delimitation and its purpose in the Indian electoral system. • Identify the role and functions Election Commission of India (ECI) in the electoral process. • Explain constituency, electoral roll, enumerator. • Understand the party system in India. • Explain the meaning and features of a coalition government in the Indian political system. Explain key provisions of the Anti-Defection Law with reference to political instability and the need for anti-defection measures.
8.	Building Blocks in Economics (7 Hours)	• Scarcity of resources, opportunity cost and the need for making choice. What do economists do?	C8.2 • Explain the meaning of scarcity, choice, and opportunity cost in everyday life, and economic decision-making. • Describe what economists do and how they study production, distribution, and consumption of goods and services.

		• What to produce, how to produce, and for whom to produce? • Difference between market, centrally planned, and mixed economic systems • Welfare economy	• Recognise how economic analysis helps in policy-making and solving real-world issues. • Describe the three central problems of an economy — what to produce, how to produce, and for whom to produce. • Identify and differentiate the characteristics of planned, free market, and mixed economic systems. • Explain the concept of a welfare economy and the importance of social safety nets.
9.	The Price Puzzle: What Drives the Market (8 Hours)	• Laws of demand and supply • Real-world deviations from textbook theory, such as in case of necessities, luxury goods, perishable items, and expectations • Some related concepts — price ceilings and market failures (externalities, information asymmetry, public goods)	C7.1 • Explain the Law of Demand and Law of Supply with the help of real life examples. • Interpret how changes in price affect the quantity demanded and quantity supplied of goods and services. • Identify the equilibrium price and quantity where demand and supply intersect. • Analyse how changes in market conditions (e.g., increase in demand or supply) lead to surplus or shortage and affect equilibrium. • Explain the concept of price ceilings and how they can lead to shortages or black markets. • Understand market failures and identify their main types. • Understand public goods (non-excludable and non-rival goods like parks or street lighting).

Part 2

S. No.	Theme (time allocation instructional hours)	Outline/Concepts	Learning Outcomes (pertinent) CGs, Cs Students will be able to:
1.	Oceans and Life (7 Hours)	• Introduction to ocean relief, movement of ocean water- waves, tides and currents • Marine resources and their significance; open seas, navigation fishing, and livelihood concerns and challenges • Cyclones and	C4.1, C4.2 • Explain the movement of ocean waters, including waves, tides, and currents. • Analyse the connections between ocean currents, and global and regional climate patterns. • Understand the importance of marine resources for human livelihoods and ecosystems. • Examine the relationship between oceans, climate, livelihoods, and natural disasters. • Highlight key rules, conventions, and

		Tsunamis — early warning systems • International maritime rules and regulations	international agreements governing ocean navigation. and the use of marine resources. • Explain the need for international cooperation and agreements in the sustainable use of ocean resources. • Construct models or sketches representing ocean relief.
2.	Life on Earth (7 Hours)	• Biomes: Distribution and characteristics; biosphere reserves in India • Forest and ecotourism; forest dwellers, their livelihoods, and challenges • Forest and wildlife conservation • Government efforts to support forest dwellers	C4.3, C4.4, C4.5, C4.6 • Identify the major biomes of the world and describe their key climatic conditions, characteristic flora, and fauna. • Locate biosphere reserves on the map of India. • Appreciate local traditional practices related to biodiversity conservation and analyse their effects. • Explain the concept and importance of biosphere reserves in conserving ecosystems and biodiversity. • Analyse the concept of ecotourism and discuss its role in promoting sustainable forest ecosystem and conservation. • Investigate the causes of forest fires in the local area, and prepare a plan for mitigation and prevention.
3.	Resistance and Resilience (1000 CE – 1700 CE) (9 Hours)	• Safeguarding sovereignty: resistance, alliances and confederacies • Development of art and architecture, languages and literature • The Bhakti tradition • Forts and fortifications • Expansion of Indian economy and state	C1.3, C1.4, C3.1 • Explain the cultural, political, and military contributions of regional kingdoms in India. • Appreciate how diverse communities and regions shaped India's history from 1000 CE to 1700 CE. • Explore how regional kingdoms adapted to changing political, economic, and cultural contexts over time. • Analyse the continuity of the civilisational history of India as a nation upto 18th century CE.
4.	India and the World-I (1900 BCE- 1200 CE) (8 Hours)	• Trade and commerce — trade with Mesopotamia, Greece, Roman Empire, China and Southeast Asia • Cultural Connections — Interactions with Greece and Rome, Central Asia, China, and Influence on South East Asia	C1.2, C1.4, C6.1, C2.3, C9.1 • Explore India's relations with early civilisations of the world. • Identify the major articles of trade and the major trading ports. • Appreciate the significant contributions of India in diverse spheres in an integrated manner. • Appreciate the influence of Indian religion and culture, particularly in Southeast Asia.

