TEACHER TEXT

Higher Secondary Course

PHYSICS

XII

Government of Kerala

DEPARTMENT OF EDUCATION

State Council of Educational Research and Training (SCERT), Kerala

2015

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Foreword

Dear Teacher,

We have introduced activity based, learner-centred, process oriented pedagogy in Higher Secondary classes as part of the continuation of curriculum revision at school level.

As per the rules of the RTE Act, the idea of learning outcomes was introduced in the Kerala school curriculum 2013. Knowledge of learning outcomes is essential to plan the teaching learning process and assessment in a precise and practical manner.

As you know, the process of transacting the curriculum is challenging as it demands higher level of proficiency and dedication on the part of the teacher who plays a pivotal role.

For effective learning, learning experiences should be based on specific objectives and focussed on learning outcomes.Our teachers are quite resourceful and can easily come up with much more compelling and innovative ideas and strategies than the ones suggested in this book. You are always welcome to do so to make teaching-learning process an enjoyable experience.

The Teacher Text in Physics for second year Higher Secondary Course offers a few guidelines which aim at familiarising the practising teachers with the changed strategies to be adopted in the classroom.

Suggestions for improvement are most welcome.

With regards,

Director
SCERT, Kerala

About Teacher Text...

The teacher text should be one that helps the teacher in daily planning, provides instructions adequate to carry out the activities in the textbook, persuades the teacher to seek for more information and provides the additional information needed for the teacher. The relevance of the teacher text is that the teacher must be provided with deeper insight of the activities in the textbook, additional activities, samples of assessment and transaction strategies. Hence the following are included in the teacher text.

Preface

A preface is provided for each unit. The main concepts aimed in the lesson, process skills to be developed among students, the values and attitudes to be inculcated and the social significance of the topic are indicated in the preface. The preface is a window to each lesson.

Unit Frame

Each unit frame is prepared in relation to important science concepts. A unit frame has 3 parts. The first part includes details regarding the science concepts that the child should know, the process skills to be developed for achieving the learning outcomes. The second part indicates the learning activities. The last part includes the major learning outcomes that the student must achieve. The approximate time needed for each unit is mentioned. The lesson is divided into three or four modules by grouping learning outcomes and the related science concepts. Prepare lesson plan according to the module.

Towards the Unit

For the effective transaction of the content certain activities are suggested. The teacher can follow those suggested activities or make use of a suitable learner centred, activity based, strategies based on his/her own requirement. Details necessary for carrying out the ICT possibilities are provided in the teacher text.

Assessment

It needs no emphasis to state the importance of assessment for effectively conducting learning activities. Indicators of important activities and products that ought to be subjected to assessment in each module are provided in the teacher text. This does not mean that they are only to be assessed. The teacher has to prepare on his/her own worksheets for continuous assessment-self-assessment and peer assessment tools. Some samples are given in the teacher text.

Contents

Part-A

Part-B

Science Learning Approach

It can be said that Science is the sum of all experiences gained by humans hitherto. Such experiences are interpreted in the light of earlier experiences. Our surroundings come live to our experiences through sight, hearing, taste, touch and smell. The proper analysis of the experiences on the basis of earlier knowledge leads us to the construction of new knowledge. Every piece of knowledge thus constructed is a window for further enquiry. Logical thinking becomes effective through asking logical questions, collecting relevant information and conducting comprehensive analysis. This is the method of science learning.

But science learning is not to be limited to a mere assortment of data about energy, substances and living things. It is to be applied to all fields of life. There will be no superstitious beliefs or wrong ideas in a society that follows this method. Such a society will not suffer exploitation or deceit.

Learning Objectives of Science

- nourish wonder, curiosity and observation skills.
- scientifically explain surroundings
- strive for improvement
- assimilate and execute the method of science.
- investigate constantly and draw conclusions after analysing data.
- analyse natural phenomenon
- eliminate superstitious beliefs and evil practices
- prevent the misuse of science
- develop scientific perspective
- cultivate eco-friendly attitude
- identify mutual interdependence in nature
- use the assimilated knowledge for the welfare of all creatures
- extend the concept of sustainable development
- relate learning to daily life situations

- acquire physical-mental-social health by observing personal hygiene and social hygiene.
- cultivate a scientific consciousness based on humanity
- appreciate the achievements of science
- use the achievements of science for social welfare.
- respect those who offered lives for science.
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Science Education - Approach

To achieve the above said objectives, we have to keep on constantly improving the learning approach we adopted in Science Education. The traditional view of science education as the process of imparting knowledge assimilated through the years about the universe had changed around forty years ago. The view that the process of science is as important as the content has come into the realm of science education. However, today, the approach that certain other facts beyond content and process are also to be considered, has gained significance. Discussing Mc Vormack and Yager's 'Taxonomy for Science Education' becomes relevant in this context. According to this, there are five domains that science education must lay emphasis on:

1. Knowledge domain
2. Process domain
3. Creativity domain
4. Attitudinal domain
5. Application domain

1. Knowledge domain

Science students are expected to know scientific principles and available scientific facts. It is through science learning that a clear idea about universal phenomena, the relation between them and their explanations are gained. The following are primarily included in this domain:

- facts
- concepts
- rules
- temporary inferences and laws used by scientists currently

An understanding of this area can be created through experiments and observations, discussions, debates, project activities and references.

2. Process domain

Process is a chain of procedures used with a purpose for a particular result or to achieve a particular aim. Process skills are skills that enable identifying concepts and evidences, and after collecting them, analysing and drawing conclusions.

Concept formation is an essential factor for not only science learning, but the learning of all subjects. It is because of gaining the concept 'life' that a creature, not seen before, can be identified as a living thing. Similarly it is the result of comprehending the concept 'dissolving' that it can be concluded that an unknown substance that disappears in water, does not vanish but gets dissolved in water. Concept formation regarding science facts is very important. However the students should go through the education process to attain proper concept assimilation. The concept created by the students through experiments and observations, collecting evidences and analysis can be developed and used by them in day-to-day life situation. This substantiates the fact that learning should be process-based.

A few important process skills are:

- observing
- classifying
- using number relationship
- measuring and preparing chart
- using space - time relationship
- communicating and understanding communication of others
- Predicting
- Inferring
- making operational definition
- formulating hypothesis and examining it
- Interpreting data

- identifying and controlling variables
- engaging in experiments
- collecting and recording data
- explaining and analysing data
- raising questions
- arriving at generalisation
- identifying solutions of problems
- arriving at conclusions
- taking decisions
- foretelling and assuming
- handling instruments

Observing

Observation is the process of acquiring knowledge through the five senses. Learning experiences which provide the opportunity to use all the five senses may be used.

Classifying

The process of grouping information gained through observation, based on salient features is called classifying. Starting from simple groupings of data, it can extend to the level of classification into minute sub groups. The ability to classify will vary according to the age, maturity and cognitive level of the students.

Using number relationships

This involves the analysis of available data, consolidation and meaningful explanation using the language of mathematics. Learning experiences may provide the opportunity to develop the skills of counting, addition, subtraction, multiplication, division and finding averages.

Measuring & Charting

As part of data collection the student will have to measure quantities such as length, time, mass, temperature, force and density. What instruments are required for this? How can these instruments be used? What is the level of accuracy expected in measurements? How to record the data? All these are to be considered.

Using Space-time relationships

An in-depth enquiry relating to shape, distance, movement, speed, accuracy, direction and time comes under this area. It begins from identifying the shape, speed, direction and other such features of objects.

Communicating and understanding communication

It is essential that knowledge developed is expressed in different ways - oral and written. The students need opportunities to communicate through tables, graphs, pictures, models, short write-ups, descriptions and lectures and also to take part in debates and discussions. Clarifying doubts by asking appropriate questions is another skill in this area.

Predicting

An inquisite person attempts to answer the question if......... then? and proceeds to try out the guessed answer. Answer to this question is important in science. The teacher expects the student to predict the outcome of various events and experiments. Students need to develop the skill of predicting by drawing on the knowledge gained through experiments and observations.

Inferring

Observation and data collection are not important in themselves. Inferences based on them are however, crucial. A proper inference can be drawn only if the student has good skills of analysis. The defects in analysis of data will affect the quality of inference.

Making operational definitions

The meaning of ideas need to be stated precisely and clearly to make them useful. This helps in communication. Operational defintions may be incomplete and temporary. But in given situations they can be logical and practical.

Formulating hypothesis

A hypothesis is a temporary conclusion drawn using insight. A problem can have a number of casual factors and solutions. Based on knowledge and experiences relating to the problem the causes and solutions can be guessed. Such a guess is a hypothesis and need to be tested out and rejected if disproved. Hypothesis which are proved right become conclusions.

Interpreting data

Interpretation of collected data may lead to new ideas and generalizations. Opportunities may be provided for interpreting data and formation of new ideas.

Controlling variables

Variables influence the outcome of experiments. Variables are to be controlled during experiments. For the experiment to be accurate and scientific the variables are to be effectively controlled.

Experimenting

An experiment is a planned activity to test the validity of hypotheses drawn. Experimentation contains the process skills in an integrated way. It is the main method used by scientists. Formulating methods to test the hypothesis, conducting experiments, recording, interpretation of data and drawing conclusions are included in it.

The duty of the teacher is to help the learner to acquire the method of science in a natural way through learning activities based on simple & complex process skills starting from observation. The students are to be given learning experiences that are learner-centred, process oriented, and environment based and not the conventional content/ product oriented experiences. When this approach is followed along with process skills the student acquires knowledge, facts, ideas, concepts and principles.

In the new approach of curriculum, the student forms ideas and conclusions through processes. Project activities, seminar presentations and experiments enable the student to employ more than one process skill.

3. Creativity domain

Science education is considered today as a process enabling the student only in achieving certain scientific information. This is a point of view that totally ignores the student's creativity and imagination. It is essential that the student is able to deviate from the conventional path and think differently.

A few skills pertaining to this domain are given below:

- visualizing, formulating experiments
- relating objects and concepts in new ways

- identifying alternative / unusual uses for objects
- finding solution for problems and puzzles
- fantasizing
- designing instruments and machines
- dreaming'
- thinking differently

4. Attitudinal domain

One of the main aims of Science Education is the desirable change in attitudes and inculcations of values. It cannot be said that there is any benefit in daily life by science education if there is no substantial change in perspective of life and in the stand towards social or individual problems, even if concepts and process skills are attained. It is commonly seen in our country that even people who possess higher degrees in science adopt unscientific methods in day-to-day issues. Therefore science education should cater to the development of areas like attitudes, values, decision-taking etc.

Factors that may be included in this domain -

- faith in one's abilities
- ability to understand human feelings and respect them
- expressing one's emotions and thoughts creatively
- thinking rationally about individual values and taking decisions accordingly.

5. Application domain

The concepts, processes and values become meaningless if the student cannot implement them in daily life. Similarly, pure scientific principles and concepts divorced from technology, will not have much relevance in daily life. Scientific information is seen to be irrelevant for the student if it is not related to daily life.

These are some processes in the Application domain:

- observe instances of science concepts in day-to-day life
- use the concepts and skills gained to solve problems related to life.
- create an idea of science concepts related to household instruments.

- evaluate events and developments related to science
- take scientific decision on matters of food, health, life style etc.
- relate science to other subjects

Method of Science Learning

These objectives can be realized only when the scientific method is adopted for science learning . Science learning should be process-based. Activities that ensure the development of skills like collecting information appropriate for problem-solving. analysing the information, arriving at proper conclusions, examining the conclusions and using them in new contexts are to be conducted in the classroom. Science learning should not be restricted to the classroom. Hence outdoor learning also should be emphasized.

While saying that science learning should be process-based, it does not mean that it is merely conducting activities. Each activity must have an objective. It should be ensured that the student realizes / achieves the objective. Conducting activities and not consolidating may not help in acquiring the result. The student must be able to identify what he / she has achieved when a learning process is completed. This will help him / her in further studies.

Conclusions are made on the basis of the evidences derived / drawn from learning activities. The evidences and the conclusions made therein have to be evaluated critically. While subjecting the method followed and the activities to evaluation again, the opportunity to identify errors, if any, and rectifying them opens up. The derived concepts are accepted or rejected only after subjecting them to criticism with high standards of academic discipline. This is possible only in classrooms that function in a democratic way where there is room for free and fearless interaction.

Concept formation occurs during interaction with the teacher, interaction with friends, observation or engaging in experiments. The student thus gets various kind of experiences.

Teaching - Learning Strategies

The explosion of knowledge has resulted in a new vision of knowledge. Earlier, it was thought that the most effective method was the transmission of knowledge by teacher to the student. However, the modern view is that the student has the responsibility and the right to construct knowledge. The teacher of modern times hence has to use instructional approaches that motivate the student to construct knowledge on his own.

Instructional strategies should be viewed as a social skill which is part of the educational environment and not as a technique to be mastered. They are to be considered as important components of teacher-student interaction and not as teacher activities alone. While instructional methods are planned the social and psychological aspects of the learner need to be taken into consideration.

Let us examine some instructional strategies helpful in attaining the learning outcomes.

1. Project

Project is one of the most suitable methods of instruction for science. It is a method of self instruction using the method of science and useful in the development of a number of process skills and hence it is essential to use projects in science education.

What is a project?

When a problem is felt, data regarding the problem is collected. The collected information is summarised and analysed. The conclusions that are obtained from analysis are used to solve the problem - these steps reflect the essentials of a project. By doing projects the students are given the opportunity to train in the method of science. In doing so, the student acquires problem solving ability which helps to tide over problematic situations in life and progress in life.

Projects help to develop scientific temper, scientific attitude and interest in learning science and to ensure active participation of the student in learning activities.

Stages of a project

Feeling the problem

The project topic should not be arbitarily created. It should reflect a felt problem in the learning situation which requires a solution to proceed further.

Project topics arise when discussions relating to lessons are held in the class. It is important that the student has an internal urge to find out a solution to the particular problem. When the topic is presented the teacher must ensure this.

Defining the aim

If the student is to tackle the problem in a way suitable to his/her abilities, thinking skills and available facilities, the aims of the project need to be defined precisely. To state the aims of the project simply and clearly, the student needs the help of the teacher.

Planning

Hypothesizing

Drawing temporary conclusions on the basis of information available at the time is known as hypothesising.

Methods and instruments

Study methods and instruments are to be selected based on aims of the project and the hypothesis drawn. The nature of the topic, instruments used and the scientific approach followed should be correlated.

Survey

Once survey method is selected, where, when and how to conduct the survey must be decided. What will be the sample and who are to be approached for data will also be considered. Questionnaires and survey forms are to be drawn up. During the planning phase all these are to be discussed in detail. Teacher must interact with the students, give suggestions and ensure that the instructions are suitable and effective.

Experimentation

When experimental method is to be used, it must be considered whether necessary equipment is available. If not can these be improvised? How can materials and instruments be made availalble? These questions must be considered.

Tabulation of data

- What information is to be collected?
- What method can be used for collecting information?

- When should observations be made?
- How to tabulate data?
- Are pictures, samples, and working models required?
- Are checklists, rating scales and score cards needed?
- The method of analysis should be decided in advance. Keeping to schedules, honest collection of data, accuracy of data and precision are important.

Analysis

The collected and tabulated data can be analysed to examine the validity of the hypothesis. The collected data need to be classified and compared. Comparison with standard information may also be required.

Graphics and similar representation will make the analysis easier.

Conclusion

Based on similarities, differences and relationships evident from analysis of data, the validity of hypothesis may be examined. Those found invalid are rejected and others are accepted as conclusions.

Execution of the project

An outline of the project based on the components discussed above may be drawn up. The project activities may be carried out according to this plan with necessary modifications at the appropriate stages. Difficulties faced during execution of the project, data obtained and information collected, are to be entered in the 'activity log book'. This will be helpful during report writing.

Visits made during the conduct of the project, experiments, arranging equipment, recording data and analysis should be supervised by the teacher. Teacher must take care to conduct discussions, with students frequently to evaluate the progress of the project.

Application

The suggestions that arise from the project must be used for problem solving whereever applicable.

Project report

Report is to be prepared by the students themselves. The structure of the report should be finalised through discussion with the students. It must be ensured that it is not too complex and hinders activities.

- The cover page may show title of the project, name of the student/members of the group, and school address.
- The report may contain

1. Title
2. Introduction
3. Hypothesis/Aims
4. Method of study
5. Collected data
6. Analysis and Conclusions
7. Suggestions (if any)
8. Reference (if any)
9. Appendix (questionnaire, observation schedule, checklist etc.)

The activity log book should be made use of to prepare the project report. The aims and method of study of the project would be recorded in the activity log book during the time of execution of the project. The credibility of the project and data can be established with the help of activity log book.

Project Presentation

The project can be evaluated and the work done may be assessed when the project is presented. Ideas can be communicated and shared with others through presentation of the project.

