



BANGLADESH TECHNICAL EDUCATION BOARD

Agargaon, Dhaka-1207.

**4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)**

ELECTRICAL TECHNOLOGY
TECHNOLOGY CODE: 667

**FIRST SEMESTER
DIPLOMA IN ENGINEERING
PROBIDHAN-2016**

Electrical Technology

1st Semester

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total	
						Theory		Practical			
						Cont. assess	Final exam	Cont. assess	Final exam		
1	61011	Engineering Drawing	0	6	2	0	0	50	50	100	
2	65812	Physical Education & Life Skill Education	0	3	1	0	0	25	25	50	
3	65911	Mathematics-1	3	3	4	60	90	50	0	200	
4	65913	Chemistry	3	3	4	60	90	25	25	200	
5	66711	Basic Electricity	3	3	4	60	90	25	25	200	
6	66713	Electrical Engineering Materials	2	0	2	40	60	0	0	100	
7	66811	Basic Electronics	2	3	3	40	60	25	25	150	
		Total	13	21	20	260	390	200	150	1000	

61011

ENGINEERING DRAWING

**T P C
0 6 2**

OBJECTIVES:

- To develop the ability to use various drawing instruments and materials.
- To enable in constructing and using various types of scales in drawing.
- To provide the ability to construct various geometrical figures.
- To enable to adopt various symbols used in drawing.
- To understand the orthographic and isometric projection.

SHORT DESCRIPTION:

Drawing instruments and their uses; Lettering, numbering and constructing title strip; Adopting alphabet of lines and dimensioning; Constructing scales; Constructing geometrical figures; Constructing conic sections; Adopting symbols; Views and isometric projections.

DETAIL DESCRIPTION:

1 Practice with drawing instruments and materials for basic drawing technique.

- 1.1 Identify the different types of drawing instruments.
- 1.2 Use different types of drafting equipment.
- 1.3 Identify different types of drafting software.
- 1.4 Identify the standard sizes of drawing board and sheets.
- 1.5 Draw the border lines in drawing sheets following standard rule.
- 1.6 Draw horizontal, vertical and inclined lines with the help of set squares and T-square.
- 1.7 Draw 15 degree, 75 degree, 105 degree and 120 degree angles with the help of set squares.
- 1.8 Use lettering guide, template, scale pantograph and French curve.

2 Practice Letter and number freehand and with instruments.

- 2.1 Identify the necessity of good lettering in engineering drawing.
- 2.2 Draw freehand single stroke vertical letters from A to Z (upper and lower case) and numbers 0 to 9.
- 2.3 Draw freehand inclined (65 degree to 75 degree) single stroke letters from A to Z (upper and lower case) and numbers from 0 to 9.
- 2.4 Draw block letters (Gothic) using 5: 4 proportions.
- 2.5 Select a suitable size of letters and write a few sentences using all the letters selecting suitable scale.
- 2.6 Draw title strip with proper placement using suitable size of letters and measurements.

3 Adopt the alphabet of lines.

- 3.1 Select different lines in drawing.
- 3.2 Use center line, hidden line, phantom line, break line, dimension line, extension line, section line and cutting plane line.
- 3.3 Use different thickness of line to emphasize a part of drawing.
- 3.4 Select recommended grades of pencils for various types of lines for engineering drawing.

4 Adopt the elements and theory of dimensioning.

- 4.1 Put dimensions in engineering drawing according to an accepted standard.
- 4.2 Identify the elements of dimensions from a given dimensioned drawing.
- 4.3 Apply aligned and unidirectional system of dimensioning.
- 4.4 Draw size and location of dimension, continuous dimension, staggered dimension and dimensioning in limited space.
- 4.5 Add necessary dimension to a given drawing with suitable arrows.

5 Prepare scale for drawing application.

- 5.1 Calculate representative fraction and interpret a scale reading.
- 5.2 Use different types of scale to find full size dimension.
- 5.3 Draw a plain scale to show meter, centimeter and millimeter of a given distance on object.
- 5.4 Draw a diagonal scale to show three units having given RF.
- 5.5 Read particular distance on plain and diagonal scale.
- 5.6 Use scale of chord.
- 5.7 Draw angle of 49 degree, 78 degree and 95 degree with the help of scale of chord.

6 Construct geometric figures (regular polygons) & Construct conic sections.

- 6.1 Draw regular polygons i.e. pentagon, hexagon and octagon having given one side.
- 6.2 Draw an ellipse by concentric circle method.
- 6.3 Draw an ellipse by parallelogram method.
- 6.4 Draw an ellipse by four center method.
- 6.5 Draw a parabola having given foci and director.
- 6.6 Draw a parabola from given abscissa and ordinate.

7 Adopt standard symbols in drawing.

- 7.1 Identify symbols used in drawing.
- 7.2 Draw a legend using symbols of different engineering materials.
- 7.3 Draw the symbols of different plumbing fittings and fixtures used in drawing.
- 7.4 Draw the symbols of different electrical fittings and fixtures used in drawing.
- 7.5 Interpret information from drawing containing standard symbols.

8. Understand the views of engineering drawing.

- 8.1 Identify different types of views
- 8.2 Interpret different types of views

9 Apply the Principles of orthographic projection to a straight line.

- 9.1 Draw the orthographic projection of a straight line under the following conditions : -
 - a) Line parallel to both planes
 - b) Line perpendicular in vertical plane and parallel to horizontal plan
 - c) Line parallel to vertical plane and perpendicular to horizontal plane
 - d) Line inclined at given angle to horizontal plane and parallel to vertical plane
 - e) Line inclined at given angle to vertical plane and parallel to horizontal plane

10 Apply the principles of orthographic projection of rectangular and circular planes (Lamina)

- 10.1 Draw the orthographic projection of rectangular lamina Parallel to both planes.
- 10.2 Draw the orthographic projection of rectangular lamina inclined at given angle to horizontal plane
- 10.3 Draw the orthographic projection of circular lamina parallel to both planes

11 Apply the principles of orthographic projections of geometric solids

- 11.1 Draw the orthographic projection of a cube kept at an angle with one of the planes in first angle method
- 11.2 Draw the orthographic projection of a pyramid kept at an angle with both the planes in 1st angle method
- 11.3 Draw the orthographic projection of a cone kept at an angle with both the planes in third angle method.
- 11.4 Draw the orthographic projection of a prism kept at an angle with vertical plane in third angle method.

12 Understand the importance, use and scope of isometric views in engineering.

- 12.1 Identify isometric views
- 12.2 Draw the isometric view of rectangular and circular lamina
- 12.3 Draw the isometric projection of solids such as: cube, cylinder, pyramid, prism and steps from different orthographic views
- 12.4 Draw the isometric projection of three deterrent engineering parts from orthographic views

REFERENCE BOOKS:

- 1 Geometrical Drawing - I H Morris
- 2 Prathomic Engineering Drawing - Hemanta Kumar Bhattacharia
- 3 Civil Engineering Drawing - Guru Charan singh

65812	PHYSICAL EDUCATION & LIFE SKILL DEVELOPMENT	T	P	C
		0	3	1

OBJECTIVES:

- To enhance body fitness.
- To make aware of First aid procedure.
- To acquaint with the common games and sports.
- To develop Life Skill.

SHORT DESCRIPTION

Warm up; Yoga; Muscle developing with equipment; Meditation, First aid; Sports science, Games & sports; Life skill development.

DETAIL DESCRIPTION

1. Recite national anthem and make assembly

- 1.1 line and file.
- 1.2 Make assembly.
- 1.3 Recitation of national anthem.
- 1.4 National anthem in music.

2. Conduct warm up.

- 2.1 Conduct general warm up :

Spot running (Slow, Medium & Fast), Neck rotation, Hand rotation, Side twisting, Toe touching, Hip rotation, Ankle twisting, Sit up and Upper body bending (Front & Back).

- 2.2 Conduct squad drill :

Line, File, Attention, Stand at ease, Stand easy, Left turn, Right turn, About turn, Mark time, Quick march, Right wheel, Left wheel, Open order march & Closed order march.

- 2.3 Conduct specific warm up :

Legs raising one by one, Leg raising in slanting position, Knee bending and nose touching, Heels raising, Toes touching (standing and laying position), Hand stretch breathing (Tadasana, Horizontal, Vertical).

- 2.4 Conduct mass physical exercise

Hand raising, Side twisting, Front & back bending, Front curl, Straight arm curl two hand, Hands raising overhead and Push up.

3. Conduct YOGA.

- 3.1 Dhyanasan : Shabasan, Padmasan, Gomukhasan, Sharbangasan, Shashangasan, Shirshasan
- 3.2 Shasthyasan : Halasan, Matsasan, Pavan Muktsan, Ustrasan.
- 3.3 Prana and Pranayama: Nadisuddhi Pranayama, cooling pranayamas (sitali pranayama, Sitkari Pranayama, Sadanta pranayama), Ujjayi pranayama,

4. Exercise Muscle developing with equipment.

- 4.1 Practice Damball: Front curl, Hand sidewise stretching, Arms raising overhead.
- 4.2 Practice Barball: Front press, Leg press, rowing motion with leverage bar.
- 4.3 Practice Rope climbing: Straight way climbing, Leg raising climbing.
- 4.4 Practice Horizontal bar: Chinning the bar with front grip, chinning the bar with wide back grip.
- 4.5 Practice Jogging Machine: Slow, Medium, and Fast running.
- 4.6 Practice A. B king pro (Rowing Machine): Sit up.
- 4.7 Practice Sit up bench: Sit up.