		Indian Knowledge Systems — Medicine, Mathematics and Astronomy, Medicine, Religion	
5.	Authority (10 Hours)	- The Roots of Authority: in Kautilya and <i>shukraniti</i>- <i>danda</i> and relationship with <i>nyaya</i> and <i>bala</i>; the types of <i>nyaya</i> and <i>bala</i> - Constitutional status of justice and security since ancient times - Links the role of citizens with the elections and the democratic institutions - Types of authority — functional, sensitive, and welfare-oriented	C5.1, C5.2, C 5.3 - Explain the roots of authority in Indian political thought. - Interpret the relationship between <i>Danda</i> (discipline/ force) and <i>Nyaya</i> (justice) as the twin foundations of authority, development, and security. - Trace the evolution of authority structures in India. - Understand the post-independence concept of justice and security. - Illustrate types of authority. - Develop an understanding of citizen discipline, justice, and strength. - Illustrate the role of citizens in authority.
6.	From Ideas to Startups (8 Hours)	- What is entrepreneurship and explain the resources required to start a business - Case studies of successful entrepreneurs - Creative destruction with examples - Start-up ecosystem in India. - Make in India initiative, role of MSMEs and the unorganised sector in India's economic growth. - Stages of starting and executing a business idea through a business plan - Some basic accounting concepts	C7.3 - Define entrepreneurship and explain its importance in innovation, job creation, and economic growth. - Understand the key resources for business. - Explain how resources are managed to produce goods and services. - Analyse real-world examples of successful entrepreneurs. - Describe the features of India's start-up ecosystem and initiatives like Make in India, Startup India, and Digital India. - Recognise the role of Micro, Small, and Medium Enterprises (MSMEs) and the unorganised sector in promoting employment, innovation, and inclusive growth. - Identify and explain the stages of starting a business from developing an idea to creating and executing a business plan. - Understand simple profit and loss. Identify the key components of a balance.

7.	Smart Ways to Manage Your Finances (6 Hours)	• Relevance of personal financial management in daily life • Inflation and its impact on purchasing power • Simple vs. compound interest rate • Budgeting • Various savings and investment options like fixed deposit, stocks, bonds, mutual funds, etc. • Risk and insurance • Personal income tax	CG8 • Explain what personal financial management means and why it is essential in everyday life. • Recognise how managing income, spending, saving, and investment helps achieve financial stability and long-term goals. • Explain the difference between simple interest and compound interest. • Prepare a simple personal or family budget showing income, expenditure, and savings. • Identify various savings and investment instruments. • Understand the relationship between risk and return in different investment types. • Understand the concept of income tax and why citizens are required to pay it.
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Note-Course Structure will be provided shortly

CLASS IX (2025-26)
INTERNAL ASSESSMENT: 20 MARKS

Type of Assessment	Description	Marks
Periodic Assessment	Pen Paper Test	5
Multiple Assessment	Quiz, debate, role play, viva-voce, group discussion, visual expression, interactive bulletin boards, gallery walks, exit cards, concept maps, peer assessment, self- assessment etc. through interdisciplinary project , Report Writing on field visits, Commentaries/visual interpretations, site-map making	5
Subject Enrichment Activity	Project work (Interdisciplinary)	5
Portfolio	Classroom, work done (activities/assignments) reflections, narrations, journals etc. Achievements of the student in the subject throughout the year. Participation of the student in different activities like Heritage India quiz etc.	5

CLASS IX
PRESCRIBED TEXT BOOKS

S. No.	Name of the Book	Publisher
1	Social Science-Part 1	NCERT
2	Social Science-Part 2	NCERT

Vocational Education

Vocational Education at the secondary stage introduces learners to work-centered knowledge, skills, and values linked to local contexts, livelihoods, and emerging economic opportunities.

