

**VOCATIONAL HIGHER SECONDARY
MAINTENANCE AND REPAIRS
OF DOMESTIC APPLIANCES**

TEACHERS' SOURCEBOOK

FIRST YEAR



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Preface

Dear Teachers,

Education is a means of self realization and self-reliance. It is a kind of journey from darkness to light satisfying the wants and needs of the individual and society. The purpose of education is to make man perfect. Without vocational education, we will not be competent in the world of globalisation and technical advancement. What makes us different from others is what we learn from family, society, educational institutions and other formal agencies.

There are rapid changes in the process of learning and teaching especially in technical subjects. Sophisticated methods of information and other satellite technology provide man knowledge at his disposal. Mere theoretical knowledge is inadequate and improper for making the learner adept in the process of nation building. New pedagogic approach which revolutionised the world is to be adopted to equip our children with skill and acquisition.

To modernise the system of Vocational Higher Secondary education, the new activity oriented system of learning is introduced. Now the focus is on constructing new pedestal on which student centred education is to be built up. In the vocational stream, more importance is given to achieve the practical skill. Assignments, projects, on the job trainings, field visits etc. are the integral parts in the new learning process . General objectives, curriculum objectives, planning in the learning and teaching process etc. are included in this source book. The MRDA course is designed to develop the skill in the maintenance and servicing of electrical and electronic house hold appliances. This source book may help the teacher to evaluate the students continuously as well as terminally .

Maximum care and attention is given to the preparation of the source book. Additional information and innovations are solicitedly welcomed. Criticism on due course is also kindly welcomed. I hope this source book has satisfied the intended purpose for the MRDA course.

With regards,

Thiruvananthapuram
25.11.2005

Dr. E. Valsala Kumar
Director
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GENERAL APPROACH

Introduction

The ultimate aim of education is human refinement. Education should enable the learner to formulate a positive outlook towards life and to accept a stand which suits the well being of the society and the individual as well.

The attitude and potential 'to work' has determined the destiny, progress and cultural development of the human race. As we all are aware, the objective of education is to form a society and individuals having a positive work culture. The educational process expected in and outside our formal schools concentrate upon inculcating concepts, abilities, attitudes and values in tune with these 'work culture.' Hence vocationalised education cannot be isolated from the main stream of education. In another sense, every educational process should be vocationalised. However, due to our inability to utilise the resources wisely, scarcity of job opportunities is a severe issue of the present society. For overcoming this deep crisis, emergent techniques have to be sorted out and appropriate researches have to be seriously carried out. It is in this sense that the content and methodology of vocational Higher Secondary Education have to be approached.

The Vocational Higher Secondary course was envisaged as a part of the National Policy on Education with the noble idea of securing a job along with education. The relevance of Vocational education is very great in this age of unemployment. This education system, which ensures a job along with higher education stands aloof from all other systems of education.

A learning environment which ensures vocational aptitude, vocational training, basic life skills, competencies related to different subjects, appropriate values and attitudes and existential readiness has to be provided here.

The curriculum should be one which recognises the specific personality of the learner and should develop it in a desirable way. It should provide opportunity to imbibe novel ideas to follow a critical approach and for learning through experiences.

The competency to transform ones own resources for the betterment of the society and the individual is to be ensured in each individual. Training in the sense of equality, democratic sense, environmental consiousness and devotion to the constitution is an inseparable factor of the curriculum.

The need of a systematic curriculum is prevailing in vocational subjects. A scientifically structured curriculum incorporating the unique features and peculiarity of Kerala ensuring the possibility of higher education and utilising the national and international possibilities of employment is required.

The new curriculum should be capable of assimilating the life skills, scientific temper, attitude of co-existence, leadership qualities and mental health to face the challenges of life. It should be capable of strengthening the competencies imbibed by the learners up to the tenth class.

A curriculum for selecting vocational areas according to the aptitude of the students, learning it in depth, acquire general awareness in the basic areas and to secure jobs has become the social need of the day. A learner centred, process oriented, need based vocational curriculum is envisaged.

What is learning?

- Learning is construction of knowledge and so it is a live and continuous mental process.
- Learning is a process of advancement through adding and correcting in the light of comparing the new issue with the previously learned concepts.
- Learning takes place as a part of the effort to solve problems.
- Learning takes place by assimilating bits of knowledge into ones own cognitive structure.
- Learning is not a linear process. It is a spiral process growing deeper and wider.
- Learning is an intellectual process rather than the mere memorisation of facts. Learning is a conglomeration of a variety activities like problem analysis, elucidation, critical thinking, rational thinking, finding out co-relations, prediction, arriving at conclusions, applications, grouping for other possibilities and extracting the crux. When opportunities are provided for intellectual processes learning will become effective and intellectual ability will get strengthened.

Theoretical foundations of learning

Education is the best device that can be adopted for creation of a new society. It should be democratic in content and process and should acknowledge the rights of the learner. It should also provide opportunity for better citizenship training. The concept of equality at all areas should get recognition in theory and practice.

There should be conscious programme of action to develop nationality, humeness and love against the encroachment of the sectarianism of caste and religion.

The learner should be able to take firm steps and to deferred against the social crisis like privatisation, liberalisation, globalisation etc. and against all kinds of dominations.

They should develop a discrimination to use the acquired learning as a liberative weapon.

They should be able to view education and life with the perspective of social well being.

They should get opportunity to recognise that co-operation is better than competition and that co-operation is the key to social life and culture.

A basic awareness of all the subjects needed for life is essential for all students.

The remnants of perspectives formed in us during the colonial period still influence our educational philosophy. The solution to the present day perplexities of the society which approaches education on the basis of competitions and marketisation is only a comprehensive view of life.

It is high time that education was recognised on the basis of the philosophy of human education. The human approach to education has to reflect in its content, learning process and outlook. The perspective of 'learning to be ' and learning to live together as expressed by the UNESCO and the concepts of existential, intrapersonal and interpersonal intelligence.

The basis of new approaches on curriculum and teaching- learning process are derived from the developments tookplace in the east and west of the world.

When we begin to see the learner at the centre of the learning process, the teaching process has to be changed timely. It is the result of the rapid growth and development of Science and Technology and Pedagogy. If we want to undergo the changing process, we have to imbibe the modern hypothesis regarding learner that they have

- great curiosity
- good imagination
- numerous other qualities and interests
- independent individuality
- interest in free thinking and working in a fearless atmosphere.
- interest in enquiring and questioning.
- ability to reach conclusions after logical thinking.

- ability for manifest and establish freely the conclusions arrived at.
- interest for recognition in the society.
- determination to face the interference of society and make components which is a part of social life.
-

When we consider the learning system, the domains to be stressed in education according to the modern development becomes relevant.

The **knowledge** domain consists of

- Facts
- Ideas
- Laws
- The temporary conclusions and principles used presently by scientists.

The learning is a process. The continuous procedures we undergo to reach a particular goal is process. The skills which are parts of the process to analyse the collected ideas and proofs and come to a conclusion is called *process skills*. Some important **process skills** are,

the skills;

- To observe
- To collect data and record
- To classify
- To measure and prepare charts
- To experiment
- To predict
- To recognise and control the variables
- To raise questions
- To generalise
- To form a hypothesis and check.
- To conclude
- To communicate
- To predict and infer
- To use tools.
-

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

The process of grouping is known as **classifying**. Starting from simple groupings of data, it can extend to the level of classification into minute sub-groups.

In addition to this, consider the skills related to **creative domain** also, they are skills:

- To visualize
- To connect facts and ideas in new ways
- To find out new and uncommon uses of objects
- To fantasize
- To dream
- To develop creative isolated thoughts
-

Creativity is an essential component of process and activities. The element of creativity is involved in finding out problems, formation of hypothesis, finding 'solutions' to problems etc. Through activity oriented learning experiences, opportunities to express creativity can be created.

Again, the following factors consisting in the **Attitudinal domain** are also important as;

- Self confidence
- Love for scientific knowledge
- Attitude to know and value history
- Respect human emotions
- Decide with reasonable present problems
- Take logical decisions regarding personal values

'Hypothesis' is a temporary conclusion drawn using insight. Based on knowledge and experiences relating to the problems the causes and solutions can be guessed.

As regards the **application domain** the important factors are the ability to:

- observe in daily life examples of ideas acquired.
- take the help of scientific process to solve the problems of daily life.
- choose a scientific life style
- connect the ideas acquired with other subjects.
- integrate the subjects with other subjects.

Some basic stands have to be taken on the new scientific knowledge about intelligence learning and teaching. When such basic concepts are accepted changes are required in the following factors.

- The vision, approach, structure and content of the curriculum.
- The vision, approach, structure and content of the textbooks.
- Role of the teacher and the learner.
- Learner atmosphere, learning materials and learning techniques.

Some scientific perspectives accepted by modern world in educational psychology are given below.

Constructivism

This approach puts forward the concept that the learner constructs knowledge. New knowledge is constructed when ideas are examined and practiced in new situations relating them with the previously acquired knowledge and experience. That is assimilated into the cognitive structure of one's knowledge. This method which gives priority to critical thinking and problem solving provides opportunity for self motivated learning.

Social Constructivism

Social constructivism is a sub section of constructivism. Knowledge is formed, spread and imbibed and it becomes relevant in a social environment. Interactive learning, group learning, co-operative participatory learning, all these are concepts put forward by social constructivism.

The main propounders of constructivism are piaget, vygotsky and Bruner.

Discovery learning and interactive learning have prime importance. Learning takes place as a part of the attempt for problem solving. The activities of a learner who confronts cognitive disequilibrium in a learning situation when he tries to overcome it leads to the renewal of cognitive structure. It is through this process construction of new knowledge and the assimilation of them take place. Observation and enquiry are unavoidable factors. The learner advances towards new areas of acquisition of knowledge where he tries to compare his new findings with the existing concepts.

Learning is a live mental process. Rather than the ability for memorisation of facts cognitive process has to be given emphasis. The process of problem analysis, elucidation, critical thinking, rational thinking, finding out co-relation, prediction, hypothesis formation, application, probing for other possibilities, extracting the crux and other processes are of critical importance in learning.

Constructivism gives greater predominance to co-operative learning. Social and cultural factors influence learning. Sharing of knowledge and experience among learners, collective enquiry, assessment and improvement, group activity and collaborative learning by sharing responsibilities with the objective of public activity, provide opportunity for effective learning.

In learning internal motivation is more important than external motivation. The learner should have interest and initiative in learning. Learning situation should be capable of forming a sense of ownership in the learner regarding the learning process.

Learning is not a linear process. It progresses in a spiralled way advancing deeper and wider.

Learner-his nature and features

The learners in standard XI has undergone a learner centered and process oriented learning experience up to X standard. He is adequately competent to select vocational subjects according to his aptitude and interest and to acquire higher education and profession as he wishes. The aspirations about future life is framed in this particular age foreseeing national and international job opportunities. Some of the peculiarities of the learner at this stage are:

- Physical, intellectual and emotional planes under go intensive changes during this age and their reflections can be observed.
- Ability to enquire, discover and establish cause-effect relationship between phenomena.
- Readiness to undertake challenges.
- Capacity to shoulder leadership roles.
- Attempt to interpret oneself.
- Susceptibility to different pressures.
- Doubts, anxieties and eagerness about sex.
- Longing for social recognition.

Needs of the learner

- To make acquaintance with a job through vocational education.
- To acquire more knowledge in the concerned area through higher education.
- To recognise and encourage the peculiar personality of the later adolescent period.
- To enable him to defend against the unfavourable circumstances without any help

Role of the Learner

- Active participant in the learning process.
- Acts as a researcher
- Sharer of information
- Sharer of responsibilities
- Collects information
- Takes leadership
- Involves in group work
- Acts as a co- participant
- Observes his environment
- Experiments and realises
- Makes interpretations and draws inferences.

Role of the Teacher

The teacher should;

- consider the 'Stress and strain' of the teenagers
- understand the socio- economic and cultural background of the students.
- promote and motivate the students to construct knowledge.
- arrange proper situations to interact in and outside of the classroom.
- guide the students by explanations, demonstrations etc.
- promote opportunity for co-operative learning and collaborative learning.
- facilitate interpersonal and intra-personal interactions.
- act as a problem solver
- effectively guide the students for the selection and conduct of various continuous evaluation elements.
- continuously evaluate the progress of the learners.
- gives scaffolding/support wherever necessary.
- motivate for learning
- promote divergent thinking.
- act as a democratic group leader.
- act as a co-learner
- gives variety of learning experiences.
- be a constant student
- facilitate for reference/data collection
- have a clear understanding about the age, needs, peculiarities, abilities, nature, aptitude etc. of the learner.
- have the ability to motivate the learner in order to acquire and enrich their knowledge.
- be a guide to the learner in developing insights and creating responses on current affairs.
- be capable to lead the learner into a variety of learning methods and process based on curricular objectives.
- be a link between school and community.
- be a good organiser, guide, friend, philosopher and co-learner.
- have an inter disciplinary approach in learning activities.
- be able to guide the learner in his/her career prospects based on his interest aptitude and ability.
- be impartial and democratic.
- provide ample experiences to attain the basic values and objectives of the curriculum.
-

New Concepts of Learning

1. Discovery Learning-

The teacher has to create a motivating atmosphere for the learner to discover concepts and facts, instead of listening always. Creating occasion to progress towards discovery is preferred. Instead of telling everything before and compelling to initiate the models, situations are to be created to help the children act models as themselves.

2. Learning by discussion

'Discussion leads to learning' is Burner's theory. Here discussion is not opposing each other. It is a sharing on the plane of ideas. New ideas are arrived at by seeking explanations, by mutual giving and taking of ideas and by problem solving.

3. Problem solving and learning

Only when the learner feels that some thing is a problem to be solved that he takes the responsibility of learning it. It is an inborn tendency to act to solve a problem that causes cognitive disequilibrium in a particular area. It is also needed to have confidence that one is capable of doing it. The problems are to be presented in consideration of the ability and level of attainment of the learner.

4. Collaborative learning

This is the learning in which the responsibilities are distributed among the members of the group keeping common learning objectives. The common responsibility of the group will be successful only if each member discharges his duties. All the members will reach a stage of sharing the result of learning, equally through the activity with mutual understanding. The teachers who arrange collaborative learning will have to make clear the responsibilities to be discharged. This is possible through the discussion with the learners. Collaborative learning will help to avoid the situations of one person working for the whole group.

5. Co-operative learning

This is the learning in which the learners help one another. Those who have more knowledge, experience and competency, will help others. By this exchange of resources the learners develop a plane of social system in learning also. As there are no high ups and low ones according to status among the learners they can ask the fellow students doubts and for helps without any hesitation or in hesitation. Care should be taken not to lead this seeking of help to mechanical copying. It should be on the basis of actual needs. So even while encouraging this exchange of ideas among the members of the group cautious acceptance is to be observed as a convention. There should be an understanding that satisfactory responses should come from each member and that the achievement of the group will be assessed on the basis of the achievement of all the members

6 Zone of Proximal Development

Vygotsky observes that there is a stage of achievement where a learner can reach by himself and another higher zone where he can reach with the help of his teachers and peers and elders. Even though some can fulfil the learning activity by themselves there is the possibility of a higher excellence. If appropriate help is forth covering every learner can better himself.

7 Scaffolding

It is natural that the learner may not be able to complete his work if he does not get support at the proper time. The learner may require the help of the teacher in several learning activities. Here helping means to make the learner complete the activity taking responsibility by himself. The teacher has to keep in mind the objective of enabling the learner to take the responsibility and to make it successful.

8 Learning: a live mental process

Learning is a cognitive process, only a teacher who has an awareness about what the cognitive process alone can arrange learning situations to the learner to involve in it. Learning can be made effectively and intellectual sharpness can be improved by giving opportunity for the cognitive processes like reminding, recognising compromising, co-relating, comparing, guessing, summarising and so on. How is cognitive process considered in language learning? Take guessing and prediction for example.

- Guessing the meaning from the context.
- Guessing the content from the heading.
- Predicting the end of the story.
- Guessing the incident, story from the picture.
- Guessing the facts from indications.
- and other such activities can be given for the cognitive process of summarisation.
- Preparation of blue print.
- Preparation of list.
- Preparation of flow chart.
- Epitomising in one word.
- Giving titles and so on.
- Symbols, performance of character indications, lines of a poem, tables, pictures, concepts, actions, body language and such things can be given for interpretation. Process based language learning has to give prime importance to the cognitive process.

9 Internal motivation

Internal motivation is given more importance than external motivation. The teacher

has to arouse the internal motivation of the learner, A person internally motivated alone can immerse in learning and own its responsibility.

10 Multiple intelligence

The Theory of Multiple Intelligence put forward by Howard Gardener has created a turning point in the field of education. The National curriculum document has recommended that the curriculum is to be designed taking into consideration of this theory.

Main factors of the intellect :

1. Verbal/linguistic Intelligence -

Ability to read and write, making linguistic creations , ability to lecture competence to effective communication , all these come under this . This can be developed by engaging in language games and by teaching others.

2. Logical /mathematical Intelligence

Thinking rationally with causes and effect relation and finding out patterns and relations come under this area. Finding out relations ,explaining things, sequential and arithmetical calculations etc. are capable of developing this area of intelligence.

3. Visual /spatial Intelligence

This intelligence is seen in those who are able to visualise models and bringing what is in the imagination into visual form. In philosophers, designers and sculptors this area of intelligence is developed. The activities like modelling using clay and pulp, making of art equipments, sculpture, and giving illustrations to stories can help the development of this ability.

4 Bodily Kinaesthetic Intelligence

The activities using body language come under this. This area of intelligence is more developed in dancers and actors who are able to express ideas through body movements and in experts in sports, gymnastics etc.

5 Musical Intelligence

This is an area of intelligence which is highly developed in those who are able to recognise the different elements of music in musicians and in those who can here and enjoy songs. Playing musical instruments, imitating the songs of musicians, listening silently to the rhythms and activities like this are capable of developing this area of intelligence.

6 Interpersonal Intelligence

Those in whom this area of intelligence is developed show qualities of leadership and behave with others in a noble manner. They are capable of understanding the thought of others and carrying on activities like discussion successfully.

7 Intrapersonal Intelligence

This is the ability to understand oneself. These people can recognise their own abilities and disabilities. Writing diaries truthfully and in an analysing way and assessing the ideas and activities of others will help developing this areas of intelligence

8 Naturalistic Intelligence

A great interest in the flora and fauna of the nature, love towards fellow beings interest in spiritual and natural factors will be capable of developing this area.

9. Existential Intelligence

The ability to see and distinguish ours own existence as a part of the universe, ability to distinguish the meaning and meaninglessness of life, the ability to realise the ultimate nature of mental and physical existences, all these are the peculiarities of this faculty of intelligence.