The project can be presented in

- Class room
- Science club meeting
- Science fairs
- School annual day meeting
- PTA meeting
- Ayalkootam
- Other selected forums

The project method helps to train the students in the method of science to familiarise them with self study habits and to find solutions for local problems. We must take care to cultivate this as an important method of study in our schools.

II. Seminar

Reporting is a core component of learning science. In seminar, data relating to a specific topic is collected, analysed and presented as paper for the benefit of others. It helps the learner to improve his / her communication skills and provides opportunities for collection of secondary data and for drawing conclusions. It is useful in cultivating interests and attitude in science topics and in personality development. Topics chosen for seminars may be contemporary and should have social relevance.

Organization of seminar

- Topic presentation
- Finding out sub topics or different areas
- Group formation
- Assigning sub topics to different members of the groups. Each group prepare paper on all the sub topics.
- Discussion by each group on the sub-topics (Refer books, magazines, institutions, etc.)
- Organising ideas
- Paper writing
- Seeking the opinion of the teacher.
- Presentation
- Discussion
- Summarising
- The teacher may provide reference materials and give directions at all stages.
- Writing of report
- The report may include new information gained through data collection, conclusions and findings.
- The information collected by all the members may be included.
- Tables, charts, books and other resource materials may be included.

Teacher may examine the paper at different stages and provide guidelines. The activities and participation of each student in the group may be assessed.

Paper presentation

- Teacher may function as the moderator during the initial stages, but it is better to assign this role to students themselves.
- All the group members must be present in the dias during presentation and must actively participate in the discussion after presentation by the leader.
- Questions from the audience are to be answered by group members taking turns.
- Teacher may intervene wherever necessary to provide instructions and help.
- When sub topics are presented, after all the presentations are over general discussion may be held. Teacher may summarise the discussion.
- A summarised version of the report may be recorded in the activity log book.

Seminar papers and reports may be kept in the information corner.

III Discussion

Discussion is an effective method in the teaching learning process. In the process approach it has a significant role. Discussions are essential for the student to share their findings, ideas and conclusions at each stage of learning with fellow students and teachers and to assess progress.

Group discussion is an ideal method to inculcate social consciousness, co-operation, democratic attitude, friendliness, open mindedness and compromising attitude which are the ultimate aims of education. It helps the development of communication skill, hypothesis formulation, designing of experiments and analytical skills.

General discussion is a method where discussion proceeds based on the thought provoking questions raised by the teacher addressing the whole class. Based on the random presentations of the group members teacher and students move ahead with the development of concepts. Finally teacher consolidates the concepts/ideas discussed in the class.

In a student centred classroom, the following points must be borne in mind while conducting a discussion.

Discussion points may be provided to guide the progress of the discussion.

This will help the students to reach the proper conclusion. Discussion points may be in the form of questions.

- During group discussion the teacher may observe each group and if needed help them to channel the discussion towards the common objective.
- All students may be given opportunity to take part and express their ideas.
- It must be ensured that time limits are observed.
- The conclusion reached may be entered by each student in the activity log book and a group representative must present these during consolidation.
- The teacher may correct or add to the conclusions and ensure that all the relevant ideas have been covered.
- Students may be directed to enter the consolidated ideas in the activity log book.

IV Debate

After presenting a controversial topic, arguments in favour and against are put forward and a detailed analysis of facts is done by both sides in a debate.

Relevance of Debate

- To develop the skill of presenting the views of oneself logically and argue convincingly
- To develop the ability to compare others' views with the views of oneself and to understand relevant aspects or ideas of others.
- To develop leadership quality, democratic attitude and communication skills.

Conducting a debate

The selection of the debate topic must be done very carefully. A controversial topic (one which can be viewed from two different perspectives) is suitable for debate. Both viewpoints must help in cultivating certain positive attitude among students.

The teacher must not take a decision favouring one group. An objective approach is to be maintained while presenting the topic.

Only then the students will prepare to debate both aspects. The processes in the debate are;

- Topic presentation
- Preliminary discussion - students are grouped into two.
- The two groups discuss the arguments they are going to present.
- Responsiblities assigned for presenting different viewpoints & arguments.
- Either the teacher or a student functions as the moderator.
- Each group present their arguments.
- Moderator present an analysis of the ideas and consolidate the points.
- Moderator present an analysis of the ideas and consolidate the points. Moderator may present the consolidation in tune with the method of science. The consolidated information is recorded in the activity log book.

Responsibilites of the moderator

- Introductory presentation
- Guiding the discussion
- Ensuring that the discussions are on right track
- Ensuring the time limits
- Consolidation of arguments

A model for planning

Stage 1 - 1 period

- Introductory presentation of the topic
- Grouping of students

- Group discussion
- Collection of information within groups
- Assigning reponsibilities
- Fixing date and time of debate.

Stage 2 - Debate

- Seating arangements
- Introductory remarks
- Presentation of arguments from two sides
- Discussion
- Consolidation

The moderator's main responsibility is consolidation. It must be unbiased, analytical and efficient as the role of a judge in weighing the merits of a legal point.

Stage - 3

- Preparing report on the debate.
- Entering the details of the debate in activity log book.

V Experiments

Experiments familiarise the students with the method of science and develops the process skills. It serves the following aims.

- Development of process skills.
- Ability to handle science equipments
- Development of interest in science, sense of responsibility, aptitude and attitude.
- Providing direct experience

Planning

- Must be related to learning outcomes.
- Introductory discussions must help the students to understand the need and aims of experiments. The students should develop an idea of what variables are to be controlled. Similary they should decide on what to observe. They are also to be instructed on the manner of recording and the safe handling of equipments and materials must be demonstrated to them.

- Experiments must be suitable to the age and maturity level of students.
- Must be interesting to the students.

Points to note:

- If only limited number of equipment is available students may work in groups.
- Each group must be given appropriate instruction
- Experiments must proceed according to instructions given.
- It must be ensured that measurements are accurate.
- Observations must be recorded
- Time limit must be observed.

Teachers must be present during all stages of the experiment to provide necessary instructions.

VI Outdoor learning

Direct observation is essential for the development of ideas in a process based learning. Outdoor learning provides experience in the natural setings that cannot be provided through a class room situation or laboratory.

Relevance

- Learning becomes environment based
- Direct learning experiences are gained
- Learning is linked to real life and practical situations.
- Helps to share experiences with people who apply science in real situations.
- Develops values, attitudes and interests
- Helps to develop personal qualities
- Helps to evaluate the development of emotional domain.

Planning

- Lesson unit - Objectives intended
- What are to be observed? to be enquired? to be collected?
- How to record?
- What services of local community are needed?

- Place, travel facilities, expected expenses, materials needed.

Assessment

- Recordings in the activity log book and report.
- Participation of students
- Sharing of experiences and explanations given on questions raised
- Punctuality

VII. Information Communications Technology

During a time of information explosion, comprehensive study of a subject cannot be limited to books alone. Information technology is a medium which can help one to collect and exchange new knowledge that is created by the minute. A contemporary mode of teaching requires the help of it to a great extend.

VIII Assignments

Assignments are learning activities helping to achieve the learning outcome and also lead the pupil from the present level to a higher level of learning.

Assignments may be of the types - writings, drawings, construction of models etc. In assignments involving construction of models, a note on methods used in construction may also be submitted.

The discussion and planning may be carried out in classroom to complete the assignments in time. Clarifications may be given about the sources. Teacher may provide the sources if needed.

IX Solving of numerical problems

General Steps

- Analysis and data entry
- Selection of suitable equation
- Substitution and calculation
- Final answer with unit

For a class of 50 pupils, 5 groups can be formed (Pupils on bench can be treated as a group). Problems are given in groups. Each student should go through the problem. They should follow the above crieteria for solving the problem. After individual attempt, let them start group discussion. With the clarification, let them finish the problem and present the method of solving.

Different types of problems, can be given to groups and teacher should consolidate the findings.

X Activity log book

The student carries out a number of activities as part of learning. Observations, collections, data organisation in tables, analysis, consolidation and reports are some of these. The activity log book is a record of all activities that the student carries out in process based learning - problems faced, methods adopted to solve them and conclusions drawn. It is useful to the student as well as to others who want to assess the students work and progress.

The student must record all the information about activities. The activity logbook must help to record data systematically to analyse the collected data and to consolidate the ideas so as to share it with others.

In short, the activity logbook is expected to be a comprehensive record of learning of a year. It is a record of all the learning experiences in the subject that a student has undergone during a year.

XI Science Club

The School Science Club must transform into a platform for presenting innovative, instruments, seminar papers, projects, experiments etc made by students as part of their activities in the classroom. It is learnt that School Science Clubs function mostly for Science fairs only. This should change and the Science Clubs must become a means for promoting science aptitude among students. The club should start functioning in June itself and must prepare a years' an action plan for one year. A science exhibition can be held to exhibit the products of students at the end of the year. There are many opportunities for the science club like observing important days related to science learning, classes of experts on special topics, seminars etc.

Syllabus

(CLASSES XII - THEORY)

(Total Periods: 180)

Unit I

ELECTROSTATICS **(Periods 25)**

Electric charges and their conservation. Coulomb's law - force between two point charges, forces between multiple charges; superposition principle and continuous charge distribution.

Electric field, electric field due to a point charge, electric field lines; electric dipole, electric field due to a dipole; torque on a dipole in a uniform electric field.

Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside). Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipoles in an electrostatic field.

Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor, Van de Graaff generator.

Unit II

CURRENT ELECTRICITY **(Periods 22)**

Electric current, flow of electric charges in a metallic conductor, drift velocity and mobility, and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity.

Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance.

Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel.

Kirchhoff's laws and simple applications. Wheatstone bridge, metre bridge.

Potentiometer - principle and applications to measure potential difference, and for comparing emf of two cells; measurement of internal resistance of a cell.

Unit III

MAGNETIC EFFECTS OF CURRENT AND MAGNETISM (Periods 25)

Concept of magnetic field, Oersted's experiment. Biot - Savart law and its application to current carrying circular loop.

Ampere's law and its applications to infinitely long straight wire, straight and toroidal solenoids. Force on a moving charge in uniform magnetic and electric fields. Cyclotron.

Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors - definition of ampere. Torque experienced by a current loop in a magnetic field; moving coil galvanometer - its current sensitivity and conversion to ammeter and voltmeter.

Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of a revolving electron. Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements.

Para- dia- and ferro - magnetic substances, with examples.

Electromagnets and factors affecting their strengths. Permanent magnets.

Unit IV

ELECTROMAGNETIC INDUCTION ANDALTERNATING CURRENTS (Periods 20)

Electromagnetic induction; Faraday's law, induced emf and current; Lenz's Law, Eddy currents. Self and mutual inductance.

Alternating currents, peak and rms value of alternating current / voltage; reactance and impedance; LC oscillations (qualitative treatment only), LCR series circuit, resonance; power inAC circuits, wattless current.

AC generator and transformer.

Unit V

ELECTROMAGNETIC WAVES **(Periods 4)**

Need for displacement current.

Electromagnetic waves and their characteristics (qualitative ideas only). Transverse nature of electromagnetic waves.

Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays) including elementary facts about their uses.

Unit VI

OPTICS **(Periods 30)**

Reflection oflight, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applications, optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lens-maker's formula. Magnification, power of a lens, combination of thin lenses in contact combination of a lens and a mirror. Refraction and dispersion of light through a prism.

Scattering of light - blue colour of the sky and reddish appearance of the sun at sunrise and sunset.

Optical instruments: Human eye, image formation and accommodation, correction of eye defects (myopia and hypermetropia) using lenses.

Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Wave optics: Wavefront and Huygens' principle, reflection and refraction of plane wave at a plane surface using wavefronts.

Proof of laws of reflection and refraction using Huygens' principle.

Interference, Young's double hole experiment and expression for fringe width, coherent sources and sustained interference of light.

Diffraction due to a single slit, width of central maximum.

Resolving power of microscopes and astronomical telescopes. Polarisation, plane polarised light; Brewster's law, uses of plane polarised light and Polaroids.

Unit VII

DUAL NATURE OF MATTER AND RADIATION (Periods 8)

Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation - particle nature of light.

Matter waves - wave nature of particles, de Broglie relation. Davisson-Germer experiment (experimental details should be omitted; only conclusion should be explained.)

Unit VIII

ATOMS AND NUCLEI (Periods 18)

Alpha - particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars; isotones.

Radioactivity - alpha, beta and gamma particles / rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission and fusion.

Unit IX

ELECTRONIC DEVICES (Periods 18)

Energy bands in solids (qualitative ideas only), conductors, insulators and semiconductors; semiconductor diode - I-V characteristics in forward and reverse bias, diode as a rectifier; I-V characteristics of LED, photodiode, solar cell, and Zener diode; Zener diode as a voltage regulator. Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR). Transistor as a switch.

Unit X

COMMUNICATION SYSTEMS (Periods 10)

Elements of a communication system (block diagram only); bandwidth of signals (speech, TV and digital data); bandwidth of transmission medium. Propagation of electromagnetic waves in the atmosphere, sky and space wave propagation. Need for modulation. Production and detection of an amplitude-modulated wave.

PRACTICALS

Total Periods 60 (Section A)

Experiments

1. To find resistance of a given wire using metre bridge and hence determine the specific resistance of its material.
2. To determine resistance per cm of a given wire by plotting a graph of potential difference versus current.
3. To verify the laws of combination (series / parallel) of resistances using a metre bridge.
4. To compare the emf's of two given primary cells using potentiometer.
5. To determine the internal resistance of given primary cell using potentiometer.
6. To determine resistance of a galvanometer by half-deflection method and to find its figure of merit.
7. To convert the given galvanometer (of known resistance of figure of merit) into an ammeter and voltmeter of desired range and to verify the same.
8. To find the frequency of the ac mains with a sonometer.

Activities

1. To measure the resistance and impedance of an inductor with or without iron core.
2. To measure resistance, voltage (ac / dc), current (ac) and check continuity of a given circuit using multimeter.
3. To assemble a household circuit comprising three bulbs, three (on / off) switches, a fuse and a power source.
4. To assemble the components of a given electrical circuit.
5. To study the variation in potential drop with length of a wire for a steady current.
6. To draw the diagram of a given open circuit comprising at least a battery, resistor / rheostat, key, ammeter and voltmeter. Mark the components that are not connected in proper order and correct the circuit and also the circuit diagram.

EXPERIMENTS (Section B)

1. To find the value of v for different values of u in case of a concave mirror and to find the focal length.

2. To find the focal length of a convex mirror, using a convex lens.
3. To find the focal length of a convex lens by plotting graphs between u and v or between 1/u and 1/v.
4. To find the focal length of a concave lens, using a convex lens.
5. To determine angle of minimum deviation for a given prism by plotting a graph between the angle of incidence and the angle of deviation.
6. To determine refractive index of a glass slab using a travelling microscope.
7. To find refractive index of a liquid by using (i) concave mirror, (ii) convex lens and plane mirror.
8. To draw the I-V characteristics curves of a p-n junction in forward bias and reverse bias.
9. To draw the characteristics curve of a zener diode and to determine its reverse break down voltage.
10. To study the characteristics of a common-emitter npn or pnp transistor and to find out the values of current and voltage gains.

Activities

1. To identify a diode, an LED, a transistor, and IC, a resistor and a capacitor from mixed collection of such items.
2. Use of multimeter to (i) identify base of transistor, (ii) distinguish between npn and pnp type transistors, (iii) see the unidirectional flow of current in case of a diode and an LED, (iv) check whether a given electronic component (e.g. diode, transistor or IC) is in working order.
3. To study effect of intensity of light (by varying distance of the source) on an LDR.
4. To observe refraction and lateral deviation of a beam of light incident obliquely on a glass slab.
5. To observe polarization of light using two polaroids.
6. To observe diffraction of light due to a thin slit.
7. To study the nature and size of the image formed by (i) convex lens (ii) concave mirror, on a screen by using a candle and a screen (for different distances of the candle from the lens/mirror).
8. To obtain a lens combination with the specified focal length by using two lenses from the given set of lenses.

Guidelines for Practical Physics

As Physics is a basic science, Experimental Physics is highly significant in the higher secondary level. A minimum of 10 experiments must be performed by each student with at least one experiment from each of the following section.

Year	*Section*	*Units as per NCERT Theory Text Book*	*Minimum No. of Expt. to be performed*	*Minimum Expts. to be performed in the year.*
First Year	1	1, 2	1	10
	2	3, 4, 5, 6	1	
	3	7, 8	1	
	4	9, 10	1	
	5	11, 12, 13	1	

Students must be provided ample opportunities to be familiar with maximum number of apparatus and scientific principles through practical physics.

Performing experiments using same apparatus / principle and recording them as different experiments should be avoided. Eg. (i) Find the volume of given sphere using Vernier Calipers and (ii) Determine the density of rectangular block using Vernier Calipers can not be recorded as two separate experiments.