5. Conduct Meditation.

- 5.1 Define meditation.
- 5.2 Classification of Meditation.
- 5.3 Nadanusandhana (A-Kara chanting, U-Kara chanting, M-Kara chanting, AUM-kara chanting).
- 5.4 OM-Meditation.
- 5.5 Cyclic Meditation (Starting Prayer, Instant Relaxation Technique, Centering, Standing Asanas, Sitting Asanas, Quick Relaxation Technique).

6. Demonstrate First Aid Skill.

- 6.1 Define First aid.
- 6.2 Know First aider.
- 6.3 Discuss the responsibilities of a First aider.
- 6.4 Identify different types of equipment of First aid.
- 6.5 Practice Muscle Cramp-Ice applications (Remedy).
- 6.7 Practice dislocation-Ice application (Remedy).

7. Exercise Rules and technique of following games and sports.

- 7.1 Kabadi.
- 7.2 Football.
- 7.3 Cricket.
- 7.4 Badminton.
- 7.5 Athletics.
- 7.6 Swimming.

8. Sports Science.

- 8.1 Define exercise physiology.
- 8.2 State the function of muscles.
- 8.3 Know the concept of work, energy and power.
- 8.4 Express the effect of exercise on heart and circulatory system.
- 8.5 Show the motor components for physical fitness.
- 8.6 Define sports biomechanics.
- 8.7 Define sports psychology.
- 8.8 State the meaning of nutrition, diet and balanced diet.
- 8.9 State the meaning of the terms –test, measurement and evaluation.

9. Show skill on conversation on day to day life of the following:

- 9.1 Today's market price.
- 9.2 Festivals (religious festivals, National festivals).
- 9.3 Celebration of National days.
- 9.4 Aim in life.
- 9.5 Visite to historical places/sites.

10. Understand human relation.

- 10.1 Define family relation.
- 10.2 Know the relation with neighbor.
- 10.3 Identify humanitarian service.
- 10.4 Explain service for handicapped (intelligent, physical, social etc).
- 10.5 Explain service for orphan/patient.

11. Experience vote of appreciation.

- 11.1 About dress.
- 11.2 For good work.
- 11.3 For good result.
- 11.4 For good news.

12. Practice stress management.

- 12.1 Grow habit to be a man of humor.
- 12.2 Always keep brain cool.
- 12.3 Run with positive thinking.
- 12.4 Explain factors that determine our attitude.
- 12.5 State the benefits of a positive attitude.
- 12.6 Follow steps to building a positive attitude.

13. Practice time management.

- 13.1 Determine essential time for a task.
- 13.2 Determine delay and unexpected time.
- 13.3 Determine time for daily activities.
- 13.4 Plan for daily activities.

14. Play roll to conduct interview technique on:

- 14.1 Mental preparation to face an interview.
- 14.2 Selection of dress for interview.
- 14.3 Introducing himself/herself to the interviewer.
- 14.4 Coping interview.

15. Practice team work on:

- 15.1 Organize a team.
- 15.2 Select a team leader.
- 15.3 Distribute the task to the members.
- 15.4 Accept opinion of team members.
- 15.5 Complet the task as a team.

16. Practice social work.

- 16.1 Exercise tree plantation.
- 16.2 Exercise community service.
- 16.3 Rover Scout.
- 16.4 Sanitation.
- 16.5 Pure drinking water.
- 16.6 Social Culture.

REFERENCE BOOK:

Modern Yoga	_ Kany Lal Shah
Rules of games and sports	_ Kazi Abdul Alim
Yoga	_ Sobita Mallick
Iron Man	_ Nilmoni Dass

65911**MATHEMATICS-1****T P C
3 3 4****OBJECTIVES:**

- To acquaint the students with the basic terminology of Algebra.
- To be able to understand the complex numbers which are being used in electrical engineering.
- To be able to understand the binomial expansion.
- To be able to use the knowledge of trigonometry in solving problems of engineering importance.

SHORT DESCRIPTION:

Algebra: AP & GP, polynomials & polynomial equations, complex number, permutation & combination, binomial theorem for positive integral index and negative & fractional index.

Trigonometry: ratio of associated angles, compound angles, transformation formulae, multiple angles and sub-multiple angles.

DETAIL DESCRIPTION:**1 Understand the concept of AP & GP.**

- 1.1 Define AP and common difference.
- 1.2 Find last term and sum of n terms, given first term and common difference.
- 1.3 Define GP and common ratio.
- 1.4 Find the sum of n terms given first and common ratio.

2 Apply the concept of polynomial in solving the problems.

- 2.1 Define polynomials and polynomial equation.
- 2.2 Explain the roots and co-efficient of polynomial equations.
- 2.3 Find the relation between roots and co-efficient of the polynomial equations.
- 2.4 Determine the roots and their nature of quadratic polynomial equations.
- 2.5 Form the equation when the roots of the quadratic polynomial equations are given.
- 2.6 Find the condition of the common roots of quadratic polynomial equations.
- 2.7 Solve the problems related to the above.

3 Understand the concept of complex numbers.

- 3.1 Define complex numbers.
- 3.2 Perform algebraic operation (addition, subtraction, multiplication, division, square root) with complex number of the form $a + ib$.
- 3.3 Find the cube roots of unity.
- 3.4 Apply the properties of cube root of unity in solving problems.

4 Apply the concept of permutation.

- 4.1 Explain permutation.
- 4.2 Find the number of permutation of n things taken r at a time when,
 - i) Things are all different.
 - ii) Things are not all different.
- 4.3 Solve problems related to permutation:
 - i) Be arranged so that the vowels may never be separated.
 - ii) From 10 men and 6 women a committee of 7 is to be formed. In how many ways can this be done so as to include at least two women in the committee.

5 Apply the concept of Combination.

- 5.1 Explain combination.
- 5.2 Find the number of combination of n different things taken r at a time.
- 5.3 Explain nCr , nCn , $nC0$
- 5.4 Find the number of combination of n things taken r at a time in which p particular things
 - i) Always occur
 - ii) never occur.
- 5.5 Establish i) $nCr = nCn-r$
 - ii) $nCr + nCr-1 = n+1Cr$
- 5.6 Solve problems related to the combination.

6 Apply partial fractions to break the numerator and denominator.

- 6.1 Define proper and improper fractions.
- 6.2 Resolve into partial fraction of the following types:
 - a) Denominator having a non-repeated linear factor.
 - b) Denominator having a repeated linear factor.
 - c) Denominator having a quadratic factor.
 - d) Denominator having a combination of repeated, non repeated and quadratic factors.

7 Apply the concept of the binomial theorem.

- 7.1 State binomial expression.
- 7.2 Express the binomial theorem for positive index.
- 7.3 Find the general term, middle term, equidistant term and term independent of x.
- 7.4 Use binomial theorem to find the value of
 - i) $(0.9998)^2$, correct to six places of decimal.
 - ii) $(1 + \sqrt{2})^5 - (1 - \sqrt{2})^5$

8 Apply the concept of the binomial theorem for negative index.

- 8.1 Express the binomial theorem for negative and fractional index.
- 8.2 Solve problems of the following types:

$$\text{Expand (i)} (1 - nx)^{-\frac{1}{n}} \text{ (ii)} \frac{1}{\sqrt[4]{4.08}}$$

9 Apply the concept of associated angles.

- 9.1 Define associated angles.
- 9.2 Find the sign of trigonometrical function in different quadrants.
- 9.3 Calculate trigonometrical ratios of associated angle.
- 9.4 Solve the problems using above.

10 Apply the principle of trigonometrical ratios of compound angles.

- 10.1 Define compound angles.
- 10.2 Establish the following relation geometrically for acute angles.
 - i) $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$.
 - ii) $\cos(A \pm B) = \cos A \cos B \pm \sin A \sin B$.
- 10.3 Deduce formula for $\tan(A \pm B)$, $\cot(A \pm B)$.
- 10.4 Apply the identities to work out the problems:
 - i) Find the value of $\sin 750^\circ$, $\tan 750^\circ$.
 - ii) Show that $\frac{\sin 75^\circ + \sin 15^\circ}{\sin 75^\circ - \sin 15^\circ} = \sqrt{3}$
 - iii) If $\alpha + \beta = \theta$, $\tan \alpha + \tan \beta = b$, $\cot \alpha + \cot \beta = a$,
Show that $(a - b) = ab \cot \theta$.

11 Apply sum and product formula of trigonometrical ratios.

- 11.1 Express sum or difference of two sines and cosines as a product and vice-versa
- 11.2 Solve problems of the Following types:
 - i) Show that, $\sin 55^\circ + \cos 55^\circ = \sqrt{2} \cos 10^\circ$
 - ii) Prove that, $\cos 80^\circ \cos 60^\circ \cos 40^\circ \cos 20^\circ = \frac{1}{16}$

12 Apply the concept of ratios of multiple angles.

- 12.1 State the identities for $\sin 2A$, $\cos 2A$ and $\tan 2A$.
- 12.2 Deduce formula for $\sin 3A$, $\cos 3A$ and $\tan 3A$.
- 12.3 Solve the problems of the following types.
 - i) express $\cos 5\theta$ in terms of $\cos \theta$.
 - ii) if $\tan \alpha = 2 \tan \beta$, show that, $\tan(\alpha + \beta) = \frac{3 \sin 2\alpha}{1 + 3 \cos 2\alpha}$

13 Apply the concept of ratios of sub-multiple angles.

13.1 Find mathematically the identities for $\sin \alpha$, $\cos \alpha$ and $\tan \alpha$ in terms of $\frac{\alpha}{2}$ and $\frac{\alpha}{3}$

13.2 Solve the problems of the type:

find the value of $\cos 3^\circ$, $\cos 6^\circ$, $\cos 9^\circ$, $\cos 18^\circ$, $\cos 36^\circ$ etc.