Emotional Intelligence

The concept of emotional intelligence put forward by **Daniel Golman** was used in framing the new curriculum. The fact that one's **Emotional Quotient (E.Q)** is the greatest factor affecting success in life is now widely accepted. The teacher who aims to focus on improving the emotional intelligence of students need to concentrate on the following.

i) Ability to take decisions

Rather than imposing decision on students while planning and executing activities, the students may be allowed to take part in the decision making process. Taking decisions through open discussion in the class, inviting students suggestions on common problems etc. are habits to be cultivated.

ii) Ability to reach consensus

- When different opinions, ideas and positions arise, the students may be given the responsibility to reach a consensus.
- Imagining what would be the course of action in some situations, allowing to intervene in a healthy way in problems between individuals.

iii) Problem solving

- Developing the idea that there is reason and solution to any problem.
- Training in finding reasons for problems.
- Suggesting solutions through individual or group efforts.
- Discussing social problems.
- Analysing the shortcomings in methods to solve problems.

Whether plastic can be banned within school premises can be given as a problem. Group discussion will provide reasons and solutions. Problems which can influence classroom learning and for which the learner can actively contribute

solutions need to be posed.

- Self criticism, evaluation
- Ability to face problem-situation in life
- Thinking what one would do if placed in the situation of others, how one would respond to certain experiences of others - All these foster the growth of emotional intelligence.

iv) Life skills

Life skills need to be given a prominent place in education. W.H.O. has listed ten skills required for success in life.

- Self awareness
- Empathy
- Inter personal relations
- Communication
- Critical thinking
- Creative thinking
- Decision making
- Problem solving
- Coping with emotion
- Coping with stress

The new curriculum addresses these areas.

Knowing the characteristics of the learner, role of the teacher and how to use the teachers handbook help the teacher to plan and effectively implement learning activities.

Objectives of the Vocational Higher Secondary Curriculum.

- To facilitate higher education while giving opportunity to enter in the field of employment.
- To develop environmental awareness, sense of national integration, tolerance and human values so as to ensure social and cultural improvement.
- To enable the learner to find out his own employment.
- To inculcate mental courage in the learner to face unfavourable situations.
- To make human resource development possible.
- To enable the learner to understand social problems and to react appropriately.
- To develop the learner to identify and develop his own competencies.
- To develop vocational aptitude, work culture and attitude in the learner so as to provide useful products and services to the society.
- To create an awareness about mental and physical health.
- To acquire awareness about different job areas and to provide backgrounds for acquiring higher level training in subjects of interest.

- To develop possibilities of higher education by creating awareness about common entrance examinations.
- To provide situation for the encouragement of creative thinking and organising training programmes in each area, creative abilities and to develop artistic talents.

Nature of Approach

The learning device is to be organised in the selected vocational subjects in such a way that adequate practical experience should be given, making use of the modern technology. The development in each area on the basis of information technology is to be brought to the learner. The work experience in the respective fields(OJT, Field trip, Production/Service cum training centre, Survey, Workshop, Exhibition, Youth festival, Physical fitness etc.) are to be adjusted suitable to the learning and evaluation process. The participation and leadership of the students in planning and execution is to be ensured through this kind of activities. Social service is to be made a part of the course.

Approach towards Vocational Higher Secondary Education

The learning methodology has to be organised so as the learning provide adequate practical thinking on the opted vocational subject utilising the new technology. The development of information technology should be made available in each sector. Work experience, OJT, Field trip, production Service cum training centre, Survey, Workshops, Exhibitions, Youth festivals, Physical fitness etc should be systematised well appropriate to learning and evaluation. Learner participation should be ensured in the planning and implementation of these activities. Social service should be a part of the course. If a learner has to change his school, he should be provided an oppurtunity to continue his studies in the new school. While considering criteria for admission to higher courses, grades of vocational subjects should also be given due weightage. In tune with the changes in the Vocational Higher Secondary Education changes should be ensured in the field of higher education.

The teachers have to take special care in arranging learning activities for the development of all the faculties of intelligence.

Learning activities and learning atmosphere.

A proper learning atmosphere is essential for the betterment of learning activities.

They are:

- Proper physical environment
- Healthy mental atmosphere
- Suitable social atmosphere
- Active participation of PTA, Local bodies and Scool Resource Group (SRG)
- Reference materials and visual media equipments.
- Academic monitoring

EVALUATION

Introduction

As the curriculum is based on a particular vocation, evaluation becomes an inevitable procedure. Evaluation is done along with learning process throughout the course of study. In order to make an evaluation, the teacher should be able to understand the student's scholastic and co-scholastic knowledge. Capacity building in the selected vocation is the most important part in vocational education and it should be evaluated accordingly. The technical skills, interest and devotion in the particular field, communication skills, analysis, organising and presentation skills etc. have to be evaluated. The personal and social qualities also have to be evaluated. Thus evaluation is an integral part of learning process which assesses the implementation of the curriculum.

Need and importance of Evaluation

Evaluation is to assess the scientific knowledge of students and to recognise to what extent they have achieved the specified capabilities. A written examination at the end of an year which is purely based on a textbook is not of much use. "Evaluation is a systematic process of collecting, analysing and interpreting evidence of students' progress and achievement both in cognitive and non-cognitive areas of learning for the purpose of taking a variety of discussions".

The teacher can properly assess the level of the learner and can identify his/her strength and weakness. This will help each student to evaluate themselves and to improve their level of learning by taking necessary assistance from the teacher (self evaluation) classmates can evaluate themselves through interaction (peer group evaluation) Evaluation even help the teacher to analyse and improve their performance. Evaluation helps to integrate the teacher, learner and even the parents. Thus student who are socially useful and can perform productive work are created. This will improve the quality of our young generation.

Features of Evaluation

- Evaluation should be humane in nature. It must help the students grow as social beings.
- Evaluation should be the responsibility of the teacher who teaches the students

and is responsible for developing the requisites.

- Evaluation should be consistent with its purpose and must provide a reliable and valid measure of the student's performance.
- Evaluation should reflect the outcome of each learning intervention and should provide all the students with equal opportunity to display their individual potential.
- Evaluation should take into account both the background and the prior experience of the students.
- Procedures for grading and their reporting should be appropriate and easily understood by one and all.
- Evaluation should restore the faith and trust of the masses by ensuring transparency in the procedure.

Theories of constructivism and multiple intelligence are the basis of modern learning. So evaluation strategies have also to be changed. Evaluation must be;

- Continuous and comprehensive
- Scholastic and co-scholastic
- Depending on grading system.
- Depending on a vocational or trade proficiency.

Continuous and Comprehensive Evaluation

Most of our traditional evaluation methods are related only to the area of scientific knowledge or the memory of students. To eliminate the limitations of this method we are forced to evaluate the multi-dimensional competencies of the learner with respect to the practicability and nature of the subject.

Continuous and Comprehensive Evaluation is an essential ingredient of any learning process. It helps the learner to understand and evaluate his own progress and to develop adequate strategy for further improvement. Continuous Evaluation also helps us to measure the attained goals of formulated curriculum objectives.

Merits of Continuous and Comprehensive Evaluation system are:

1. Making student's learning regular
2. Provides for a variety of activities
3. Effective feedback is possible
4. Assess the allround development of the learner on a continuous basis through a variety of activities.
5. Remedial and diagnostic teaching is possible.
6. The process as well as the product is assessed.

Different tools are used to evaluate the multi dimensional competencies of the learners. The Continuous and Comprehensive Evaluation (CCE) includes not only written test (class tests) but also oral tests, observation, interview, debates, discussions, seminars etc.

The learner proceeds through a variety of learning experiences. Therefore the level of progress should be evaluated in a comprehensive and continuous manner. More over, the learner is to be made aware of the findings and it helps him to measure his progress. Necessary help should be provided to them in time. As such we can generate the environment and opportunity for Continuous Evaluation.

In order to evaluate the multi- dimensional competencies of the learner, different tools and techniques have to be used. The multi- dimensional competencies of the learner include :

- Class -room interaction
- Task orientation
- Creative expression
- Field/institutional interactions
- Knowledge assessment/ expression

Continuous Evaluation Items

1. Assignment
2. Seminar
3. Class test
4. Project etc.

* For continuous evaluation class test (CT) is made compulsory taking any two of the above said indicators. CT can be a written test, oral test (viva), Practical test.

CE Item	Evaluation Indicators	Weightage	Score
1. Assignment	1. Awareness of the content 2. Comprehensiveness of the content 3. Systematic and sequential arrangement 4. Observation/suggestions/Views Judgements/ Evaluation 5. Timely Submission	4/3/2/1 4/3/2/1 4/3/2/1 4/3/2/1 4/3/2/1	20
2. Seminar	1. Ability to plan and organise 2. Skills in the collection of data 3. Awareness of the content (presentation of the paper, participation in discussion, ability to substantiate the ideas and views)	4/3/2/1 4/3/2/1 4/3/2/1	

	4. Ability to prepare the report (sequence in the presentaionof the concepts, authenticity and clarity of ideas/views/concepts)	4/3/2/1	
	5. Quality of Seminar Document	4/3/2/1	20
3. Project	1. Ability to plan (Selection of the method for solution of the problem, identifying suitable tools, planning the various activities to be carried out in each stage)	4/3/2/1	
	2. Ability to collect data (sufficiency and Relevance of data. Classification and arrangement of data for analysis, reliability and authenticity of the Collected data.)	4/3/2/1	
	3. Ability to analyse the elements and procedure (Structuring of elements and developing logic. Efficiency in using the package/tool. Recognising design errors and correcting them)	4/3/2/1	
	4. Ability to prepare the project report (Reflection of the process skills. Communicability and authenticity of the report in relation with the Project diary)	4/3/2/1	
	5. Viva Voce(Knowledge of the content and Process)	4/3/2/1	20

CE item calculation

Subject		item: Assignment					Total Score (20)
Sl. No	Name	Evaluation Indicators					
		I (4)	II (4)	III (4)	IV (4)	V (4)	
1	Anand	2	3	4	4	4	17
2	Shibu	4	3	4	4	4	19

Total CE calculation

Sl. No	Name	CE Items			Total (60)	Total CE Out of 20
		1 Class Test (20)	2 Assignment (20)	3 Seminar/ Project (20)		
1	Anand	18	17	19	54	18
2	Shibu	20	19	18	57	19

Grading for CE

Each item in CE is evaluated giving its required score and graded as shown. 5 point grading is given

17 → 20 → A grade

13 → 16 → B grade

9 → 12 → C grade

5 → 8 → D grade

below 5 → E grade

Terminal Evaluation (TE)

Terminal Evaluation is in written form. The test should not be aimed to test the memory alone. The terminal evaluation questions give more emphasis on application level, analysis and synthesis. The questions are framed so that the students are able to apply their different mental process. The maximum score is 80 and the minimum score of TE is 24 (30%).

The terminal evaluation questionnaire should be capable of measuring

- Content validity
- Criterion validity
- Constant validity
- Reliability
- Class test, term evaluation and annual examination should be in tune with the new approach.
- Should not be prepared to test the rote memory.
- Questions asked should provoke the thinking abilities of students.

- Questions to test the competency of application analysis, synthesis and evaluation are to be given. In other words the questions should be framed in such a way that the students are able to apply their various mental processes.
- Questions should be based on the learning process and the new approach to each subject.
- Results should be scientifically analysed.
- Evaluation results should be analysed and follow up may be carried out at relevant levels (remedial measures).
- Eighty percent marks are set apart for the common examination as the part of the Term Evaluation

The Question Paper must have

- Application level questions
- Synthesis level questions
- Comparison of facts
- Challenging questions
- Scope for obtaining innovative ideas
- Giving creative thinking by the students
- Questions based on the objectives of learning activities
- Practical oriented questions
- Environment related questions
- Divergent thinking level questions

Role of the Teacher in the Evaluation Process

- Preparation for the effective execution of evaluation
- Preparation of daily planning notes (teaching manual) and helping learners in their activities.
- While learners are engaged in doing seminars/collections/assignments/ conduct interim evaluation and provide necessary help.
- Consider assignment, seminar, collections etc. as learning activities and approach them as evaluation materials.
- Prepare a format to record continuous evaluation.
- Identify and evaluate the progress at different stages.
- Find out learner's difficulty by conducting feedback.
- Make use of the support mechanism fully, provided by the department of education.
- Make the parents aware of the new approach to curriculum and evaluation system through class P.T.A.
- Make use of the training programme for professional excellence and transparency in work.

- Make use of the Humanities Teachers Council for academic progress.
- Identify and make use of the possibility of action research to resolve classroom learning problems.

Grading

It is not scientific to assess the achievement of a student solely based on the marks in the terminal examinations. Marking system proved unscientific in evaluating the growth and development of students both in cognitive and non-cognitive areas. To overcome these shortcomings, a popular mode of evaluation based on students' performance- grading system- has been evolved. At the Higher Secondary stage, it is desirable to use a point absolute grading to co-ordinate and record the evaluation. After giving the score, they are changed into percentages and appropriate letter grades are awarded corresponding to each percentage.

Subject Consolidation

Sl. No	Name	CE (20)	TE (80)	Total CE+ TE (100)	Grade

The maximum score of CE + TE is 100 and the minimum score is 30(30%)

Practical Evaluation (PE)

PE is the important part of vocational practicals. The practical skills must be evaluated after completing all practical experiments in each term and at the end of the academic year. PE must cover all required indicators to evaluate the technical skill and practical knowledge of the different topics covered.

Indicators for PE varies according to the course.

Vocational Competency Evaluation

Being a vocational course, a system to judiciously evaluate the required value addition and consequent capacity building in the selected vocational subject is highly essential. As the other evaluation components like CE, PE and TE cannot assess the vocational competencies and professional skills acquired by the students, an internship evaluation (IE) component has been introduced to meet this requirement.

Internship evaluation should be done based on the following components.

I. Regularity and punctuality.

A regular presence and habit of time bound completion of task is a must for attaining maximum efficiency.

Regularity and Punctuality can be evaluated by 5 point scale.

Rating scale

		1	2	3	4	5
1	Regularity	Never regular	Often regular	Usually regular	Most of the time regular	Always regular
2	Punctuality	Never Punctual	Often Punctual	Usually Punctual	Most of the time Punctual	Always Punctual

Regularity and punctuality can be assessed by using attendance of the student and time bound completion of tasks.

II. Value addition

Value addition can be evaluated through conducting field visits/survey. The experiences gained through field visit and survey increases the level of intrinsic motivation and positive attitude towards the vocational field and there by increase his value as a skilled semi- professional.

The aim of value addition is to measure the interest, devotion, group management and perseverance of the learner in specific areas Value addition can be evaluated from field visit and survey.

III. Capacity building

Capacity building can be evaluated through conducting the following activities.

1. OJT/Simulated experiment
2. Performance- Camp/ Exhibition/ Clinic.
3. Performance- Production/Service cum Training centre.

These components helps the students to practice the acquired skills in the real situation and there by increasing self confidence and promoting self reliance.

Capacity building is aimed at measuring the skills of the learner from OJT/ production cum training centre/ research and development/graded area exposure/ simulated experiments.

IE Item	Evaluation Indicators	Weightage	Score
1. Regularity and Punctuality			10
2. Value addition	<p>Field Visit</p> <ol style="list-style-type: none"> 1. Attitude and readiness towards the task. 2. Capacity for observation. 3. Data collection. 4. Application of ideas. 5. Documentation/ recording. <p style="text-align: center;">OR</p> <p>Survey</p> <ol style="list-style-type: none"> 1. Planning. 2. Data collection. 3. Consolidation of data and analysis. 4. Drawing inference. 5. Reporting. 	<p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p>	20
3. Capacity building	<p>OJT/ Simulated Experiment/ Practical skill</p> <ol style="list-style-type: none"> 1. Involvement/ Participation. 2. Skills in doing work/ Communication skill. 3. Time bound action. 4. Capacity for observation, analysis and innovation. 5. Documentation, Recording and display. <p style="text-align: center;">OR</p> <p>Performance in camp/ Exhibition/ clinic</p> <ol style="list-style-type: none"> 1. Ability for planning and organising. 2. Mastery of subject. 3. Ability for communication. 	<p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p>	20

IE Item	Evaluation Indicators	Weightage	Score
	4. Innovation.	4/3/2/1	
	5. Involvement/Social commitment.	4/3/2/1	
	OR		
	Performance in production/ service cum training centre (PSCTC)		
	1. Mastery of vocational skills.	4/3/2/1	
	2. Managerial capacity.	4/3/2/1	
	3. Promoting self confidence.	4/3/2/1	
	4. Innovative approach.	4/3/2/1	
	5. Promoting self - reliance.	4/3/2/1	

Vocational Competency Items for Internship Evaluation

Items	Score
Regularity & Punctuality	10
Field visit/survey(any one)	20
OJT/simulated experiment/ Practical Skill/ Performance- Camp/exhibition/Clinic Performance- PSCTC (any one)	20
Total	50

A minimum of 80% attendance is required for promotion to the second year. Those who have shortage of attendance should repeat first year. Those who have 80% and above attendance but failed to achieve 30% of Internship Evaluation (IE) will be promoted to the second year. He has to improve the component in which he performed poor. He has to attain the minimum by improving the particular component to get eligible for appearing second year public examination.

MAINTENANCE AND REPAIRS OF DOMESTIC APPLIANCES

Introduction

In the era of globalization, mankind can be developed through adopting new trends in science and technology. The spectrum of this electrical and electronic branch directs the prosperity of human being by a measure of per capita income earned through self or wage employment. In the lively hood, the man and machine cannot be separated. The development is boosted through the specialisation in concerned areas. Hence the sector of electrical and electronics plays a vital role in the dynasty of technologies.

In the modern life, the usage of electrical and electronics appliances is inevitable. This leads to the increase of job opportunities in this field. Hence this course is very important in the current scenario. This course deals with basic principles, working and servicing of electrical and electronics domestic equipments. On the other hand, it also helps to seek new opportunities in the concerned branch for higher education.

Objectives of the course

- To prepare the learner to enter self-employment to develop self reliance through production, servicing and repairing of electrical and electronic domestic equipments.
- To equip the learner to get wage employment in public as well as private sector by attaining skill and undertaking the service work.
- To meet the need for skilled man power to the society
- To acquire electrical and electronics engineering skill at the higher secondary level itself and thereby enable him to equip with modern technology to get a foundation for his future career.

Learning Approach

The philosophy of modern education contributes the following such as.

1. Learning process is the construction of knowledge.
2. Cognitive structures change through the process of adaptation, assimilation and accommodation

3. Learning takes place through problem solving

Learning process is done through this change in cognitive structure. Hence the teacher has to use the instructional approach to motivate the students to construct knowledge of his own.

The vocational Education is highly effective for carrying out process- based learning. This engineering course focuses on occasion for doing practicals and execute innovative projects and encourage imagination, skill and problem solving capacity.