Physics Practical Log Book

The experiments performed by the student must be recorded in the log book. The student should be encouraged to draw the tabular column and write the aim, principle, and procedure of the experiment before performing the experiment in the lab and the certified logbook should be submitted for practical examination. A single logbook should be used for first and second year. A minimum of 22 experiments should be recorded in the practical log book.

Higher Secondary Practical Examination

An internal practical examination should be conducted at the end of HSE first year for a maximum 20 scores. Certified log book should be submitted for this internal examination also. Duration of the examination is 1½ hrs. This score should be considered for second year CCE.

Score Distribution

Sl No.	Item	Score
1.	Principle and theory	5
2	Setting up of apparatus	2
3	Performance of the experiment	6
4	Result in SI units/ conclusion	4
5	Ascertaining the awareness of concepts	1
6	Record	2
	Total marks for one Expt.	20

Two experiments should be done at the time of practical board examination (One experiment fromPlus One and other from second year). The total marks for paractical board examination is 40.

Learning Outcomes

On successful completion of the chapter, the learner:

1. ELECTRIC CHARGES AND FIELDS

1.1. Explains the types of charges and electroscope.

1.2. Distinguishes conductors and insulators by citing examples.

1.3. Explains the charging by conduction and induction with examples.

1.4. Explains the basic properties of charges.

1.5. States and formulates the Coulomb's law and solves numerical problems related to it.

1.6. Explains the forces among multiple charges.

1.7. Explains electric field, intensity and its physical significance.

1.8. Formulates the electric field due to a system of charges and solves numerical problems related to it.

1.9. Explains the properties of electric field lines.

1.10. Defines electric flux and formulates the relation connecting electric flux and intensity.

1.11. Defines electric dipole and dipole moment.

1.12. Formulates the electric field intensity due to an electric dipole on its axial and equatorial lines and solves numerical problems related to it.

1.13. Formulates the expression for torque on a dipole in a uniform and electric field.

1.14. Explains different types of continuous charge distribution and their units.

1.15 Explains and proves Gauss' law in electrostatics.

1.16 Formulates the expression of electric intensity due to an infinitely long straight uniformly charged wire, uniformly charged thin spherical shell and uniformly charged infinite thin sheet and solves problems related with them.

2. ELECTROSTATIC POTENTIAL AND CAPACITANCE

2.1. Explains the difference between electrostatic potential and potential difference.

2.2. Formulates the potential due to a point charge and an electric dipole.

2.3. Draws the graph and solves problems related to potential.
2.4. Formulates the potential due to a system of charges.
2.5. Explains the equipotential surface by citing examples.
2.6. Formulates the potential energy of a system of charges and solves numerical problems related to it.
2.7. Explains the potential energy due to a single charge in an external field and defines electron volt.
2.8. Formulates the potential energy due to a system of two charges and dipole in an external electric field and solves numerical problems related to them.
2.9. Explains the concept of electrostatics of conductors.
2.10. Differentiates different dielectrics by citing examples and explains electric polarization.
2.11. Defines capacitance and its unit.
2.12. Formulates the expression for capacitance of a parallel plate capacitor and solves problems related to it.
2.13. Explains the effect of dielectric on capacitance.
2.14. Formulates the expression for effective capacitance when capacitors are connected in series and parallel and solves problems related to it.
2.15. Formulates the energy of a capacitor.
2.16. Explains the construction and working of a Van de graff generator.

3. CURRENT ELECTRICITY

3.1. Defines electric current and writes its equation.
3.2. Explains Ohm's law and solves numerical problems related to it.
3.3. Experiments to find the resistance.
3.4. Defines drift velocity and formulates expression for current in terms of drift velocity.
3.5. Identifies the factors affecting the resistivity
3.6. Explains the dependence of temperature on the resistance of material and classifies materials according to temperature coefficient of resistance.
3.7. Identifies carbon resistors.
3.8. Explains series and parallel combination of resistances and formulates the equation of effective resistance of each case and solve numerical problems related to them.

3.9. Formulates equations of energy and power.

3.10. Identifies the factors affecting power and energy of a device.

3.11. Differentiates emf and voltage.

3.12. Formulates equation for effective emf and resistance when the cells, are connected in series and parallel.

3.13. States Kirchoff's first and second rules and solve problems.

3.14. States and explains Wheatstone principle.

3.15. Sketches the diagram of meter bridge, derives the expression to find unknown resistance, experiments to find the unknown resistance.

3.16. Sketches the diagram of Potentiometer and states principle of Potentiometer.

3.17. Experiments to compare the emf of cell and to measure the internal resistance of a cell.

4. MOVING CHARGES AND MAGNETISM

4.1. Explains Lorentz force and solves numerical problems related to it.

4.2. Formulates the equation of force on current carrying conductor and solves problem related to it and states Fleming's left hand rule.

4.3. Explains the motion of charged particles perpendicular and inclined to the magnetic field, formulates equations for various parameters related to the above motion such as velocity, radius, period , frequency and pitch and solves numerical problems related to it.

4.4. Explains a velocity selector, construction and working of a cyclotron, formulates equation for energy of a particle emitted from cyclotron and solves numerical problems related to it.

4.5. States Biot Savart law and expresses it mathematically.

4.6. Formulates equations for magnetic field at a point on the axis and centre of a current loop using Biot Savart law and solves problems related to it.

4.7. States Ampere's circuital law, applies it to find out magnetic fields produced by a straight infinite current carrying wire, a solenoid and a toroid and solves problems related to them.

4.8. Formulates equation of force per unit length between two parallel current carrying conductors and solves problems related to it.

4.9. Defines one ampere.

4.10. Formulates equation to find the torque on current loop and its magnetic moment and solves problems related with them.

4.11. Compares the fields due to electric and magnetic dipoles.

4.12. Formulates the equation of dipole moment of circular loop and revolving electron.

4.13. Defines Bohr magneton.

4.14. Explains the construction and the working of moving coil galvanometer and defines current and voltage sensitivities.

4.15. Explains the conversion of ammeter and galvanometer to voltmeter and solves problems related with them.

5. MAGNETISM AND MATTER

5.1. Explains the properties of bar magnet and cites examples.

5.2. Determines the magnitude of 'B' on the axial line of a solenoid.

5.3. Formulates the relation connecting 'm' and 'B'.

5.4. States Gauss's law in magnetism.

5.5. Explains the magnetic elements of earth.

5.6. Distinguishes the types of magnetic substances.

5.7. Explains the properties of magnetic substances.

5.8. Formulates the relation connecting B and H.

5.9. Defines retentivity and coercivity.

5.10. Explains hysterisis and classifies the types of magnets.

6. ELECTROMAGNETIC INDUCTION

6.1. Demonstrates and explains the Faraday's experiments, coil-magnet and coil-coil experiment.

6.2. Defines magnetic flux and its unit.

6.3. States and explains Faraday's law of electromagnetic induction and solves problems related to it.

6.4. States Lenz's law, illustrates it as a consequence of the law of conservation of energy.

6.5. Demonstrates and formulates motional emf and solves numerical problems related to it.

6.6. Explains eddy current and its applications, cites examples in various devices.

6.7. Explains self induction and mutual induction and formulates the expression for self inductance of a solenoid, mutual inductance between two coils and energy stored in a solenoid and solves numerical problems related to them.

6.8. Explains the working of ac generator and formulates the expression for the emf developed, gains the concept of sinusoidal variation of emf induced in it and solves numerical problems related to it.

7. ALTERNATING CURRENT

7.1. Formulates the expression for current and phase difference between emf and current and average power of an ac circuit containing R only and draws phasor diagram.

7.2. Formulates the expression for current and phase difference between emf and current and average power of an ac circuit containing inductor only and draws phasor diagram. Defines inductive reactance and solves numerical problems related to it

7.3. Formulates the expression for current and phase difference between emf and current and average power of an ac circuit containing capacitor only and draws phasor diagram.

7.4. Defines capacitive reactance and solves numerical problems related to it.

7.5. Formulates the expression for current and phase difference between emf and current of an LCR series circuit, draws phasor diagram, solves numerical problems related to it.

7.6. Explains impedence diagram, the term resonance, cites examples, Q factor and bandwidth.

7.7. Formulates average power in an LCR circuit and explains the terms power factor and wattless current.

7.8. Explains the mechanism of LC oscillations with the expression for frequency.

7.9. Explains various types of transformers, transformer equation and energy losses.

8. ELECTROMAGNETIC WAVES

8.1. Explains the insufficiency of Ampere's circutal theorem, defines displacement current, formulates equation for it, distinguishes between conduction and displacement currents and solves numerical problems related to it.

8.2. Explains the properties of electromagnetic waves and interprets the expressions for electric and magnetic fields in an electromagnetic wave.

8.3. Explains production and detection of different regions of electromagnetic spectrum.

9. RAY OPTICS AND OPTICAL INSTRUMENTS

9.1. Explains laws of reflection, principal axis, sign convention, principal focus and focal plane of spherical mirrors.

9.2. Draws geometry of reflection of incident ray on spherical mirrors and formulates the relation between radius of curvature and focal length.

9.3. Identifies the position, nature and size of image for different positions of an objects in spherical mirrors, draws ray diagram and formulates the mirror equation.

9.4. Defines magnification of spherical mirrors and formulates equation.

9.5. Explains refraction of light using examples.

9.6. Explains total internal reflection and its technological applications.

9.7. Explains refraction at spherical surfaces.

9.8. Explains refraction through a thin lens and formulates lens maker's formulae.

9.9. Defines magnification and power of lenses.

9.10. Formulates equations for effective focal length of lenses in contact and combination of a lens and a mirror.

9.11. Explains refraction through a prism and solves numerical problems related to it.

9.12. Explains dispersion of light, chromatic aberration and cites examples.

9.13. Explains scattering of light by citing examples.

9.14. Explains the structure and working of human eye, its defects and solves numerical problems related to it.

9.15. Explains the working of simple and compound microscopes and formulates the equations for magnification.

9.16. Explains reflecting and refracting types of telescopes and formulates their magnifications.

10. WAVE OPTICS

10.1. Explains Huygens' principle, formulates laws of refraction and reflection of plane waves using Huygens' principle, explains Doppler effect and solves numerical problems.

10.2. Explains coherent and incoherent addition of waves, explains interference and Youngs experiment and formulates expression for bandwidth and solves problems related with interference.

10.3. Explains diffraction due to a single slit and formulates the conditions for diffraction maxima and minima.

10.4. Solves problems related with diffraction due to a single slit.

10.5. Defines limit of resolution and resolving power of microscopes and astronomical telescope.s

10.6. Explains and formulates resolving power of microscopes and astronomical telescopes .

10.7. Explains Polarisation, polaroids and states Malus's law.

10.8. Explains Polarization by scattering, and polarization by reflection(Brewster's law).

11. DUAL NATURE OF RADIATION AND MATTER

11.1. Classifies the electron emissions.

11.2. Defines photoelectric effect and cites examples.

11.3. Explains the photo electric effect and wave theory of light.

11.4. Formulates the Einstein's photo electric equation.

11.5. Defines a photon and explains the photon picture of em radiation and explains the wave nature of matter.

11.6. Using de Broglie waves, formulates the de Broglie wave equation

11.7. Explains the experimental set up of Davison and Germer experiment and formulates the relation for de broglie wave length.

12. ATOMS

12.1. Describes Alpha particle scattering experiment and explains Rutherford's model of an atom.

12.2. Explains distance of closest approach and impact parameter.

12.3. Formulates expressions for the radius of electron orbit, speed and energy of electron in an orbit.

12.4. Identifies the drawbacks of Rutherford's atomic model.

12.5. Differentiates the Emission and Absorption atomic spectra of Hydrogen atom.

12.6. Explains various lines of Hydrogen spectrum.

12.7. Explains Bohr atom model and formulates the expressions for Radius, Speed and Energy of electron in an orbit.

12.8. Explains energy level diagrams of Hydrogen atom and identifies the limitations of the Bohr model.

12.9. Formulates expression for frequency of various spectral lines of Hydrogen atom (Rydberg formulae) and identifies Rydberg constant.

12.10. Draws diagram showing line spectra of Hydrogen atom.

12.11. Explains the postulate of Quantization of electron orbit using De Broglie's hypothesis.

13. NUCLEI

13.1. Explains the composition of atomic nucleus and defines atomic mass unit (amu).

13.2. Distinguishes isotopes, isobars and isotones in terms of nuclear constituents and cites examples.

13.3. Explains the formulae for Nuclear radius and solves numerical problems.

13.4. Explains the concepts mass defect and nuclear binding-energy using Einstein's mass-energy relation and solves numerical problems.

13.5. Sketches and explains the BE per nucleon curve.

13.6. Explains nuclear force and its properties.

13.7. Explains Becquerel's discovery of radioactivity.

13.8. Defines Rate of disintegration, Half-life and Mean-life and Formulates expressions for them.

13.9. Solves numerical problems related to Radioactivity.

13.10. Explains Alpha, Beta and Gamma decays.

13.11. Explains Nuclear Fission and Nuclear Fusion.

13.12. Describes nuclear chain reaction and distinguishes between controlled and uncontrolled chain reactions with examples of Nuclear Reactor and Atom Bomb.

14. SEMICONDUCTOR ELECTRONICS: MATERIALS, DEVICES AND SIMPLE CIRCUITS

14.1. Defines and identifies valance band, conduction band and forbidden energy gap.

14.2. Classifies solids into conductors , semiconductors, and insulators based on band theory.

14.3. Differentiate between intrinsic, extrinsic, n-type and p-type semi conductors by citing examples.

14.4. Defines the terms-potential barrier, depletion region, forward biasing , reverse biasing and breakdown voltage.

14.5. Draws the V-I characteristic of a p-n junction.

14.6. Explains the working of rectifier, LED and photodiode.

14.7. Explains the working of a solar cell, zener diode and draws its V-I characteristics.

14.8. Solves numerical problems related to the working of a zener diode as a voltage regulator.

14.9. Differentiate different regions of a transistor and different types of transistors.

14.10. Explain the biasing of transistor and current conduction through it.

14.11. Explains working of the transistor as an amplifier with the help of a diagram.

14.12. Derives the relation between various gains.

14.13. Solves simple numerical problems related to various gains.

14.14. Explains the working of the transistor as an oscillator with the help of a diagram.

14.15 Draws the graph showing Ic versus time.

14.16. Identify different logic gates, writes its truth table and draws the output wave form for different input wave forms.

15. COMMUNICATION SYSTEMS

15.1. Explains elements of communication system and basic terminology used in it.

15.2. Identifies bandwidth for speech, music, video etc. various types of signals and various types of medium like conducting wire, free space, fibre optic cable.

15.3. Explains the three modes of propagation of electro magnetic waves and prepare charts on advantages and disadvantages of each mode.

15.4. Explains the necessity of modulation and solves numerical problems related to it.

15.5. Explains amplitude modulation and formulates an expression for amplitude modulated signal.

15.6. Defines modulation index, draws graph of amplitude versus ω for A.M signal, labels side bands and explain side band frequencies.

15.7. Explains the production and detection of amplitude modulated wave using a block diagram.

Scheme of work

Chapter	Month	Chapters	Periods	Weight of Score
1	June	Electric Charges and Fields	14	4
2	June July	Electrostatic Potentials and Capacitors	11	4
3	July	Current Electricity	22	6
4	August	Moving Charges and Magnetism	18	5
5	August	Magnetism and Matter	7	3
6	September	Electromagnetic Induction	8	3
7	October	Alternating Current	12	4
8	October	Electromagnetic Waves	4	2
9	October November	Ray Optics and Optical Instruments	20	7
10	November	Wave Optics	10	4
11	November	Dual Nature of Matter and Radiation	8	3
12	December	Atoms	8	3
13	December	Nuclei	10	4
14	January	Semiconductor Electronics: Materials, Devices and Simple Circuits	18	5
15	January	Communication Systems	10	3
Total			**180**	**60**
	February	Revision		

Physics Practicals

Term	Units	Experiments	Periods	Remarks
1	Current Electricity Moving Charges and Magnetism Magnetism and Matter Alternating Current	Experiments 1 to 8 (From Section A)	30	Any 12 Experiments from both Section A and Section B
2	Ray Optics and Optical Instruments Semiconductor Electronics: Materials, Devices and Simple Circuits	Experiments 1 to 10 (From Section B)	30	
3	Model Practical Exam			

Note:

1. A minimum of 10 experiments should be done from Plus1 Practicals and an internal Practical Examination should be conducted at the end of First year course.

2. A minimum of 22(10+12) Experiments should be done from both Plus1 and Plus2 Practicals.

1

ELECTRIC CHARGES AND FIELDS

Introduction

Electrostatics is a branch of physics that deals with the phenomena and properties of stationary or slow-moving electric charges with no acceleration. In this chapter we are dealing with charges at rest and related laws like Coulomb's Law, Gauss's Law and their applications. The concept of field lines in an electric field and the idea of electric flux density are introduced. In this unit, we make use of the strategies like general discussion, group discussion, simple experiments, ICT, etc. for attaining the required learning outcomes.