The content includes awareness of vocational domains, foundational technical skills, safe work practices, and appreciation of the dignity of labour.

Pedagogy is experiential and activity-oriented, involving hands-on tasks, community linkages, observation of work processes, and reflective engagement with real-world situations.

Assessment is based on performance in tasks, application of skills, problem-solving, collaboration, and responsible work behaviour, with emphasis on authenticity and relevance.

Framework for Learning in Vocational Education

The Three Forms of Work

Vocations that share fundamentally common elements — requiring similar or overlapping capacities and knowledge — are grouped into the same Form of Work. This grouping enables the development of a broad base of transferable capacities while allowing schools to select locally relevant vocations.

Work with Life Forms	Work with Machines & Materials	Work in Human Services
Developing capacities to do productive work that involves plants and animals. Examples: ◦ Crop cultivation ◦ Rooftop gardening ◦ Mushroom cultivation ◦ Aquaponics / Aquaculture ◦ Precision farming ◦ Backyard poultry	Designing, making, or modifying products using materials (including waste) and machines. Examples: ◦ Apparel and fashion ◦ Construction ◦ Food processing ◦ Furniture making ◦ Plumbing ◦ Handicrafts	Interaction with people to understand their needs and requirements; developing capacities to communicate well. Examples: ◦ Community health services ◦ Hospitality / Tourism ◦ Event management ◦ Interior design ◦ Data-based services ◦ Public information services

Progression of Vocational Education through the School Stages

The design in the middle stage is such that students gain exposure to a wide range of vocations through a set of nine projects, across the forms of work in Grades 6, 7 and 8, respectively. Time allocation for Vocational Education in the middle stage, as per the NCF-SE 2023, is **110 hours per year, totaling to 330 hours across the three years.**

In the Secondary Stage, **Phase 1, students engage more deeply with six vocational areas, one from each form of work in Grades 9 and 10, respectively.**

The focus in all stages is authentic work, which means that:

- students must be able to get a hands-on practice of work in real-life situations (e.g., actual serving of guests in a canteen or event as opposed to a role-play);*
- their work must lead to productive outcomes, and*
- they must do work from end-to-end (for the life cycle of life form or product or end-to-end service).*

Nature of Knowledge in Vocational Education

In the context of Vocational Education, the NCF-SE 2023 places capacities at the core of vocational knowledge. These capacities are procedural — 'know-how' — in nature and intended to accomplish specific tasks. This procedural knowledge enables further work-focused tasks, both in the world of work and in daily life.

Type of Knowledge	Description	Examples
Procedural Knowledge ('Know-How')	Capacities and skills to perform specific tasks. Forms the core of vocational knowledge.	Pipe installation, seed sowing, client interviewing, prototype making, data entry
Conceptual Knowledge ('Know-That')	Knowledge from other curricular areas that supports and deepens vocational understanding.	Soil chemistry (Science), cost estimation (Mathematics), record-keeping (Language)
Knowledge of the World of Work	Understanding norms, guidelines, markets, safety protocols, and the ecosystem of work.	Rules and regulations, transportation logistics, safety norms, market linkages
Values and Dispositions	Attitudes and behaviours essential to productive work, common across all vocations.	Attention to detail, persistence, curiosity, empathy, teamwork, dignity of labour
Cross-cutting Competencies	Competencies that are common across all kinds of work and demonstrated in practice.	Environmental literacy, use of technology, financial literacy, rootedness in India

Aims of Vocational Education

In alignment with the aims of school education, the aims of Vocational Education are:

- **Developing and understanding the basic capacities for different forms of work:** Students will develop a broad-based understanding of different forms of work, which will equip them to successfully manage their personal affairs. This will also equip them to identify, create, and initiate business, work and community opportunities.
- **Preparation for specific vocations:** Students will develop capacities to be gainfully employed in one or more specific vocations after leaving school.
- **Respect for the dignity of labour and all vocations:** Students will develop respect for the dignity of labour through the acquisition of positive attitudes towards work and the workplace.
- **Developing values and dispositions related to work:** Students will develop persistence and focus, curiosity and creativity, empathy and sensitivity, and collaboration and teamwork. They will be willing to do physical work and will pay keen attention to details.