Evaluation

Evaluation has a significant role in making the learning process more effectively. The need of society decides the nature of education. Our education system is undergoing rapid change. As a part of this, new methods and scientific techniques are brought into practice. This system provides more importance to learner centered activities. Evaluation is the process of collecting, analysing and interpreting abilities of students both in scholastic and co-scholastic areas of learning. It helps the teacher to analyse and improve the performance and assess the level of learner.

A one time evaluation for the whole curriculum based on this textbook knowledge alone is not scientific. The new system introduces an evaluation which is continuous and comprehensive. Hence evaluation includes the following items such as TE, CE, PE and VCE. The pattern adopted is as shown below.

Evaluation of I year

Stream: Electrical and Electronics Engineering

Class - I year

Subject: MRDA

Sl. No1	CE	TE	PE	IE	Total score	Minimum For Pass %
VT	20	80	.....	.....	100	30
VP	.....	.....	150	.....	150	40
VCE	.....	.....	.....	50	50	30

No minimum for CE

But minimum 30% for TE and VCE

Terminal Evaluation

Terminal evaluation should be in written form. The intention of the test must not be confined to memory text alone. It is an important tool for evaluating the facts, concepts and ideas gained by the learner. While preparing questions for terminal evaluation, more emphasis should be given to the level of application, analysis, synthesis and evaluation than knowledge and understanding. The question should be framed on such a way that the students are able to apply their various mental process. The maximum score fixed for TE is 80%.

Continuous Evaluation

Continuous evaluation got a place along with terminal evaluation in making the learning process more effective by providing diverse experience to this students, keeping in view the skills to be attained continuously by them. It assess the overall development of learner. Traditionally we were following only single evaluation tool which measure the intellectual capacity of the learner. To eliminate the limitations of this method we have to evaluate the multidimensional competencies of the learner with regard to the practicality and reasonable thinking.

CE Items

The following 3 items should be taken for preparing CE score sheet.

1. Class Test
2. Assignment
3. Seminar

Evaluation Profile

Sl. No1	Name of student	Class Test	Assignment	Seminar	Total	Score Average	Grade
		20	20	20	60	20	
1.	Remya	13	14	15	42	14	B
2.	Habeeb Rahman	12	15	14	41	13.6=14	B
3.	Thomas	7	6	9	22	7.3 = 7	D
4.	Gopinath	18	19	19	56	18.66=19	A

The scores in the CE items are converted to its corresponding grade as shown below.

SCORE	GRADE
17-20	A
13-16	B
9-12	C
5-8	D
Below 5	E

Class Test

Minimum 2 class tests should be conducted. Terminal examinations may also be considered for evaluation purpose with prior notice to the students. The average score of these tests should be taken and recorded in evaluation profile. The features of class test are as follows.

- Class test need not be a written test. It can also be an oral test or quiz
- After completing a unit, it can be in the form of a unit test.
- It can be a test including more than one unit
- Class test should be informal. No time table or printed question paper is required. No need of a blue print.
- Questions should be suitable for subject approach.
- Arrange more remedial activities to solve the problems identified through class test after discussing it with pupils.

Practical Evaluation

Practical should be conducted at the end of each year. Evaluation should be done as detailed below.

Sl. No	Particulars	Percentage	Score
1	Identification of objectives and requirements		
	a. Layout & circuit diagram	10%	15
	b. Estimation of materials & Tools	10%	15
2.	Procedure and Precautions	10%	15
3.	Working skill and Handling of tools	30%	45
4.	Result/ Out put	10%	15
5.	Record/ Observation book	10%	15
6.	Viva and identification of components/ accessories	20%	30
	Total	100	150
	Minimum for pass	40%	60

Minimum C Grade is required for pass

Score in %	Score	Grade
90-100	135- 150	A+
80-89	120-134	A
70-79	105-119	B+
60-69	90-104	B
50-59	75-89	C+
40-49	60-74	C
30-39	45-59	D+
20-29	30-44	D
Below 20	29 and below	E

Note

1. A proper record of the work done in the lab should be maintained in the observation book.
2. Valuation of the observation book will be done at the time of PE

LEARNING STRATEGIES

In the modern era, the introduction of new technologies and globalisation ensures only the survival of the fittest. So it becomes a necessity to equip the learners to face the growing challenges in the competitive world. Hence the traditional approach to learning is no more relevant in the present context. The teacher should use instructional techniques that motivate the student to construct his own knowledge. Now the learners are not passive listeners, but they are the active participants in the construction of knowledge. Here the teacher – student interaction should be given much importance.

In the new instructional strategy, while selecting the methods of teaching, the social and psychological aspects of the learner is to be taken into consideration. The given activities for learning are only suggested one. It can be altered according to the discretion of the teacher.

To obtain the objective, the new system of education is introduced in the Vocational Higher Secondary Education. For attaining the objectives of the M.R.D.A course in this system, we can adopt the following strategies.

I. Project

Project is the most important method for learning engineering tactics. This is a creative way of self-learning that develops a number of process skills.

Stages of project

a) Feeling the problem

Project has to be done on a felt problem in the class room during learning. By doing projects, the student acquires problem solving ability in his education as well as life.

Project work areas are usually evolved from the discussions in the class room. For example, while studying transformer, the student will get a clear idea about transformer. This creates an urge in the students to make a transformer of his own. This leads to a project of making a transformer

b) Defining the Objective

After the problem is identified, the learner has to collect some information to fulfil the objective. This necessitates the need for defining the objective of the project clearly with the help of the teacher.

The aim of project shown in the example above is to design and construct a transformer. If the design is precisely stated, the project planning will become more easy.

c) Team formation

Project can be taken up on an individual basis or group basis. But group projects have many advantages. Here the project on transformer can be done on group basis.

d) Planning

Planning of the project is important to complete the work in a time bound manner. This includes the following steps.

- **Formulation of Hypothesis**

This means arriving at a temporary conclusion on the basis of information available at that time. Hypothesis of the stated project may be

- a. The transformer core section made of E & I sections.
- b. The transformer core made of L sections.

- **Identifying methods and Tools**

The method selected and the materials and tools listed should be according to the stated objectives and formulated hypothesis. Approaching a transformer manufacturer for getting more information regarding the design and construction can be selected as a method.

- **Identify the source of material or Data**

Before starting the project, the student must have a clear idea about the availability of the material, place of purchase, and method and place for collecting additional data required.

- **Estimation and costing or Analysis of data**

Depending upon the project, the student should prepare a class estimate for undertaking the project work. In the case of data collecting, he should analyse the collected data. In the said project estimation and costing is to be done.

e) Execution of project

The execution of project activities may be according to the plan. necessary modifications may be done as and when required. Difficulties faced during the project execution are to be entered in 'project diary' which will be helpful at the time of report writing. Teacher must take care to conduct frequent discussions with students to evaluate the progress of the work.

f) Preparation of Project Report

The report of the project should contain all details regarding the project. It must be a self explanatory document containing diagram, circuit details, charts etc. The report is to be prepared by

the students themselves. The format of a project report is listed below.

Cover page of the project may show

- a Title of the project
- b Name of the student / members of the group and
- c School address.

The report may contain the following details

- a. Title of the project
- b. Authentication certificate
- c. Acknowledgement
- d. Content
- e. Introduction
- f. Objectives
- g. Hypothesis
- h. Methodology
- i. Collection of data / Design and circuit details with estimate
- j. Analysis
- k. Findings / Result
- l. Suggestions
- m. Conclusion
- n. References
- o. Appendices – Questionnaire, checklist, observation, schedule etc.

g) Presentation of project

During presentation of the project the work done can be evaluated and assessed. Also ideas can be communicated and shared with others. The presentation must be brief and simple. The venue for presenting the project can be selected conveniently. It can be presented at the places such as class room, science club meeting, science fairs, Social gathering or other selected forum . The

student must be so well – versed with the subject that the doubts raised during project presentation must be convincingly cleared .

II. Assignment

Assignment is a learning activity of assigning some specific work to the students as a continuation of class room activity to study the topic deeply. It may be given on individual or group basis. Assignments include preparation of charts, collection of materials, drawings, problem solving, construction activity etc. In assignments involving construction, a note on methods used may also be submitted. The discussion and planning may be carried out in classroom to complete the assignments in time. Clarification and sources, if needed, may be provided by the teacher.

III Seminar

Seminar is a learning method which provides the learner with the depth of the subject, communication skill, power of analysis etc. Here the data is collected, analysed and presented as a paper for the benefit of all concerned. The paper is presented either by one student or a group of students. After presenting the paper, there will be a discussion / interaction in which all students can participate. Through this discussion they get an opportunity to clear their doubts and make clarifications. It helps the learner to improve his / her communication skill and provides opportunity for the collection of secondary data for drawing conclusions.

Stages involved in conducting a seminar

- 1) Selection of topics
The selected topics should have relevance to the subject of study.
- 2) Assigning topic to individual or team.
- 3) Collection of information / data
- 4) Preparation of draft paper to the teacher for comments.
- 5) Finalisation of the paper.
- 6) Programme scheduling to fix the date, time and venue of the seminar.

7) Seminar paper presentation

One student from each group should present the paper. One of the students can moderate the seminar. The teacher may moderate the seminar at initial stages. During preparation of final report new ideas from any group may be consolidated.

8) Discussion / interaction from students belonging to other groups.

9) Summing up the deliberations.

10) Evaluation / Feed back from both students and teachers.

11) Preparation of final report containing all the points covered in the seminar. Individual report is needed.

IV. Debate

Debate is a creative and collective process of eliciting all related facts of a topic, that enables the participants to enrich their knowledge through healthy dialogues. In a debate there will be minimum two groups and a moderator.

Stages of debate

1. Topic selection
2. Selection of panels keeping balance with intelligence, gender etc.
3. Selection of moderator
4. Collection of information guided by the teacher
5. Conducting the debate under the control of moderator by avoiding any sort of personal conflicts.
6. Conclusion by the moderator expressing his final version or verdict.

V Brain Storming

This is the best method for solving creative problems. It facilitates generation of ideas quickly.

Rules for conducting Brain storming

1. No response is wrong. So welcome every response.

2. Welcome as many responses as possible
3. No criticism is allowed.
4. Allow to work on others idea.

Steps in brain storming

1. Presentation of the problem
2. Provide relevant information
3. Record the ideas put forth by the participants
4. Combine similar ideas
5. Evaluate each idea / solution
6. Selection of the best solution

If brain storming is used as an instruction strategy, the last step is not essential.

VI. Discussion

Discussion is essential for the student to share new findings, ideas and conclusions at each stage of learning with fellow students and teachers. In general discussion the teacher should guide the discussion through questioning and summarising. The major stages involved in discussion are

- 1) Introduction initiated by the teacher
- 2) Development of discussion by giving lead points and follow up interactions
- 3) Transition stage in which the key points are reviewed by the teacher and
- 4) Summarising stage in which teacher provides additional support materials to ensure the achievement of the objectives.

VII Group Discussion

Group discussion is an ideal method to develop co-operation, democratic attitude, friendliness and compromising attitude which are the ultimate aims of education. 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 within a time limit. The conclusion reached may be entered by each student. A group representative must present this during consolidation in which the teacher may correct or add informations to ensure that all the relevant ideas have been covered.

VIII Collection

Collection is a continuous learning activity which ensures complete participation of students. The collected item may be materials, pictures, charts, ideas, data etc. Collection provides direct experience to learners.

IX Practical works

Experimentation contains the process skills in an integrated way. In the new approach of curriculum, the student forms ideas and comes to conclusions through process. The term 'practical' when associated with a science subject usually means an experiment. The objective of doing a science experiment is to explore new ideas through investigation only. Its main purpose is to verify some principles associated with theory. The relevance of 'practical' in the traditional science subjects ends here. But this is not the case with 'Vocational Practical.'

The ultimate goal of a Vocational Education is to generate skill through continuous practice along with investigation and invention. Continuous practice transforms the unskilled to the skilled. This is the significance and importance of practicals in the Vocational Stream. Hence it is very crucial that vocational teachers as well as instructors should understand the importance of vocational practical and act accordingly.

X Field trip/ Study tours

Field trips provides learning through viewing. It is based on the principle that 'seeing is better than hearing.' It enables the student to retain the learning longer and to make the topic more interesting. For instance conducting a field trip to see a 3 phase transformer will help the students to identify the parts, their

functions and the protective devices used etc. through direct experience.

Both field trip and study tours give an opportunity for the students to understand the facts by physical verification. Field trip is a short visit to a local area with specific purpose. On the other hand study tour is a trip with more than one objective.

Note:-

In addition to the above mentioned learning strategies, there are many other methods such as interview survey etc. which can be used in appropriate situations. The activities included in this hand book can be replaced with a better technique to make the learning more easy.

More Suggested Activities:-

1. Conduct workshop for the repair of domestic appliances.
2. Conduct a trade fair about the new domestic appliances with the help of PTA through Production/ Service cum Training centres (PSTC)
3. To assist in wiring works in the Economically backward area.
4. Conduct an Exhibition / Technical fair to motivate the innovative talent of students (working model / still model)

SYLLABUS

1. Electric Circuits :

Concept of Atomic structure, charge, potential and potential difference-units-different voltage sources (Ac and Dc)-concept of Electric current and its unit- Effects of current- Resistance-conductors and Insulators- Ohm's law-Effect of temperature on resistance- Laws of resistance- specific resistance-simple problem-Kirchhoff's laws- series, parallel and series parallel combination of resistors-simple problems-work, power and Energy-units-simple problems.

(20 hrs)

2. House Wiring :

Various types of tools and wiring accessories -conduit wiring- safety precautions-Effect of electric shock on human body- first aid for electric shock-rules and standards in house wiring- types of wires and its rating-types of fuses and its rating- MCB and ELCB- Earthing-Necessity-pipe earthing-Measurement of earth resistance-Calculation of sub circuits-layout, wiring diagram and Estimation for simple Domestic installation.

(21 hrs)

3. Magnetism :

Properties of magnets-permanent and temporary magnet-magnetic and non-magnetic materials-different terms associated with magnetic circuits - Electromagnetic induction - Faraday's laws of electromagnetic induction- Lenz's law- Fleming's right hand rule-and cork screw rule. Self and mutual induction-units- eddy current -hysteresis loss

(18 hrs)

4. Fundamentals of AC :

Generation of AC - idea of AC sine wave cycle, frequency, time period, amplitude, instantaneous value, average value, rms value, form factor, phase and phase difference-single phase circuits containing

resistors, inductors and capacitors-impedance, power and power factor-simple problems- Resonance in R-L-C series circuit - kW, KVA and KVAR-e phase supply-star and delta connection -properties.

(16hrs)

5. Measuring Instruments :

Classification of measuring instruments-Torques uses in indicating instruments-moving coil and moving iron instruments-use of voltmeter and ammeters-idea of wattmeter and Energy meter- constructional details of energy meter-method of connection of voltmeter, Ammeter, Wattmeter and Energymeter, in circuits-uses and connection of merger, multimeter, Earth tester and Tong tester.

(21 hrs)

6. Transformer :

Basic principle-parts of single phase and three phase transformers-emf equation- transformation ration- calculation of primary current, secondary current and number of turns- Losses and efficiency- Application and rating- Necessity of cooling- different methods-properties of transformer oil- winding of small transformers.

(19hrs)

7. DC Machines:

Importance of DC-parts of DC generator-principle of working -emf equation-classification -failure of building up of voltage- DC motor - working principle-classification- Necessity of starter-3 point starter-Field of applications of different types of motors- Losses and efficiency of DC machines-concept of Lap and wave winding-methods of speed control and reversal.

(15 hrs)

8. Electrical House hold Appliances :

Principle of working, parts and servicing of Non automatic electric Iron, Automatic Iron, Electric heater, Hot plate, Water heater, Electric oven and Electric toaster.

(19 hrs)

9. Illumination :

Concept of illumination, lumen and efficiency-parts , working and connection of incandescent lamp, Fluorescent lamp- HPMV Lamp, Sodium vapour Lamp and Halogen lamp- Stroboscopes effect of tube light-Advantages of electronic choke and CFL.

(11hrs)

THEORY

CURRICULUM OBJECTIVES

UNIT-1- Electric circuits

- 1.1 To enhance concept of structure of atom, through general discussion
- 1.2 To understand the concept of charge, potential and potential difference through discussion.
- 1.3 To create an idea of different voltage sources (ac and dc) through demonstration and discussion.
- 1.4 To understand current and its various effects through demonstration and discussion.
- 1.5 To understand the concept of resistance and classification of materials as conductors and insulators through material collection and discussion
- 1.6 To study the relation between voltage, current and resistance, (ohm's law) through experiment, discussion and problem solving
- 1.7 To study the effect of temperature on resistance of different materials through group discussion.
- 1.8 To study the laws of resistance and specific resistance through discussion and problem solving.
- 1.9 To understand the series, parallel and series parallel combination of resistors through discussion, problem solving, simple experiment and demonstration
- 1.10 To introduce Kirchhoff's laws through discussion
- 1.11 To understand the concept of work, power and energy through discussion, problem solving and provide the skill of energy calculation through project work.

UNIT-2- House wiring

- 2.1 To understand various types of tools and wiring accessories required for all types of conduit wiring through material collection, demonstration and group discussion.
- 2.2 To understand the precautionary measure for safety, first aid against shock and effects of electric shock on human body through seminar
- 2.3 To understand rules and standards in house wiring through general discussion and class room transaction.
- 2.4 To understand types of wires and ratings through demonstration and discussion.
- 2.5 To understand the functions, rating and types of fuses through seminars.
- 2.6 To understand the functions, connections and ratings of MCB and ELCB through demonstration and discussion .
- 2.7 To understand the necessity of earthing, measurement of earth resistance using earth tester through experiment and details of pipe earthing through observation.
- 2.8 To acquire knowledge of subcircuit calculation, preparation of lay out and estimation through discussion and assignment.
- 2.9 To familiarize domestic wiring through practical work.

UNIT-3- Magnetism

- 3.1 To recognize different types of magnets and their properties through discussion and demonstration or through assignment.
- 3.2 To develop a clear idea about magnetic and non-magnetic materials and to classify them through the collection of material, demonstration and discussion.
- 3.3 To familiarise different terms related to magnetism by discussion.
- 3.4 To acquire the concept of induction by demonstrating and discussing Faraday's laws of electromagnetic induction and Lenz's law.
- 3.5 To give idea about Cork Screw rule and Fleming's right hand rule through picture, demonstration using finger, OHP, chart and discussion.

- 3.6 To develop the concept of different magnetic losses through discussion and plotting B-H curve.
- 3.7 To differentiate self and mutual induction by discussion.

UNIT-4- Fundamentals of A.C.