UNIT FRAME

Concepts & Process skills	Process/Activity with assessment	Learning outcomes
♦ Electric charges, Conductors and Insulators • Experimenting • Observing • Classifying • Interpreting • Analyzing	• General Discussion on electric charges • Simple Experiment - Frictional Electricity ICT - Types of Charges and electroscope	• Explains the types of charges and electroscope. • Distinguishes conductors and insulators by citing examples.
♦ Charging by conduction and induction ♦ Basic properties of electric charges • Observing • Experimenting • Analysing • Interpreting	• Simple experiment - Charging by conduction and induction. • General discussion on basic properties of charges. **Assessment:** • Active participation in General discussion (Process) • Activity Log Book (Portfolio)	• Explains the charging by conduction and induction with examples. • Explains the basic properties of charges
♦ Coulomb's law, Forces among multiple charges. • Observing • Problem solving. • Analysing • Interpreting	• General Discussion on Coulomb's Law • ICT on Coulomb's Law	• States and formulates the Coulomb's Law and solves numerical problems related to it. • Explains the forces among multiple charges.
♦ Electric field ♦ Electric field due to a system of charges. ♦ Physical significance of electric field. • Observing • Problem Solving • Analysing • Interpreting	• ICT about electric field • General Discussion on electric field due to a system of charges. **Assessment:** • Active participation in General discussion (Process) • Activity Log Book (Portfolio)	• Explains electric field, intensity and its physical significance. • Formulates the electric field due to a system of charges and solves numerical problems related to it.

Unit Frame

Concepts & Process skills	Process/Activity with assessment	Learning outcomes
♦ Electric field lines Electric flux • Observing • Identifying • Analysing	• ICT - PhET simulation on electric field lines and flux. • General discussion on Electric Flux	• Explains the properties of electric field lines. • Defines electric flux and formulates the relation connecting electric flux and intensity.
♦ Electric dipole -Field at a point on its axial and equato rial lines • Problem Solving • Observing • Analysing	• General discussion on Electric Flux • General Discussion on electric dipole and intensity at a point on its axial and equatorial lines. • ICT on electric dipole.	• Defines electric dipole and dipole moment • Formulates the electric field intensity due to an electric dipole on its axial and equatorial lines and solves numerical problems related to it.
♦ Dipole in a uniform external field. • Observing • Problem Solving • Analysing	• General Discussion on dipole in a uniform external field • ICT in the above case.	• Formulates the expression for torque on a dipole in a uniform electric field.
♦ Continuous charge distribution • Observing • Problem Solving • Analysing	• General Discussion on continuous charge distribution. • Group Discussion on continuous charge distribution.	• Explains different types of continuous charge distribution and their units.
♦ Gauss's Law Applications of Gauss's Law • Observing • Problem Solving • Analysing • Interpreting.	• General Discussion on Gauss's Law and its applications. • ICT on Gauss's law. • **Assessment:** • Active participation in General discussion (Process) • Activity Log Book (Portfolio)	• Explains and proves Gauss's Law in electrostatics. • Formulates the expression of electric intensity due to an infinitely long straight uniformly charged wire, uniformly charged infinite thin sheet and uniformly charged thin spherical shell and solves problems related with them.

Towards the Unit...

Content: Electric field lines

Suggested Activity: PhET Simulation - Charges and Fields

To transact the idea of Electric field lines, teacher uses the simulation named Charges and Fields available in www.phet.colorado.edu.

Discussion Points:

Teacher places a single charge from the positive charge basket (Available on the right side of the window). By clicking the show hi-res view (or show lo-res view), the variation of Electric Field intensity is seen (in red colour).

How do you find the Intensity of Electric field at a point around this source charge?

(Hint: By placing a unit positive charge at the given point)

Teacher asks a student to come and do the simulated experiment by using the options available in the above PhET Simulation. A test charge is taken from the E - Field sensor basket and placed at various locations. What do you observe?

(Hint: The arrow showing the magnitude and direction of Electric field changes in length and direction at different locations)

Teacher asks another student to do the same experiment using negative source charge.

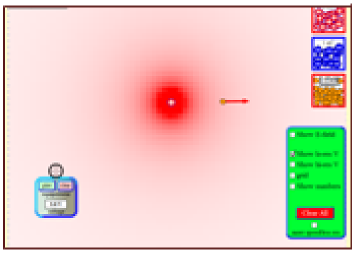


Figure 1

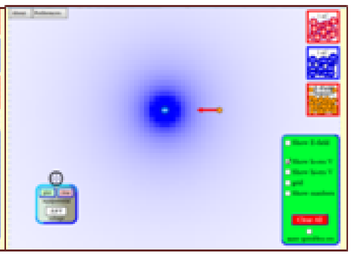


Figure 2

Teacher introduces the concept Electric field lines. To make the idea concrete, teacher asks the students to do the following experiment in PhET.

Place a test charge near a positive source charge. A long Electric field line directing outward is obtained. Place another test charge on the head of arrow. Another Electric field line with decreased length is obtained. Repeat this experiment, and a screen is obtained as in the figure 3.

Students are asked to repeat the experiment with a negative charge, a system of positive and negative charges, a system of two positive charges and a system of two negative charges.

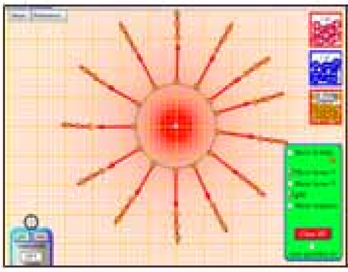


Figure 3

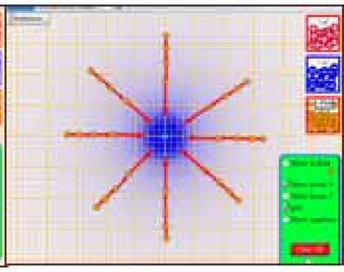


Figure 4

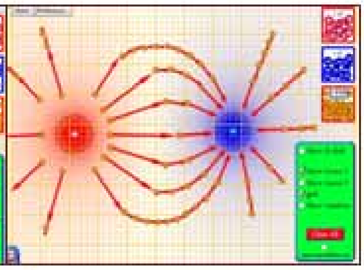


Figure 5

Teacher explains various properties of Electric field lines and asks the students to draw field lines to Point charge, system of two like and unlike charges in their activity logbook.

Consolidation

Teacher consolidates the concept Electric Field lines and their properties.

REPOSITORY OF CE ITEMS

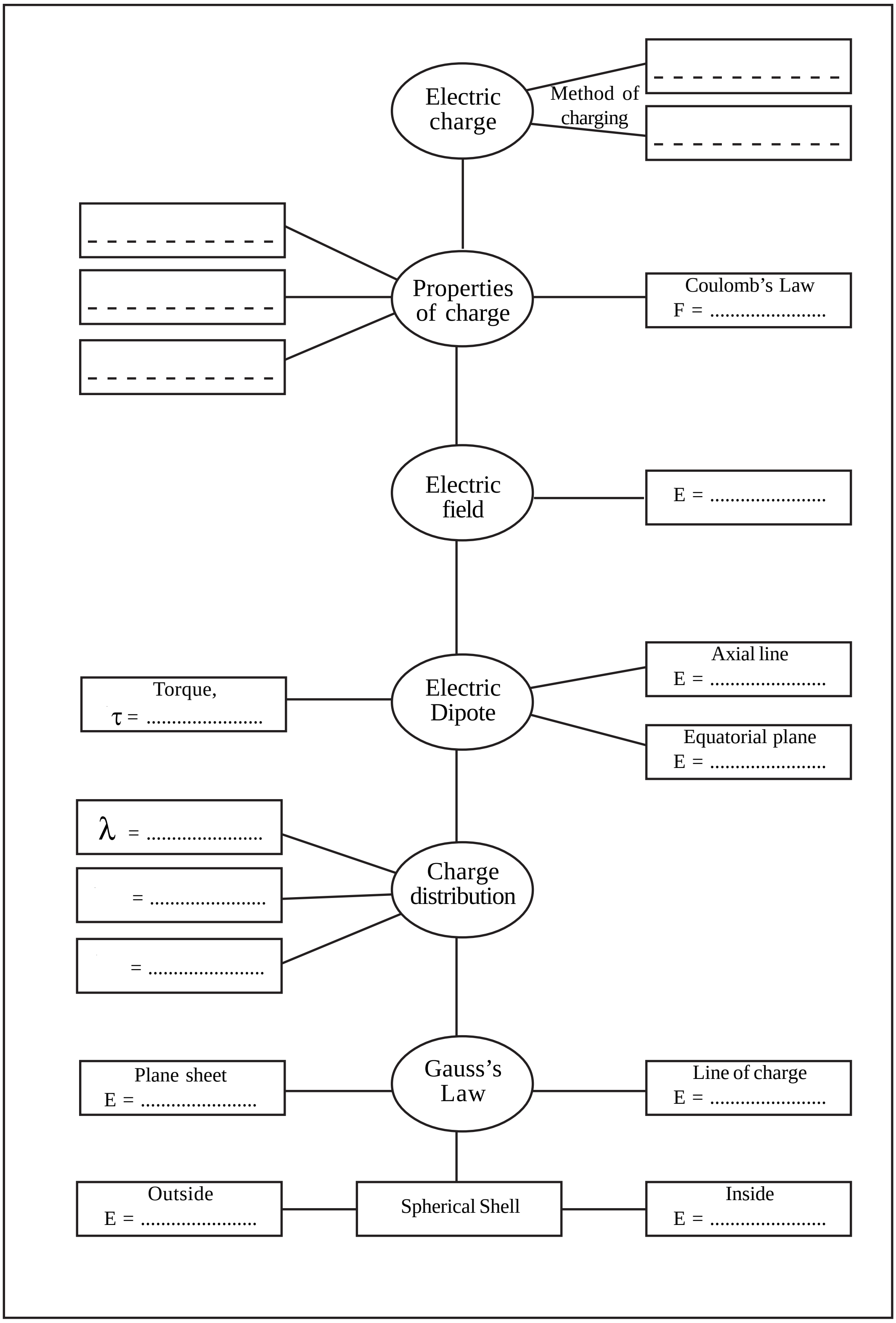
1. Process Assessment
   - General Discussion
   - Group Discussion
2. Portfolio Assessment
   - Activity Log book
   - Worksheets
   -
3. Unit Based Assessment
   - Unit Test
   -

ICT Possibilities

- PhET Simulations

Worksheets

Worksheet-1: Concept Mapping


Electric charge
Method of charging
Properties of charge
Coulomb's Law
F = ...
Electric field
E = ...
Electric Dipote
Torque,
τ = ...
Axial line
E = ...
Equatorial plane
E = ...
Charge distribution
λ = ...
= ....
= ....
Gauss's Law
Plane sheet
E = ...
Line of charge
E = ...
Spherical Shell
Outside
E = ...
Inside
E = ...

Worksheet-2: Electric Force and Field

Complete the table

Sl. No.	Charge creating the electric field (Q)	Charge used to test the electric field (q)	Force experienced by test charge	Electricfield intensity (E)	Distance
1	4×10^{-4} C	1×10^{-6}C	0.20 N	....	d
2	4×10^{-4} C	2×10^{-6}C	....	$2 \times 10^{+5}$ N/C	d
3.	8×10^{-4} C	1×10^{-6}C	....	$2 \times 10^{+5}$ N/C	2d
4.	4×10^{-4} C	....	0.64 N	$2 \times 10^{+5}$ N/C	0.5d

Work sheet-3: Electric dipole

Complete the table

Charge	Dipole length (2a) mm	Dipole moment (P)	Distance from the centre of dipole (r)	Electric field along axial line	Electric field along equat-orial line
10×10^{-6}C	0.5×10^{-6}m	....	1 m	....	....
10×10^{-6}C	0.5×10^{-6}m	....	2 m	....	....
10×10^{-6}C	0.5×10^{-6}m	....	3 m	....	....

Work sheet 4: Draw Electric field lines in the following charge distribution

Charge distribution	Electric field lines due to charge distribution
Point charge Dipole Infinite long charged wire Infinite plane sheet Spherical shell	

Work sheet 4: Complete the table by taking, E_0 = 100 units.

r	r^2	r^3	Due to Infinite wire	Due to Point charge/ Spherical Conductor	Due to Dipole
			E_0/r	E_0/r^2	E_0/r^3
1	1	1	100	100	100
2	4	8	50	25	
3	9	27			
4	16	64			
5	25	125	20	4	0.8

? Sample TE Items

1. A] A body is negatively charged by friction. It means that

   a) The body gains some electrons b) The body loses some electrons

   c) The body loses some neutrons d) The body gains some neutrons

   B] Ordinary rubber is an insulator. But special rubber tyres of air crafts are made slightly conducting. Why?

   C] A polythene piece rubbed with wool is found to have a negative charge of 4×10^{-6}C. Calculate the number of electrons transferred from wool to polythene. *(Hint : q = ne)* *(Score : 1+2+2)*

2. A] The SI unit of relative permittivity is

   (a) Nm^2C^{-2} (b) $Nm^{-2}C^2$ (c) $C^2N^{-1}m^{-2}$ (d) None of these

   B] How does the Coulomb force between two point charges depend upon the dielectric constant of the intervening medium?

   (Hint : $F \ \alpha \ \frac{1}{\tau}$ *)*

   C] Two point charges repel each other with a force F when placed in water of dielectric constant 81. What will be the force between them when placed at the same distance apart in air? *(Score: 1+1+2)*

   (Hint : $F_{air} = F_{water} \times \varepsilon r$ *)*

3. A] Coulomb's Law for the force between electric charges most closely resembles:

   (a) Hooke's law (b) Newton's law of Gravitation

   (c) Gauss's theorem (d) Law of Conservation of Energy

   (Hint : c)

B] What is the use of a Gold leaf electroscope?

C] Mention any two properties of Electric field lines. *[Score: 1+1+2]*

4. Match the following

Sl.No	A	B
1	Electric Field	$C^2N^{-1}m^{-2}$
2	Electric dipole moment	NC^{-1}
3	Electric flux	Cm
4	Absolute Permittivity	Vm

(Score: 2)

5. An electric dipole is a pair of equal and opposite point charges q and -*q*, separated by a distance 2*a*.

A] A particular dipole consists of a positive charge at x = 0 m, y = 0.1 m and a negative charge at x = 0 m, y = -0.1 m. The direction of the dipole moment is along

(a) +× (b) -× (c) +y (d) -y

B] Obtain an expression for electric field at a distance r on the perpendicular bisector of an electric dipole.

C] An electric dipole with dipole moment 4×10^{-9} C. m is aligned at 30° with the direction of a uniform electric field of magnitude 5×10^4 NC^{-1}. Calculate the magnitude of the torque acting on the dipole.

(Hint : τ = PE Sin) *(Score: 1+2+2)*

6. A] The ratio of Electric fields on the axial line and at the equatorial line of an electric dipole will be

(a) 1:1 (b) 2:1 (c) 4:1 (d) None of these

B] An arbitrary surface encloses a dipole. What is the electric flux through this surface? *(Hint : = 0)*

C] An electric dipole, when held at 30^o with respect to a uniform electric field of 10^4 NC^{-1} experiences a torque of 9×10^{26} Nm. Calculate the dipole moment. *[Score: 1+1+2]*

References

1. PHYSICS Textbook for Class 12 - NCERT
2. Fundamentals of Physics - HC Verma (*Bharati Bhavan Publishers & distributors*)
3. Fundamentals of Physics Halliday, Resnick & Walker (Wikey India)
4. www.phet.colorado.edu
5. Introduction to Electrodynamics-David J Griffiths (*Prentice Hall, India*)

2

ELECTROSTATIC POTENTIAL AND CAPACITANCE

Introduction

Electric potential is a location-dependent quantity that expresses the amount of potential energy per unit charge at a point. In this unit we are discussing how to use the concept of potential and potential energy in the study of electrostatic phenomena. Equipotential surfaces, the properties of conductors and dielectrics, Capacitors and their combinations are also discussed.