REFERENCE:

SL No	Author	Title	Publication
01	S. P Deshpande	Mathematics for Polytechnic Students	Pune Vidyarthi Graha Prakashan
02	H. K. Das	Mathematics for Polytechnic Students (Volume I)	S.Chand Prakashan
03	Ashim Kumar Saha	Higher Mathematics	Akshar Patra Prakashani
04	S.U Ahamed & M A Jabbar	Higher Mathematics	Alpha Prakashani

65913**CHEMISTRY**

T	P	C
3	3	4

OBJECTIVES:

1. To understand mole concept and volumetric analysis.
2. To represent the formation of bonds in molecules.
3. Able to select appropriate materials used in construction.
4. Apply knowledge to enhance operative life span of engineering material and structure by various protective methods.

SHORT DESCRIPTION:

Chemistry is a basic science subject which is essential to all engineering courses. It gives knowledge of engineering material, their properties related application and selection of material for engineering application. It is intended to teach student the quality of water and its treatment as per the requirement and selection of various construction materials and their protection by metallic and organic coatings. The topics covered will provide sufficient fundamental as well as background knowledge for the particular branch.

DETAIL DESCRIPTION:**1. Understand Atomic Structure and Chemical Bond.**

- 1.1 Define element, atoms, molecules, Fundamental particle of atom, their mass, charge, location.
- 1.2 Define atomic number, mass number, Isotope, Isotone and Isobar.
- 1.3 Explain electronic configuration based on Hunds Rule, Aufbau's principle, Paulis exclusion principle.
- 1.4 Define atomic weight, equivalent weight of an element, molecular weight, mole in terms of number, mass, volume.
- 1.5 Define symbol, valency and formula.
- 1.6 Explain Chemical bond, octet rule.
- 1.7 Explain Formation of various types of chemical bonds: Covalent, Ionic, Co-ordinate bond.
- 1.8 Explain the bonding along with example CH_4 , H_2 , O_2 , NaCl , MgCl_2 .
- 1.9 Explain Quantum number, Orbit and Orbital.

2. Understand Ionic Equilibrium.

- 2.1 Explain the concept of acid, base, salt and types of salts.
- 2.2 Define pH, pOH, pH scale.
- 2.3 Distinguish between basicity of an acid and acidity of a base.
- 2.4 State normality, molarity, molality, volumetric analysis.
- 2.5 Explain Titration and Indicator.
- 2.6 Describe buffer solution and its mechanism.

3. Understand chemical reaction, oxidation and reduction.

- 3.1 Define Chemical reaction and explain the various types of chemical reaction.
- 3.2 Explain the full meaning of a chemical equation.
- 3.3 State the concept of catalyst.
- 3.4 Explain the modern concept of oxidation and reduction.
- 3.5 Describe the simultaneous process of oxidation and reduction.
- 3.6 Explain the oxidation number.

4. Understand Water Treatment.

- 4.1 State the concept of hard and soft water.
- 4.2 Define hardness of water.
- 4.3 Describe the softening method of permuted process and ion exchange resin process.
- 4.4 Mention the advantages and disadvantages of hard water in different industries.
- 4.5 Visit a water treatment plant write a report.

5. Understand Corrosion and Alloy.

- 5.1 Mention the types of corrosion(dry and wet corrosion).
- 5.2 Describe atmospheric corrosion, types of atmospheric corrosion and their mechanism, oxide films factors affecting atmospheric corrosion.
- 5.3 Explain electrochemical corrosion, mechanism of electrochemical corrosion, types of electrochemical corrosion. factors affecting electrochemical corrosion.
- 5.4. Explain protective measures against corrosion: Coating (Galvanic and Zinc, Organic coating agents, Electroplating, metal cladding)
- 5.5 Explain the concept of alloy.

6. Understand the Concept of Organic Chemistry and Introduction to polymers.

- 6.1 Mention types of Chemistry.
- 6.2 Mention the catenation property of carbon.
- 6.3 State organic compounds, its properties and applications.
- 6.4 Explain the classification of organic compound by structure and functional group: Define Homologous series, Alkanes, Alkenes and Alkynes; properties and uses of general formula; Names and structure of first five members hydrocarbons.
- 6.5 Explain polymer, monomer, classification of polymers, polymerization, addition and condensation polymerization.
- 6.6 Define plastics and explain its types and uses.

7. Understand Glass and Ceramic.

- 7.1 Define glass and its constituents; classify glasses, give elementary idea of manufacturing process of glass.
- 7.2 Give introduction to ceramic materials and its constituent.
- 7.3 Describe industrial application of glass and ceramic.
- 7.4 Visit industry and write a report.

8. Understand Soap and Detergent.

- 8.1 Give introduction to Lipid, Fats and oils.
- 8.2 Explain saponification of fats and oils, manufacturing of soap.
- 8.3 Describe synthetic detergent, types of detergents and its manufacturing.
- 8.4 State exclusives: TNT, RDX, Dynamite.
- 8.5 Define paint and varnish.
- 8.6 Describe adhesives.

9. Cement, pulp and papers.

- 9.1 Classify cement and mention its uses and manufacturing process.
- 9.2 Describe manufacturing process of pulp and papers.
- 9.3 Conduct industry visit and reporting.

PRACTICAL:**1. Practice the use of laboratory tools and safety measures.****2. Conduct observation and measurement.**

- 2.1 Determine the strength of HCl solution using 0.1N Na_2CO_3
- 2.2 Determine the strength of NaOH by using 0.1N HCl solution.

3. Perform qualitative analysis of known and unknown salts.

- 3.1 Identify known salt (sample Copper, Iron, Aluminum, Iodide, Ammonium and Zinc salt.)
- 3.2 Identify unknown basic radical (e.g. Iodide, Copper, Iron, Zinc, Aluminum, Ammonium)
- 3.3 Identify unknown acid radicals (e.g. Chloride, Nitrate, Sulphate, Carbonate)

REFERENCE BOOKS:

- | | |
|--|--|
| 1. Higher secondary Chemistry (paper 1 st and 2 nd) | -Dr.Gazi Md.Ahsanul Karim. And Md.Robiul Islam |
| 2. Higher secondary Chemistry (Paper 1 st and 2 nd) | -Dr.Soroz kanti Singha Hazari . |
| 3. An Introduction to Metallic corrosion and its prevention | - Raj Narayan. |
| 4. Organic Chemistry - Morrisson and Boyad. | |
| 5. Inorganic Chemistry - Ali Haider | |

66711**BASIC ELECTRICITY**

T	P	C
3	3	4

OBJECTIVES:

- To familiarize the basic electrical quantities & laws and to apply those in solving problems of electrical circuits.
- To acquaint with electrochemistry, electromagnetism, electromagnetic induction and electrostatic.
- To introduce electrical wiring.

SHORT DESCRIPTION:

Electric current, voltage, resistance ; Ohm's law; conductors, semiconductors and insulators; Basic electrical circuits; Power and energy; Basic electrochemistry; Electromagnetism; Electromagnetic induction; Electrostatics; Wires and cables; Hand tools used in wiring; House wiring; Controlling devices; Protective devices; Earthing.

DETAIL DESCRIPTION:**Theory:****1. Understand electricity and its nature.**

- 1.1 State the meaning of electricity.
- 1.2 Describe the structure of atom.
- 1.3 Define current, voltage and resistance.
- 1.4 State the units of current, voltage and resistance.

2. Understand conductor, semiconductor and insulator.

- 2.1 Define conductor, semiconductor and insulator.
- 2.2 Explain the conductor, semiconductor, and insulator according to electron theory.
- 2.3 List different types of conductors, semiconductors and insulators.
- 2.4 Describe the factors affecting the resistance of a conductor.
- 2.5 State laws of resistance.

$$2.6 \text{ Prove the relation, } R = \rho \frac{L}{A}$$

- 2.7 Explain the meaning of resistivity and name the unit of resistivity.
- 2.8 Solve problems relating to laws of resistance.

3. Understand Ohm's Law

- 3.1 State Ohm's law.
- 3.2 Explain the limitations of Ohm's law
- 3.3 Deduce the relation among current, voltage and resistance.
- 3.4 Solve problems relating to Ohm's law.

4. Understand electric circuit.

- 4.1 Define electric circuit.
- 4.2 State the elements of electric circuit
- 4.3 Classify electric circuits.
- 4.4 Define series circuit, parallel circuit and mixed circuit.
- 4.5 Describe the characteristics of series circuit and parallel circuit.
- 4.6 Calculate the equivalent resistance of series circuit, parallel circuit and mixed circuit.
- 4.7 Solve problems relating to series, parallel and mixed circuit.

5. Apply the concept of electrical power and energy.

- 5.1 Define electrical power and energy.
- 5.2 State the unit of electrical power and energy.
- 5.3 Show the relation between electrical power and energy.
- 5.4 List the name of instruments for measuring electrical power and energy.
- 5.5 Draw the connection diagram of wattmeter and energy meter in an electric circuit.
- 5.6 Solve problems relating to electrical power and energy.

6. Understand the principles of Joule's law.

- 6.1 Describe the heating effect of electricity.
- 6.2 Explain Joule's law regarding the development of heat in electric circuit.
- 6.3 Explain mechanical equivalent of heat (J)
- 6.4 Solve problems relating to Joule's law.