- 4.1 To understand the principle of generation of AC through demonstration and discussion.
- 4.2 To identify AC parameters like frequency, cycle, time period, amplitude, phase, r.m.s value, average value, etc. through discussion.
- 4.3 To study the circuits containing pure resistors, inductors and capacitors through discussion.
- 4.4 To understand impedance, power and power factor of R-L, R-C and R-L-C series circuit and parallel circuit through discussion and problem solving.
- 4.5 To understand condition for resonance in R-L-C series circuit through discussion.
- 4.6 To study the concept of power factor and its importance through discussion.
- 4.7 To study active power, reactive power and apparent power through discussion.
- 4.8 To develop a concept of 3-phase supply through drawings and discussion.
- 4.9 To identify Star and Delta connections and its properties through demonstration and discussion.

UNIT-5- Measuring Instruments

- 5.1 To understand the classification of electrical measuring instruments through demonstration and discussion.
- 5.2 To understand different types of torques in indicating type instrument through discussion
- 5.3 To understand principle of working of moving coil and moving iron instruments through demonstration and discussion.
- 5.4 To understand the working principle of induction type Wattmeter through a general discussion.

- 5.5 To understand the uses and connection of Ammeter, Voltmeter and Wattmeter through simple experiments and discussion.
- 5.6 To study the constructional details, connections, working principle and errors of energy meter through demonstration, discussion and practical work.
- 5.7 To study the parts and uses of megger and earth tester through simple experiments and discussion.
- 5.8 To study the uses and connections of multimeter and Tong tester through general discussion and demonstration.
- 5.9 To create awareness about the latest trends in measuring instruments about digital meters through assignment.

UNIT-6- Transformers

- 6.1 To develop a general idea of transformer through group discussion.
- 6.2 To study the principle of working of transformer through discussion and brain storming.
- 6.3 To identify the parts of single phase and three phase transformers through demonstration and field visit.
- 6.4 To derive E.M.F equation of a transformer and transformation ratio through discussion and derivation.
- 6.5 To compute the primary and secondary currents and number of turns through problem solving.
- 6.6 To study losses associated with transformer and its efficiency through discussion.
- 6.7 To know the field of applications of transformers and its rating through discussion.
- 6.8 To develop an idea about the necessity of transformer cooling and different methods adopted through discussion and field visit.
- 6.9 To study the properties of transformer oil through discussion.
- 6.10 To develop the skill in small transformer winding through project.

UNIT-7- DC Machines

- 7.1 To develop the concept of the importance of d.c. through group discussion.
- 7.2 To develop the concept about the constructional details, principle and working of D.C generator through demonstration and discussion
- 7.3 To reach the concept of derivation of e.m.f equation through discussion.
- 7.4 To understand the classification of D.C generators through discussion, with the help of diagrams and visual aids.
- 7.5 To analyse the reason of failure of building up of voltage and its remedial measures through brain storming and discussion.
- 7.6 To develop the concept of the constructional details, classification principle and working of D.C motor through discussion with the help of diagrams and visual aids.
- 7.7 To understand the necessity, parts, working and connection of three point starter through experiment, demonstration and discussion.
- 7.8 To understand the field of applications of d.c machines through discussion.
- 7.9 To understand the losses and efficiency of d.c machine through discussion.
- 7.10 To understand lap and wave winding through demonstration, discussion and assignment.
- 7.11 To develop an idea about the methods of speed control and reversal of rotation through simple experiments and discussion.

UNIT-8- Electrical House Hold Appliances

- 8.1 To acquire a deep knowledge about the parts, wiring diagram and working of non-automatic, electric iron, through equipment demonstration, picture presentation and discussion.
- 8.2 To acquire the skill for dismantling and assembling a non-automatic electric iron through discussion and practicals.
- 8.3 To recognize different faults of non-automatic electric iron and acquire the skill to rectify them through general discussion test and practicals.

- 8.4 To acquire a deep knowledge about the parts, wiring diagram and working of Automatic electric iron through equipment demonstration, picture presentation and discussion.
- 8.5 To acquire the skill for dismantling and assembling of Automatic electric iron through discussion and practicals.
- 8.6 To recognize different faults of Automatic electric iron and acquire the skill to rectify them through general discussion tests and practicals.
- 8.7 To acquire a deep knowledge about the parts, wiring diagram and working of electric heater through equipment demonstration, picture presentation and discussion.
- 8.8 To acquire the skill for dismantling and assembling of electric heater through discussion and practicals.
- 8.9 To recognize different faults of electric heater and acquire the skill to rectify them through general discussion test and practicals.
- 8.10 To acquire a deep knowledge about the parts, wiring diagram and working of Hot plate through equipment demonstration, picture presentation and discussion.
- 8.11 To acquire the skill for dismantling and assembling of hot plate through discussion and practicals.
- 8.12 To recognize different faults of hot plate and acquire the skill to rectify them through general discussion, tests and practicals.
- 8.13 To acquire a deep knowledge about the parts, wiring diagram and working of water heater through equipment demonstration, picture presentation and discussion.
- 8.14 To acquire the skill for dismantling and assembling of water heater through discussion and practicals.
- 8.15 To recognize different faults of water heater and acquire the skill to rectify them through general discussion, test and practicals.
- 8.16 To acquire a deep knowledge about the parts, wiring diagram and working of electric oven through equipment demonstration, picture presentation and discussion.

- 8.17 To acquire the skill for dismantling and assembling electric oven through discussion and practicals.
- 8.18 To recognize different faults of electric oven and acquire the skill to rectify them through general discussion, tests and practicals.
- 8.19 To acquire a deep knowledge about the parts, wiring diagram and working of Electric toaster through equipment demonstration, picture presentation and discussion.
- 8.20 To acquire the skill for dismantling and assembling electric toaster through discussion and practicals.
- 8.21 To recognize different faults of electric toaster and to acquire the skill to rectifying them through tests and practicals.
- 8.22 To understand latest development and new products in the area of above said appliances through assignments.

UNIT-9- Illumination

- 9.1 To introduce the concept of illumination, lumen and efficiency through discussion.
- 9.2 To understand parts and working of incandescent lamp through assignment / seminar.
- 9.3 To understand parts, working and circuit connection of fluorescent lamp through seminar and practical work.
- 9.4 To understand parts working and circuit connection of H.P.M.V lamp through discussion and practical work.
- 9.5 To enable the students to know working and application of sodium vapour lamp and halogen lamp through discussion.
- 9.6 To study about the stroboscopic effect and its elimination through discussion and experiment.
- 9.7 To study the advantages of electronic choke and CFL through assignment.
- 9.8 To acquire the skill of simple illumination designing through a project work.

CURRICULUM OBJECTIVES

1. Safety Precautions and Symbols

- 1.1 To study Safety Precautions.
- 1.2 To study I.E Rules, signs and symbols as per Indian Standard Specification.

2. Electrical Circuits

- 2.1 To verify Ohm's law

3. Wiring Tools and accessories

- 3.1 To study hand tools.
- 3.2 To study different wiring accessories
- 3.3 To study wire joints.
- 3.4 To measure the size of wire using wire gauge.
- 3.5 To study the IE rules related to wiring.

4. House Wiring

- 4.1 To estimate and wire up a circuit to control a lamp by one switch.
- 4.2 To estimate and wire up a circuit to control two lamps in series by one switch.
- 4.3 To estimate and wire up a circuit to control different lamps independently.
- 4.4 To estimate and wire up a circuit to control one lamp from two different places.
- 4.5 To estimate and wire up a series parallel circuit.
- 4.6 To estimate and wire up a three pin plug socket and power plug socket.
- 4.7 To estimate and wire up a distribution board circuit for light load.
- 4.8 To estimate and wire up a distribution board circuit for power load.
- 4.9 To estimate and wire up a distribution board wiring using MCB and ELCB.
- 4.10 To study the connection of phase selector switch.
- 4.11 To study pipe earthing.

- 4.12 To study the calculation of Subcircuit of light load and power load.
- 4.13 To prepare the estimation of a single bed room house.
- 4.14 To prepare the estimation of a two bed room house.
- 4.15 To prepare the estimation and wire up a lamp and bell circuit wiring.

5. Measurement

- 5.1 To measure the voltage and current using an ammeter and voltmeter and calculate the power.
- 5.2 To measure the power using a wattmeter and calculate the power factor.
- 5.3 To measure the insulation resistance using a megger.
- 5.4 To measure electrical energy using an energy meter and study the common errors in energy meter.
- 5.5 To measure the earth resistance using earth tester.

6. Transformer

- 6.1 To rewind small transformer
- 6.2 Determine the size of wire and core size.
- 6.3 Identify the insulating materials and other electrical winding accessories.
- 6.4 Prepare coil for rewinding.
- 6.5 Assemble, connect and test the performance of small transformers.
- 6.6 Find out the turns ratio and the voltage ratio.

7. DC Machines

- 7.1 To prepare lap and wave winding diagrams.
- 7.2 To study equalizer connections.
- 7.3 To practice rewinding of any DC Motor.

8. Household Appliances

- 8.1 To study different tests to be performed for finding different faults.
- 8.2 To practice dismantling and reassembling of automatic and non-automatic electric iron.
- 8.3 To study the working of thermostat.
- 8.4 To study the common faults and servicing of electric iron (automatic and non-automatic).
- 8.5 To dismantle, identify different parts, possible faults, servicing and assembling of hot plate and heater.
- 8.6 To dismantle, identify different parts, possible faults, servicing and assembling of water heater.
- 8.7 To dismantle, identify different parts and re-assembling electric oven and toaster.

9. Illumination

- 9.1 To wire up tube light with electro magnet choke and electronic choke. Find out the faults and rectify it.
- 9.2 To wire up a HPMV lamp circuit and find out the starting and running current.

PLANNING

Planning is the process of incubation prior to hatching a plan. It is the process of thinking before acting. The role of a teacher in the new system of education is that of a facilitator. Here, the learning process is learner centered and activity oriented. Before facing the students, the teacher should have planned each and every activities to be performed, there by enable the student to get the objective in a time bound manner. Whether the activities are conducted in the class or outside, they are to be completed within a specified time.

The planning should have productivity, originality and capability to produce result. It ranges from the commencement of work to the end result. If it fails, everything fails. It is the soul and blood of an activity. Teacher is a great planner who motivates the students to move from one aim to another.

The planning of the whole curriculum must be in such a way that the learner should develop sufficient skill, knowledge and innovative ideas to mould his career. To achieve all the above stated goals, the teacher must prepare the planning documents such as year plan, unit plan and daily plan

YEARPLAN

The year plan is the total number of units to be transacted through the three terms, units to be covered during each month and the number of hours required for each unit. A model of year plan is given.

YEAR PLAN - THEORY

Term	Month	Unit	Curriculum Objective No.	Name of unit	Hour	Total hour/Term
I	June	1	1.1-1.4	Electric Circuits	10	48
	July	1	1.5-1.11	Electric Circuits	10	
		2	2.1-2.5	House Wiring	9	
	August	2	2.6-2.9	House Wiring	12	48
		3	3.1-3.2	Magnetism	7	
	II	September	3	3.3-3.7	Magnetism		11	67
4			4.1-4.3	Fundamentals of AC	8	
October		4	4.4-4.9	Fundamentals of AC	8	
		5	5.1-5.4	Measuring Instruments	11	
November		5	5.5-5.7	Measuring Instruments	10	
		6	6.1-6.7	Transformer	9	
December	6	6.8-6.10	Transformer	10		
III	January	7	7.1-7.9	DC Machines	15	45
		8	8.1-8.2	House Hold Appliances	3	
	February	8	8.3-8.22	House Hold appliances	16	
		9	9.1-9.4	Illumination	1	
	March	9	9.5-9.7	Illumination	10	
				Total		160

YEARPLAN - PRACTICAL

Term	Month	Unit	Curriculum Objective No.	Name of unit	Hour	Total hour/Terms
I	June	1	1.1 - 1.2	Safety Precautions I.E rules signs and symbols	38	146
		2	2.1	Electric Circuit	12	
	July	3	3.1 - 3.5	Wiring Tools & Access ories	30	
		4	4.1	House Wiring	12	
II	August	4	4.2 - 4.5	House Wiring	54	
		4	4.6 - 4.10	House Wiring	54	
	September	4	4.11 - 4.15	House Wiring	44	
		5	5.1	Measurement	10	
	November	5	5.2 - 5.5	Measurement	24	
		6	6.1 - 6.5	Transformer	30	
III	December	7	7.1 - 7.3	DC Machine	52	214
		8	8.1 - 8.4	House Hold Appliances	54	
	January	8	8.5 - 8.7	House Hold Appliances	52	
		9	9.1 - 9.2	Illumination	54	
			Total		520	

UNIT PLAN

Teacher may prepare unit plan before the actual transaction of the unit in the classrom. This plan must make clear the curriculum objectives intended, periods required for transaction of these objectives, instructional strategies to be used and materials required. The methods to evaluate the outcomes may also be mentioned in it. A model of unit plan is given below. Unit analysis for each unit given in the source book may be utilised for preparing unit plan.

UNIT PLAN
UNIT 1- ELECTRIC CIRCUITS

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
1.1 To enhance concept of structure of atom	Atomic Structure	Observation Communication	General Discussion	Reference Materials Chart Diagrams etc.	Ability to present ideas and participate in the discussion
1.2 To understand the concept of charge, potential and p.d	Definition and Properties	Observation,	Discussion	Diagrams, Charts	Ability to conceive the idea.
1.3 To create an idea of d. c & a.c and different sources of voltage	D.C & A.C. Wave forms cells, A.C generator etc.	Observation,	Demonstration and Discussion	Charts, Cell etc.	Ability to differentiate a.c and d.c
1.4 To understand the concept of current and its various effects.	Definition, unit magnetic, heating and lighting effects	Observation,	Demonstration and Discussion	Source of e.m.f, wires, bulb, compass needle	Ability to conceive the idea
1.5 To understand the concept of resistance and classification of materials	Definition, unit conductors , insulators	Observation, and Analysis	Demonstration and Discussion	Different conducting and insulating materials, voltage source, wires, ammeter	Ability to observe and classify materials
1.6 To study the relation between voltage, current and resistance	Ohm's law	Experimentation, observation and Analysis	Experimentation, Discussion and problem solving	Variable voltage source, voltmeter, ammeter, Connecting wires	Ability to understand the concept and experimenting skill

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
1.7 To Study the effect of temperature on resistance of different materials	Temperature coefficient of resistance	Observation	Discussion	Reference Materials Chart	Ability to conceive the idea
1.8 To study laws of resistance and specific resistance	Dependance of resistance on length, area, nature of material and temperature. Specific Resistance- Definition and unit	Observation	Discussion and Problem solving	Reference Materials	Ability to understand the laws
1.9 To understand series, parallel and series parallel connection of resistance	Equivalent resistance in each case and circuit properties	Observation and experimentation	Discussion Experimentation and Problem solving	Bulbs, wires Voltmeters, Ammeters Lampload, Voltagesource	Ability to do experiment and problem solving
1.10 To introduce kirchhoff's laws	Voltage law and current law	Observation	Presentation through charts, Diagrams and then discussion	Diagrams and Charts	Ability to understand the laws.
1.11 To understand the concept of work, power and energy	Definition, Units	Observation Analysis, Mathematical ability	Discussion Problem Solving and Project work	Reference material Tabular column	Ability to conceive the idea and conduct project work.

DAILY PLAN

The daily plan includes curriculum objectives to be transacted during class period, learning activities, learning aids and feed back. The model of a daily plan is given below.

Class : _____	Time : 1 hour
Date : _____	Sub. : MRDA Theory
	Unit : electric Circuits
	Topic : Ohm's law

Curriculum Objectives : To study the relation between voltage, current and resistance

Materials : Variable voltage source, voltmeter, ammeter, connecting wires

Learning Activities	Feed back/Response
<ul style="list-style-type: none"> ● Lead the learners by checking the previous knowledge of voltage and current ● Give the experiment to learn the relationship between voltage, current and resistance. ● Help them to connect meters and take readings ● General discussion on the basis of the readings and through this Ohms law can be realised. ● Given problems related to ohm's law ● Consolidation 	<ul style="list-style-type: none"> ● All of them responded well ● Students took the reading and noted down the values ● They engaged in discussion and understood the relation between voltage, current and resistance ● They solved the problem individually and there by achieved the ability to apply the knowledge of ohm's law ● Three of the students not done the problem.

PART II
UNIT WISE ANALYSIS

1

ELECTRIC CIRCUITS

Introduction

Our world is growing fast in material prosperity. This is totally based on electricity. We cannot imagine to live in a world without electricity. The students may already have a concept of electric circuits. This introductory chapter is aimed to give an overall awareness about various electrical quantities such as potential, potential difference, current etc. Ohm's law, resistance different modes of combinations of resistors and classification of materials based on resistance are also discussed . The idea of work power and energy is essential to correlate the effects of electric current in various fields.

Syllabus

Concept of atomic structure, charge, potential, and potential difference- units- different voltage sources (a.c and d.c) concept of electric current and its unit. Effect of current , Resistance, conductors and insulators. Ohm's law- effect of temperature on resistance- Laws of resistance- specific resistance- simple problems. Kirchhoff 's laws, series, parallel and series parallel combinations of resistors- simple problems. Concept of work, power and Energy- units- simple problems.

Curriculum Objectives

- 1.1 To enhance concept of structure of atom, through general discussion
- 1.2 To understand the concept of charge, potential and potential difference through discussion.
- 1.3 To create an idea of different voltage sources (ac and dc) through demonstration and discussion.
- 1.4 To understand current and its various effects through demonstration and discussion.
- 1.5 To understand the concept of resistance and classification of materials as conductors and insulators through material collection and discussion

- 1.6 To study the relation between voltage, current and resistance, (ohm's law) through experiment, discussion and problem solving
- 1.7 To study the effect of temperature on resistance of different materials through group discussion.
- 1.8 To study the laws of resistance and specific resistance through discussion and problem solving.
- 1.9 To understand the series, parallel and series parallel combination of resistors through discussion problem solving, simple experiment, demonstration and assignment.
- 1.10 To introduce Kirchhoff's laws through discussion
- 1.11 To understand the concept of work, power and energy through discussion, problem solving and provide the skill of energy calculation through project work.

Concept of structure of atom

Activity 1.1 : General discussion

Through a general discussion, students develop the concept of atomic structure

Discussion Points

- Atom -particles- location of particles, charge etc,
- Valence electrons

Finally the teacher can enhance the idea

Charge, potential and potential difference

Activity 1.2 : Discussion

Through classroom discussion on the following topics, students can understand the concepts of potential and potential difference

Discussion Points

- Charges -positive and negative charges
- Density of charges
- Potential difference
- Electro motive force
- Units

Teacher can consolidate the idea

Voltage sources

Activity 1.3 : Demonstration and discussion

- Teacher can demonstrate various voltage sources of DC like cell, dynamo etc.