UNIT FRAME

Concepts & Process skills	Process/Activity with assessment	Learning outcomes
♦ Electrostatic potential and potential difference. • Observing • Problem solving • Analysing	• General Discussion on electrostatic potential and potential difference.	• Explains the difference between electrostatic potential and potential difference.
♦ Potential due to a point charge and due to an electric dipole • Observing • Problem solving • Analysing • Interpreting	• General discussion on potential due to a point charge and electric dipole. • ICT on electric dipole	• Formulates the potential due to a point charge and an electric dipole • Draws the graph and solves problems related to potential
♦ Potential due to a system of charges - Equipotential surface, - Potential energy of a system of charges. • Observing • Problem solving. • Analysing • Interpreting	• ICT on potential due to a system of charges and equipotential surface. (worksheet 1) • General Discussion on P.E of a system of charges. **Assessment:** • Active participation in General discussion (Process) • Activity Log Book (Portfolio) • Worksheet (Portfolio)	• Formulates the potential due to a system of charges. • Explains the equipotential surface by citing examples. • Formulates the potential energy of a system of charges and solves numerical problems related to it.
♦ Potential energy in an external field - Single charge - System of two charges and dipole. • Observing • Identifying • Analysing	♦ General Discussion on potential energy of single charge, system of two charges and dipole in an external field.	• Explains the potential energy due to a single charge in an external field and defines electron volt • Formulates the potential energy due to a system of two charges and dipole in an external electric

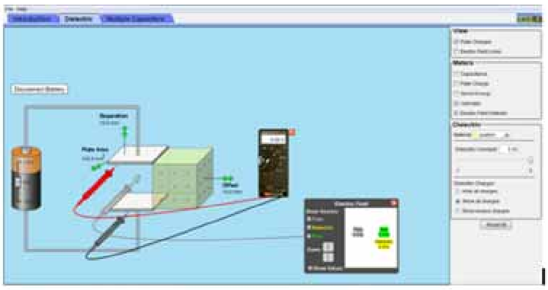
Concepts & Process skills	Process/Activity with assessment	Learning outcomes
		field and solves numerical problems related to them.
• Electrostatics of conductors, Dielectrics and polarization • Observing • Analysing • Interpreting	• General discussion on electrostatics of conductors. ICT on dielectrics and polarisation	• Explains the concept of electrostatics of conductors. • Differentiates different dielectrics by citing examples and explains electric polarization.
♦ Capacitors and Capacitance - Parallel plate capacitor - Effect of dielectric • Observing • Problem Solving • Interpreting • Analysing	• General discussion and ICT on capacitors and parallel plate capacitor. • General discussion and demonstration using PhET simulation about dielectric polarization. (worksheets 2, 3 and 4) **Assessment:** • Active participation in General discussion (Process) • Activity Log Book (Portfolio) • Worksheet (Portfolio)	• Defines capacitance and its unit. • Formulates the expression for capacitance of a parallel plate capacitor and solves problems related to it. • Explains the effect of dielectric on capacitance.
♦ Combinations of capacitors • Observing • Experimenting • Classifying ♦ Energy stored in a capacitor • Observing • Problem Solving • Interpreting • Analysing	• General Discussion on combination of capacitors. • Simple experiment on combination of capacitors. • General discussion on energy of a capacitor.	• Formulates the expression for effective capacitance when capacitors are connected in series and parallel and solves problems related to it. • Formulates the energy of a capacitor.
♦ Van de graff generator • Observing • Identifying • Interpreting • Analysing	• ICT- video showing Van de graff generator **Assessment:** • Active participation in General discussion (Process) • Activity Log Book (Portfolio) • Worksheet (Portfolio)	• Explains the construction and working of a Van de graff generator.

Towards the Unit...

Content: Effects of Dielectrics on a Capacitor

Suggested Activity: PhET Simulation - Capacitor Lab

Teacher brushes up the idea of Capacitance of a Parallel plate capacitor and shows a simulation - Capacitor Lab - which is available at *www.phet.colorado.edu*.



Discussion Points:

Teacher connects voltmeter to the upper and lower plates of the capacitor and places electric field detector in between the plates (the tools available in the Simulation).

- Can you see the readings of potential difference and electric field between the plates?

Hint: The capacitor is charged gradually by increasing the battery voltage.

- What do you see now?

[Hint: Potential difference and Electric field between the plates increase. ie, $V \propto E$]

After charging the Capacitor, Teacher disconnects the battery and increases the distance between the plates.

- What do you observe now?

[Hint: E does not change, but V increases. ie, $V \propto d$]

- Then how do you relate E, V and d?

[Hint: $V = Ed$]

Teacher introduces a dielectric slab between the plates.

- What do you observe inside the dielectric slab? What change does occur in the Electric field?

[Hint: Dielectric polarizes and net electric field decreases]

- Why does the net field decrease?

[Hint: The field produced by the dielectric polarization is opposite to the applied field]

- The students are asked to write a relation connecting the charge density of the Capacitor plate and the Electric field?

[Hint: $E = \frac{\sigma}{\varepsilon_0}$ *]*

- Then how do you express the net Electric field?

[Hint: $E = \frac{\sigma - \sigma_p}{\varepsilon_0}$ *]*

- What is the expression for Potential difference between the plates?

[Hint: $V = Ed = \frac{\sigma - \sigma_p}{\varepsilon_0} d$ *]*

- What happens to σ_p when Electric field is increased?

[Hint: σ_p *increases with E]*

Teacher explains that $\sigma - \sigma_p$ also increases with E. Since E increases with σ, $\sigma - \sigma_p$ increases with σ.

ie, $\sigma - \sigma_p = \frac{\sigma}{k}$, where k is the Dielectric constant of the medium.

Now, How can you re write the expression $V = \frac{\sigma - \sigma_p}{\varepsilon_0} d$

[Hint: $V = \frac{\sigma d}{\varepsilon_0 k} = \frac{Qd}{A\varepsilon_0 k}$ *]*

Then, what will be the equation for Capacitance?

[Hint: $C = \frac{Q}{V} = \frac{\varepsilon_0 KA}{d}$ *]*

Teacher asks the students to do the worksheet No-2.

Consolidation

Teacher consolidates the discussion by explaining the effect of dielectric in a parallel plate capacitor.

REPOSITORY OF CE ITEMS

1. Process Assessment
   - General Discussion
   - Group Discussion
2. Portfolio Assessment
   - Activity Log book
   - Worksheets
3. Unit Based Assessment
   - Unit Test

ICT Possibilities

- PhET Simulations

Worksheet 1: Complete the Table

Charge distribution	Shape of Equipotential Surface
Point charge	
Dipole	
Linear charge	
Plane charge	
Spherical charge	

Worksheet 2: Using PhET simulation (Capacitor Lab)

(Take readings from PhET simulation)

Area of the plate(A)	Distance between the plates(d)	Dielectric constant of medium in between the plates	Electric field(E)	Potential difference (V)	Charge (Q)	Capacitance (C)
100 mm^2	5 mm 7 mm 10 mm	5 5 5				
100 mm^2 200 mm^2 300 mm^2	10 mm	5 5 5				
100 mm^2	10 mm	1 3 5				

Worksheet 3

Complete the table

	Capacitance C (μF)	Potential difference (V)	Total charge (Q)	Potential difference across C_1 (V_1)	Potential difference across C_2 (V_2)	Charge stored in the capacitor C_1 (q_1)	Charge stored in the capacitor C_2 (q_2)
Capacitor-1 C_1	10	12					
Capacitor-2 C_2	20	12					
C_1 and C_2 are in series		12					
C_1 and C_2 are in Parallel		12					

Worksheet 4

Complete the Table

	Capacitance C (μF)	Potential difference (V)	Total charge (Q)	Total energy stored (U)	Energy stored in the capacitor 1 (U_1)	Energy stored in the capacitor 2 (U_2)	Remarks about energy.
Capacitor-1 C_1	10	12					
Capacitor-2 C_2	20	12					
C_1 and C_2 are in series		12					
C_1 and C_2 are in Parallel		12					

? Sample TE Items

1. A) In a region of constant potential

   (a) the electric field is uniform

   (b) the electric field is zero

   (c) there can be no charge inside the region.

   (d) the electric field shall necessarily change if a charge is placed outside the region

   B] Arrive at an expression for Electric Potential at a distance r from a point charge q placed in vacuum

   C] In a television picture tube electrons are accelerated from rest through a potential difference of 10 kV using an electron gun. What is the muzzle velocity of the electrons emerging from the gun?

   [Score: 1 + 2 +1]

Hint: A) b

c) $v \quad \sqrt{\frac{2eV}{m}}$ m / s

2. A) The quantity electric potential is defined as the amount of _____.

   (a) electric potential energy (b) force acting upon a charge

   (c) potential energy per charge (d) force per charge

   b) Obtain an expression for the electric potential due to an electric dipole *[Score: 1 + 3]*

Hint: A) c

3. A proton is moved 10 cm along a path parallel to a uniform electric field of strength 10^5 V / m.

   (a) What is the change in the potential energy of the proton in the above case?

   (b) Express the change in potential energy in electron volts?

   (c) How much work would be done if the proton is moved perpendicular to the electric field? *[Score: 2 + 1]*

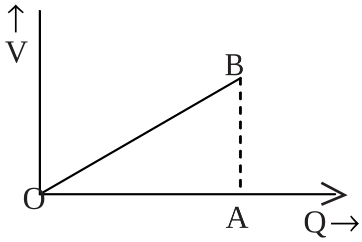
Hint: a) $E = 10^5$ v / m , 10^5 v / m, $dx = 10 \times 10^{-2}$ m

$dv = Edx$; $du = qdv$

b) $du = \frac{1.6 \quad 10^{\ 19} \quad 10^4}{1.6 \quad 10^{\ 19}} = 10^4$ eV

c) zero

4.



a) How can you find energy stored in the capacitor using the above graph?

b) The plates of a parallel plate capacitor having area 90 cm^2 each are separated by 2.5mm. What would be its Capacitance? [ε_0 = 8. 85 × 10^{-12} $C^2N^{-1}m^{-2}$] [Score: 1 + 2]

Hint:

a) Area under the graph

b) $C = \frac{A\varepsilon_0}{d}$

5. For a parallel plate capacitor with each plate of area 'A' separated by a distance 'd' in air, the Capacitance is given by, $C = \frac{A\varepsilon_0}{d}$

a) Represent the variation of charge 'q' given to the capacitor of capacitance 'C' with potential difference 'V' in a graph?

Hint: Slopped straight line

b) If you connect the plates of a parallel plate capacitor by a copper wire, what happens to its capacitance? Justify your answer.

Hint: Capacitance is equal to zero. No charges are stored in the plates.

c) Using the above expression, show that the energy density of a parallel plate capacitor is $\frac{1}{2}\varepsilon_0 E^2$ where 'E' is electric field between parallel plates. [Score: 1 + 2 + 3]

6. A) Two metal spheres of radii R_1 and R_2 are charged to the same potential. The ratio of charges on the spheres is given by

(a) $\sqrt{R_1} : \sqrt{R_2}$ (b) $R^2_1 : R^2_2$ (c) $R_1 : R_2$ (d) $R^3_1 : R^3_2$

Hint: (c)

B) What do you mean by equipotential surfaces?

C) Draw the equipotential surface of an electric dipole

[Score: 1 + 1 + 1]

Hint: $R_1 : R_2$

7. a) Electric potential at the equatorial line of a small dipole with dipole moment p at a distance r from the dipole is given by

(a) Zero (b) p / 4 ðå$_0$r^3 (c) p / 4ðå$_0$r^2 (d) 2p / 4ðå$_0$r^3

Hint: (a)

b) What is the electrical potential energy of an electron located at 10.0 cm from a charge of +6.0 µC?

Hint: PE = $\frac{1}{4 \;_0}\frac{q_1 q_2}{r}$

c) How much work is required to move the electron to an infinite distance from the charge? [Score: 1 + 2 + 1]

Hint: same value of PE as b.

8. a) What is the velocity of an alpha particle (containing two protons and two neutrons), if it is accelerated from rest through a potential difference of 100kV (in ms^{-1})

(a) 1.1×10^6 (b) 1.6×10^6 (c) 2.1×10^6 (d) 3.1×10^6

Hint: $\frac{1}{2}mv^2 = qv$

b) Deduce an expression for the energy stored in a Capacitor.

c) A sphere of radius 1 cm has potential of 8000 V, compute the charge density on its surface.

Hint: $v = \frac{1}{4 \;_0}\frac{q}{r}$; $\sigma = \frac{q}{A}$ [Score: 1 + 2 + 2 =5]

REFERENCES

1. PHYSICS Text book for Class 11 - NCERT
2. Concepts of Physics - HC Verma (Bharati Bhavan)
3. Fundamentals of Physics - Halliday, Resnick and Walker (Wikey India)
4. www.phet.colorado.edu
5. Introduction to Electrodynamics - David J Griffiths (Prentice Hall India)

3

CURRENT ELECTRICITY

Introduction

Electric current is the flow of charged particles. We study the properties of electric currents, Ohm's law, drift velocity, temperature dependence on resistance, Kirchhoff's laws, Wheat stone network, Meter bridge potentiometer. In this chapter, general discussion, PhET simulations, simple experiments, project works and lab works are the activities used to study some basic laws of steady electric currents and circuits.

Unit Frame

Concepts & Process skills	Process/Activity with assessment	Learning outcomes
♦ Electric current Ohms law • Experimenting • Identifying and controlling variables • Measuring and charting	• General discussion • Experiment - Ohm's law	• Defines electric current and writes its equation • Explains Ohm's law and solves numerical problems related to it • Experiments to find the resistance
♦ Drift velocity and origin of resistivity • Making operational definition • Identifying and controlling variables	• General discussion ICT- PhET simulation	• Defines drift velocity and formulates expression for current in terms of drift velocity • Identifies the factors affecting the resistivity
♦ Temperature dependence of resistance • Observing • classifying ♦ Carbon resistors Combination of resistors • Experimenting • observing	• General discussion • ICT - video showing dimming of brightness of bulb with temperature (*MIT demonstration video*) • Demonstration for measuring carbon resistor using its colour code and verify it by using multi meter • General discussion • Group Discussion • Simple experiment to find the effective resistance when it connected in series and in parallel	• Explains the dependence of temperature on the resistance of material and classifies materials according to temperature coefficient of resistance • Identifies carbon resistors • Explains series and parallel combinations of resistances and formulates the equation of effective resistance in each case and solves numerical problems related to them.
♦ Electric energy and power • Experimenting • Observing Identifying and controllng variables	• Simple experiment using two bulbs having different power **Assessment** • Involvement in General discussion (Process) • Activity logbook (Portfolio)	• Formulates equations of energy and power • Identifies the factors affecting power and energy of a device

Concepts & Process skills	Process/Activity with assessment	Learning outcomes
♦ Cell - emf and internal resistance ♦ Cells in series and parallel • experimenting • Observing • Predicting	• Simple experiment using cells with different emf and an external resistance (bulb) (worksheet 1, 2 and 3)	• Differentiates emf and voltage • Formulates equation for effective emf and resistance when the cells are connected in series and parallel
♦ Kirchoff's rule • observing	• Simple experiment using carbon resistors, bread board and multimeters	• States Kirchoff's first and second rules and solves problems.
♦ Wheatstone bridge • Experimenting • Using number • relationship	• Simple experiment using carbon resistors of different values.	• States and explains Wheatstone principle
♦ Meter bridge experimenting	• General discussion • Experiment to find the unknown resistance	• Sketches the diagram of meter bridge, derives the expression to find unknown resistance and experiments to find the unknown resistance
♦ Potentiometer experimenting	• Experiment to compare the emf of cells and measure the internal resistance of a cell **Assessment:** • Involvement in General discussion (Process) • Activity logbook (Portfolio) • Worksheets (Portfolio).	• Sketches the diagram of Potentiometer and states principle of Potentiometer • Experiments to compare the emf of cell and to measure the internal resistance of a cell

Towards the Unit...

Content: Cell- Emf and internal resistance and Combination of cells

Suggested Activity: Simple Experiments

Teacher supplies a new cell having emf E (6 V), a bulb, voltmeter , ammeter, key and connecting wires.

Students are directed to draw a circuit diagram that allows current flow through bulb, by using a cell.

Teacher asks the students to make the connection as drawn by them and record the observations in the work sheet 1

Discussion points

- What is the use of a key in the circuit? How will you connect a key in the circuit? (*series/parallel)*
- How can you measure potential difference across the cell? *(connect a voltmeter parallel to the cell)*

Name the device to measure current through the circuit? How is it connected in the circuit.

(using ammeter, connected in series)

Students modify the circuit diagram by drawing key, voltmeter and ammeter Teacher asks students to make connections as in the circuit diagram and measure the pd across the cell when key is closed.

(There is a current flow in the circuit)

- What is the value of p.d across the cell? Is it 6V? (No, we get a p.d which is less than 6V) Teacher differentiate the terms emf and voltage (E and V)
- Why does the p.d across the cell decrease when ever there is a current flow through the circuit?

(due to p.d across the internal resistance of the cell (Ir))

- What is the net p.d across the cell at the time of current flow? *($V = E- Ir$)*

Measure the p.d across the bulb if there is a current flow (hint: $V = IR$)

Is there any relation between p.d across the cell and p.d across the bulb?

(Both are same)

- How can we measure the value of internal resistance by measuring E, V and I ?

$(r=\frac{E-V}{I})$

Series combination

Students are directed to draw a circuit diagram of cells connected in series across a bulb with ammeter, voltmeter and key

Teacher supplies two cells having different emfs 6V and 4V, and ask to repeat the experiment as shown above by two cells separately and connecting two cells in series and record the observations in the worksheet 1.