Through these aims, schools will develop vocational knowledge, capacities, and dispositions in students, giving them livelihood opportunities, as well as enabling them to contribute and participate in the economy of the country. NCF-SE 2023 emphasizes the importance of cross-curricular linkages between Vocational Education and conceptual knowledge developed in other curricular areas. Students will progress from the broad-based exposure to a range of vocations in the middle stage to a more in-depth exposure to six vocations over two years.

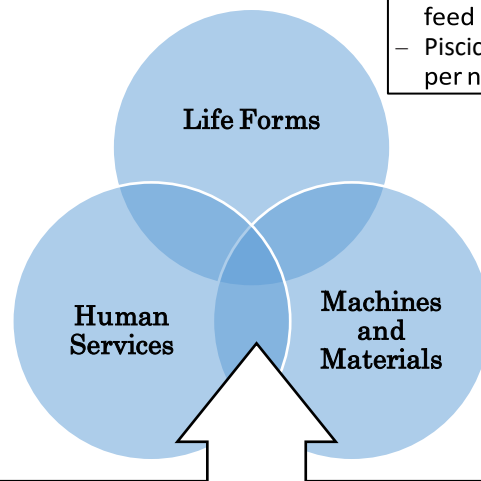
Artificial Intelligence:

Artificial intelligence (AI) will be integrated into the syllabus in two ways:

- i) First, reference will be provided for the use of AI while developing content related to vocations. For example, if discussing agricultural practices, the use of apps for identification and management of pests and diseases will be included. Similarly, when discussing apparel making, the use of AI for creating 3D models will be included.
- ii) Second, vocations related to AI or those heavily dependent on AI will be introduced. For example, precision farming, AI and data science, and mechatronics.

Human Services: Communicate important information

- Tourism: Provides details of reservation, responds to special requests, and provides emergency contact in brochure with costs
- Event management: Monitors facilities available, schedule for preparation with timelines, plans options with costs
- Interior design: Provides options through annotated diagrams, mood board, layouts with costs



Life Forms: Support growth and development of life forms through water and food

- Precision farming: Follows watering and fertilization schedule based on precise needs
- Backyard poultry: Provides exact amount of feed and water as per needs
- Pisciculture: Provides exact amount of feed as per needs

Machines and Materials: Creates prototype or sample to scale

- Construction: Creates measurement, design, drawing to scale, making a small sample with recycled materials
- Fashion: Creates measurement, design, drawing, making a pattern with recycled materials
- Furniture: Creates measurement, design, drawing to scale, making a small sample with recycled materials

Across Forms of Work: Create and maintain systematic record of processes, tools and materials. It is applicable across automobile repair (parts, specification, maintenance schedules), pest management (date, time, amount, impact on environment), and elderly care (daily log of parameters,

Transferability within and across forms of work

Learning Standards

In the Secondary Stage, Grades 9–10, there are three curricular goals for each form of work. Each curricular goal deals with an overarching component:

- **CG-1 involves the use of knowledge and skills in the work.**
- **CG-2 involves the values inculcated while working (since they are not always measurable, they need to be observed in students' practices).**
- **CG-3 involves the application of knowledge and skills in home-based tasks.**

The following are the curricular goals and competencies to be developed for any form of work:

- ❖ **CG-1 Develops in-depth basic skills and allied knowledge of work and their associated materials/procedures.**
 - C-1.1 Perform procedures competently through required tools/equipment.
 - C-1.2 Differentiates between effective and non-effective practices in completing the task.
- ❖ **CG-2 Develops essential values while working in a specific vocation.**
 - C-2.1 Develops the following values while engaging in work:
 - Attention to detail
 - Persistence and focus
 - Curiosity and creativity
 - Empathy and sensitivity
 - Collaboration and teamwork
 - Willingness to do physical work
- ❖ **CG-3 Develops basic skills and allied knowledge to run and contribute to the home.**
 - C-3.1 Applies the acquired vocational skills and knowledge in a home setting.

Details of Syllabus

The curricular goal, competency and learning outcomes related to values and dispositions will be foundational, and will apply across the entire content and tasks related to the work assigned for students. Therefore, the learning outcomes for CG-2, which relates to values and dispositions, are indicated at the beginning of the tables mapping competencies and learning outcomes for Grades 9 and 10 below.

Grade 9

The curricular goal, competency and learning outcomes related to the development of values and dispositions will be common across all forms of work. Since these Learning Outcomes are foundational, no specific content is mapped to them.