7. Understand the concept of cells.

- 7.1 Describe the meaning of potential difference.
- 7.2 Define the meaning of cell.
- 7.3 Classify cell.
- 7.4 Define primary cell
- 7.5 List different types of primary cell
- 7.6 Describe the construction and principle of action of a simple voltaic cell.
- 7.7 List the defects of a simple voltaic cell.
- 7.8 Describe the causes of defects of a simple voltaic cell.
- 7.9 Describe the methods of removing the defects of a simple voltaic cell.
- 7.10 Distinguish between primary & secondary cell

8. Understand the concept of capacitors and inductors.

- 8.1 Define capacitor and capacitance.
- 8.2 Name the unit of capacitance.
- 8.3 Name the different types of capacitor.
- 8.4 State the uses of capacitor.
- 8.5 Define inductor and inductance.
- 8.6 Name the unit of inductance
- 8.7 Name the different types of inductor.
- 8.8 State the uses of inductor.
- 8.9 Determine the equivalent capacitance of a number of capacitors connected in series and parallel.
- 8.10 Explain the energy storage in a capacitor.
- 8.11 Solve the problems relating to capacitors.

9 Understand Electromagnetism.

- 9.1 Describe magnetic field, magnetic lines of force and its properties.
- 9.2 Describe field intensity and magnetic flux density.
- 9.3 Distinguish between absolute permeability and relative permeability.
- 9.4 Describe the concept of magnetic effect of electrical current.
- 9.5 States Maxwell's cork screw rule.
- 9.6 Explain the force experienced in a current carrying conductor in a magnetic field.
- 9.7 State Fleming's left hand rule.
- 9.8 Explain the work done by a moving conductor in a magnetic field.
- 9.9 Explain the force between two parallel current carrying conductors.

10. Understand electromagnetic induction.

- 10.1 Define Faraday's laws of electromagnetic induction.
- 10.2 Describe the magnitude of dynamically induced emf and statically induced emf.
- 10.3 Solve problems relating to emf generation.
- 10.4 Define Lenz's law and Fleming's right hand rule for determining the direction of induced emf and current.
- 10.5 Define self-induced emf and self-inductance.
- 10.6 Explain inductance of an iron cored inductor.
- 10.7 Define mutual inductance and co-efficient of coupling.

11. Understand the uses of wires and cables.

- 11.1 Define electrical wires and cables.
- 11.2 Distinguish between wire and cable.
- 11.3 Describe the construction and uses of PVC, VIR, TRS or CTS and flexible wires
- 11.4 Describe the procedure of measuring the size of wires and cables by wire gauge.
- 11.5 Describe the current carrying capacity of a wire.

12. Understand the usefulness of joints and splices.

- 12.1 Define the meaning of joints and splices.
- 12.2 State the five steps of making a joint.
- 12.3 Describe the procedure to make a pig tail joint, western union joint, Britannia joint, duplex joint, tap joint and simple splice.
- 12.4 Give example of the uses of above mentioned joints.

13. Understand the different methods of house wiring.

- 13.1 State the meaning of wiring.
- 13.2 List the types of wiring.
- 13.3 State the procedure for channel wiring, surface conduit wiring and concealed wiring.
- 13.4 State the types of wiring used in :
 - a) Residential building.
 - b) Workshop
 - c) Cinema hall/Auditorium
 - d) Temporary shed
- 13.5 List the name of fittings used in different types of electrical wiring.

14. Understand the construction and uses of controlling devices.

- 14.1 Define controlling device.
- 14.2 Name the different types of controlling device.
- 14.3 Describe the constructional features and uses of tumbler switch, iron clad switch, push button switch and gang switch.

15. Understand the construction and uses of protective devices.

- 15.1 Define protective device.
- 15.2 Name the different types of protective device.
- 15.3 Name the different types of fuse used in house wiring.
- 15.4 Describe the construction and uses of renewable fuse.
- 15.5 Name the different types of circuit breaker used in house wiring.
- 15.6 Describe safety procedure against electrical hazards.
- 15.7 List the performance of safety practices for electrical equipment, machines and accessories.

16. Understand the necessity of earthing.

- 16.1 Define earthing and mention the elements of earthing.
- 16.2 Explain the necessity of earthing.
- 16.3 Name different types of earthing.
- 16.4 List the value of earthing resistance in different conditions.

17. Apply the principle of controlling electrical circuit by switch.

- 17.1 Sketch the wiring diagram of one lamp controlled by one SPST switch and describe its uses.
- 17.2 Sketch the wiring diagram of one lamp controlled by two SPDT switches and describe its uses.
- 17.3 Draw the wiring diagram of a calling bell.
- 17.4 Draw the wiring diagram of a calling bell with more than one lamp controlled from more than one point.
- 17.5 Draw the wiring diagram of a fluorescent tube light circuit.
- 17.6 Describe the working principle of fluorescent tube light.

PRACTICAL:**1. Practice with electrical measuring instruments.**

- 1.1 Identify Voltmeters, Ammeters, Ohmmeter, Wattmeter, Energy meter and AVO meter.
- 1.2 Select & read the scale of given meters.
- 1.3 Connect correctly voltmeter, ammeter, wattmeter and energy meter to a given circuit.

2. Verify Ohm's Law.

- 2.1 Sketch the circuit diagram for the verification of Ohm's Law.
- 2.2 List tools, equipment and materials required for the experiment.
- 2.3 Prepare the circuit according to the circuit diagram using proper equipment.
- 2.4 Check all connections before the circuit is energized.
- 2.5 Verify the law by collecting relevant data.

3. Verify the characteristics of series and parallel circuits.

- 3.1 Draw the working circuit diagram.
- 3.2 List tools, equipment and materials required for the experiment.
- 3.3 Prepare the circuit according to the circuit diagram using proper equipment.
- 3.4 Check all connections before the circuit is energized.
- 3.5 Record data and verify that in a series circuit total voltage and resistance is equal to the summation of individual voltage and resistance respectively but total current is equal to the individual current.
- 3.6 Record data and verify that for a parallel circuit supply voltage is equal to the branch voltage, supply current is equal to summation of branch currents and total conductance is equal to the summation of branch conductance.

4. Show skill in measuring the power of an electric circuit.

- 4.1 Sketch the necessary circuit diagram of an electrical circuit with electrical load, ammeter, voltmeter and wattmeter.
- 4.2 Prepare the circuit according to the circuit diagram using ammeter, voltmeter and wattmeter.
- 4.3 Record the power, measured by the wattmeter and verify the reading with that of calculated from ammeter and voltmeter.
- 4.4 Compare the measured data with that of calculated and rat power.

5. Show skill in measuring the energy consumed in an electrical circuit.

- 5.1 Sketch the necessary diagram of an electric circuit with wattmeter, energy meter and electrical load.
- 5.2 Prepare the circuit according to the circuit diagram user wattmeter and energy meter.
- 5.3 Record the energy measured by the energy meter and verify with that of calculated from wattmeter for a fixed time.

6. Make artificial magnets.

- 6.1 Make an artificial magnet by rubbing method (Single touch)
- 6.2 Make an artificial magnet by divided touch method.
- 6.3 Make an artificial magnet by passing electrical current.
- 6.4 Detect the polarity of the produced artificial magnet with the help of a compass needle.

7. Practice with hand tools, wires and cables.

- 7.1 List the hand tools used in electrical wiring.
- 7.2 Identify the hand tools used in electrical wiring.
- 7.3 Draw neat sketches of hand tools used in electrical wiring.
- 7.4 Identify different types of wires and cables.
- 7.5 Measure the diameter of the identified wire and cables using standard wire gauge.

8. Show skill in making a duplex joint and a T-joint.

- 8.1 Sketch a duplex joint and a T-joint
- 8.2 Perform skinning and scraping of two pieces of PVC duplex cables and two pieces of simplex PVC cables.
- 8.3 Make the joints according to sketches.
- 8.4 Write a report.

9. Show skill in preparing wiring circuit of two lamps controlled from the points separately.

- 9.1 Sketch a working circuit of two lamps controlled from two points separately.
- 9.2 Make the wiring circuit using required materials and equipment on a wiring board.
- 9.3 Test the connection of circuit by providing proper supply.

10. Show skill in preparing wiring circuit of one lamp controlled from the points.

- 10.1 Sketch a working diagram of one lamp controlled by two SPD tumbler switches.
- 10.2 Complete the wiring circuit using required materials and equipment on wiring board.
- 10.3 Test the connection of circuit by providing proper supply.

11. Show skill in preparing wiring circuit of one bell with two indicating lamps controlled from two points.

- 11.1 Sketch a working diagram of one bell with two indicating lamps controlled by two push button switches.
- 11.2 Make the wiring circuit using required materials and equipment on wiring board.
- 11.3 Test the connection of circuit by providing proper supply.

12. Show skill in preparing wiring circuit of a fluorescent tube light.

- 12.1 Sketch a working diagram of a fluorescent tube light circuit.
- 12.2 Make the connection of a fluorescent tube light circuit using required materials and equipment.
- 12.3 Test the connection of the circuit by providing supply.

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- | | |
|--|------------------|
| 1. A text book of Electrical Technology | - B. L. Theraja |
| 2. Basic Electricity | - Charles W Ryan |
| 3. Basic Electrical theory and Practice | - E. B. Babler |
| 4. Solved Examples in Electrical Calculation | - D. K. Sharma |
| 5. Introduction to Electrical Engineering | - V.K. Mehta |

66713**ELECTRICAL ENGINEERING MATERIALS****T
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2****OBJECTIVES:**

- Develop and understand the concept of conducting materials.
- Develop and understand the concept of insulating materials.
- Develop and understand the concept of semiconducting materials.
- Understand the magnetic materials.
- Understand the transformer oil.
- Understand the optical fiber.