Disscussion

In series combination , what is the current through each cell? (Hint: same)

What happens to the voltage across each cell?

(different $V_1= E_1- Ir_1$, $V_2= E_2- Ir_2$)

What is the p.d across the two cells?

($V=V_1+V_2 = E_1+E_2- I (r_1+ r_2)$)

If two cells are considered as single cell having emf E and internal resistance 'r', what is the equivalent potential difference across the cell

($V= E-Ir$)

Students arrive at the equation for equivalent emf and internal resistance

($E= E_1+E_2$, $r = r_1 +r_2$)

How can we measure the value of effective internal resistance by measuring E, V and I ?

$(r=\frac{E-V}{I})$

- **Parallel combination**

Students are directed to draw a circuit diagram of cells connected in parallel across a bulb with ammeter, voltmeter and key

Teacher asks the students to repeat the experiment as shown above by connecting two cells in parallel and record the observations in the worksheet1

Discussion points

In parallel combination , what happened to the voltage across each cell?

(same V)

What is the current through each cell?

$$(\text{different} \quad I_1 = \frac{E_1 - V}{r_1}, \quad I_2 = \frac{E_2 - V}{r_2})$$

What is the net current due to both cells?

$$(I = I_1 + I_2 = \frac{E_1 \quad V}{r_1} \quad \frac{E_2 \quad V}{r_2})$$

$$= \frac{E_1}{r_1} \quad \frac{E_2}{r_2} \quad v \quad \frac{1}{r_1} \quad \frac{1}{r_2}$$

What is the equation for V?

$$V = \frac{E_1 r_2 \quad E_2 r_1}{r_1 \quad r_2} - I \frac{r_1 r_2}{r_1 \quad r_2}$$

If two cells are considered as single cell having emf E and internal resistance r, what is the current due to this equivalent cell?

$$(I = \frac{E - V}{r})$$

Students arrive at the equation for equivalent emf and internal resistance

$$(E = \left(\frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}\right) \quad \text{and} \quad \frac{1}{r} = \left(\frac{1}{r_1} + \frac{1}{r_2}\right))$$

Consolidation

Teacher consolidate the concept of emf, internal resistance and comination of cells.

REPOSITORY OF CE ITEMS

1. Process Assessment
   - General Discussion
   - Group Discussion
   - Simple Experiments
2. Portfolio Assessment
   - Activity Log book
   - Worksheets
3. Unit Based Assessment
   - Unit Test

ICT Possibilities

- PhET Simulations (AC and DC circuits)

Worksheet 1

(For recording observation of simple experiment for cell and combination of cells) Complete the Table and answer the questions given below:

	Emf (V)	Voltage (V)	Current (I)	Internal resistance $r = \frac{E-V}{I}$
Cell 1	E_1=			r_1
Cell 2	E_2=			r_2
Cells 1, 2 (in series)	E_s =			r_s =
Cells1,2 (in Parallel)	E_p =			r_p =

1. What about the emf and internal resistance of cells when cells are connected in series

   (Effective emf and internal resistance are larger than the highest corresponding values of the given cells.

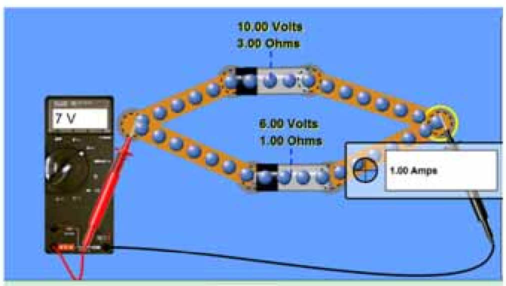
2. What about the emf and internal resistance of cells when cells are connected in Parallel?

   (The value of effective emf becomes in between emfs of given cells. Internal resistance is smaller than the smallest value internal resistance of given cells)

Worksheet 2 :

Combination of Cells in Parallel (Using PhET Simulation)

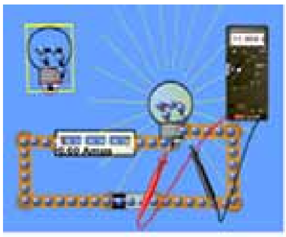
Cells are connected in Parallel , currents are flowing through the cells and total resistance is the sum of the resistance . Complete the table to find the effective emf and effective resistance.

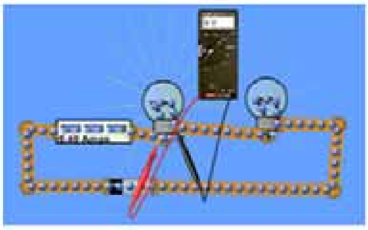


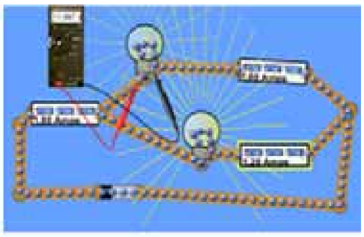
E_1 (V)	E_2 (V)	Net p.d (V)	r_1 Ω	r_2 Ω	Effective Ω	Current r circuit A	$I r_1$ in the (V)	$I r_2$ (V)	Effectve E_1 (V)	Effective E_2 (V)	Effective E according to equation (V)
10	6	4	3	1	4	1	3	1	10 -3 = 7	6+1 = 7	$\frac{10\quad 1\quad 6\quad 3}{3\quad 1}\quad 7$
9		3	2		1	1					
10	6			3	3						
10	10			3	1						
10	10			3	3						

Worksheet 3

Using PhET simulation construct circuits as given below(take resistance of bulb B_1 = 10 ohm , B_2=20 ohm, emf of cell 12V). Complete the table by measuring voltage and current in each case and calculate the power.







	V	I	R	V_1	V_2	I_1	I_2	P	P_1	P_2
Bulb 1 (B_1)										
Bulb 2 (B^2)										
B_1 and B_2 are in series										
B_1 and B_2 are in Parallel										

1) When bulbs are connected in series what happens to

   a) Voltage drop across each bulbs (different V, high voltage for bulb having high resistance.)

   b) Net current

      (decreases, because net R increases)

   c) Net power

      (Smaller than the Smallest value of power of the individual bulb)

   d) Power of each Bulb

      (Bulb having high resistance have more power than the other)

2) When bulbs are connected in parallel what happens to

   a) Voltage drop across each bulbs

      (Same)

   b) Net current

      (Increases because net R decreases)

   c) Current through each Bulb

      (Different I, low for high R)

   c) Net power

      (Larger than the largest value of power of the individual bulb)

   d) Power of each Bulb

      (Bulb having high resistance have low power than the other)

Project 1

You are given different resistors as shown below. Design a resistance box having resistance in between 1 to 2 lakhs (any integer no. in between 1 and 2 lakhs)

Resistor having resistance in ohm	numbers
1	5
10	7
100	7
1000	7
10 K	7
100 K	3

[Hint

Resistance	Combination of resistors
1	1
2	1+1 series
2	1+1 series
5	10+10 parallel
10	10
20	10+10 series
20	10+10 series
50	100+100 parallel
100	100
200	100+100 series
200	100+100 series
500	1K+1K parallel
1000	100
2000	1K+1K series
2000	1K+1K series
5000	10K+10 K parallel
10000	10 K
20000	10K+10 K series
20000	10 K+10 K series
50000	100 K+ 100 K parallel
100000	100 K

Make the required a value of resistances given in (first column) by connecting either in series or in parallel as mentioned in second column

Resistance	Take connection from
1	1
2	2
3	2+1
4	2+2
5	5
6	5+1
7	5+2
8	5+2+1
9	5+2+2

10	10
11	10+1
132567	100 K +20 K + 10 K + 2 K + 500 + 50 + 10 + 5 + 2

Example using PhET

(Fig 1 shows connection of 7 resistors (1 Ω, 2Ω, 2Ω. 5 Ω, 10Ω, 50 Ω, 100 Ω) in series.

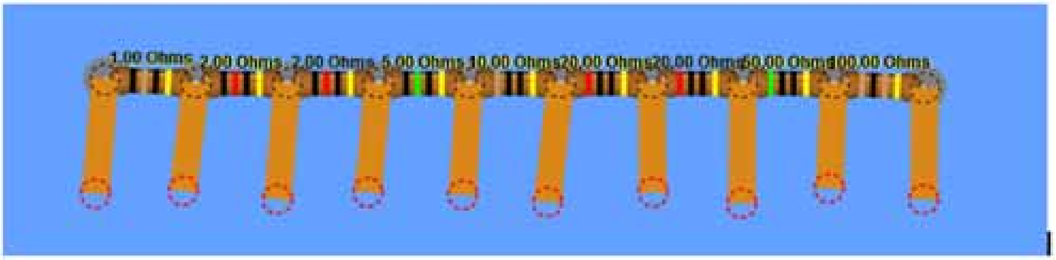


Fig 1

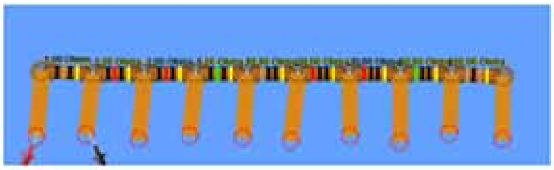


Fig 2

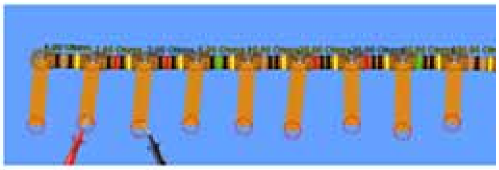


Fig 3

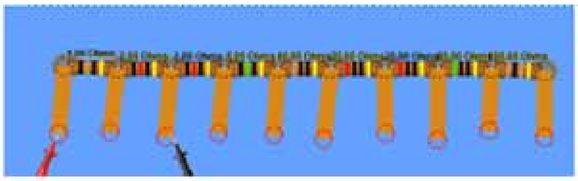


Fig 4

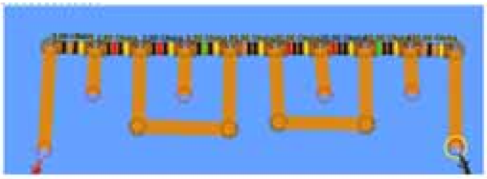


Fig 5

Figure 2, 3, 4, and 5 explain how to make connections to get 1Ω, 2Ω, 3Ω, 163Ω, respectively.

? Sample TE Items

1. a) Write the equation of resistance in terms of length and area of cross section

   b) Deduce the equation of resistance in terms of mass, density, resistivity and length of the conductor.

   (Hint: $R= \tilde{n}l/A$; $A= V/l$; $R= \tilde{n}l^2/V$; $V=m/d$; $R=d\,\tilde{n}l^2/m$)

   c) Two wires of equal length, one of aluminum and other of copper have same resistance. Which of the two wires is lighter? Hence explain why aluminum wires are preferred for overhead power cables.

(($\tilde{n}_{Al-}$ = 2.63 X 10^{-8} Ωm, $\tilde{n}_{Cu}$= 1.72 X 10^{-8} Ωm. Relative density of Al= 2.7. Relative density of cu= 8.9)

Hint: $m = \frac{d\rho l^2}{R}$, *aluminum is lighter than copper* [Score: 1+2+3]

2. a) If temperature increases what happened to relaxation time?
   (i) decreases (ii) increases (iii) remains constant (iv) first increases and then decreases.

Hint : (i)

b) How does, temperature change the resistance of wire?

Hint : if temperature increases' relaxation time decreases' resistivity increases' Resistance increases

c) Using relations connecting current and drift velocity, current density and electric field (Ohms law) Derive an equation for the resistivity

d) At what temperature will the resistance of a copper wire becomes three times its value at 0^0C (Temperature coefficient of resistance of copper= 4×10^{-3} / ^{0}C) [Score: 1+2+2+2]

Hint : $R_t = R_o(1+\alpha t)$

3. a) A carbon resistor is coloured as yellow- violet - orange - gold, what is the value of its resistance?

b) What is its effective resistance if a set of n equal resistors of resistance R connected (1) in series and (2) in parallel.

Hint : $R_s = nR$, $R_P = R/n$

c) A set of n equal resistors of resistance R are connected in series to a battery of emf E and internal resistance r=R. A current I is observed to flow. Then the n resistors are connected in a parallel to the same battery. It is observed that the current is increased 10 times. What is the value of n?

Hint: $I_s = \frac{E}{(nR+R)}$; $I_p = \frac{E}{(\frac{R}{n}+R)}$; n = 10 [Score: 1+2+2]

4. A potential difference of V volt across a resistance of resistance R produces a current I.

a) Write an equation for energy produced across the resistor.

b) Two resistors having resistance 2 ohm and 4 ohm are connected in series across 12 V battery. What is the

a) Effective resistance of the circuit.

Hint : 6

b) Current flowing through each resistor.

Hint : $I = \dfrac{E}{R_1 \quad R_2} = 2A$

c) Voltage drop across each resistor.

Hint : $V_1 = 4V, V_2 = 8V$

d) Power dissipated across each resistor. [Score: 1+2]

Hint : $P = I^2R$

5. a) Fill in the blanks using the sentences given in the bracket.

Kirchoff's junction rule is a reflection of ………….. and loop rule is a reflection of ………… (conservation of charge, conservation of energy, conservation of momentum, conservation of angular momentum)

Hint : conservation of charge, conservation of energy

b) Draw the arrangement of resistors in Wheatstone bridge

c) Applying Kirchoff's first and second rule derive the principle of Wheatstone bridge [Score: 1+2+3]

6. a) What is the working principle of Meter Bridge?

b) Draw the figure of Meter Bridge to measure the unknown resistance

c) An unknown resistance R_1 is connected in series with a resistance of 10 ohm. This combination is connected to one gap of Meter Bridge while a resistance R_2 is connected in the other gap. The balance point is at 50 cm. Now when the 10 ohm resistance is removed and the balance point shifts to 40 cm. the value of R_1 is (in ohm)

Hint : $10 + R_1 = \dfrac{R_2 \times 50}{50}$ (1) ; $R_1 = \dfrac{R_2 \times 40}{60}$ (2) *solving (1) and (2)* $R_l = 20\,\Omega$

[Score: 1+2+3]

7. a) A cells of emf E is connected in the secondary ciruit of potentiometer.

Potential drop across the potentiometer wire due to primary cell is......................

(a) greater than E (b) less than E (c) equal to E
(d) less than I V

Hint : (a)

b) A cell of internal resistance 2ohm and emf 6V is connected to a uniform wire of length 10m of resistance 10 ohm. The potential gradient in the wire is …………

Hint : $I = \frac{E}{R + r} = 0.5A$; Potential gradent, $\varnothing = \frac{Ir}{l}$

c) If the balancing point is obtained at 300cm, what is the value of emf of the secondary cell?

Hint: $E = \varnothing l$ [Score: 1+2+2]

REREFENCES

1. NCERT Text book
2. Concept physics by HC Verma
3. Fundamentals of physics by Halliday, Resnick and Walker

5

MAGNETISM AND MATTER

Introduction

Magnetic phenomena are universal in nature. The earth's magnetism predates human evolution. In this unit, the discussion is mainly about the earth's magnetism, the classification of materials, on the basis of their magnetic properties and Gauss's law.

UNIT FRAME

Concepts & Process skills	Process/Activity with assessment	Learning outcomes
♦ The Bar magnet, magnetic field lines. • Observing • Experimenting • Distinguishing	• General Discussion on Magnetism. • Simple experiement used to demonstrate field line, ICT about magnetism.	• Explains the properties of bar magnet and cites examples.
♦ Bar magnet as an equivalent solenoid ♦ The dipole in a uniform magnetic field. • Observing • Problem solving • Analysing	• General discussion on solenoid and magnetic dipole. **Assessment :** Active participation in groups. (Process) Activity log book (Portfolio) Assignment on magnetic properties. (Portfolio)	• Determines the magnitude of 'B' on the axial line of a solenoid. • Formulates the relation connecting 'm' and 'B'.
♦ Magnetism and Gauss's law, The earths magnetism. • Observing • Problem solving • classifying	• General discussion on Gauss's law and earth's magnetism. • ICT about earth's magnetism	• States Gauss's law in magnetism. • Explains the magnetic elements of earth.
♦ Magnetisation, Magnetic intensity and magnetic properties of materials. • Observing • Problem solving • Classifying • Analysing • Interpreting	• ICT about the types of magnetic substances • General discussion on B & H.	• Distinguishes the types of magnetic substances. • Explains the properties of magnetic substances. • Formulates the relation connecting 'B' and 'H.'
♦ Hysterisis, Permanent magnets and electro magnets. • Observing • Classifying • Experimenting • Analysing	• General discussion on Hysterisis • Simple experiment about Solenoid and magnetism.	• Defines retentivity and coercivity. • Explains hysterisis and classifies the types of magnets.