For All Forms of Work

CG-2 Develops essential values or disposition while working across areas	
Competency	Learning Outcomes
C-2.1 Develops the following values while engaging in work • Attention to detail • Persistence and focus • Curiosity and creativity • Empathy and sensitivity • Collaboration and teamwork • Willingness to do physical work • Respect for the value of money	Students will be able to: • Keenly observe the usage of tools and materials during demonstration and asks relevant questions • Show care and respect towards people doing physical labour, irrespective of gender • Plan tasks with peers and helps others during difficulty at work • Rework or redo task for improved efficiency • Ask questions about functioning of tools and machines, and give suggestions for alternative use • Show willingness to do physical work, while enjoying working with tools and materials • Use resources judiciously • Describe life cycle cost
While the curricular goals and competencies will remain the same, the learning outcomes will be different for each form of work, to cater for the nature of each form.	

Work with Life Forms

The table below maps learning outcomes and content against the competencies for work with life forms in Grade 9. These are articulated in generic terms, so that they can be fulfilled through vocations that the state, board or schools may choose.

Themes	Theme Outlines/ Key Concepts	Learning Outcomes
Introduction to Vocational Area (Suggestive Instructional hours: 10 hours)	• Understanding the vocational area — contribution, livelihood ecosystems, value chains, employment opportunities • Conditions for plant growth	Students will be able to: CG-1, C-1.1 • Describe the relevance of the vocation — with reference to society, nation and the world • Explore different sources of information and

Themes	Theme Outlines/ Key Concepts	Learning Outcomes
	- under different geographical conditions - Using meteorological data from a DIY observatory - Testing input materials and making amendments - Quality criteria - Selection of work on the basis of guidelines	- map resources to identify work assigned - Test suitability of growing medium, using appropriate tools and materials for physical observation and chemical testing (including technology or AI, if possible), and makes amendments where relevant - Use meteorological data to take decisions related to work C-1.2 - Describe quality criteria related to inputs, process and output
Vocation-specific themes (Suggestive Instructional hours: 26 hours)	- Site visit - Developing process chart - Tools and materials: use, storage, safety protocols - Preparation of soil or growing medium, or shelter (as relevant) - Layout of space or shelter - Initiating and nurturing growth - Using nutrient supplement - Protection: pest control, managing disease, physical protection - Meeting water requirements - Harvesting: tools and processes - Layout of space for growing plants - Monitoring and supporting growth - Maintaining records related to costs, and growth and development - Safety protocols related to handling tools and performing tasks - Segregation and disposal of waste - Applying learning - outside school setting	Students will be able to: CG-1, C-1.1 - Develop a process chart based on observation and interaction with experts, and plan to monitor work against milestones - Create and maintain conditions essential for growth and development of plants or animals, based on geographical conditions and local criteria, using appropriate tools and materials (including technology, if possible) - Prepare growing medium as per needs of the plant or animal, using appropriate tools and materials - Initiate growth of plant or animal (e.g., plants seeds, saplings, tubers; introduces spawn to water) as per requirements, using appropriate tools and materials - Set up a simple system for irrigation or providing water (using technology, if possible) as per schedule - Take steps to support development of plants — monitor growth by physical observation and using technology, if possible; provide nutrients and protection from physical harm, pests and diseases using appropriate tools and materials - Harvest, store and package produce using appropriate tools and materials - Maintain records of costing (inputs and cost of 'soft' services including time, human resource, etc.) and expenditure C-1.2. - Explore traditional and indigenous materials and methods

Themes	Theme Outlines/ Key Concepts	Learning Outcomes
		• Use technology or AI where relevant to optimize work • Apply safety protocols (including cyber safety) as prescribed for tools and materials • Reflect on improvements to optimise processes and use tools and materials • Dispose waste (e.g., crop stubble, leftover growing media) in an environment friendly manner CG-3, C-3.1 • Explain how learnings can be applied outside the school

Work with Machines and Materials

The table below maps learning outcomes and content against the competencies for work with machines and materials in Grade 9. These are articulated in generic terms, so that they can be fulfilled through vocations the state/board/schools may choose