SHORT DESCRIPTION:

Conducting and no conducting materials, conduct materials, high resistive materials, magnetic materials, insulating materials, transformer oil, semiconducting materials, optical fiber.

DETAIL DESCRIPTION:**1. Differentiate the conducting and non-conducting materials.**

- 1.1 Define conducting, non-conducting and semi conducting materials.
- 1.2 Explain energy band diagram of conducting, non-conducting and semi conducting materials.
- 1.3 Distinguish between conducting, non-conducting and semi conducting materials.
- 1.4 List at least five names of each group of materials.

2. Understand the concept of receptivity and mechanical properties of conducting materials.

- 2.1 Define receptivity of materials.
- 2.2 Define temperature co-efficient of materials and melting point of solid materials.
- 2.3 List the factors affecting receptivity of electrical materials.
- 2.4 Define malleability, conductivity and tensile stress.
- 2.5 Describe the mechanical properties and receptivity of hard and annealed copper, aluminum, low and high tensile steel.

3. Understand the concept of contact materials.

- 3.1 Define contact materials.
- 3.2 Describe the physical and electrical properties of silver, tungsten, carbon and copper.
- 3.3 Explain the uses of copper, carbon and graphite as materials for brush.
- 3.4 Compare the advantages of using copper, carbon and graphite as brushes materials.

4. Understand the high resistive materials

- 4.1 Define the term high resistivity.
- 4.2 State general properties of nichrome, eureka, manganin, german silver, tungsten and carbon.
- 4.3 State composition of nichrome, eureka, manganin, german silver and tungsten.
- 4.4 List uses of high resistive materials.

5. Understand the concepts of fuse materials

- 5.1 Define fuse, metal and alloys.
- 5.2 Describe the properties of fuse material.
- 5.3 List the name of metals and alloys to be used as fuse materials.
- 5.4 Compare the advantage of using metals and alloys as fuse materials.

6. Understand the magnetic properties of materials.

- 6.1 Define magnetic materials, soft magnetic materials and hard magnetic materials with examples.
- 6.2 Classify the magnetic materials as diamagnetic, paramagnetic and ferromagnetic types.
- 6.3 Describe the composition and properties of soft magnetic materials.
- 6.5 Describe composition and properties of hard magnetic materials.
- 6.6 List the use of hard and soft magnetic materials.
- 6.7 Describe magnetization curve, hysteresis loop and hysteresis loss.

7. Understand the concepts of insulating material.

- 7.1 Describe insulating materials.
- 7.2 State the importance of insulating materials.
- 7.3 State the basic of classifying insulating materials.
- 7.4 Interpret the classification of insulating materials on the basis of temperature.
- 7.5 State the criteria for selection of proper insulating materials.
- 7.6 List the properties of ideal insulating materials.
- 7.7 State electrical properties of insulating materials.
- 7.8 Name the normal range for the receptivity of a low grade, medium grade and high grade insulating materials.
- 7.9 State the effect of temperature on the insulating materials.
- 7.10 State the factors affecting the electric breakdown strength of insulating materials.
- 7.11 State the temperature limit for class "C" and class "F" insulating materials.
- 7.12 Name insulating materials which can withstand temperature higher than 180 degree C.
- 7.13 State the effect of moisture on the insulating materials.
- 7.14 Define "Loss angel" with respect to an insulating materials.

8. Understand the characteristics of solid insulating materials.

- 8.1 Define solid insulating materials.
- 8.2 List the solid insulating materials.
- 8.3 List the fibrous type of insulating materials.
- 8.4 State the properties and application of cotton, varnish, cloth and insulating materials.
- 8.5 Compare the properties and applications of cotton, varnish, cloth and silk insulating materials.
- 8.6 State the properties of impregnated paper insulation.
- 8.7 List the application of impregnated paper insulation materials.
- 8.8 State the properties of glass and asbestos insulation.
- 8.9 List the application of glass and asbestos insulation.
- 8.10 Describe the properties and application of ceramic/porcelain insulating materials.
- 8.11 List two types of Mica insulating materials.
- 8.12 State the properties and application of Mica.
- 8.13 Write down the properties of Poly ISO Butyl (PIB) insulating materials.
- 8.14 State the properties of cross link Poly Ethylene (XLPE) insulating materials.
- 8.15 List the application of Poly ISO Butyl and cross Link Poly Ethylene insulating materials.
- 8.16 Short description and application of Silicon resins and Epoxy resins.
- 8.17 State the importance of mechanical properties for insulating materials.
- 8.18 Define gasket.
- 8.19 Mention the composition, properties and application of gasket.
- 8.20 Prepare a list of insulating materials used in transformer.

9. Understand the characteristics of Liquid Insulating Materials.

- 9.1 Define insulating oil.
- 9.2 State the properties of insulating oil.
- 9.3 State the physical properties of liquid insulating materials.
- 9.4 Describe the electrical properties of liquid insulating materials.

- 9.5 State thermal properties of liquid insulating materials.
- 9.6 Describe the causes of failure of insulating oil.
- 9.7 Compare the advantages and disadvantages of liquid insulating materials with the solid insulating materials.
- 9.8 State the uses of insulating oil in high voltage equipment.

10. Understand Transformer oil and Silica gel.

- 10.1 Define transformer oil.
- 10.2 Describe the properties of transformer oil.
- 10.3 Explain the testing of dielectric strength of transformer oil.
- 10.5 Discuss the contamination and purification of transformer oil.
- 10.6 Define silica gel.
- 10.7 Mention the composition of silica gel.
- 10.8 Describe the properties of silica gel.
- 10.9 Discuss the importance of silica gel.

11. Understand the characteristics of gaseous insulating materials.

- 11.1 Define gaseous insulating materials.
- 11.2 List the gaseous insulating materials.
- 11.3 State the characteristics of gaseous insulating materials.
- 11.4 State the characteristics of SF₆ gas.
- 11.5 List the advantages of SF₆ gas.
- 11.6 State the characteristics of Nitrogen.
- 11.7 State the characteristics of Hydrogen.
- 11.8 List the uses of gaseous insulating materials.

12. Understand the semiconducting materials.

- 12.1 Define semiconductor.
- 12.2 Classify semiconducting materials.
- 12.3 Describe the properties of semiconducting materials.
- 12.4 State the importance of semiconducting materials.
- 12.5 Identify the physical and electrical properties of semiconductor.
- 12.6 State the Hall Effect.
- 12.7 Describe the uses of semiconducting materials.
- 12.8 Discuss the uses of photo conducting materials.
- 12.9 Describe Gallium Arsenide materials.
- 12.10 Describe the properties of Gallium Arsenide materials.
- 12.11 Describe the uses of Gallium Arsenide materials.

13. Understand the concept of optical fiber.

- 13.1 Define optical fiber.
- 13.2 Materials used for commercial optical fiber.
- 13.3 Describe the construction details of optical fiber.
- 13.4 Discuss the types of optical fiber.
- 13.5 Describe the advantages of optical fiber.
- 13.6 Describe the applications of optical fiber.

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- Engineering Materials by Dakker
- Engineering Materials by Sushil
- Optical Fiber Communications by John M. Senior
- Text Book of Electrical Engineering by Raina, Bhattacharya, Joneja
- Electrical Engineering Materials by N. Alagappan & N.T Kumer

66811**BASIC ELECTRONICS**

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OBJECTIVES:

- To provide the understanding skill on Electronic Components, Electronic measuring and testing equipment.
- To provide understanding and skill on the basic concept of semiconductor junction and to identify physically a range of semiconductor diodes.
- To develop comprehensive knowledge and skill on special diodes and devices.
- To develop the abilities to construct different rectifier circuits.
- To provide understanding of the basic concept and principle of transistor and to identify physically a range of transistor.
- To provide understanding and skill on the basic concept of logic gates.

SHORT DESCRIPTION:

Electronic components; measuring and test equipment; color code and soldering; semiconductor; P-N junction diode; special diodes and devices; power supply; transistor; transistor amplifier; logic gates.

DETAIL DESCRIPTION:**Theory:****1. Understand the Electronics, its components and measuring and testing equipment.**

- 1.1 Define electronics.
- 1.2 Describe the scope of electronics.
- 1.3 Describe the active and passive components used in electronic circuits.
- 1.4 Define resistor, inductor and capacitor and mention the function of those in electronic circuits.
- 1.5 Describe the procedure of determining the value of resistor, inductor and capacitor using numeric and color code.
- 1.6 Describe the function of (i) Ammeter, (ii) Voltmeter, (iii) AVO meter, (iv) Function Generator, (v) Logic Probe, (vi) Semiconductor Device Tester and (vii) Oscilloscope.

2. Understand the Concept of Semiconductor used in Electronics.

- 2.1 Define Semiconductor.
- 2.2 Describe covalent bond and the effect of temperature on Semiconductor.
- 2.3 Explain the energy band diagram of conductor, semiconductor and insulator.
- 2.4 Explain the characteristics of carbon, silicon, germanium and gallium arsenide.
- 2.5 Describe the classification of Semiconductor.
- 2.6 Describe the generation & recombination of hole and electron during doping in extrinsic semiconductor.
- 2.7 Describe the formation of P-type & N-Type semiconductor material.
- 2.8 Explain the majority & minority charge carriers of P-type & N-Type Semiconductor.