- Through a general discussion teacher can impart the idea of different AC Sources.

Current and effects of current

Activity 1.4 : Demonstration And discussion

A general discussion can be conducted.

Discussion Points

- Flow of electrons
- Rate of flow of electrons
- Units

Thus teacher can consolidate the concept of electric current.

Demonstrate the effects of current such as magnetic effect and Heating effect by the following way.

- Place a compass needle near a current carrying conductor and note the deflection of the needle.
- Connect an electric bulb across a battery and observe the effect of lighting. Teacher can convey the idea of magnetic effect and heating effect of electric current.

Conducting a general discussion the teacher can impart the idea of chemical effect (decomposition of electrolyte)

Resistance and classification of materials based on resistance

Activity 1.5 : Discussion and collection of materials

Students are asked to collect different materials such as copper, iron, wood, plastic, rubber etc.

Teacher can demonstrate the values of current through each material by connecting them to the same voltage source with the help of an ammeter.

A general discussion can be conducted.

Discussion Points

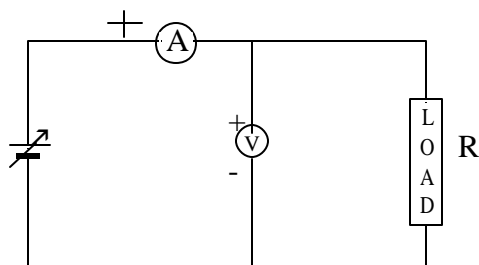
- Why current differs in each case
- Classification of materials into insulators and conductors
- List of conductors according to their conductivity.

Teacher consolidate the idea of resistance, its unit, conductors and insulators.

Ohm's Law

Activity 1.6 : Classroom demonstration , Experiment, discussion and problem solving

Direct the students to construct the circuit as shown in figure. Teacher



should help the students to take different meter readings (Ammeter and voltmeter) by varying the supply voltage. From the above readings it can be seen that ratio of voltage and current is a constant.

Solve simple problems.

Effect of Temperature on resistance

Activity 1.7 : Discussion

A General discussion is conducted to get the effect of temperature on resistance of different materials by deviding the class in to 3 groups

Discussion Points

- Effect of temperature on resistance of metals and alloys
- Effect of temperature on resistance of insulator
- Compare their effects

Teacher consolidates and give the idea of temperature coefficient of resistance.

Laws of resistance and specific resistance

Activity 1.8 : Discussion and problem solving

A general discussion can be facilitated.

Discussion Points

- Common factors affecting resistance of a material
- How does the length of the material affect resistance ?
- How does the area of crosssection of the material affect the resistance ?

Teacher consolidate the idea of different factors affecting resistance of a material. Then teacher can lead the students to specific resistance and its equation.

Different problems can be solved.

Series, Parallel and Series- Parallel combination of Resistances

Activity 1.9 : Discussion, problem solving, simple experiment Demonstration and assignment

Take two lamp loads of different wattages and measure the resistance of each load separately by V-I method.

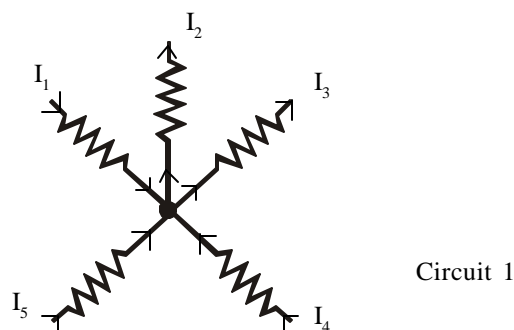
Findout the effective resistance by connecting them in series and parallel using V-I method . In each case teacher demonstrate different values of current and voltage by connecting different ammeters and voltmeters of proper ranges .

From basic current law and voltage law teacher can lead the students to find the equivalent resistance in each case. Teacher consolidate the properties of series and parallel cicuit. Solve simple problems of series, parallel and series parallel circuits.

Kirchhoff's Laws

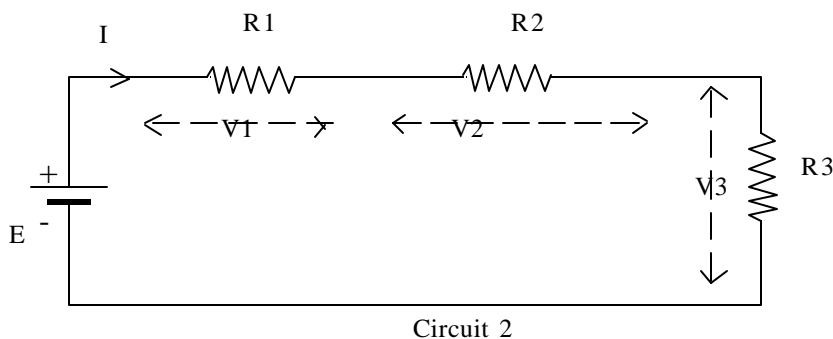
Activity 1.10 : Discussion

Conduct a general discussion based on the given circuit



Discussion Points

- Junction
- Direction of current flow
- Algebraic sum of current at the junction



Discussion Points

- Voltage drop across each element
- Total supply voltages with polarity

Teacher consolidate the idea of Kirchhoff's current and voltage law.

Learning process continues: Each group of students is directed to draw similar circuits and accumulate the concept of voltage law.

Work power and Energy

Activity 1.11 : Discussion, problem solving and Project Work

Teacher can conduct a general discussion on the following topics

Discussion Points

- Work
- Power
- Energy
- Equation
- Units

Teacher consolidate the idea

Solve simple problems for power and Energy calculation

Power and Energy calculation can be studied by conducting a **project**.

Each student is directed to note down the rated power of each appliances in his house. Note the working hours of each appliance for one day. Calculate the energy consumption. Compare it with the energy meter reading.

CE Indicators

- Assignment
- Project
- Class test

UNIT ANALYSIS
 UNIT 1- ELECTRIC CIRCUITS

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
1.1 To enhance concept of structure of atom	Atomic Structure	Observation Communication	General Discussion	Reference Materials Chart Diagrams etc.	Ability to present ideas and participate in the discussion
1.2 To understand the concept of charge, potential and potential difference.	Definition and Properties	Observation,	Discussion	Diagrams, Charts	Ability to conceive the idea.
1.3 To create an idea of d. c & a.c and different sources of voltage	D.C & A.C. Wave forms cells, A.C generator etc.	Observation,	Demonstration and Discussion	Charts, Cell etc.	Ability to differentiate a.c and d.c
1.4 To understand the concept of current and its various effects.	Definition, unit magnetic, heating and lighting effects	Observation Communication and Analysis	Demonstration and Discussion	Source of e.m.f, wires, bulb, compass needle	Ability to conceive the idea
1.5 To understand the concept of resistance and classification of materials	Definition, unit conductors, insulators	Observation, and Analysis	Demonstration and Discussion	Different conducting and insulating materials, voltage source, wires, ammeter	Ability to observe and classify materials
1.6 To study the relation between voltage, current and resistance	Ohm's law	Experimentation, observation and Analysis	Experimentation, Discussion and problem solving	Variable voltage source, voltmeter, ammeter, Connecting wires	Ability to understand the concept and experimenting skill

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
1.7 To Study the effect of temperature on resistance of different materials	Temperature coefficient of resistance	Observation	Discussion	Reference Materials Chart	Ability to conceive the idea
1.8 To study laws of resistance and specific resistance	Dependance of resistance on length, area, nature of material and temperature. s.p.Resistance-Definition and unit	Observation and analysis	Discussion and Problem solving	Reference Materials	Ability to understand the laws
1.9 To understand series, parallel and series parallel connection of resistance	Equivalent resistance in each case and circuit properties	Observation and experimentation	Discussion, Experimentation, problem solving and assignment.	Bulbs, wires Volts meters, Ammeters Voltage source, lamp loads	Ability to do experiment and problem solving
1.10 To introduce kirchhoff's laws	Voltage law Current law	Observation,	Presentation through, diagram chart and then discussion	Diagrams and Charts	Ability to understand the laws
1.11 To understand the concept of work, power and energy	Definition, Units	Observation Analysis, Mathematical ability	Discussion Problem Solving and Project work	Reference material Project Report model	Ability to conceive the idea and conduct project work.

HOUSE WIRING

Introduction

The consumer is benefitted by the economic usage of electrical energy through a properly designed wiring system. It should be economically estimated, neatly layouted and suitably protected. Through observation and study at lower classes, the students may have an idea about simple wiring systems. This unit provides a technical study of wiring and specifies important rules used while designing a domestic installation. It also features the need for earthing with pipe earthing details; functions of fuse and study of modern protective devices like MCB and ELCB.

Syllabus

Various types of tools and wiring accessories- conduit wiring-safety precautions- Effect of electric shock on human body- first aid for electric shock- rules and standards in house wiring- types of wires and its rating- types of fuses and its rating -MCB and ELCB- Earthing- Necessity-pipe earthing- measurement of earth resistance- Calculation of sub circuits- Layout, wiring diagram and Estimation for simple domestic installation.

Curriculum Objectives

- 2.1 To understand various types of tools and wiring accessories required for all types of conduit wiring through material collection, demonstration and group discussion.
- 2.2 To understand the precautionary measure for safety, first aid against shock and effects of electric shock on human body through seminar.
- 2.3 To understand rules and standards in housewiring through general discussion and classroom transaction
- 2.4 To understand the types of wires and ratings through demonstration and discussion
- 2.5 To understand the functions, rating and types of fuses through seminar.
- 2.6 To understand the functions, connections and rating of MCB and ELCB through demonstration and discussion .

- 2.7 To understand the necessity of earthing, measurement of earth resistance using earth tester through experient and details of pipe earthing through obsrvations.
- 2.8 To acquire knowledge of subcircuit calculation, preparation of layout and estimation through discussion and assignment.
- 2.9 To familiarise domestic wiring through practical work.

Conduit Wiring

Activity 2.1 : Material collection, demonstration and group discussion

Through group discussion, students brush up the idea of conduit wiring both surface and concealed conduit.

Discussion Points

- Types of conduct wiring
- Comparison of different types of conduit wiring
Collect different materials and wiring accessories used in conduit system and discuss various aspects like
- Use of each item
- Material used
- Rating
Demonstrate different tools used in conduit wiring consolidation

Consolidation

Teacher consolidate the idea of conduit wiring, tools and wiring accessories used.

Safety precautions

Activity 2.2 : Seminar

Sub topics

1. Precautionary measures for safety
2. First aid against electric shock
3. Effect of electric shock on human body

The teacher consolidates the points.

Rules and Standards of wiring

Activity .2.3 : General discussion and class room transaction

After a general discussion, teacher may convey the rules and standards related to house wiring.

Discussion Points

- Position of switch boards, light and fan points etc.

- Total connected load and number of fuses.
- Idea of distribution board
- Colour of wires used for the phases, neutral and earth connection.

Types of wires and Ratings

Activity 2.4: Demonstration And discussion

- Collect different types of wires
- Measure the gauge of different types of wires using SWG and classify them.
- with the help of a table containing current carrying capacity of different wires, ratings of wires can be done.

Fuses

Activity 2.5 : Seminar

Form four groups. Each group must be given the following sub topics.

- Fuses, functions and material used
- Terms related to fuse and rating of fuse.
- Open type and semi enclosed type fuses.
- HRC type

The teacher should consolidate the main points and demonstrate

MCB And ELCB

Activity 2.6 : Demonstration and discussion

Functions, circuits and connection diagrams of MCB and ELCB can be consolidated after a demonstration and general discussion.

Discussion Points

- Functions of MCB and ELCB
- Internal circuit arrangements
- Working principle
- Connection diagram
- Advantages

Earthing

Activity 2.7 : Discussion and Practical work

Through a general discussion teacher may impart the necessity and idea of earthing

Discussion Points

- Functions of earthing
- Types of earthing

- Pipe earthing with neat sketch
As a general work, pipe earthing can be done
Conduct practical work to measure the earth resistance using earth tester.

Calculation of Subcircuit, Preparation of layout and estimation

Activity 2.8 : Discussion and Assignment

Students have already learnt the maximum number of points and maximum power in a subcircuit from IE rules.

Give an example to control a lamp by a switch

Conduct a general discussion based on the following points

- Layout preparation
- Wiring diagram

From the preparation of the diagram/circuit, the teacher can consolidate the idea.

- The teacher can ask the students to list out the materials and accessories for the above said wiring diagram.
- Prepare an estimation of the above work using the material listed out. Price list can be referred.

Assignment

Students are divided into two groups. Each group is given separate assignments.

- Preparation of estimation for a single bed room house.
- Preparation of estimation for a two bed-room house

The number of light points and power points is to be specified

Conduct a group discussion to analyse the prepared estimates.

House Wiring

Activity 2.9 : Practical Work

Conduct a practical work individually to wire up a distribution board using ICDP/ ICTP, energy meter, ELCB and MCB's for a specified number of light points and power points. Power plug connection should also be included.

Teacher can conduct practical work on wirings like

- One lamp controlled by one switch
- Two lamps in series
- Parallel connection
- Stair case control

- Series parallel circuit wiring
- Lamp and Bell circuit wiring

CE Indicators

- Seminar
- Assignment
- Class test

UNIT ANALYSIS
UNIT 2- HOUSE WIRING

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
2.1 To understand the types of conduit wiring, tools and wiring accessories for it.	Conduit wiring Different tools and wiring accessories	Observation	Material collection Demonstration and discussion	Conduit wiring accessories and tools	Ability to observe and participate
2.2 To understand the safety precautions, effects of electric shock and first aids	Safety precautions electric shock, first aid	Observation and presentation	Seminar	Charts	Ability to observe and present
2.3 To understand rules and standards in house wiring	IE rules regarding wiring.	Observation,	Discussion	Reference material	Ability to observe
2.4 To understand the types of wires and their ratings	Ratings and types of wires	Observation,	Material collection, Demonstration and discussion	Different types of wires, SWG, table containing current rating of wires	Ability to Observe
2.5 To understand the functions, rating and types of fuses.	Parts of fuse functions of fuses	Communication presentation	Seminar	Reference materials	Ability to conduct seminar
2.6 To understand functions, ratings and connections of MCB and ELCB	Concept of MCB and ELCB	Observation	Demonstration Discussion	MCB, ELCB, Charts	Ability to observe

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
2.7 To understand the necessity of earthing and measurement of earth resistance	Earthing Pipe Earthing Measurement of earth resistance	Observation Experimentation and Measurement	Discussion Practical work	Earthing materials Charts , tools Earth tester	Ability to observe experiment and measure the quantities
2.8 To acquire knowledge of subcircuit calculation, preparation of layout and estimation	Subcircuit calculation Preparation of layout Preparation of estimation	Observation and Application	Discussion Assignment	Charts	Ability to observe and apply
2.9 To familiarise domestic wiring	Layout Wiring diagram Estimation Material/tools required Precautions	Observation and experimentation	Practical work	Wiring materials Accessories and Tools	Ability to observe and do experiment

3

MAGNETISM

Introduction

Electricity and magnetism are equally related to each other. For the production and application of electricity, the role of magnetism is inevitable. In the lower classes, the students have learnt about the properties of magnets, applications and concept of electromagnetic induction. Here the teacher can elicit these ideas by making group discussion and simple experiments.

In this chapter, the above said ideas are further developed through more detailed study. The idea about the losses in magnetic circuits are also explained.

Syllabus

Properties of magnet-permanent and temporary magnet -magnetic and non-magnetic materials- different terms associated with magnetic circuits- - Electromagnetic induction- Faraday's laws of electromagnetic induction- Lenz's law- Fleming's right hand rule-Cork screw rule- self and mutual induction- units- eddy current- hysteresis loss.

Curriculum Objectives

- 3.1 To recognise different types of magnets and their properties through discussion and demonstration or through assignment.
- 3.2 To develop a clear idea about magnetic and non-magnetic materials and to classify them through the collection of materials, demonstration and discussion.
- 3.3 To familiarise different terms related to magnetism by discussion
- 3.4 To acquire the concept of induction by demonstrating and discussing Faraday's Laws of electromagnetic induction and Lenz's law.
- 3.5 To give idea about Cork screw rule and Fleming's right hand rule through picture, demonstration using finger, OHP, chart and discussion
- 3.6 To develop the concept of different magnetic losses through discussion and plotting BH curve

3.7 To differentiate self and mutual induction by discussion

Magnets and properties

Activity 3.1 : Demonstration and Discussion

- Collect permanent magnets of different shapes and demonstrate its various properties.
- Construct an electromagnet
 1. Demonstrate the reversal of magnetic polarity by changing the battery terminals
 2. Variation of magnetic strength by controlling the current
- It can also be given as an assignment

Magnetic and Non-magnetic Materials.

Activity 3.2 : Collection of materials, demonstration and discussion

- Collect different materials like paper, Iron, Aluminium, gold etc.
- Classify them according to their magnetic properties as non magnetic, dia magnetic, para magnetic, and ferro magnetic substances with the help of a magnet.
- Teacher can consolidate the concepts of magnetic and non magnetic materials and their classification after a discussion.

Discussion Points

- Magnetic and non magnetic materials
- Classification of magnetic materials based on attraction

Terms associated with magnetic circuits

Activity 3.3: General discussion

Through a general discussion, develop the concept of

1. Magnetic Field
2. Magnetic Flux
3. Flux density
4. M.M.F
5. Reluctance
6. Permeability etc.

Faraday's Laws of Electromagnetic Induction

Activity .3.4 : Demonstration and discussion

Experimental set up using solenoid, Galvanometer and bar magnet

- Move the bar magnet through the solenoid and note down the galvanometer deflection. This indicates the induced current by Faraday's First Law.
- By varying the speed of movement of bar magnet note down the range of Galvanometer deflection. This indicate the magnitude of induced current by Faraday's second law.
- Lenz's law can be discussed.

Fleming's Right hand rule and Cork screw rule

Activity 3.5: Picture demonstration and discussion

- Discuss the above laws with the help of an OHP or chart

Magnetic Losses

Activity 3.6: Group discussion

- The basic idea of induction is familiar to the students . Teacher can elicit the idea of eddy current and eddy current losses.
- Plot and discuss hysteresis loop

Discussion Points

- Area of hysteresis loop
- Coercive Force
- Residual magnetism
- Selection of core material based on loop area
- Hysteresis loss.