Towards the Unit...

Content : Elements of earths magnetic filed:

Suggested Activity

General discussion and demonstration

A light magnet is brought to the class room and is suspended horizontally. It will align in a particular direction. General discussion is carried out.

Discussion Points:

- Why does the magnet always align in a particular direction?
- What is meant by geographic north and south poles?
- The north pole of a freely suspended magnet points towards geographic north. Why?
- Does the magnetic south pole and geographic north pole coincide?
- What is meant by geographic meridian and magnetic meridian?
- Do these two meridians coincide any where?

(Hint : Declination)

- When a compass needle is pivoted so that it can rotate in a vertical plane, will it align horizontally?
- If it is not aligning horizontally, what does it means?

(Hint: Magnetic field is not horizontal but makes some angle with the horizontal)

- If the above dip needle is taken to the pole and the magnetic equator, how it will align?

(Hint: B_v and B_h)

- What is the value of B_v and B_h?

(Hint : $B_v = B \sin\theta$ $B_h = B \cos\theta$)

- What is the relation connecting dip and Horizontal intensity?

$\left(Hint : \tan\theta = \frac{B_v}{B_h}\right)$

Consolidation

- Magnetic elements
- Definitions of declination, dip and horizontal intensity.
- Relation connecting dip and horizontal intensity.

? Sample TE Items

1. A ball shows super conductivity. If this ball is placed near to a bar magnet.
   - i) In which direction will it move?
   - ii) What will be the direction of its magnetic moment?

Ans: *(Score 1 + 1)*

   - i) A super conducting material is diamagnetic in nature. Thus it will be repelled.
   - ii) The direction of magnetic moment will be opposite to the direction of magnetic field of magnet.

2. a) Draw the diagrams to depict the behaviour of magnetic field lines near a bar of
   - i) Copper
   - ii) Aluminium
   - iii) Mercury cooled to a very low temperature.

   b) The veritical component of the earth's magnetic field at a given place is $\sqrt{3}$ times its horizontal component. If total intensity of earth's magnetic field at the place is 0.4G. Find the value of
   - i) Angle of dip
   - ii) the horizontal component of earth's magnetic field (Score 1 + 2)

Ans:

   - i) Copper is a diamagnetic sub (diagram)
   - ii) Aluminium is paramagnetic (diagram)
   - iii) Mercury cooled to a very low temperature (4.2K) becomes a super conductor. Super conductors exhibit dia magnetism (diagram)

   b) $Bv = \sqrt{3}B_H$

$$\tan\theta = \frac{B_V}{B_H} = \frac{\sqrt{3}B_H}{B_H} = \sqrt{3}$$

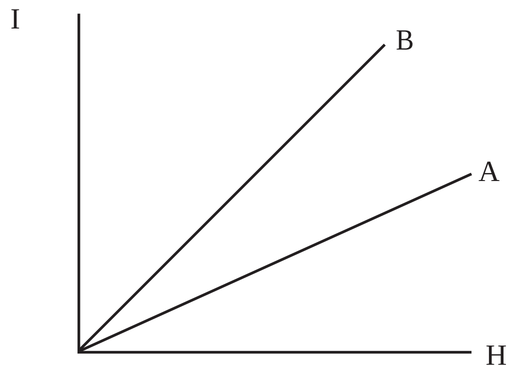
$\theta = 60^0$

   ii) Horizontal component of earth's field

$B_H = B\cos\theta = 0.4 \cos 60 = 0.2G.$

3. The following figure shows the variation of intensity of magnetisation versus the applied magnetic field intensity H for two magnetic materials A and B.

a) Identify the materials A and B



b) Why does the material B have a larger susceptibility than A, for a given field at constant temperature? Justify your answer with help of above group.

c) For material, A plot the variation of intensity of Matnetic field versus temp? *(Score 1 + 2+2)*

Ans:

a) A - Paramagnetic material (slope is + ve and smaller)

B - Ferromagnetic material (slope is +ve and larger)

b) Slope gives, χ_m The slope of B is larger than H. Hence material B have a larger susuptilitity than A.

B consists of domains which orient themsleves along the magnetic field.

4. a) In which direction does the dia, para and a ferromagnetic material move when these are kept in a non-uniform external magnetic field?

b) Name two main characteristics of a ferromagnetic material which help us to decide its suitability for making

i) Permanent magnet ii) and electromagnet.

c) Which of these two characteristics should have high or low values for each of these two types of magnets? *(Score 3 + 2 + 2)*

Ans:

a) 1 A diamagnetic substance tends to move very slowly from stronger to weaker parts of the field.

2. A paramagnetic substance moves from weaker to stronger part.
3. A ferro magnetic substance moves from weaker to stronger part.

b) For a permanent magnet the ferromagnetic material should have high retentivity, high coercivity and high permeability.

For an electro magnet, the material should have low retentivity and low coercivity.

5. A compass needle is pivoted about the horizontal axis and is forced to move in the magnetic meridian. Find the angle of dip corrosponding to the following situations.

   i) Vertical direction at a place,

   ii) Horizontal direction at a place.

   Give the value of angle of dip at these places. (Score 2)

Ans.:

i) Compass needle points in vertical directions angle of dip $\theta = 90^0$

ii) Compass needle points in horizontal direction the angle of dip $\theta = 0^0$

(Hor. comp. of B is zero at the north pole and vert.comp. is 90^0 at the north pole)

6. A closely wound solenoid of 1000 turns and area of cross-section 2×10^{-4} m^2 carries a current of 2A. It is placed with its horizontal axis at 30^0 with the direction of a uniform horizontal magnetic field of 0.16T.

   a. What is the torque experienced by the solenoid due to this field?

   b. If the solenoid is free to turn about the vertical direction, specify the orientations of stable and unstable equillibrium ?

   c. What is the amount of work needed to displace the solenoid from its stable orientation ot its unstable orientation? (Score 2 + 2+1)

Ans:

a) m = NIA

$= 1000 \times 2.0 \times 2.0 \times 10^{-4} = 0.40$ Am^2 or *J/T*

$T = mB\sin\theta = 0.40 \times 0.16 \times ½ = 0.032$ Nm.

b) Stable orientation, (parallel to B)

$u_i = mB\cos 0^0 = -0.40 \times 0.16 \times 1 = -0.064J$

Unstable orientation,

$u_f = -mB\cos 180^0 = -0.40 \times 0.16 \times -1$

$= +0.064$ J.

c) Amount of work needed.

$W = u_f - u_i = 0.064 - (-0.064)$

$= 0.128$ J.

7. If χ stands for the magnetic susceptibility of a given material identify the class of materials for which.

i. $-1 \leq \chi < 0$ ii. $0 < \chi < \varepsilon_r$ (ε stands for a +ve number)

a) Write the range of relative magnetic permeability of these materials.

b) Draw the pattern of magnetic field lines when these materials are placed in an external magnetic field. *(Score 2 + 2)*

Ans:-

i) If $-1 \leq \chi < \varepsilon_r$ the material is diamagnetic. The range of relative permeability is $0 \leq \mu_r < 1$

ii) If $o < \chi < \varepsilon_r$ material is paramagnetic. The range of relative permeability is $1 < \mu_r < 1 + \varepsilon$

b) Hint : Draw field lines correspnds to the above cases.

8. A magnetic dipole is placed in a uniform magnetic field with its axis tilted w.r.t its position of stable equillibrium.

a) Deduce an expression for the time period of oscillations.

b) If this magnet is replaced by a combination of two similar bar magnets, placed over each other, how will the time period vary?

Ans.: *(Score 3 + 2)*

a) Derive $T = 2 \sqrt{\frac{I}{mB}}$

b) In the difference position of two magnets

$m_{net} = o$ $I_{net} = 2I$, $T = \infty$

In the sum position of two magnets

$m_{net} = 2m$ $I_{net} = 2I$

T will remain same.

9.a) Name and define the two elements of earth's magnetic field other than the horizontal component of the earth's magnetic field.

b) Why do we say that at the place like Delhi and Mumbai, a magnetic needle shows the true north direction quite accurately as compared to other places in India? *(Score 2 + 1)*

Ans.:

b) The declination, in india is small, $0^0.41¢$ NE at Delhi and 0.58^0 NW at Mumbai. Thus at both of these places a magnetic needle shows the true north quite accurately.

WORK SHEET I

1. Which property of magnets other than attractive was also known since ancient time?
2. The place of minimum attractive power in magnet is called

   a) South region b) North region

   c) Neutral region d) None of these.
3. A bar magnet and a solenoid produce .... magnetic fields. (opposite / similar)
4. The time period of oscillation of the dipole is

   a. $2\sqrt{\frac{2I}{nB}}$ b. $2\sqrt{\frac{I}{2mB}}$ c. $4\sqrt{\frac{I}{mB}}$ d. $2\sqrt{\frac{I}{mB}}$
5. Lines of force do not intersect each other. Justify.
6. State Gauss's law in magnetism.
7. A short bar magnet placed with its axis 30^0 with an external field of 800 G experiences a torque of 0.016 Nm.

   a) Find the magnetic moment b) Calculate the work done in moving it from its most stable to unstable position?
8. The magnetic potential energy U_m is given by

   a) $U_m = -m.B$ b) $U_m = m.B$

   c) $U_m = 2m.B$ d) $U_m = -2m.B$.
9. A large magnet is broken into two pieces so that their lengths are in the ratio 2:1 what is the ration of pole strengths of the two pieces?

   a) 1:2 b) 2:1 c) 4:1 d) 1:1

Answers:

1. Directional Propery
2. Neutral region
3. Similar
4. $2\sqrt{\frac{I}{mB}}$

7. a) $\theta = 30^0$

   $T = m\ B\ Sin\theta = 0.40\ Am^2$

   $W = 2\ mB = .06\ 4\ J.$

8. a
9. d, polestrength does not depend on length.

WORK SHEET -2

1. Dimension of succeptibility is ....
2. Which of the following relation is correct?

   a. $\mu = \mu_o(1 + \chi)$ b. $\mu = \mu_o \mu_r$ c. $\mu = 2\mu_o \mu_r$ d. Both (a) and (b)
3. The unit of H is ....
4. Write the dimensions of M and its unit.
5. Obtain the relation connecting succeptibility and relative permeability.
6. What is Meissner effect?
7. .... is used for running magnetically levitated superfast trains.

   a) diamagnets b) Paramagnets c) Ferromagnets

   d) Super conducting Magnets.
8. Distinguish between para, ferro and diamagnetic substance with examples.
9. What are magnetic elements? Explain

Answers

1. Dimensionless quantity
2. $\mu = \mu_o(1 + \chi)$
3. Am^{-1}
4. $L^{-1}A$, Am^{-1}
6. $\mu = \mu_o(1 + \chi_m)$
7. The phenomenon of perfect diamagnetism in super conductors is called Meissner effect.

WORKSHEET 3

Draw the field lines of the following.

a) Barmagnet	
b) Current carrying finite solenoid	
c) Electric dipole	

WORKSHEET- 4

Draw the magnetic field lines in the following substances

a) Diamagnetic	
b) Paramagnetic	
c) Ferromagnetic	

WORKSHEET-5

Write the dipole analogy in electrostatics and magnetism.

	Electrostatics	Magnetism
1. Dipole moment	P	
2. Equatorial field	$-P/4\pi\varepsilon r^3$	
3. Axial field	$2P/4\pi\varepsilon \mathbf{r}$	
4. External field torque	PXE	
5. External field energy	-P.E	

Repository of CE Items

1. **Process Assessment**
   - General discussion
   - Group discussion
2. **Portfolio Assessmnent**
   - Activity logbook
   - Unit based assessment
   - Assignment
3. **Unit Base Assessment**
   - Worksheet 1
   - Worksheet 2
   - TE Questions.

ICT Possibilities

- PPT about magnitism
- Video (Terrestrial Magnetism)

REFERENCE

NCERT Textbook

University Physics

Pradeep's Physics

Simplied Physics.

6

ELECTROMAGNETIC INDUCTION

Introduction

In the chapter Moving charges and Magnetism we have discussed how we can produce magnetism from electricity. In this chapter we will find the method of producing electricity by varying magnetic field - namely the phenomenon of electromagnetic induction.

UNIT FRAME

Concepts & Process skills	Process/Activity with assessment	Learning outcomes
♦ `Experiment of Fara day and Henry • Observing • Infering • Identifying	• Demonstration and ICT on Faraday's experiment	• Demonstrates and explains the Faraday's experi-ments-coil-magnet and coil-coil experi-ment.
♦ Magnetic flux and field • Observing • Infering • Identifying	• General discussion and ICT on magnetic flux	• Defines magnetic flux and its unit
Faraday's law of elec-tromagnetic induction • Infering • Identifying	• General discussion	• States and explains Faraday's law of electromagnetic in-duction and solves problems related to it
♦ Lenz's law and conservation of en ergy • Observing • Inferring • Identifying	• Demonstration and general discussion **Assessment** : Involvement in general discussion(Process) • Activity log (Portfolio)	• States Lenz's law, illustrates it as a consequence of the law of conservation of energy.
♦ Motional emf • Observing • Infering • Identifying	• Demonstration and general discussion	• Demonstrates and formulates motional emf and solves nu-merical problems related to it.
♦ Eddy current • Observing • Infering • Identifying	• Demonstration and general discussion	• Explains eddy cur-rent and its applica-tions, cites ex-amples in various devices.

Concepts & Process skills	Process/Activity with assessment	Learning outcomes
♦ Inductance - self inductance and mutual inductance and energy in a solenoid • Observing • Infering • Identifying	• Demonstration and general discussion • General discussion General discussion and ICT	• Explains self induction and mutual induction and formulates the expression for self inductance of a solenoid and mutual inductance between two coils and energy stored in a solenoid and solves numerical problems related to them.
♦ A.C generator • Observing • Analysing • Identifying	**Assessment:** Involvement in general discussion(Process) Activity log (Portfolio)	• Explains the working of ac generator and formulates the expression for the emf developed, gains the concept of sinusoidal variation of emf induced in it and solves numerical problems related to it.

Towards the Unit...

Content: Energy stored in an inductor

Teacher starts the discussion by giving the idea of work required to establish electrical energy and the conversion of this work as energy in the magnetic field of a solenoid

What is meant by self induction?

[Hint: The property of a solenoid to oppose the growth or decay of current in it.]

If there is an opposition to the growth of current, how can a current be send through a solenoid?

[Hint: By doing work against this opposing force.]

During self induction, what is the back emf induced in a coil ?

[Hint: å=LdI/dt]

(Teacher also explains that emf is the work done in bringing unit charge once around the circuit.)

What is the work needed in an electric circuit to send a current I?

[Hint: dW= edq

dW= eIdt]

How will you calculate the work done to build up current from 0 to I

[Hint: W= ∫L I dt]

Why do we integrate?

[Hint: Induced emf e is not a constant and varies.]

What happens to this work ?

[Hint: This work done is stored as the energy.]

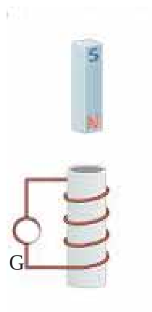
What is the expression for energy stored in an inductor and where and in which form it is stored?

Consolidation

The teacher consolidates the discussion and explains how energy is stored in the magnetic field of an inductor.

? Sample TE Items

1) A bar magnet is dropped vertically into a solenoid as shown in the figure.



a) What do you observe in the galvanometer?

b) How will you account for the electric energy developed in the circuit ?

c) State the law associated with this energy

d) What do you know about the acceleration of the magnet. Justify your argument. (Score 1+2+1+1)

Ans: a) A deflection in the galvanometer.

b) The gravitational potential energy of the magnet is converted into electrical energy

c) Lenz's law.

d) Acceleration of the magnet is less than the acceleration due to gravity.

The current in the solenoid is such that the near end of the solenoid is North pole.Due to the opposing force its acceleration is reduced.

2. Choose the wrong option.

a) Volt = weber/sec   b) weber = henry.ampere

c) Joule = henry. Ampere2   d) volt = weber.sec (Score : 1)

Answer: d) volt = weber.sec

3) 'If a metal ring is dropped, with its plane vertical, from a height , a current is developed in the ring'. Is this statement true? Justify your answer. (Score : 2)

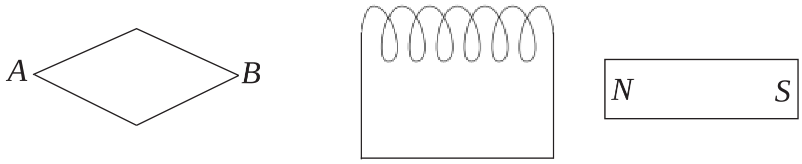
Answer: *This statement is false. When the coil is dropped there is no change in magnetic flux so that the net current is zero.*

4) A circular coil of n turns is rotated about an axis in its plane . Arrive at an expression for the induced emf in the coil. How will you account for this emf? (Score : 3)

5) 'In a dc motor the current flowing through it is minimum when it rotates at full speed'. Justify this statement. (Score : 2)

Answer: *When the armature coil of the motor is rotating, it acts as a dynamo and an emf is developed. At full speed , the induced back emf is maximum and hence the net emf (applied emf- back emf) is minimum and hence the current is minimum.*

6) In the following figure, current through the near end of the solenoid is anticlockwise.