3. Understand the Concept of P-N Junction Diode

- 3.1 Define PN junction diode
- 3.2 Describe the formation of depletion layer in PN junction.
- 3.3 Discuss potential barrier, drift & diffusion current and their physical significance.
- 3.4 Explain forward and reverse bias in PN junction with barrier voltage.
- 3.5 Mention the behavior of PN junction under forward and reverse bias.
- 3.6 Explain the forward and reverse Voltage-Current (VI) characteristics curve of PN junction diode.
- 3.7 Define (i) static resistance, (ii) dynamic resistance, (iii) forward breakdown voltage, (iv) peak inverse voltage (PIV) and (v) reverse break down voltage.
- 3.8 Describe the specification of PN Junction diode.

4. Understand the DC power supply.

- 4.1 Define dc power supply and describe its importance in electronics.
- 4.2 Define regulated and unregulated power supply.
- 4.3 Describe the operation of a typical regulated dc power supply with block diagram.
- 4.4 Define rectifier and rectification.
- 4.5 Explain the operation of half wave, full wave and bridge rectifier circuit.
- 4.6 Determine the ripple factor, efficiency and TUF of half wave, full wave and bridge rectifier.
- 4.7 Define filter circuit and explain the operation of capacitor, inductor-capacitor and pi (π) filter circuit.

5. Understand the Concepts of Special diode.

- 5.1 Define Zener Diode.
- 5.2 Describe the operation of Zener diode.
- 5.3 Explain VI characteristics of Zener diode.
- 5.4 Explain Zener diode as a auto-variable resistor.
- 5.5 Describe the application of Zener diode in (i) voltage stabilization, (ii) meter protection and (iii) peak clipper circuits.
- 5.6 Describe the construction, operation and application of (i) Tunnel diode, (ii) Varactor diode, (iii) Schottky diode, (iv) Step-Recovery diode, (v) PIN diode, (vi) LED, (vii) LCD, (viii) photo diode and (ix) Solar cell.

6. Understand the construction and operation of Bipolar Junction Transistor (BJT)

- 6.1 Define Transistor.
- 6.2 Describe the construction of PNP and NPN Transistor.
- 6.3 State the biasing rules of BJT.
- 6.4 Explain the mechanism of current flow of PNP and NPN Transistor.
- 6.5 Establish the relation among Base, Emitter and Collector current ($I_E = I_C + I_B$).
- 6.6 Draw the three basic transistor configuration (CB, CC, CE) circuits.
- 6.7 Describe current amplification factor α , β and γ .
- 6.8 Establish the relation among α , β and γ .
- 6.9 Solve problem related to I_E , I_C , I_B , α , β and γ

7. Understand the concept of BJT Amplifier

- 7.1 Define (i) amplifier, (ii) amplification and (iii) gain.
- 7.2 Mention the classification of amplifier.
- 7.3 Describe the principle of operation of a common emitter (ce) amplifier.
- 7.4 Draw DC & AC equivalent circuits of the CE amplifier circuit.
- 7.5 Mention the formula of (i) input resistance, (ii) output resistance, (iii) current gain, (iv) voltage gain and (v) power gain.
- 7.6 Solve problem related to different gain and resistance.

8. Understand the main feature of digital electronics

- 8.1 Describe the difference between analog and digital system.
- 8.2 State the advantage of digital system over analog system.
- 8.3 Define logic gate.
- 8.4 Describe the basic logic gates and their functions (AND gate, OR gate and NOT circuit or INVERTER).
- 8.5 Describe the NAND, NOR, XOR & XNOR logic gates and their functions.
- 8.6 Define Truth table and Prepare truth table to describe the functions of AND, OR, NOT, NAND, NOR, XOR and XNOR logic gates.

PRACTICAL:**1 Show skill in identifying the electronic components.**

- 1.1 Observe the electronic components board and read the manuals.
- 1.2 Identify the different types of resistor with their values, tolerance and wattage.
- 1.3 Identify the different types of potentiometer with their values and wattage.
- 1.4 Identify the different types of capacitor with their values, dc working voltages and types.
- 1.5 Identify the different types of diode and rectifier with the specification numbers and specifications.
- 1.6 Identify the different types of transistor with their specification numbers and specifications.
- 1.7 Identify the different types of LED's, IC's and miniature relays with their specification numbers and specifications.
- 1.8 Identify different types of transformer with their specifications.
- 1.9 Identify different inductors with their values and current ratings.
- 1.10 Study the printed circuit boards.
- 1.11 Sketch the symbols of components used in electronic circuits.
- 1.12 Describe the basic function of each component.
- 1.13 Write a report on above activities.

2 Show skill in electrical measurement.

- 2.1 Perform simple voltage and current measurements on basic series and parallel resistor circuits using the following instruments.
 - a) Voltmeter and ammeter.
 - b) AVO meter.
 - c) Digital multi-meter.
 - d) Basic CRO.

3 Show skill for determining the values of different resistors and capacitors with the help of color code.

- 3.1 Select color code resistors of different values.
- 3.2 Identify the colors and their numerical numbers.
- 3.3 Determine the value of resistors with tolerance.
- 3.4 Determine the value of capacitors and dc working voltage.
- 3.5 Write a report on above activities.

4 Show skill in performing soldering.

- 4.1 Select wires (single strand and multi strand) and cut wires to required length.
- 4.2 Select soldering iron, soldering tag and soldering lead.
- 4.3 Remove wire insulation to required length.
- 4.4 Clean and tin both iron and work piece.
- 4.5 Use a tinned iron in order to transfer adequate heat to the joint.
- 4.6 Joint two single-stranded wires mechanically and solder.
- 4.7 Joint two multi-strand wires mechanically and solder.
- 4.8 Perform soldering exercise for making three dimensional wire frames.
- 4.9 Sketch and write a report on the job.

5 Show skill in soldering & de-soldering of electronic components and wires to the other components and circuit boards.

- 5.1 Select electronic components, wires and PCB.
- 5.2 Determine the rating of the soldering iron suitable for the work piece.
- 5.3 Clean and tin both iron & work piece.
- 5.4 Feed new soldering materials to the tinned and heated joint in order to produce a correct soldering.
- 5.5 Check the quality of soldering.
- 5.6 Clean and tin iron and de-solder the joint and components.

- 5.7 Use solder suckers and solder braid for de-soldering.
- 5.8 Write a report on the Job.

6 Show skill in checking the semiconductor diode.

- 6.1 Collect a range of semi-conductor diodes and manufacturer's literature.
- 6.2 Select the digital multi-meter and set the selector switch to ohm range.
- 6.3 Determine the specification of semi-conductor diode.
- 6.4 Compare the determined specification with that of manufacturer's literature.
- 6.5 Measure forward & reverse resistances of the diode.
- 6.6 Identify P and N side of the diode.
- 6.7 Determine the condition of the diode.

7 Show skill in sketching forward and reverse characteristics curves of a semiconductor diode.

- 7.1 Select meter, power supply, components and materials.
- 7.2 Complete circuit according to circuit diagram for forward bias.
- 7.3 Check all connections.
- 7.4 Measure forward bias and corresponding forward current.
- 7.5 Record results in tabular form.
- 7.6 Connect circuit according to circuit diagram of reverse bias.
- 7.7 Measure reverse bias and corresponding reverse current.
- 7.8 Record results in tabular form.
- 7.9 Sketch the curves from collected data.

8 Show skill in sketching waves of half-wave rectifier circuit.

- 8.1 Select meter, component, oscilloscope and materials.
- 8.2 Complete circuit of a half wave rectifier according to the circuit diagram.
- 8.3 Check the circuit before operation.
- 8.4 Measure the input and output voltage and observe wave shapes in the oscilloscope.
- 8.5 Sketch the input and output voltage wave shapes.

9 Show skill in sketching waves of full-wave center tapped rectifier circuit.

- 9.1 Select meter, component, oscilloscope and materials.
- 9.2 Complete a full-wave rectifier circuit according to the circuit diagram.
- 9.3 Check the circuit supply & polarity of supply.
- 9.4 Measure the input & output voltages and observe wave shapes in the oscilloscope.
- 9.5 Sketch the output voltage wave shape.
- 9.6 Compare the result with full-wave rectifier circuit.

10 Show skill in constructing full-wave bridge rectifier.

- 10.1 Select meter, component, oscilloscope and materials.
- 10.2 Build the circuit according to the circuit diagram.
- 10.3 Check the circuit.
- 10.4 Measure the input and output voltages.
- 10.5 Observe wave shape.
- 10.6 Compare the result with other rectifiers.

11 Show skill in identifying the bipolar junction transistor.

- 11.1 Select PNP and NPN bipolar junction transistors.
- 11.2 Take DMM and manufacturer's literature of transistor.
- 11.3 Identify transistor terminals.
- 11.4 Measure base-emitter, base-collector, forward and reverse resistance.
- 11.5 Determine the specifications with the help of manufacturer's literatures.
- 11.6 Identify PNP and NPN transistors.

12 Show skill in determining input and output characteristics of a transistor in common emitter connection.

- 12.1 Select component, AVO meters, circuit board and required materials.
- 12.2 Complete the circuit.
- 12.3 Adjust the biasing voltage to appropriate point.
- 12.4 Record input and output voltage and current.
- 12.5 Plot the curve with recorded data.

13 Show skill in testing special diodes.

- 13.1 Select different types of special diodes.
- 13.2 Set the AVO meter in the ohm scale.
- 13.3 Measure resistances for each of two terminals.
- 13.4 Determine the condition (good and bad).
- 13.5 Determine the different terminals.