Self and Mutual Induction

Activity 3.7: Group discussion

Through A general discussion students can differentiate self and mutual induction

Discussion Points

- Self induction
- Mutual induction
- Factors affecting self induction
- Application of self and mutual induction

CE Indicators

- Group Discussion
- Assignment

UNIT ANALYSIS
UNIT 3- MAGNETISM

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
3.1 To recognise different types of magnets and their properties	Concept of permanent and temporary magnet	Observation Discussion	Collection of Materials Demonstration Discussion	Permanent magnet Ironcore, Copper wire, Battery, Variable resistor	Ability for observation and participation
3.2 To study classification of magnetic materials	Diamagnetic Paramagnetic and Ferromagnetic Materials	Observation Identifying Inferring	Collection of material Demonstration discussion	Permanent magnet Paper, Iron Aluminium, Gold etc.	Ability for observation and participation
3.3 To familiarise different terms associated with magnetism	Definitions of various terms	Observation,	General Discussion	Discussion points	Ability to conceive the idea
3.4 To acquire the concept of induction	Faraday's laws, Lenz's law	Observation, Inferring	Demonstration Discussion	Bar magnet Solenoid Galvanometer	Ability to acquire knowledge and participation in discussion
3.5 To give idea about cork screw rule and Fleming's right hand rule	Definitions	Observation Communication Inferring	Picture Demonstration and Discussion	OHP, Charts	Ability to conceive and apply the idea
3.6 To develop the concept of magnetic losses	Eddy current loss Hysteresis loss	Communication Observation	Group Discussion Plotting graph	Chart Reference books	Ability to understand
3.7 To understand and differentiate self and mutual induction	Self induction Mutual induction	Communication Observation	Group Discussion	Discussion points	Ability to understand the concept

4

FUNDAMENTALS OF AC

Introduction

Alternating current has a vital role in day to day life. Almost 90% of electrical and electronic equipments work on AC supply. Students may have previous knowledge about the basic idea of A.C. The main goal of this unit is to make a clear idea about single phase and three phase A.C parameters. The idea contained in this chapter are very essential for the analysis of A.C circuits. Therefore the teacher should give more emphasis and care while transacting the curriculum objective. The concept of impedance, powerfactor and its importance are also dealt with in this unit.

Syllabus

Generation of AC- Idea of AC sine wave, cycle, frequency, time period, amplitude, instantaneous value, average value, rms value, and form factor circuits containing resistors, inductors and capacitors-impedence, power and power factor - simple problems- Resonance in R-L-C series circuit-KW, KVA and KVAR. Three phase supply-star and delta connections-properties.

Curriculum Objectives

- 4.1 To understand the principle of generation of A.C through demonstration and discussion
- 4.2 To identify AC parameters like frequency, cycle, time period, amplitude, phase, rms value, average value etc. through discussion.
- 4.3 To study the circuit containing pure resistors, inductors and capacitors through discussion.
- 4.4 To understand impedance, power and power factor of R-L, R-C and R-L-C series circuit and parallel circuit through discussion and problem solving.
- 4.5 To understand condition for resonance in R-L-C series circuit through discussion.
- 4.6 To Study the concept of power factor and its importance through discussion.
- 4.7 To study active power, reactive power and apparent power through discussion.

4.8 To develop a concept of 3-phase supply, through drawings and discussion.

4.9 To identify star and delta connections and its properties through demonstration and discussion.

A.C Fundamentals- Generation of sine wave

Activity 4.1 : Demonstration and Discussion

For principle of generation- refer magnetism activity no. 3.4

Construction of sine wave

- Draw a circle with radius equal to amplitude of voltage/current.
- Divide the circle into 12 equal parts with an angular displacement of 30° each.
- Extend the line joining 0° and 180° and divide this line into 12 equal parts.
- Draw vertical lines through each point on the horizontal line
- Extend each point on the circle to meet the respective perpendicular line.
- Mark the intersecting points and join them to get the corresponding sine wave.

We can also adopt the method of giving values to ωt from 0° to 360° in the equation $E = E_m \sin \omega t$. Plot the values in the graph and join them. Then we get a sine wave.

Study of A.C parameter like frequency, period etc.

Activity 4.2: Discussion

Conduct a discussion to study the A.C parameter such as frequency, time period, cycle, phase, amplitude, instantaneous value, average value and r.m.s value using chart and C.R.O. Also discuss form factor, peak factor and relation between Frequency and Time period. Calculation of R.M.S and maximum value of A_c can be done using voltmeter and C.R.O.

Circuits containing pure resistive, Inductive and Capacitive Loads

Activity 4.3: Discussion

Conduct a discussion about the circuits containing pure resistive, inductive and capacitive loads.

Discussion Points

- Relation of voltage and current in pure resistive, pure inductive and pure capacitive loads.
- Vector diagram and phasor diagram in each case
- Definition, units and equation for inductive and capacitive reactances.

Vector and phasor diagram of R-L, R-C and R-L-C series circuits.

Activity 4.4: Discussion and Problem Solving

Draw the vector and phasor diagram of R-L, R-C and R-L-C series circuits and conduct a discussion.

Discussion Points

- Impedance and its derivation with unit
- Concept of powerfactor
- Equation for current, p.f and power.
- The teacher should give different problems to make the concepts more clear.

Condition for resonance in R-L-C series Circuit

Activity 4.5: Discussion

Discuss the condition for resonance in R-L-C series circuit

Concept of Powerfactor and its importance

Activity 4.6: Discussion

Discuss the concept of powerfactor and its importance.

Discussion Points

- Definitions
- Adverse effects of low power factor
- Methods to improve power factor

Construction of Power Triangle

Activity 4.7: Discussion

Construct a power triangle and discuss .

Discussion Points

- Definitions with units
- Equation and Relation between them.

Threephase Supply

Activity 4.8: Drawing and Discussion

- Drawing of three phase wave form using red, yellow and blue colours to indicate the three different phases.
- Display the wave form in the C.R.O
- Discuss the method of generation to get a clear concept of three phase supply.

- Finally ask the students to draw 3 phase wave form using colours.

Star and Delta Connections

Activity 4.9: Demonstration and Discussion.

Demonstrate and discuss the students about star and Delta connections.

Discussion Points

- Connection
- Line value
- Phase value

Relationship between line current, phase current, line voltage and phase voltage for star and delta connections.

Simple problems relating line and phase values of current and voltage.

CE Indicators

- Assignment
- Class test

UNIT ANALYSIS
UNIT 4- FUNDAMENTALS OF AC

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
4.1 To understand principle of generation of A.C	Faraday's Laws of electromagnetic induction	Observation	Experimental set up, construction of sinewave as assignment, Demonstration and Discussion	Galvanometer, Solenoid, DC Source	Ability to analyse the results of experiment
4.2 To identify AC parameters like frequency, cycle, time period, amplitude, phase, r.m.s value, average value etc.	Concept of sine wave	Inferring	Discussion	Chart, Graph and C.R.O	Ability to analyse and find the parameters
4.3 To study circuits containing pure resistors, inductors and capacitors	Concept of relation between voltage and current in R-L-C Load	Inferring	Discussion Draw vector diagram and phasor diagram of current and voltage for each load	Chart	Ability to analyse the chart
4.4 To understand impedance, power and power factor of R-L, R-C and R-L-C series circuit and parallel circuit	Comparing the relationships between voltage and current in inductive, resistive and capacitive circuits	Observation,	Discussion and problem solving	Cards preparation to illustrate impedance triangle	Ability to derive and solve problems
4.5 To understand condition for resonance in R-L-C series circuit	Resonance	Observation	Discussion	Reference material	Ability to understand resonance
4.6 To study the concept of power factor and its importance	Loss of power in inductive load and methods to reduce lagging power factor	Observation	Discussion	Charts and Tables	Ability to observe and participate

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
4.7 To study active power, reactive power and apparent power	Definition and concept of power triangle	Observation	Discussion and Construction of power triangle using cardboard	Chart/ Cards	Ability to observe and understand
4.8 To develop a concept of 3 phase supply	Concept of 3 phase supply	Analysis Observation Concept development	Discussion Drawings and Display on C.R.O	Chart, Graph and C.R.O	Ability to analyse 3 phase supply
4.9 To identify star and delta connections and its properties	Difference in Connection	Observation	Discussion	Star-delta starter	Ability to observe

5

MEASURING INSTRUMENTS

Introduction

For analysing the electrical quantities it is important to measure the values of current, voltage, resistance, power etc. So the study of measuring instruments are essential.

This unit deals with working principle of instruments such as Voltmeter, Ammeter, Wattmeter and Energymeter. Since energy meter is an integral part of electrical power distribution, study of its constructional details is important. Uses of megger, earth tester multimeter and tong tester are also included in this chapter.

Syllabus

Classification of measuring instruments-Torques acting in indicating instruments-moving coil and moving iron instruments- use of voltmeters and Ammeters-Idea of Wattmeter and energy meter- constructional details of energy meter-Method of connection of voltmeter, Ammeter, wattmeter and Energy meter in circuits- uses of megger, multimeter, Earth tester and Tong tester-Their connections.

Curriculum Objectives

- 5.1 To understand the classification of electrical measuring instruments through demonstration and discussion.
- 5.2 To understand different types of torques in indicating type instrument through discussion.
- 5.3 To understand principle of working of moving coil and moving iron instruments through demonstration and discussion.
- 5.4 To understand the working principle of induction type Wattmeter through a general discussion.
- 5.5 To understand the uses and connection of Ammeter, Voltmeter and Wattmeter through simple experiments and discussion.

- 5.6 To Study the constructional details, connections, working principle and errors of energy meter through demonstration, discussion and practical work.
- 5.7 To study the parts and uses of megger and earth tester through simple experiments and discussions.
- 5.8 To study the uses and connections of multimeter and Tong tester through general discussion and demonstration.
- 5.9 To Create awareness about the latest trends in measuring instruments about digital meters through assignment.

Measuring Instruments - Classification

Activity 5.1 : Demonstration and Discussion

Conduct seminar

"Measuring instruments"

Different types of measuring instruments.

- Discuss the difference between these instruments
Teacher can consolidate the classification as
 - Indicating type
 - Recording type
 - Integrating type

Types of torques in indicating type instruments

Activity 5.2: Discussion

Conduct a general discussion

Discussion Points

- Types of torques
- Necessity of these torques
- Methods to produce these torques.

Moving coil and Moving iron instruments

Activity 5.3: Demonstration and Discussion

Moving Coil type:-

Demonstrate the internal parts of permanent Magnet Moving coil instrument and conduct general discussion with the help of diagrams.

Discussion Points

- Constructional details
- Working principle, Fleming's left hand rule
- Methods used to provide damping and controlling torques.

Moving iron type:-

Through a general discussion teacher can impart the idea of classification of moving iron instruments as

Attraction type MI

Repulsion type MI

Demonstrate the internal parts of attraction type and repulsion type instruments and conduct a discussion with the help of diagrams.

Discussion Points

- Constuctural details
- Working principles
- Method of damping and controlling torque used

Induction type wattmeter

Activity 5.4: General Discussion

With the help of a neat diagram conduct a general discussion

Discussion Points

- Current coil and pressure coil
 - Induction
 - Connection
- Teacher can consolidate the working of Wattmeter

Uses and connection of Ammeter , Voltmeter and Wattmeter

Activity 5.5 : Discussion and simple experiment

Through a discussion teacher can consolidate the idea

- How Ammeter and Voltmeter is connected in a circuit?
- Why they are connected so ?
- Their uses
- Connection of Wattmeter

Conclude the idea and give the students simple experiments to find out the current, voltage and power drawn for a suitable load.

Energy meter

Activity 5.6: Demonstration, Discussion and practical work

Demonstrate the internal parts of an energy meter. Divide the students into 3 groups. Discuss the following points in each group with the help of diagrams.

Discussion Points

- Constructional details
- Working principle
- Connection

Conduct a simple experiment to find out the electrical energy consumed by a load by connecting an energy meter.

A general discussion can be conducted to study the errors in energy meter.

Discussion Points

- Creeping effect
- Methods to avoid it
- Importance of power factor compensation to avoid phase error
- Why temperature errors are neglected in our atmospheric condition ?

Conduct a practical work to find out the percentage error of an energy meter.

Megger, Earth tester

Activity 5.7 : General Discussion and simple Experiments

Conduct a general discussion with the help of diagrams

Discussion Points

- Constructional details
- Working principle
- Uses
- Connection

Conduct a simple experiment using megger to measure the insulation resistance of an installation.

Conduct a simple experiment using earth tester to measure the earth resistance by connecting the terminal marked 'E' to a good earth and terminal 'C', 50 m away from the earth terminal and 'P' at the middle using spikes. Rotate the handle at about 160 rpm and take the readings . Repeat the procedure for different distances.

Tong tester and Multimeter

Activity 5.8: General Discussion and demonstration

- Through a general discussion students can understand the uses of tongtester and Multimeter.
- By a suitable demonstration they get a clear idea of its connections.

Latest trends in Digital instruments'

Activity 5.9 : Assignment

Give assignment to 'aware about digital measuring instrument's

CE Indicators

- Assignment
- Seminar
- Class test

UNIT ANALYSIS
UNIT 5- MEASURING INSTRUMENTS

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
5.1 To understand the classification of measuring instruments	Classification of measuring instruments such as indicating type, Recording type and Integrating type	Observation Classification	Demonstration Discussion Seminar	Various types of measuring instruments	Ability to identify different types of instruments
5.2 To understand different torques in indicating type instruments	Different torques in indicating type instrument	Observation	Discussion	Reference Material	Ability to understand and different torques
5.3 To understand principle of working of moving coil and moving iron instrument	Constructional details and working types of MI instruments	Observation	Demonstration Discussion	MI and MC Instruments Diagram, chart	Ability to conceive the principle
5.4 To understand the working principle of induction type wattmeter	Parts Working principle	Observation	General Discussion	Wattmeter Diagram, chart	Ability to observe
5.5 To understand the uses and connection of Ammeter, Voltmeter and Wattmeter	Uses Connections	Observation and Experimentation	Discussion simple experiments	Ammeter Voltmeter Wattmeter Tools	Observing and experimenting capability
5.6 To study constructional details, connections working principle and errors of energymeter	Constructional details Connections Working principle Errors	Observation and Experimentation	Discussion Demonstration Practical Work	Energy meter Wattmeter Ammeter, Voltmeter tools Diagram and Chart	Observing and experimenting capability

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
5.7 To study the parts and use of megger and Earth tester	Parts Working principle, use and Connections	Communication and Observation	Discussion Simple experiment	Earth tester Megger Tools	Ability to understand the parts and uses
5.8 To study the uses and connection of multimeter and tong tester	Uses Connections	Observation	General Discussion	Tong tester Multimeter	Observing capability
5.9 To create awareness about the latest trends in measuring instruments (Digital meters)	Digital meters, Types , uses	Observation	Assignment	Reference Materials	Ability to prepare assignment

6

TRANSFORMER

Introduction

In all electrical and electronic systems, the transformer is used for transferring power. The learner may have already studied the principle of working and uses of transformer.

In this unit more ideas about transformer are discussed. The applications of transformers, rating, e.m.f equation, different losses occurred and different cooling systems are explained in detail.

Syllabus

Basic principle part of single phase and three phase transformers-emf equation - Transformation ratio- calculation of primary current, secondary current and number of turns-losses and efficiency- Application and rating- Necessity of cooling- Different methods- Properties of transformer oil- Winding of small transformers.

Curriculum Objectives

- 6.1 To develop a general idea of transformer through group discussion .
- 6.2 To study the principle of working of transformer through discussion and brain storming.
- 6.3 To identify the parts of single phase and three phase transformers through demonstration and field visit.
- 6.4 To derive emf equation of a transformer and transformation ratio through discussion and derivation.
- 6.5 To compute the primary and secondary currents and number of turns through problem solving.
- 6.6 To study losses associated with transformer and its efficiency through discussion.
- 6.7 To know the field of applications of transformers and its rating through discussion.

- 6.8 To develop an idea about the necessity of transformer cooling and different methods adopted through discussion and field visit.
- 6.9 To study the properties of transformer oil through discussion.
- 6.10 To develop the skill in small transformer winding through project.

Transformer (General idea)

Activity 6.1 : Group discussions

Teacher can divide the class into 3 different groups and conduct a discussion by giving the following topics to each group.

Discussion Points

- What is a transformer?
- Different types of transformer (based on construction, function)
- Use of transformer in general life.

Teacher can consolidate a general idea about transformer.

Principle of working of a Transformer

Activity 6.2 : Discussion and brainstorming

Conduct a general discussion

Discussion Points

- Transferring of Energy
- Induction phenomenon
- Transformer rating.

Through brain storming collect different ideas about the parts and working of transformer. The teacher introduce the concept of mutual induction through classroom interaction by giving lead points to co-relate mutual induction with transformer working.

Parts of a single phase and three phase transformers

Activity 6.3 : Demonstration, discussion and field visit

Give an idea of parts of single phase transformer through demonstration and discussion.

Discussion Points

- Material used for winding and core.
- Why core is laminated?
- Number of turns
- Insulation materials used.

Field Trip: Conduct a field trip to a Substation and discuss the following points.

- Different parts
- Functions
- Type of cooling used
- Primary and secondary connections

Continue Process / Study:-

Direct each student group (3 members) to visit the nearby distribution transformer and observe the input and output connection, Connecting cables, mounting style and Name plate details. These points are discussed in the classroom and teacher concludes.

EMF Equation and Transformation ratio (K)

Activity 6.4 : Discussion and derivation

Develop the derivation of emf equation and turns ratio through classroom discussion and interaction.

Discussion Points

- Faraday's laws of electromagnetic induction
- Form Factor
- Frequency, Flux density, Time period, Cross section area of core, Flux and number of turns.
- Change of Flux and time taken for it.

The emf equation can be derived by the teacher

Transformer ratio can also be explained through discussion

Calculation of Primary and Secondary Currents and Number of turns

Activity 6.5 : Problem Solving

By solving appropriate numeric problems connecting emf equation and transformation ratio, students get more idea.

Losses associated with Transformer and its Efficiency

Activity 6.6: Discussion

Different losses and efficiency of transformer can be discussed.

Discussion Points

- Types of losses – Definitions and equations
- Methods to minimise
- Definition and equation of efficiency

- All – day efficiency
- Condition for maximum efficiency

Teacher can consolidate the idea.

Application and Rating

Activity 6.7 : Discussion

A general discussion can be conducted

Discussion Points

- Rating of transformer
- Why rated in KVA
- Applications

Transformer Cooling

Activity 6.8: Field visit and discussion

Refer the activity 6.3

Conduct a discussion

Discussion Points

- Necessity of transformer cooling
- Different methods adopted

Properties of Transformer Oil

Activity 6.9: Discussion

A general discussion can be conducted to understand the properties of transformer oil

Transformer Winding

Activity 6.10 : Project

- Develop skill in small transformer winding through design and model preparation . Points to be considered while designing are:
- Size and material of core
- Size and material of winding
- Types of insulation
- Number of turns in primary and secondary
- Note down the output voltage of the wounded transformer. Verify this voltage with the theoretical calculation.