(a) Identity the polarity of the near end of the solenoid

(b) Write down the law associated with this.

(c) Identify the pole B of the compass needle (Score 1+1+1)

Answer: *(a) The polarity of the near end of this solenoid is North pole.*

(b) Lenz's law.

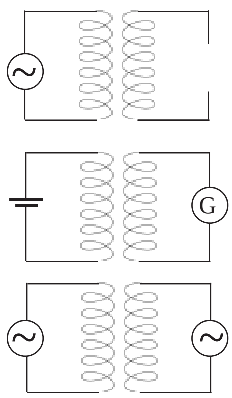
(c) The pole B of the compass needle is North pole.

7) A straight metal rod is capable of rotation about an edge. Identify the axis of rotation about which there is no induced emf between the ends of the rod. (Score : 2)

Answer: *When it rotates in the vertical plane with axis along the north- south direction, it is cutting the horizontal component of earth's magnetic field and an emf is induced. When it rotates in the horizontal plane with axis vertical, it is cutting the horizontal component of earth's magnetic field and an emf is induced. When it rotates in the vertical plane with axis along the east- west direction, it is not cutting the earth's magnetic field (as it moves parallel to the flux lines) and hence no emf is induced.*

WORK SHEET

Predict the output in the secondary coil S and fill the blanks in the table as YES / NO

	Emf only	Current only	Both emf and current nor emf	Neither current
				

In situation A suggest a method to obtain a steady current is S

2) Match the following

A	B
Faraday's first law	Direction of magnetic field
Lenz's law	Direction of force
Fleming's left hand rule	Magnitude of emf
Right hand grip rule	Direction of emf

7

ALTERNATING CURRENT

Introduction

In this chapter we discuss the properties of sinusoidely varying current (alternating current) its application and uses, alternating current applied to a resistor, capacitor and an inductor, radio tuning, transformer etc. We make use of general discussions, ICT enabled illustrations and demonstrations.

UNIT FRAME

Concepts & Process skills	Process/Activity with assessment	Learnings outcome
♦ AC voltage applied to a resistor Representation of AC current and voltage by rotating vectors • Observing • analysing • Identifying • problem solving	General discussion and ICT General discussion and ICT	• Formulates the expression for current and phase difference between emf and current and average power of an ac circuit containing R only and draws phasor diagram.
♦ AC voltage applied to an inductor • Observing • Infering • Identifying • problem solving		• Formulates the expression for current and phase difference between emf and current and average power of an ac circuit containing inductor only and draws phasor diagram. • Defines inductive reactance and solves numerical problems related to it
♦ AC voltage applied to a capacitor • Observing • Infering • analysing • problem solving	General discussion and ICT Assessment: Involvement in general discussion(Process) Activity log (Portfolio)	• Formulates the expression for current and phase difference between emf and current and average power of an ac circuit containing capacitor only and draws phasor diagram. • Defines capacitive reactance and solves numerical problems related to it.

Concepts & Process skills	Process/Activity with assessment	Learning outcome
♦ AC voltage applied to series LCR circuit Sharpness of resonance and Q factor • Observing • Analysing • Interpreting • Problem solving	General discussion and ICT Assessment: Involvement in general discussion(Process) Activity log (Portfolio)	• Formulates the expression for current and phase difference between emf and current of an LCR series circuit, draws phasor diagram, solves numerical problems related to it. • Explains impedence diagram, the term resonance, cites examples, Q factor and bandwidth.
♦ Power in an ac circuit , power factor • Analysing • Formulating • Problem solving • Interpreting	General discussion on power in an a.c, circuit, power factor	• Formulates average power in an LCR circuit and explains the terms power factor and wattless current.
LC oscillations	General discussion on LC oscillations and ICT	• Explains the mechanism of LC oscillations with the expression for frequency.
♦ Transformer • Observing • Classifying • Analysing	General discussion demonstration and ICT • Observing • Classifying • Analysing	• Explains various types of transformers, transformer equation and energy losses.

Towards the Unit...

Content: Resonance

Activity

General discussion

The teacher draws an LCR circuit and begins the discussion;

- What is the expression for current in an LCR circuit?

Hint : $I = \dfrac{E_0 \mathrm{Sin}(\omega t \pm \varphi)}{\sqrt{R^2 + (L\omega - \frac{1}{c\omega})^2}}$

- When is the current in the LCR circuit maximum?

[Hint: when inductive reactance and capacitive reactance are equal $L\omega = \dfrac{1}{C\omega}$?

- What is the maximum value of current ?

Hint: $I_{max} = \dfrac{Eo}{R}$

- How can you achieve maximum current?

[Hint: By suitably adjusting the value of ω (frequency)]

Teacher introduces the concept of resonance and name the particular frequency as resonant frequency.

- How can you increase the current at resonant frequency

[Hint: by decreasing the value of R]

- Can you graphically represent the variation of current with frequency? What will be the shape of the graph?
- Which are the factors affecting resonant frequency?

[Hint: Inductance L and Capacitance C]

- Which are the factors affecting maximum current at resonance?

[Hint: Value of resistance R alone.]

- Can you identify a situation where this resonance principle is applied?

[Hint: Radio tuning]

- What is the impedance of LCR circuit at resonance?
  [Hint: Resistance R]

? Sample TE Items

1) A 230 V ac and 230V dc are connected to the same resistor for the same time. Which of them produce more heat ? Justify your answer. (Score 2)

Answer: Since the 230 V represent the r.m.s value of ac , the heating effect produced by ac and dc are equal (Definition of rms value or dc value of ac)

2) An ac source of emf E is connected to a resistance R.

   a) Draw a circuit representing it.
   b) Arrive at the expression for current in this circuit.
   c) Draw the graphical representation of emf and current in this circuit.
   d) "Emf and current are in phase." What do you infer from this?

(Score 1+2+1+1)

3) An insulated copper in the form of a solenoid is connected in series with a bulb and a dc source.

   a) What do you observe when the dc source is replaced by an ac source of the same voltage?
   b) Identify the property of the solenoid related to this.
   c) Arrive at the expression for energy stored in a solenoid.
   d) If the solenoid is stretched to a straight wire what will be the brightness of the bulb? Justify your answer. (Score : 1+1+2+3+1)

Answer:

   a) The brightness of the bulb is reduced
   b) Self induction.
   c) By introducing a soft iron core, or by increasing the no. of turns , the brightness can be reduced.
   e) The bulb glows with maximum brightness. As the self inductance of a straight solenoid is zero, it offer no resistance

4) Which of the following is equivalent to henry/s

(a) ohm	(b) volt
(c) ampere	(d) coulomb

Answer: ohm (Score : 1)

5) Match the following

A	B
Wattles current	ohm
Impedance	cos ∅
Resonance	capacitor
Power factor	$X_L=X_C$

(Score : 2)

6) Identify the combination used as an oscillator (Score : 1)

WORKSHEET

1) An LCR circuit with L=250mH , C=10 μ F and R=5 Ω is connected to a 230V ac supply of variable frequency. Fill the blanks suitably.

Draw the variation of Z with frequency, the variation of current I with frequency and identity the resonant frequency.

Frequency	ω	**Inductive reactance $L\omega$**	**Capacitive reactance $1/c\omega$**	**$L\omega - 1/c\omega$**	**Impedance Z=**	**Current I**
20 Hz						
50 Hz						
100 Hz						
150 Hz						
175 Hz						
200 Hz						

2) An ac source of frequency 50Hz is connected to an LCR circuit with the components L=10mH, C=200 μF and R=5 Ω Complete the following table under the conditions specified.

	L only	**C only**	**R only**	**LC**	**LCR**
Impedance Z					
Phase difference ϕ					
Power factor					
Power dissipated					

3) Complete the following table suitably

Mechanical system	**Electrical system**
Mass m	
	Charge q
Force constant k	
Velocity v= dx/dt	
	Electromagnetic energy

8

ELECTROMAGNETIC WAVES

Introduction

In this chapter, we discuss displacement current, the basics of electromagnetic waves and how they make up the electromagnetic spectrum. We will explore the major trends and categories within the spectrum, as well as the various sources of electromagnetic waves.

UNIT FRAME

Concepts & Process skills	Process/Activity with assessment	Learning outcomes
♦ Displacement current • Observing • predicting • inferring	General discussion on displacement current	• Explains the insufficiency of Ampere's circutal theorem, defines displacement current, formulates equation for it, distinguishes between conduction and displacement currents and solves numerical problems related to it
♦ Electromagnetic waves - Sources of electromagnetic waves - Nature of electromagnetic waves • Observing • Interpreting • Analyzing • Problem solving	General discussion and Demonstration with ICT (PhET simulation) on production and properties of electromagnetic waves	• Explains the properties of electromagnetic waves and interprets the expressions for electric and magnetic fields in an electromagnetic wave.
♦ Electromagnetic spectrum • Observing • Classifying • Analyzing • Interpreting • Using number relationship	General discussion on production, detection, frequency range and uses Electromagnetic waves **Assessment** • Involvement in General discussion (Process) • Activity logbook (Portfolio) • Worksheet (Portfolio)	• Explains production and detection of different regions of electromagnetic spectrum.

Towards the Unit...

Content: DISPLACEMENT CURRENT

Suggested Activity: General discussion

Teacher brushes up the idea of Ampere's circuital law. The students are asked to draw Fig 8.1(a) of NCERT Textbook.

Discussion Points

- What is the magnetic field at a point in a region outside the parallel plate capacitor?

[Hint: Teacher helps to draw a circular loop of radius r. According to Ampere's law, B 2ðr = μ_oI]

Again teacher asks to draw a different surfaces, which has the same boundary. This is a pot like surface [Fig. 8.1(b)] which no where touches the current,but has its bottom between the capacitor plates.

Teacher asks the students to apply Ampere's circuital law to the pot like surface.

[Hint: B 2ðr = 0, No Current is passing through the surface]

- Do you feel any contradiction here?

[*Hint: Yes, For the same loop (considering in two different ways), the results are different]*

Teacher explains that, this discrepancy had been corrected by James Clerk Maxwell by introducing a new term called Displacement Current.

- Is there anything passing through the surface S between the plates of the capacitor?

[Hint: Yes, the electric field]

- What is the magnitude of Electric field between the plates?

[Hint: : E = ó/$å_0$ = Q/A $å_0$]

- What will be the electric flux here?

[Hint: : : ö = EA = Q/$å_0$]

- If the capacitor is connected with a time dependent current, what will be the change in Electric flux?

[Hint: dö/dt = $\frac{d}{dt}(\frac{Q}{\varepsilon_0}) = \frac{1}{\varepsilon_0}(\frac{dQ}{dt}$]

ie, i=, $å_0\frac{d\varphi}{dt}$]

- What is the cause of this current?

[Hint: Variation of Electric flux]

Teacher explains that the current due to the variation of electric flux is termed as Displacement current, and was introduced by Maxwell.

The total current is the sum of Conduction current and Displacement Current.

Teacher helps them to modify Ampere's circuital law by including the *displacement current.*

[Hint: $\oint B.dl = \mu_0(i_c + i_d) = \mu_0(i_c + \mathring{a}_0\frac{d\varphi}{dt})$ → *Ampere-Maxwell law.]*

Consolidation

Teacher consolidates Maxwell's Displacement Current.

REPOSITORY OF CE ITEMS

1. Process Assessment
    - General Discussion
    - Simple Experiments
2 Portfolio Assessment
    - Activity Log book
    - Worksheets
3. Unit Based Assessment
    - Unit Test
    - Quiz

ICT Possibilities

- PhET Simulation

WORKSHEETS

Work sheet 1

Electric field of an electromagnetic wave in vacuum is

$E_y = 6 \text{ Sin } \{10.46 \times 10^6 x + 3.14 \times 10^{14} t\}$

Complete the table

Physical quantity	Value	Unit
Electric field (E)		
Angular Wave number (k)		
Angular frequency (ù)		
Wave length (ë)		
Frequency(í)		
Velocity of wave(c)		
Magnetic field (B)		
Energy of photon		
momentum		
Permittivity of free space	8.854×10^{-12}	
Permeability of free space		
Electric energy density		
Magnetic energy density		

SAMPLE QUIZ

1. The range of frequencies or wavelengths arranged in an order is termed

   (a) Group of colours   b) Spectrum
   (c) Colour band   d) None

2. Electromagnetic radiations are

   (a) Mechanical   (b) Longitudinal
   (c) Transverse   (d) Stationary

3. Electric heater emits

   (a) IR radiations   (b) Visible rays
   (c) UV rays   (d) Micro waves

4. The velocity of electromagnetic waves c =

   (a) í/ë   (b) í ë
   (c) ë/í   (d) í+ë

5. The direction of propagation of electromagnetic waves is perpendicular to

   (a) electric field only
   (b) magnetic field only

(c) both electric and magnetic fields
(d) neither electric field nor magnetic field

6. Visible spectrum is due to

(a) Excitation of orbital electrons (b) Deexcitation of orbital electrons

(c) Vibration of atoms (d) Rotation of atoms

7. The rays emitted by molecules when they change their state of rotational or vibrational motion are

(a) Visible spectrum (b) Micro waves
(c) Radio waves (d) Infrared waves.

8. The radiations, which find application in physio therapy are

(a) Visible spectrum (b) Micro waves
(c) Infrared waves (d) Radio waves

9. The wavelength range of visible light is

(a) 0.1 µm - 0.7 µm (b) 10 µm - 10 m
(c) 0.7 µm - 0.4 µm (d) 0.4 µm - 1 nm

10. Micro waves are used in

(a) Radar (b) Telemetry
(c) Microwave oven (d) All the above

11. Radio waves are produced by

(a) Rapid acceleration and deceleration of electrons in arials
(b) Klystron valve
(c) Transition of electrons in atoms.
(d) Excited electrons in atom jump back to their normal state

12. What type of waves is used to transmit cellular telephone messages?

(a) Gamma rays (b) Radio waves
(c) Microwaves (d) Visible light

13. Which electromagnetic waves have the shortest wavelengths and highest frequencies?

(a) Gamma rays (b) Radio waves
(c) X-rays (d) Visible light

14. Electromagnetic waves that you can see are called

(a) Infrared rays (b) Microwaves
(c) X-rays (d) Visible light

15. The waves that have shorter wavelengths than visible light are

(a) TV (b) Radio stations

(c) Infrared rays (d) Gamma rays

Key: 1. B 2. C 3. A 4. B 5. C 6. B 7. D 8. C 9. C 10. D
11. A 12. C 13. A 14. D 15. D

? Sample TE Items

1. A] Displacement current is given by

(a) ì$_0 \frac{d\varphi}{dt}$ (b) å$_0$ (c) ì$_0$ (d) å$_0$ (Score -1)

Hint: (b)

B] Obtain the expression for Displacement Current?

C] Modify the Ampere's circuital theorem using Displacement Current. [Score: 1+2+1]

2. A] Which one is not representing the speed of light

(a) E / B ((b)) í ë (c) í/ë (d) υ / k (Score -1)

Hint: (c)

B] The wavelength range of Ultraviolet is 400nm to 1nm. Write its frequency range.

C] E = 3.1 cos (1.8y + 5.4 x 106t). Find the peak value Magnetic field.

D] Calculate the frequency and wavelength of the above Electromagnetic wave. [Score: 1+2+1+2]

3. Match the following

Sl No.	A	B
1	Microwave	Sterilization
2	Infrared	Diagnosis
3	Ultraviolet	Greenhouse effect
4	X - ray	Radar Communication

(Score: 2)

4. A] Which of the following has the highest frequency?

(a) Ultraviolet (b) Microwaves (c) X-rays

(d) Radio waves

Hint: (c) (Score -1)

5. A) How can we produce and detect X rays?

   B) A plane electromagnetic wave travels in vacuum along the positive z-direction. What can you say about the directions of its electric and magnetic field vectors? If the frequency of the wave is 30 MHz, what is its wavelength? (Score 1 + 1+2)

6. The amplitude of Electric field of an electromagnetic wave moving in the direction of x axis is 10 V/m along z axis

   A] The magnetic field is along the

   a) x axis b) y axis c) z axis d) none of these

   B] What is the amplitude of magnetic field?

   C] Show that the average energy density of the Electric field equals the average energy density of magnetic field

   [Score: 1+1+2]

REFERENCES

Physics Textbook for Class 12, NCERT

Introduction to Electrodynamics - David J Griffiths

Fundamentals of Physics, Halliday, Walker and Resnick

www.phet.colorado.edu

Principles of Physics - Dinesh Publications