14 Verify the truth tables of different types of logic gate.

- 14.1 Select the specific gate.
- 14.2 Prepare the experimental circuit.
- 14.3 Adjust the power supply.
- 14.4 Verify the truth table.

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| 1. A Text Book Of Applied Electronics | - R.S. Sedha |
| 2. Principles Of Electronics | - V. K. Mehta |
| 3. Basic Electronics (Solid Stater) | - B. L. Theraja |
| 4. Electronic Devices And Circuit Theory | - Robert Boylestad
- Louis Nashelsky |



BANGLADESH TECHNICAL EDUCATION BOARD
Agargoan, Dhaka-1207.

**4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)**

ELECTRICAL TECHNOLOGY
TECHNOLOGY CODE: **667**

2nd SEMESTER

DIPLOMA IN ENGINEERING
PROBIDHAN-2016

ELECTRICAL TECHNOLOGY (667)

2nd SEMESTER

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total	
						Theory		Practical			
						Cont. assess	Final exam	Cont. assess	Final exam		
1	66721	Electrical Circuits-1	3	3	4	60	90	25	25	200	
2	66722	Electrical Appliances	2	3	3	40	60	25	25	150	
3	66611	Computer Application	0	6	2	0	0	50	50	100	
4	65921	Mathematics-2	3	3	4	60	90	50	0	200	
5	65912	Physics-1	3	3	4	60	90	25	25	200	
6	65711	Bangla	3	3	4	60	90	50	0	200	
7	65712	English	2	0	2	40	60	0	0	100	
Total			16	21	23	320	480	225	125	1150	

66721

ELECTRICAL CIRCUITS-I

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OBJECTIVES

- To understand the concept of network theorems.
- To develop understanding of AC fundamentals.
- To understand the fundamental principles of single phase AC circuit in solving the different circuit problems.
- To develop skill in measuring current, voltage and power in RL, RC and RLC circuits.

SHORT DESCRIPTION

Network theorem-Circuit Parameters; Electrical network; Kirchhoff's Law; Thevenin's theorem; Norton's theorem; Superposition theorem; Maxwell's theorem; Maximum power transfer theorem; Single phase AC circuits; Principles of basic circuits; Vectors; Impedance triangle; Power and power factor.

DETAIL DESCRIPTION

THEORY

1. Circuit parameters

- 1.1 Define direct current (DC)
- 1.2 Define circuit parameters.
- 1.3 List the circuit parameters.
- 1.4 Define circuit parameters with units.

2. Electric Network

- 2.1 Define electric networks.
- 2.2 List the different types of electric networks.
- 2.3 Explain the different types of electric networks.
- 2.4 Define active and passive network.
- 2.5 Define current source and voltage source.
- 2.6 Explain the current and voltage source in electric network.
- 2.7 Give example of current source & voltage source.

3. Circuit theorems

- 3.1 State & explain Kirchhoff's current Law (KCL) and Kirchhoff's voltage Law (KVL).
- 3.2 State & explain Thevenin's theorem.
- 3.3 State & explain Superposition theorem.
- 3.4 State & explain Norton's theorem.
- 3.5 State & explain Maxwell's theorem.
- 3.6 State & explain Maximum power transfer theorem.
- 3.7 Solve problems related to all Theorems.

4. Star-Delta conversion

- 4.1 State star-delta conversion.
- 4.2 Explain star-delta conversion.
- 4.3 Convert star to delta connection and vice versa.
- 4.4 Solve problems related to star-delta conversion.

5. AC circuit and AC fundamentals.

- 5.1 Define AC circuit (AC).
- 5.2 Explain the importance of AC systems.
- 5.3 Describe the advantages and disadvantages of AC circuit.
- 5.4 Principle of the generation of AC voltage.
- 5.5 Derive the equation: $e = E_{\max} \sin \omega t$
- 5.6 Define cycle, frequency & time period with units.
- 5.7 Show the relation: $f = \frac{PN}{120}$
- 5.8 List the commercial frequency of different countries.
- 5.9 Explain phase & phase difference with diagram.
- 5.10 Solve related problems.

6. Alternating quantities and rms values.

- 6.1 Define instantaneous values, average and maximum values of alternating quantities.
- 6.2 Generalize the rms values.
- 6.3 Define form factor and peak factor.
- 6.4 Define ohmic resistance & effective resistance.
- 6.5 Compare ohmic & effective resistance.
- 6.6 Solve problems on instantaneous, average and rms values.

7. Vectors and vector quantities.

- 7.1 Define vector quantities.
- 7.2 Explain vector representation of alternating voltage and current.
- 7.3 Explain vector in Polar form.
- 7.4 Explain vector in Rectangular form.
- 7.5 Formulate the relation between vectors expressed in rectangular and polar co-ordinate.
- 7.6 Solve problems relating to vector sum & difference, multiplication and division.

8. AC circuit (containing pure resistance, inductance and capacitance).

- 8.1 Sketch a circuit containing pure Resistance.
- 8.2 Explain the vector & phasor diagram of a pure resistive circuit.
- 8.3 Deduce the current and voltage relation in pure resistive circuit.
- 8.4 Sketch a circuit containing pure Inductance.
- 8.5 Explain the vector & phasor diagram of pure Inductive circuit.
- 8.6 Evaluate the relation among inductive reactance, current and voltage in pure Inductive circuit.
- 8.7 Sketch a circuit containing pure Capacitance.
- 8.8 Explain the vector & phasor diagram of pure capacitive circuit.
- 8.9 Formulate capacitive reactance.

- 8.10 Simplify current and voltage relation in pure capacitive circuit.
- 9. AC series circuit (containing resistance, inductance and capacitance).**
- 9.1 Draw circuit containing resistance and inductance (RL) in series.
 - 9.2 Explain vector & phasor diagram in RL series circuit.
 - 9.3 Formulate impedance, current and voltage drop in RL series circuit.
 - 9.4 Draw impedance triangle in RL series circuit.
 - 9.5 Draw circuit containing resistance and capacitance (RC) in series.
 - 9.6 Explain vector & phasor diagram in RC series circuit.
 - 9.7 Formulate impedance, current and voltage drop in RC series circuit.
 - 9.8 Draw impedance triangle of RC series circuit.
 - 9.9 Solve problems on RL & RC series circuits.
 - 9.10 Sketch a circuit containing resistance, inductance and capacitance (RLC) in series.
 - 9.11 Explain vector & phasor diagram of RLC series circuit.
 - 9.12 Draw impedance triangle of RLC series circuit.
 - 9.13 Calculate inductive reactance, capacitive reactance, total impedance, current & voltage drop in RLC series circuit.
 - 9.14 Solve problems on RLC series circuit.
- 10. Power & power factor in AC circuit.**
- 10.1 Define power, power factor, active & reactive power.
 - 10.2 Calculate power and power factor of pure resistive circuit.
 - 10.3 Calculate power and power factor of pure Inductive circuit.
 - 10.4 Calculate power and power factor of pure capacitive circuit.
 - 10.5 Calculate power, power factor, active & reactive power of RL, RC & RLC series circuit.
 - 10.6 Explain the power diagram of R, L, C, RL, RC & RLC series circuit.
 - 10.7 Solve problems on power & power factor of different series circuit.

PRACTICAL

1 Show skill in using oscilloscope in measuring AC voltage & frequency.

- 1.1 Select the oscilloscope.
- 1.2 Select required tools and equipment.
- 1.3 Identify the control & function knobs of oscilloscope
- 1.4 Set the function knobs of oscilloscope as instructed.
- 1.5 Identify the control & function knobs of a signal generator.
- 1.6 Set the function knobs as instructed
- 1.7 Check all connections.

2 Show skill in verifying kerchieff's laws.

- 2.1 Select experiment circuit, components, meters and necessary materials.
- 2.2 Construct a series-parallel circuit.
- 2.3 Select the series section of the circuit.
- 2.4 Verify Kirchhoff's voltage law.
- 2.5 Select the parallel section of the circuit.
- 2.6 Verify Kirchhoff's current law.

3 Show skill in verifying Thevenin's theorem.

- 3.1 Select an experiment circuit.
- 3.2 Select tools, equipment and circuit.
- 3.3 Construct the circuit as per diagram.
- 3.4 Mark the circuit as per diagram.
- 3.5 Measure open circuit voltage across the points.
- 3.6 Measure the equivalent resistance from the two points with appropriate condition.
- 3.7 Record Thevenin's voltage and resistance.
- 3.8 Verify the data with the theoretical calculation.

4 Show skill in verifying Norton's theorem.

- 4.1 Select an experiment circuit.
- 4.2 Select tools, equipment and circuit.
- 4.3 Construct the circuit as per diagram.
- 4.4 Mark the points for Norton's equivalence.
- 4.5 Measure short circuit current at the points.
- 4.6 Measure the equivalent resistance/ conductance at the points with appropriate condition.

5 Show skill in verifying Superposition theorem.

- 5.1 Select an experiment-circuit.
- 5.2 Select tools, equipment and materials.
- 5.3 Construct the circuit with at least two sources of power supply.
- 5.4 Select a branch for superposition.
- 5.5 Activate one source at a time making other sources short circuited.
- 5.6 Measure the current though the selected branch.
- 5.7 Repeat the steps with all the .sources.
- 5.8 Add all the measured current algebraically for the selected branch.
- 5.9 Measure the current though the branch activating all the sources.
- 5.10 Compare the measured value with that of calculated value.