C.E Indicators

- Field visit
- Project

UNIT ANALYSIS
UNIT 6- TRANSFORMER

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
6.1 To develop a general idea of transformer	General idea of transformer	Observation	Group discussion	Reference	Ability to conceive the idea
6.2 To study the principle of working of transformer	Working principle of transformer	Observation	Discussion, Brain storming	Diagram, Single phase transformer	Ability to understand the working
6.3 To identify the parts of single phase and three phase transformers	Parts of transformer, use of parts	Observation	Demonstration, field visit	Single phase transformer, chart	Ability to identify parts and Field visit diary
6.4 To derive EMF equation and transformation ratio of transformer	E M F e q u a t i o n , transformation ratio	Observation and Analysis	D i s c u s s i o n , Derivation	Reference	Ability to achieve the concept
6.5 To compute primary and secondary currents and number of turns	Equations	Mathematical ability and Observation	Problem solving	Reference	Ability to compute
6.6 To study losses and efficiency of transformer	Different losses efficiency	Observation	Discussion	Reference	Ability to participate and conceive idea
6.7 To know the field of applications and ratings of transformer	Applications ratings	Observation	Discussion	Reference, Field visit diary	Ability to participate in the discussion and identify the details
6.8 To develop the idea about the necessity of transformer cooling	Transformer cooling	Observation	Field visit and discussion	Reference, Field visit diary,	Ability to understand the details of transformer, field visit diary
6.9 To study the properties of transformer oil	Properties of transformer oil	Observation	Discussion	Reference	Ability to participate in the discussion
6.10 To develop the skill in winding small transformer	Winding of transformers	Observation, communication, identification, mathematical ability and Fabrication	Project	Core and winding materials	Project work evaluation

D.C. MACHINES

Introduction

The role of electrical energy is very significant in all Fields of our daily life. The invention of dynamo led to the large scale generation of electricity. The role of motors in reducing human effort and increasing comfort is very great.

This unit provides the chances of understanding the construction, principle and the working of D.C. Machines and find out its practical applications.

Syllabus

Importance of DC-parts of DC generator- principle of Working-EMF equation-classification - failure of building up of voltage- DC motor-working principle-classification- Necessity of starter -Three point starter-field of application of different types of motors-Losses and Efficiency of DC machines-concept of Lap and wave winding -methods of speed control and reversal.

Curriculum Objectives

- 7.1 To develop the concept of the importance of DC through group discussion.
- 7.2 To develop the concept of the constructional details, principle and working of DC generator through demonstration, and discussion
- 7.3 To reach the concept of derivation of emf equation through discussion
- 7.4 To understand the classification of D.C generator through discussion.
- 7.5 To analyse the reason of failure of building up of voltage and its remedial measures through brain storming and discussion
- 7.6 To develop the concept of the constructional details, classification, principle and working of DC motor through discussion with the help of diagrams and visual aids.
- 7.7 To understand the necessity, parts, working and connection of three point starter through experiment, demonstration and discussion.
- 7.8 To understand the field of applications of DC machines through discussion.

7.9 To understand the losses and efficiency of D.C. Machine through discussion.

7.10 To understand Lap and wave winding through demonstration discussion and assignment.

7.11 To develop an idea about the methods of speed control and reversal of rotation through simple experiment and discussion.

Importance of DC

Activity 7.1 : Group Discussion

Divide the students in the class into three groups. Direct each group to discuss each of the following points.

- Sources and generation of DC
- Application of DC
- Advantages and disadvantages of DC.

Each group is directed to present the corresponding points and the teacher can conclude through discussion

Parts and working of DC generator

Activity 7.2 : Demonstration and Discussion

- Demonstrate different parts of a DC generator and conduct a general discussion using diagrams or visual aids.

Discussion Points

- Constructional details
- Working

EMF Equation of DC generator

Activity 7.3: Discussion

- Develop the derivation of emf equation through class room discussion and interaction

Discussion Points

- Faraday's Laws
- Change of Flux and time taken for it
- Rate of change of flux
- The e.m.f equation can be derived by the teacher after discussion.

Classification of DC generator

Activity 7.4: General discussion

Discussion Points

- Excitation
- Separately excited d.c generator
- types of self excited d.c generator
- Applications

Teacher can conclude the classification through one-line diagrams.

Failure of Building up of Voltage

Activity 7.5: Brain storming and discussion

- Teacher can collect different ideas of voltage failure from the classroom and consolidate it. Then conduct a general discussion

Through brainstorming and discussion teacher can conclude the reasons and remedies of building up of voltage.

Parts and Working of DC motor

Activity 7.6 : Demonstration and Discussion

- Demonstrate different parts of DC motor and conduct a general discussion using diagrams, visual aids

Discussion Points

- Constructional details
- Working

Necessity, parts, working and connection of 3 point starter

Activity 7.7: Discussion, Experiment, and Demonstration

- Concept of Necessity of starter through class room discussion.

Discussion Points

- Why starting current is high
- Problems due to high starting current
- Protection from overload, under voltage etc.
- ON-Off control
- Dismantling the three point starter and identify the parts

The working of 3-point starter can be discussed with the help of diagrams and then demonstrate it. Experiment can be conducted with 3 point starter

Field of Applications of Dc machines

Activity 7.8: Class room Discussion

- Conduct a general discussion regarding the characteristics and application of different d.c motors depending on their special feature.

Losses and Efficiency of DC Machines

Activity 7.9: Discussion

- The different losses and efficiency of DC machine can be discussed.

Discussion Points

- Types of losses
- Methods to minimise losses
- Definition and equation of efficiency
- Condition for maximum efficiency

Lap and Wave winding

Activity 7.10 : Discussion, Demonstration, and Assignment

- General discussion can be conducted

Discussion Points

- Front pitch
- Back pitch
- Winding table
- Difference between lap and wave winding
- The structure of lap winding and wave winding can be understood by using diagrams or OHP and by dismantling a DC machine.
- Assignment is given to each group to draw the different structure of lap and wave winding with different parameters.

Methods of Speed control and reversal of rotation of DC motor

Activity 7.11 : Discussion and simple experiment

- Derive the equation of speed from the emf equation and analyse different methods to control speed.
- Conduct a general discussion to find out the methods of speed reversal .
- Conduct an experiment by using a d.c motor.

Discussion Points

- Fleming's left hand rule
- Inter changing of connection

CE Indicators

- Assignment
- Group Discussion

UNIT ANALYSIS
UNIT 7- DC MACHINES

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
7.1 To develop the concept of importance of DC	Sources and generation Applications Advantages and disadvantages	Communication and Presentation	Group discussion	Text books for reference	Ability to understand the knowledge of DC
7.2 To develop the concept of constructional details, principle and working of DC generator	Constructional details Principle Working	Communication and Presentation	Demonstration and Discussion	DC generator Diagrams Tools, LCD/OHP	Ability to identify the parts and understand the working
7.3 To reach the concept of derivation of emf equation	Derivation	Discussion and presentation	Class room discussion Interaction and conclusion	Discussion points	Ability to understand the influence of various parameters in emf generation
7.4 To understand the classification of DC generator	Excitation application	Discussion and Communication	Class room discussion Interaction and conclusion	Discussion points and one line diagram	Ability to understand the method of classification and types of generator
7.5 To analyse the reasons of failure of building up of voltage	Residual magnetism Speed of rotation Field connection and its resistance	Discussion Communication	Brain storming Discussion Conclusion	Ideas	Ability to understand the different causes of failure of building up of voltage
7.6 To develop the concept of constructional details, principle and working of DC motor	Constructional details Principles Working	Communication and Observation	Demonstration and discussion	DC motor diagrams Tools LCD/OHP	Ability to identify the parts and understand the working

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
7.7 To understand the necessity, parts, working and connections of 3-point starter	Starting current back e.m.f	Observation Identification	Discussion Experiment and demonstration	Reference materials 3-point starter Tools	Ability to understand the necessity of starter, its working and parts identification
7.8 To Understand the field of application of DC machines	Application Characteristics	Inferring	Discussion	Chart showing Characteristics	Ability to understand the field of application
7.9 To understand the losses and efficiency of DC machine	Losses Efficiency	Problem solving	Discussion	Reference materials	Ability to understand different losses and efficiency of DC machines
7.10 To understand the Lap and wave winding	Front pitch Back pitch Winding table	Identification Drawing skill	Discussion Demonstration and Assignment	Diagrams/ Charts OHP	Ability to understand and draw lap and wave winding
7.11 To develop the idea of speed control of DC motor and reversal of rotation of DC motor.	Speed equation Direction of exerting Force	Derivation Inferring	Discussion and simple experiment	Chart, diagrams	Ability to understand the speed control and reversal of rotation of DC motor.

ELECTRICAL HOUSE HOLD APPLIANCES

Introduction

Modern electrical house hold appliances play a vital role in our day to day life. So it is very important to understand the principle of working of these appliances. Its maintenance and servicing are also important.

This unit deals with deep knowledge about the electric heating appliances like electric iron, electric heater, hot plate, water heater, oven and Toaster.

Syllabus

Principle of heating appliances-electric iron-principle of working, parts and servicing of Non-automatic and automtic electric Iron- thermostat-Electric heater-hot plate-water heater- electric oven-electric toaster.

Curriculum Objectives

- 8.1 To acquire a deep knowledge about the parts, wiring diagram and working of Non-automatic electric iron through equipment demonstration, picture presentation and discussion.
- 8.2 To acquire the skill for dismantling and assembling a non-automatic electric iron through general discussion and practicals.
- 8.3 To recognise different faults of non-automatic electric iron and acquire the skill to rectify them through general discussion, tests and practicals.
- 8.4 To acquire a deep knowledge about the parts, wiring diagram and working of automatic electric iron through equipment demonstration, picture presentation and discussion.
- 8.5 To acquire the skill for dismantling and assembling of automatic electric iron through discussion and practicals.
- 8.6 To recognise different faults of automatic electric iron and to acquire the skill to rectify them through general discussion, tests and practicals.
- 8.7 To acquire a deep knowledge about the parts, wiring diagram and working of electric heater through equipment demonstration, picture presentation and discussion.

- 8.8 To acquire the skill for dismantling and assembling of electric heater through discussion and practicals.
- 8.9 To recognise different faults of electric heater and acquire the skill to rectify them through general discussion, tests and practicals.
- 8.10 To acquire a deep knowledge about the parts, wiring diagram and working of hot plate through equipment demonstration picture presentation and discussion.
- 8.11 To acquire the skill for dismantling and assembling of Hot plate through practicals.
- 8.12 To recognise different faults of hot plate and acquire the skill to rectify them through general discussion, tests and practicals.
- 8.13 To acquire a deep knowledge about the parts, wiring diagram and working of water heater through equipment demonstration, picture presentation and discussion .
- 8.14 To acquire the skill for dismantling and assembling of water heater through discussion and practicals.
- 8.15 To recognise different faults of water heater and acquire the skill to rectify them through general discussion, tests and practicals.
- 8.16 To acquire a deep knowledge about the parts, wiring diagram and working of electric oven through equipment demonstration, picture presentation and discussion.
- 8.17 To acquire the skill for dismantling and assembling electric oven through discussion and practicals.
- 8.18 To recognise different faults of electric oven and acquire the skill to rectify them through general discussion, tests and practicals.
- 8.19 To acquire a deep knowledge about the parts, wiring diagram and working of electric toaster through equipment demonstration, picture presentation and discussion.
- 8.20 To acquire the skill for dismantling and assembling electric toaster through discussion and practicals.
- 8.21 To recognise different faults of electric toaster and to acquire the skill of rectifying them through general discussion, tests and practicals.
- 8.22 To understand latest developments and new products in the area of above said appliances through assignment.

Parts and working of Non- Automatic Electric Iron

Activity 8.1 : Equipment demonstration, diagram presentation and discussion

- Teacher demonstrate non- automatic electric iron and dismantle it before the students.
- With the help of dismantled parts, pictures and diagrams, the teacher ask the students to discuss the following points.

1. Name of different parts
2. Use of different parts
3. Material used for making different parts
4. Working of equipment
5. Modern trends

Dismantling and Assembling of Non automatic Electric Iron.

Activity 8.2 : Discussion and Practical work

- Teacher should brush up safety precautions and tools required while handling a non-automatic electric iron
- Each student acquires the skill to dismantle, make proper connections and assemble a non- automatic electric iron through practical work.

Faults and its remedies of a Non- automatic Electric Iron.

Activity 8.3 : General discussion and Practical work

- Conduct a general discussion on the possible faults, its reasons and remedies of a Non- automatic electric iron.
- Each student works with the equipment to acquire the skill of fault finding and repairing in the Laboratory.

Note :- The activities involved for studying the objectives from 8.4 to 8.21 in this chapter for various appliances are the same. So repeat the procedure for each appliance at every time.

Latest developments in the field of above appliances

Activity 8.22 : Assignment

- Give assignment to the students about the latest trends in different appliances

(Hint-: Refer Electrical/Electronics journals)

CE Indicators

- Assignment
- Practical work

UNIT ANALYSIS
UNIT 8 • ELECTRICAL HOUSE HOLD APPLIANCES

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
8.1 To acquire a deep knowledge about the parts and working of Non-automatic electric iron	Parts and working principle	Observation Identifying and inferring	Demonstration and Discussion	Non-automatic electric iron, tools, picture and connection diagrams	Ability to identify the parts and working of equipment
8.2 To acquire the skill for dismantling and assembling a Non-automatic electric iron.	Parts of electric iron	Observation tool handling and Servicing	Discussion and Practical work	Non-automatic Electric iron, Proper tools	Ability to dismantle and assemble the iron using proper tools
8.3 To recognise different faults of non-automatic electric iron and acquire the skill to rectify them	Different faults, remedies,	Observation Fault finding Repairing	General Discussion and Practical work	Reference material	Ability to locate fault and rectify them
8.22 To understand latest developments and new products in the area of above said appliances	Latest trends	Observation,	Assignment	Reference material	Ability to prepare assignment
<p>Note :- Objectives, ideas, process skill, activities evaluation etc. for automatic electric iron, electric heater, hot plate, water heater, electric oven and electric toaster are the same. So repeat the procedure for above appliances.</p>					

9

ILLUMINATION

Introduction

Scientific illumination is the proper way of lighting a surface to get maximum light efficiency and minimum strain to the user. This chapter deals with the terms associated with illumination, different types of lamps and their working. An effort is also made to study some energy saving devices.

Syllabus

Concept of illumination, lumen and efficiency-parts , working and connection of incandescent lamp, Fluorescent lamp- HPMV Lamp, Sodium vapour Lamp and Halogen lamp- Stroboscopic effect of tube light-Advantages of electronic choke and CFL.

Curriculum Objectives

- 9.1 To introduce the concepts of illumination, lumen and efficiency, through discussion
- 9.2 To understand parts and working of incandescent lamp through assignment/seminar.
- 9.3 To understand parts, working and circuit connection of fluorescent lamp, through seminar and practical work.
- 9.4 To understand parts working and circuit connection of H.P.M.V Lamp through discussion and practical work.
- 9.5 To enable the students know the parts, working and application of sodium vapour lamp and halogen lamp through discussion.
- 9.6 To study about the stroboscopic effect and its illumination through discussion and experiment.
- 9.7 To study the advantages of electronic choke and CFL through assignment
- 9.8 To acquire the skill of simple illumination designing through a project work.

Illumination, lumen and efficiency

Activity 9.1 : Discussion

- Conduct a general discussion

Discussion Points

- Illumination
- Lumen
- Efficiency

After the discussion teacher can consolidate the concepts

Incandescent Lamps

Activity 9.2 : Assignment

Students may make assignments which contain the following points.

- Working principle of different types
- Internal parts of various types
- Latest developments

Teacher can consolidate from the various findings of the assignments.

Fluorescent Lamps

Activity 9.3: Seminar and Practical Work

The Class may be divided into 3 groups. Each group must be given any one of the following sub topics for seminar

- Connection diagram and its explanation
- Working of fluorescent lamp.
- Function of starter and choke.
- Advantages of electronic choke

Teacher can consolidate the seminar

Conduct a practical work to understand the wiring of fluorescent lamp circuit

Conduct the same work using electronic choke

Discuss the various possible faults that can occur and their remedies

Conduct a practical work to find out different faults and rectify it.

HPMV Lamps

Activity 9.4: Discussion and Practical Work

- Conduct a general discussion of HPMV lamp

Discussion Points

- Internal parts of lamp
- Circuit connection and explanation
- Working and applications

Teacher can consolidate the idea

- Conduct a practical work to understand the circuit connection of HPMV lamp and to measure the starting and running currents.

Sodium Vapour lamp and Halogen lamp

Activity 9.5: Discussion

A general discussion can be conducted with demonstration

Discussion Points

- Parts of Lamp
- Working of sodium vapour lamp and halogen lamp
- Applications

Stroboscopic effect

Activity 9.6: Discussion and Experiment

conduct a general discussion to understand the stroboscopic effect

Discussion Points

- Definition
- Reason
- Remedies
- Double tube fitting can be done practically and need for capacitance for phase splitting should be noted with much importance.

CFL and Electronic Choke

Activity 9.7: Assignment

Give an assignment which may include the following points.

- Working
- Advantages

Teacher consolidates the concepts

Illumination Designing

Activity 9.8 : Discussion and Project

Conduct a classroom discussion to understand the following points:

1. Lumen required
2. Positioning of Lamps
3. Type of Lamps required
4. Required wattage

Give a project to small groups-simple illumination designing of Bed room Living room etc.

Suggested Survey

Conduct a survey by dividing the students into different groups containing two or three students per group.

Aims of Survey

- To make aware the society about different energy saving methods
- To instruct the society about the usage of appropriate electrical apparatus and protective devices.
- To give awareness about leakage of electrical energy.
- Give an idea about non conventional energy sources
- To locate the areas without proper street lighting and to inform the concerned authority for necessary action.