Theme	Theme Outlines/ Key Concepts	Learning Outcomes
Introduction to Vocational Area (Suggestive Instructional Hours: 10)	• Understanding the vocational area contribution, livelihood ecosystems, value chains, and employment opportunities • Properties of materials (wood, plastic, metal, clay, leather, etc.) • Introduction to technical or engineering drawing • Measurement based on technical or engineering drawing • Selection of materials and products to be developed based on the guidelines (including properties of materials) • Selection of work on the basis of guidelines • Quality criteria	CG-1, C-1.1 Students will be able to: • Describe the relevance of the vocation with reference to society, nation, and the world • Explore different sources of information and map resources to identify work to be done • Determine products to be created based on the properties and availability of materials • Demonstrate the basics of technical or engineering drawing • Demonstrate measurement based on technical or engineering drawing C-1.2 • Describe the quality criteria related to inputs, process, and output

Theme	Theme Outlines/ Key Concepts	Learning Outcomes
Vocation-specific themes (Suggestive Instructional Hours: 26)	• Site visit • Developing process chart • Tools and materials: use, storage, and safety protocols • Developing and refining prototypes or practising on a small sample • Estimation of requirements of materials • Testing product and making improvements • Finishing and packing (where relevant) the product • Maintaining records related to costs, and growth and development • Safety protocols related to handling tools and performing tasks • Segregation and disposal of waste • Applying learning outside the school setting	CG-1, C-1.1 Students will be able to: • Develop a process chart based on observation and interaction with experts, and plan to monitor work against milestones • Create a detailed 2D sketch of the selected product indicating its design and dimensions, using technology where relevant • Estimate quantities of materials required, using appropriate tools, based on the 2D sketch • Develop, review and refine a prototype using alternative or waste materials or carry out a small part of the work • Follow guidelines and protocols to create the final product • Incorporate changes, as required, in the product based on testing and feedback • Finish and package the product to ensure it is usable and presentable • Maintain records of costing (inputs and cost of 'soft' services including time, manpower, etc.) and expenditure C-1.2 • Demonstrate optimal usage of tools and material (e.g., reusing waste wood, using waste for packaging) • Demonstrate effective and efficient use of tools (e.g., holding, using, etc.) • Use technology or AI where relevant to optimise work • Apply safety protocols (including cyber safety) to each task, while ensuring the safety of self and others • Dispose waste as per protocols and environmental considerations CG-3, C-3.1 • Explain how learnings can be applied outside school

Work in Human Services

The table below maps learning outcomes and content against the competencies for work in human services in Grade 9. These are articulated in generic terms, so that they can be fulfilled through vocations the state/board/schools may choose.

Theme	Theme Outlines/ Key Concepts	Learning Outcomes
Introduction to Vocational Area (Suggestive Instructional Hours: 10)	- Understanding the vocational area contribution, livelihood ecosystems, value chains, and employment opportunities - Understanding the vocational area contribution, livelihood ecosystems, value chains, employment opportunities - Suitable environment - Sensitive and empathetic communication with the person(s) to whom service is to be provided - Selecting work on the basis of guidelines - Quality criteria	CG-1, C-1.1 Students will be able to: - Describe the relevance of the vocation with reference to society, nation, and the world - Explore different sources of information and map resources to identify the work to be done - Demonstrate an understanding of the setting up of a service environment - Demonstrate an understanding of a service mindset C-1.2 - Describe the quality criteria related to inputs, process and output based on observation and expert interaction
Vocation-specific themes (Suggestive Instructional Hours: 26)	- Site visit - Developing process chart - Tools and materials: use, storage, and safety protocols - Processes of needs identification, including tools used for understanding needs of person(s) to whom service is to be provided (e.g., questionnaire, checklist, etc.) - Designing solutions to meet the needs of the person(s) to whom service is to be provided - Tools used for providing service (e.g., thermometer, blood pressure machine, reading health records and prescriptions, tools for personal hygiene, and tools for maintaining hygienic surroundings) - Costs and billing for services	CG-1, C-1.1 Students will be able to: - Prepare a process chart outlining the key elements of the service to be provided to monitor the work against milestone - Identify the needs of the person(s) for whom service is to be provided through different ways (e.g., questionnaire, interview, etc.) - Reflect on the possible challenges while providing service and possible actions to counter them - Arrange the physical environment as per the comfort of the person(s) to whom service is to be provided - Prepare and finalise a contract for providing service - Establish the norms for communication during service, including active and empathetic listening - Create polite, respectful and responsive environment in the context of the service