Survey Format

Name and address of Consumer :
 Consumer Number :
 Monthly Electricity Bill :
 Daily consumption of Energy :
 (Monthly consumption / No. of days)

Sl. No	Name of Appliances	Wattage of appliances (W)	Number of appliances	Time of usage (Hrs)	Energy consumption in units (W.H)	Energy consumption
1.	Incandescent lamps					
2.	Fluorescent lamps					
3.	Fans					
4.	Television					
5.	VCD/DVD/VCR					
6.	Mixy					
7.	Refrigerator					
8.	Vacuumcleaner					
9.	Iron box					
10.	Water heater					
11.	Washingmachine					
12.	Others					
Total						

Signature of Consumer :

Date of Conducting survey :

CE Indicators

- Assignment
- Seminar
- Survey

UNIT ANALYSIS
UNIT 9- ILLUMINATION

Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
9.1 To introduce the concepts of illumination, Lumen and efficiency	Definition, Units	Developing idea	Discussion	Reference	Ability to understand the concept
9.2 To understand parts and working of incandescent lamp	Carbon filament, Metal filament and Metal filament gas Filled lamps	Observation	Assignment or Seminar	Diagram and material collection	Response to the assignment / Seminar
9.3 To understand parts, working and circuit connection of fluorescent lamp	Working of tube light and functions of choke and starter	Practical skill	Seminar Practical work	Fluorescent lamp, choke, starter, flexible wire, frame, and testing tools	Ability to understand the working and repairing
9.4 To understand parts working and circuit connection of H.P.M.V Lamp	working of MA type H.P.M.V Lamp	Experimentation	Discussion Practical work	H.P.M. V. Lamp with chokes, Ammeter, Voltmeter, connecting wire	Ability to understand the working and repairing
9.5 To enable the students to know the working and application of sodium vapour lamp and Halogen lamp	Working and Application	Observation and interaction	Discussion	Reference	Ability to understand working and application
9.6 To study about the stroboscopic effect and its elimination	Stroboscopic effect	Experimentation and Observation	Discussion and Experiment	Two sets of fluorescent tubes, chokes, starters, frame, flexible wires and capacitor	Ability to understand the concept

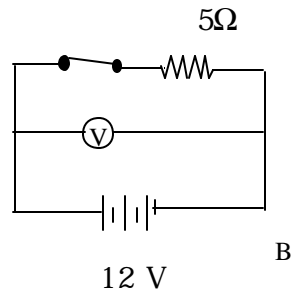
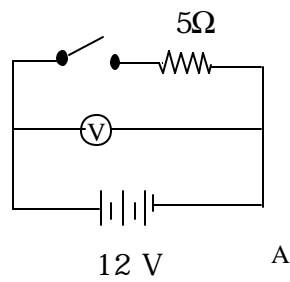
Objectives	Concepts/Ideas	Process Skills	Activity	Materials	Evaluation
9.7 To study the advantages of electronic choke and CFL	Observing about power saving	Analysis and Preparation of table	Data collection (assignment) and preparation of table by field survey	Chart, field survey performa	Ability to collect and analyse data
9.8 To acquire the skill of simple illumination designing	Lumen, types, wattage of Lamps area of room and positioning of accessories	Analysis designing	Discussion and Assignment/project	Discussion points and data for designing	Ability to do the simple illumination designing

SAMPLE QUESTIONS

UNIT I- ELECTRIC CIRCUITS

1. A student is directed to design a circuit to obtain the following conditions. The values of given resistors are 6Ω , 10Ω , and 8Ω of given resistors.
 - a. minimum resistance than the lowest of the given three resistors
 - b. Maximum resistance than the highest of the given three resistors.
2. When current pass through an incandescent lamp, it's filament heats up why ?
(Hint: Heats up due to I^2R effect and emits light)
3. Minimum range of circuit current for feeling electric shock
4. A 250V electric heater has a 2000 W heating element. It work for 2 hrs daily. Calculate the energy cost to be paid. Cost of energy per unit is Rs.3/
5. Why aluminium is used more for the transmission than distribution of electric energy
6. Two lamps of different wattages are connected in series.Which lamp will glow bright? Why?
7. Which type of connection is used in domestic wiring?
8. Suggest any five points to save energy consumption in your home?
9. Calculate the current which could flow safely through $10\text{ K}\Omega$, 1W resister
10. A tester does not glow when it is in touch with neutral . Give reason.
11. A conductor is stretched double to its original length. What happens to its resistance?
12. Appliances should not work on low voltage why?

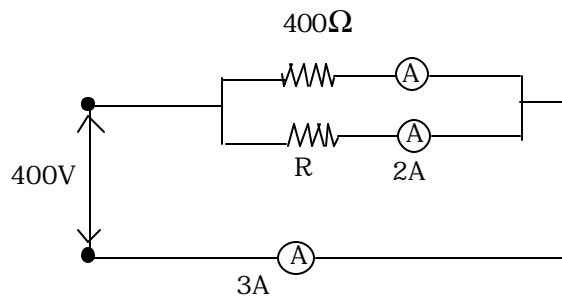
13. Give brief answer.



1. What is indicated by the voltmeter of the circuit shown in Fig A?
 2. What is indicated by the voltmeter of the circuit shown in fig B?
 3. In which case will the voltmeter indicate a higher voltage ?
14. The figure below indicates the electrical quantities for a simple circuit. Calculate and record missing values

Current	Resistance	Voltage
.....A	50 Ω	240 V
4A	.....Ω	120 V
7.5 A	15Ω	.....V
.....mA	2.5 Ω	9 V
18 mA	.....Ω	24 V
25 mA	5 KΩ	.....V

15. What should be the value of R in Ohms?



16. Arrange the following metals in the ascending order according to their electrical conductivity
Iron, Silver, Aluminium, Copper
17. "Total resistance equals the sum of the individual resistances in a series circuit".
Say true or false
18. Adding more resistances in a parallel circuit increases the total resistance:.
Say true or false
19. Adding more resistance in a series circuit increases total power used by the circuit
Say true or false
20. Write the unit of opposition to electric current.

UNIT II- HOUSE WIRING

1. What are the rules to be followed in house wiring?
2. A domestic installation is having the following loads
 - a. Lighting load :
 1. 40W lamps 8 nos.
 2. 60W lamps 6 nos.
 - b. Ceiling fan (60watts) : 8 Nos
 - c. Water pump ($\frac{1}{2}$ HP) : 1 No
 - d. Electric heater (2000watts): 1 No.

The supply voltage is single phase AC, 240v, 50 Hz, calculate the number of sub circuits and specification of DB and main switch.

(Hint: Lighting and fan : 3 sub circuits)

Power socket : 2 sub circuit

Distribution board : 4 way 5 A- 1 No

Distribution board : 3way 16A- 1 No

Main switch ICDP : 30A, 250v-1 No.)

3. Why earthing is necessary?
4. For safety the switches and fuses should connect on phase line. Why?
5. The minimum gauge of copper Earthwire to be used for a three pin, 15AMp, 250 Volt socket (Hint;- 14 SWG)
6. The earth pin of a three-pin plug is large as compared to other pins. Why?
7. Name two tools used for removing the insulation from conductors of different sizes.

(Hint: Electrician Knife, Wire Stripper)

8. What are the common defects of wiring circuits?
9. Which tools are needed for connecting up an appliance socket?
10. What is the immediate effect when there is loose contact in the termination of an electric circuit?

(Hint: Excessive heat will be produced at the termination causing damage to terminal and cable)

11. A size of a wire is specified as 3/20 what it indicates?
12. What is the ratio of tin and lead in the commonly used solder?
(Hint: 60: 40)
13. Why flux is used in soldering? Name the commonly used flux. Which type of flux need not be used in soldering?
(Hint: 1. Helps to flow the solder quickly and speeds up transfer of heat.
2. Prevent oxidation of metal surface and remove oxides from surface to be soldered) .
3. Commonly used flux is zinc chloride. Need not be used flux is corrosive flux containing active acids.
14. Why copper is preferred than Aluminium in domestic wiring?
(Hint: 1. Good conductor
2. Could be drawn into thin wires and sheets
3. Could be joined easily 4. Largest current density.
15. State the advantages of stranded conductors over solid conductors
(Hint: 1. Flexibility
2. Connections and joints are stronger
3. Longer life
4. Insulation has better grip
5. for a given area of cross-section, they carry more current.)
16. How proper earthing can be checked using test lamp ?
17. What are the advantage of MCB over rewirable fuse?
18. What are the advantages of using multistrand conductors than single solid conductor?
(Hint: 1. More flexible, durable, more heat dissipating area, skin effect reduced.
19. What will be the position of the holders and plug points in case of continuity test ?

UNIT III-MAGNETISM

1. The use of compass needle is to give information about direction. On which property does it work?
(Hint: North-south direction)
2. What are the essential conditions to induce an emf in a circuit
(Hint: Conductor, magnetic fields, Relative change)
3. Explain why an iron nail can be picked up using either end of a permanent magnet
(Hint: Iron, nail is a ferro magnetic material. The magnetic induction makes the nail a magnet of the opposite pole)
4. How would you determine the magnetic polarity of an unmarked magnet using a compass.
(Hint;- If the north pole of a magnetic compass is attracted towards one end of the unmarked magnet, that end is south pole)
5. State true or false.
All the materials whether magnetic or non magnetic have their own hysteresis loop
(Hint: False)
6. What does it mean that iron is more permeable than copper
(Hint: Iron passes more flux)
7. When the tube light is switched on, there is a sound from choke. Give reason
(Hint: Vibrating sound due to the loose core)
8. Magnetic cores are laminated. Why ?
9. How do we find out the direction of induced emf in a circuit?
10. Explain the basic laws in which electrical machines work?
(Faraday's Laws)

UNIT IV- FUNDAMENTALS OF AC

1. Why star connection is used in the secondary side of distribution transformer.
(Hint: For making single phase supply neutral is necessary)
2. Why electric supply authority insist in improving the load power factor
(Hint: Disadvantages of low power factor)
3. Motors are always rated in KW not in KVA . Why ?
4. What happens to the inductance of a coil when number of turns of the wire is doubled? (Assume radius and length remains constant)
5. A sine wave goes through 5 cycles in 10 seconds.what is its period?
6. What would happen to inductive and capacitive reactance when the frequency is doubled?
7. A resistance of 8 Ohm and inductive reactance of 25 Ohm are connected in series with a capacitor of unknown value. The current through the circuit is 12.5 A when it is connected across 240v 50hz supply. Find out the value of capacitor.
8. Give the relation between voltage and current in pure inductive circuit?

UNIT V- MEASURING INSTRUMENTS

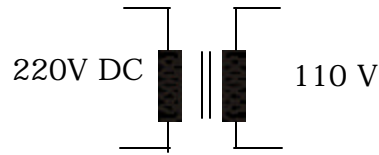
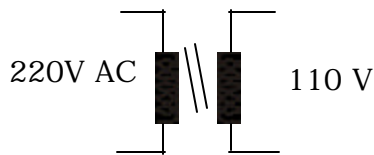
1. The reading obtained from measuring instruments gives....value of ac
(Hint: - RMS)
2. Why small holes are provided in the disc of an energy meter?
3. Which type of instrument is used for measuring DC?
4. How do you connect a voltmeter in a circuit ? Why?
5. Can we use an Ammeter as a voltmeter? How ?
6. Which type of instrument is used for measuring current, voltage and resistance ?
7. How will you identify current coil and pressure coil with inductive load?
(Hint: - Adjust p.f compensator (copper shading ring))
8. What type of error occur in energy meter when it is energised and not loaded?
9. What should be done if meter is showing error with inductive load?
[Hint:-Adjust p.f compensator (copper shading ring)]
10. A voltmeter may be removed from a circuit without affecting the circuit ,
an ammeter cannot be removed- say true or false.
11. In an energymeter, the meter constant is given as 3600Rev/KWH. The
energy consumed in one revolution is.....
12. The cause for creeping is
13. If the terminals E and L of a Megger are open. What will be the reading of
instrument?
14. The damping in moving coil type instruments is obtained by.....
15. An instrument indicates 25A current in an induction motor line circuit.
What value does it measure.
 - a. Instantaneous
 - b. Average
 - c. Effective
 - d. Peak

16. Which meter is used for measuring electrical energy? Explain its working
17. Which meter is used for measuring insulation resistance of electrical installation. Explain its working?
18. How can we measure the earth resistance?
19. Mention the speed of megger handle while testing
20. How much voltage will induce inside the megger while testing?

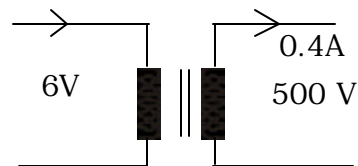
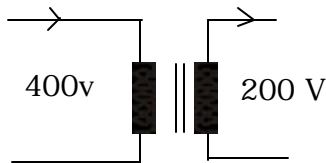
UNIT VI- TRANSFORMER

1. If the secondary turns in a transformer are doubled and at the same time the primary voltage reduced to half, then the secondary voltage will _____
2. Which part of the transformer is subjected to maximum heating?
3. Explain the function of breather?
4. Explain the function of conservator?
5. What is the colour of silica gel when it is in wet condition?
6. What is the reason for transformer humming?
[Hint:- Vibration of core due to unbalanced magnetic distribution]
7. What are the advantages of auto transformer over two winding transformer?
Hint:-
 - (1) Better voltage regulation
 - (2) Operate at high efficiency
 - (3) Low losses
 - (4) Cheap
8. Why efficiency of a transformer is high?
9. Derive the emf equation of a transformer from first principles
10. Transformers are rated in KVA ? Why?
11. How many magnetic paths are there in the core type transformer?
[Two]
12. How many magnetic paths are there in the shell type transformer?
[One]
13. What is the reason that the core is made laminated?
[Due to Eddy current production in solid core which produce heat]
14. For what purpose is the conservator fitted on top of the transformer?
[To give the space to the oil when it is heated up in the tank due to the load on the transformer]
15. What material is filled in the breather?
[Calcium chloride (silica gel)]

16. What is Emergency release?
[A pipe on the top of the tank of transformer which release gases on the short circuit]
17. The functions of no-load current in a transformer?
[Produces flux and supplies iron loss, on no-load]
18. What will be the effect on the primary side if the load on the secondary side is increased in a transformer?
[Current increases on the primary side also]
19. Why the copper losses are avoided in open circuit test?
[Due to small current (no-load current)]
20. Why is the auto transformer not used for high voltage?
[Due to common winding]
21. What will be the relation of power if the secondary of the transformer is connected in Star and Delta respectively?
22. Which of the following transformers will work properly?



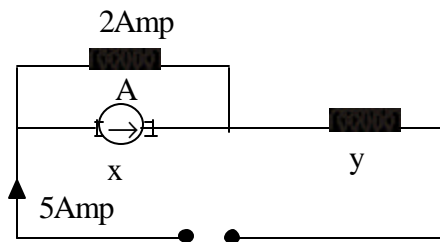
23. Which wire will be thicker and which side will have high insulator in the following diagrams?



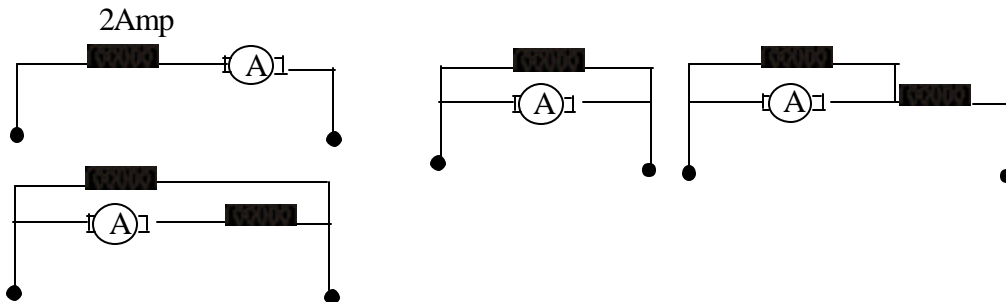
UNIT VII- D.C MACHINES

1. Generated voltage is always.....
2. Why carbon is used as brush contact in DC machines
(Hint: - negative temperature coefficient, Self lubricating property,
Soft material)
3. How the direction of rotation of a dc motor can reverse ?
4. Why starting current of a dc machine is high? How starting current is reduced?
5. How does a self excited generator start working without external excitation?
6. The efficiency of a DC machine is always less than one. What are the reasons.
7. DC series motors are used in train why?
8. What are the reasons for failure of building up of voltage in Dc machines?
9. How do the field windings of shunt and series motor differ ?
(Hint: For shunt field- thin wire, more turns and high resistance,
Series field- thick wire, lesser no of turns and low resistance)
10. Write the field of application of Lap and Wave winding
11. Is there any difference between DC motor and generator by construction?
12. The interpoles are connected to which circuit?
13. How to reduce the sparking on the commutator?
14. In which circuit is the starter resistance connected?
(Hint: In series with Armature)
15. Is no-volt coil connected in series with the field? Ans: yes
16. Is overload coil connected in series with the line ? Ans: yes
17. When the motor takes current above normal value, what happens ?
Ans. Overload coil work and short circuit the terminals of no-volt coil and handle comes back to its original position)

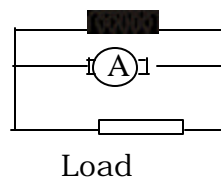
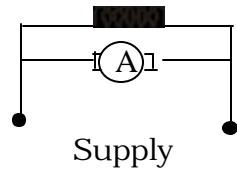
18. What happens if the no-volt coil open circuited ? Ans: the motor will run on " above normal speed")
19. If the field terminal of motor is connected with armature terminal of starter and vice-versa, what happens? (Ans: No volt coil will burn out)
20. Why the dc motor should not be started directly from mains?
21. How the supply failure is protected in dc machine?
22. Which losses are constant and which losses are variable in DC machine?
23. In which parts the constant losses and variable losses affect?
24. Can we use a wooden armature? If not, why?
25. What current will flow through X and Y



26. What are the reasons of heavy sparking on commutator?
27. Name the following motors with parts



28. Which is motor and which is generator ?



UNIT VIII- ELECTRICAL HOUSE HOLD APPLIANCES

1. An automatic electric iron is not working even after switched ON. Give possible reasons and suggest suitable remedies.
2. How can you regulate the heat of an automatic electric iron?
3. Draw different coil connections of a hot plate.
4. List your appliances working on the heating effect of electric current.
5. List out the possible faults and remedies of a water heater .
6. Which four parts may cause electrical trouble in a non-automatic electric iron.
7. If you get a zero resistance reading between the heating element and sole plate of an iron, what defect exists in the iron.

(Hint:- Grounding or Short circuit)

UNIT IX- ILLUMINATION

1. A choke coil of an operating fluorescent lamp is short circuited. What is the consequence ?
(Hint:- The current becomes so large that it may damage the tube)
2. A tube lamp circuit is connected to 220V AC supply, what will happen?
(Hint:- The tube lamp initially starts and then the tube burns out)
3. Why coiled coil filament is used in incandescent lamp?
(Hint:- To decrease heat dissipation)
4. Advantages of electronic choke over electromagnetic choke
5. Advantages of CFL
6. Which method is used to minimize stroboscopic effect?
7. If a filament is directly connected to supply voltage in open atmosphere, what will happen
(Hint:- Due to oxidation, white fumes are produced and finally burns out)
8. Why gases are filled in incandescent lamps?
9. A fluorescent lamp give more light than incandescent lamp of same wattage. why?
10. Why capacitor is used in a fluorescent tube connection?
11. Explain the working of fluorescent lamp
12. List the applications of sodium vapour lamp and mercury vapour lamp

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