Theme	Theme Outlines/ Key Concepts	Learning Outcomes
	- Process of review of the service provided - Method of documentation for feedback and reflection - Safety protocols related to sensitivity and confidentiality - Segregation and disposal of waste - Service provided by family and community - Providing service outside the school	to be provided - Maintain the records of costing (inputs and cost of 'soft' services including time, manpower, etc.) and expenditure - Track progress against process chart C-1.2 - Use technology or AI where relevant to optimise work - Follow safety protocols as indicated by the expert or teacher (including cyber safety and confidentiality) - Follow protocol for waste disposal where relevant CG-3, C-3.1 - Identify elements of the service received at home, based on learning - Explain how learnings are applied to provide service at home

Pedagogy or Instructional Methods

The NCF-SE 2023 emphasises the role of 'doing' in Vocational Education. Knowledge, capacities, and values are developed through consistent practice and on-site exposure. The pedagogical approach for Grades 9 and 10 must align with real life — students must be provided opportunities to learn through real-life work contexts.

- Emphasise “learning by doing” through hands-on, real-life work experiences with a clear focus on productive outcomes and on-site exposure.
- Ensure a balanced integration of theory and practice, with a greater proportion of time devoted to practical work, supported through projects, workshops, internships, and exposure visits.
- Promote experiential learning in real-world contexts, including structured visits to workplaces and interaction with practitioners to deepen understanding of vocations.
- Integrate technology and AI meaningfully within pedagogy to enhance learning and demonstrate their role in improving efficiency and productivity in work settings.
- Uphold equity and inclusion, ensuring equal access to tools, resources, and opportunities for all students, including those from diverse socio-economic backgrounds and differently abled learners.
- Strengthen school–industry linkages by partnering with local enterprises, institutions, and organisations to facilitate internships, exposure, and authentic work-based learning experiences.

Assessment

The focus of Vocational Education assessment in Grades 9 and 10 is to assess skills that are transferable across different kinds of work. Given the nature of vocational knowledge, the primary focus of assessment should be demonstrated performance — not written examination alone.

Mode of Assessment: Students must be assessed on the basis of the competencies, curricular goals & learning outcomes, as defined in the syllabus.

Suggestive tools of assessment:

- i. Teacher's Observations (based on demonstrated performance via rubrics, checklists)
- ii. Student Portfolio
- iii. Oral Presentations
- iv. Self and Peer Assessments
- v. Paper and Pencil tests (Situation Based Questions)

Detailed assessment guidelines shall be shared with schools once the textbooks are published by NCERT.

What is to be assessed?	What are the criteria for assessment?	Examples of tools and sources of evidence
Values and dispositions related to work	• Observation and questioning during practice • Dignity of labour for all kinds of work • Collaboration with peers • Efficiency in work • Pursuit of quality • Creativity and problem-solving • Willingness and motivation • Optimal use of all resources	• Teachers' observations • Oral presentation or viva-voce • Self-assessment
Selection, use, and maintenance of tools and equipment	• Selection of appropriate tools for task • Correct usage of tools • Keeping materials and equipment ready for use • Following safety protocols • Proper storage of tools and materials post usage	• Teachers' observations • Oral presentation or viva-voce • Paper and pencil test • Portfolio
Knowledge to perform tasks	• Conceptual knowledge necessary to do work • Context and relevance of work • Sustainable and/or indigenous practices • Knowledge of procedures and protocols (including safety and documentation) • Planning templates or creating process charts • Mapping and budgeting of resources	• Oral presentation or viva-voce • Paper and pencil test • Portfolio
Performance of tasks	• Sequencing of tasks • Creating appropriate conditions or gathering tools and materials • Estimation of material or need identification • Carrying out tasks using tools and materials • Improvements based on testing or feedback • Monitoring progress against plan • Workplace organization • Waste management	• Teachers' observations • Portfolio • Oral presentation of the task performance (rationale of performing the task)
Place of vocation in the world of work	• Importance of vocation • Livelihood ecosystem	• Oral presentation or viva-voce • Paper and pencil test • Site visit reports or observation notes
Applying quality criteria	• Identifying criteria for evaluating quality of products • Reflection on processes	• Oral presentation or viva-voce • Paper and pencil test • Portfolio • Self-assessment
Application of vocational competencies at home	• Use of vocational skills and knowledge at home	• Oral presentation or viva-voce • Paper and pencil test • Portfolio