6 Show skill in maximum power transfer theorem.

- 6.1 Select an experiment-circuit.
- 6.2 Select tools, equipment and materials.
- 6.3 Connect the source according to circuit diagram.
- 6.4 Record and computing data.
- 6.5 Calculate the P_L (Load power) using $P_L = I_L^2 R_L$ equation.
- 6.6 Verify maximum power transfer theorem.

7 Show skill in measuring effective resistance of a coil.

- 7.1 Draw the circuit diagram for determining the effective resistance.
- 7.2 Collect tools & equipment.
- 7.3 Correct the circuit according to the circuit diagram using proper equipment.
- 7.4 Check all connection points before actual operation.
- 7.5 Connect DC supply and record readings.
- 7.6 Calculate Ohmic resistance from the formula by recording relevant data: $R_{dc} = P_{dc} / I_{dc}^2$
- 7.8 Determine effective resistance from the formula $R_{ac} = P_{ac} / I_{ac}^2$
- 7.9 Compare the Ohmic resistance and effective resistance and find the ratio.

8 Show skill in determining the values of resistance & inductance and draw the vector diagram of RL series circuit.

- 8.1 Sketch the circuit diagram for determining resistance and inductance of a RL series circuit.
- 8.2 Collect tools, equipment and materials for the experiment.
- 8.3 Connect the circuit according to the circuit diagram using proper.
- 8.4 Check all connection points before actual operation.
- 8.5 Apply proper voltage & record readings from the meter.
- 8.6 Find the value of resistance & phase angle from relevant data.
- 8.7 Sketch the vector diagram with the relevant data as obtains.

9 Show skill in determining the values of resistance & capacitance and drawing vector diagram of RC series circuit.

- 9.1 Sketch the circuit diagram for RC series circuit.
- 9.2 Collect tools, equipment and materials for the experiment.
- 9.3 Connect the circuit according to the circuit diagram using proper equipment.
- 9.4 Check all connection points before actual operation & apply the voltage and record the relevant readings.
- 9.5 Determine the value if resistance, capacitance & phase angle from the data.
- 9.6 Sketch the vector diagram with the help of relevant data as obtained.

10. Show skill in determining the values of resistance & inductance, capacitance and draw the vector diagram from of RLC series circuit.

- 10.1 Sketch the circuit diagram for RLC series circuit
- 10.2 List tools, equipment and materials and for the experiment.
- 10.3 Connect the circuit according to the circuit diagram using proper equipment.
- 10.4 Check all connection points before actual operation.
- 10.5 Apply proper power supply to the circuit and record the readings from the meter.
- 10.6 Determine the values of resistance, inductance, capacitance and phase angle from the relevant data.
- 10.7 Verify the supply voltage is equal to the vector sum of voltage drop in each parameter.
- 10.8 Sketch the vector diagram with the help of relevant data as obtained.

11 Show skills in determining power factor of a RLC series circuit and drawing vector diagram.

- 11.1 Sketch the circuit diagram for RLC series circuit.
- 11.2 Collect tools, equipment and materials for the experiment
- 11.3 Connect the circuit according to the circuit diagram using proper equipment.
- 11.4 Check all connection point before actual operation.
- 11.5 Apply proper power supply to the circuit and record the readings from the meter.
- 11.6 Determine the value of phase angle and power factor from the relevant data.
- 11.7 Sketch the vector diagram with the relevant data.

Reference Books:

A text book of Electrical Technology---- B.L Theraja

Introduction to Electrical Engineering ---- V.K Mehta.

Alternating Current Circuit--- Corcoran

66722

ELECTRICAL APPLIANCES

T P C
2 3 3

OBJECTIVES

- To develop understanding and skill on the construction and operation of electrical appliances based on heating principle.
- To develop understanding and skill on the construction and operation of appliances operated by motor.
- To enable to acquire skill/competence in diagnosing/localizing faults and repairing & servicing of electrical appliances.

SHORT DESCRIPTION

Electric iron; Electric heater; Rice cooker; Electric Kettle; Geyser; Electric fan; Rechargeable (Emergency) lamp; Vacuum Cleaner; Blower; Dehumidifier; Blender; Washing machine; Refrigerator; Air conditioner; Microwave oven;

DETAIL DESCRIPTION

THEORY

1 Basic principle of electric appliances.

- 1.1.1 State the meaning of electric appliances.
- 1.1.2 List the names of appliances based on heating principles.
- 1.1.3 List the names of the appliances operated by electric motor.

2 Electric iron.

- 2.1 Define electric iron.
- 2.2 List different types of electric irons.
- 2.3 Difference between an ordinary and an automatic electric iron.
- 2.4 Identify different parts of an electric iron.
- 2.5 State the operating principles of an electric iron.
- 2.6 Explain the operation of thermostat in an automatic electric iron.
- 2.7 List the possible faults and their causes and remedies of an electric iron.

3 Electric heater.

- 3.1 Define electric heater.
- 3.2 List different types of electric heater.
- 3.3 List different parts of a room heater, surface heater and water heater.
- 3.4 List the possible faults and their causes and remedies of an electric heater.

4 Rice cooker.

- 4.1 Define rice cooker.
- 4.2 Describe the function of a rice cooker.
- 4.3 List the main parts of a rice cooker.
- 4.4 List the possible faults and their causes and remedies of a rice cooker.

5 Electric Kettle.

- 5.1 State Principle of operation of electric Kettle.
- 5.2 List deferent parts of electric Kettle.
- 5.3 List the possible faults and their causes and remedies of an electric kettle.

6 Geyser.

- 6.1 Define geyser.
- 6.2 List the different parts of geyser.
- 6.3 Mention the safety precaution of Geyser.
- 6.4 List of possible faults and causes and their remedies of a geyser.

- 7** **Table fan/pedestal fan.**
7.1 Define table fan/pedestal fan.
7.2 Describe the function of a table fan/pedestal fan.
7.3 List different parts of a table fan/pedestal fan.
7.4 List various components of an electronic fan regulator.
7.5 State the operation of an electronic fan regulator.
7.6 List the possible faults and their causes and remedies of a table fan/pedestal fan.

- 8** **Rechargeable (emergency) lamp.**
8.1 Define rechargeable lamp.
8.2 Explain the working principle of a rechargeable lamp.
8.3 Name the different parts of a rechargeable lamp.
8.4 List the possible faults and their causes and remedies of a rechargeable lamp.

- 9** **Vacuum cleaner.**
9.1 Define vacuum cleaner.
9.2 State the working principle of a vacuum cleaner.
9.3 Name the different parts of a vacuum cleaner.
9.4 List the possible faults and their causes and remedies of a vacuum cleaner.

- 10** **Electric blower.**
10.1 State the working principle of an electric blower.
10.2 Name the different parts of an electric blower.
10.3 List the possible faults and their causes and remedies of a electric blower.

- 11** **De-humidifier.**
11.1 State the principle of operation of a dehumidifier.
11.2 Name different parts and their function of a dehumidifier.
11.3 Sketch the circuit diagram of a de-humidifier.
11.4 List the possible faults and their causes and remedies of a de-humidifier.

- 12** **Blender.**
12.1 State the principle of operation of a blender.
12.2 List the different parts of a blender.
12.3 State the function of the timer in a blender.
12.4 List the possible faults and their causes and remedies of a blender.

- 13** **Washing machine.**
13.1 Define washing machine.
13.2 List the different types of washing machine
13.3 State the working principle of operation of a washing machine.
13.4 List the different parts of a washing machine.
13.5 Explain the function of the timer in a washing machine.
13.6 List the possible troubles and their causes and remedies of a washing machine.

- 14** **Refrigerator.**
14.1 Define refrigerator.
14.2 List of different components of refrigerator.
14.3 State the function of different components of refrigerator
14.4 List the possible faults and their causes and remedies of a refrigerator.

- 15** **Air conditioner.**
15.1 State the principle of operation of an air conditioner.
15.2 List different parts of an air conditioner.
15.3 State the function of filter, ducts and grills, air-conditioning circuit, control, cooling unit and
15.4 List the possible electrical faults and their causes and remedies of an air conditioner.

electrical control unit.

- 16** **Microwave oven.**
16.1 Describe the function of a microwave oven.
16.2 List the main parts of a microwave oven.
16.3 List different parts of heat control and timer in an oven.
16.4 Describe the function of heat control and timer in an oven.
16.5 List the possible faults and their causes and remedies of a microwave oven.

PRACTICAL**1 Perform maintenance and servicing an electric iron.**

- 1.1 Select the equipment and tools necessary for disassembling and servicing an electric iron.
- 1.2 Disassemble the electric iron.
- 1.3 State the different parts of the electric iron.
- 1.4 Observe the heating element and operation of thermostat in the electric iron.
- 1.5 Diagnose the possible problems in the electric iron.
- 1.6 Repair or replace the defective parts, if any.
- 1.7 Reassemble the parts and connect the iron to the power source.

2.2 Perform maintenance and servicing of different types of electric heaters.

- 2.1 Disassemble the different parts of the electric heater.
- 2.2 Sketch the main parts of the electric heater.
- 2.3 Sketch the circuit diagram of a single throw and a double throw thermostatic control electric heater.
- 2.4 Identify the possible troubles in a heater with causes and remedies.
- 2.5 Repair or replace the defective parts of the heater, if any.
- 2.6 Reassemble the parts of the heater.
- 2.7 Connect the heater to service.

3 Perform repair and maintenance of a rice cooker.

- 3.1 Disassemble the parts of the rice cooker.
- 3.2 Sketch the main parts of the rice cooker.
- 3.3 Identify possible troubles with causes and remedies of a rice cooker.
- 3.4 Assemble the parts of the rice cooker.
- 3.5 Connect the cooker to the power source.

4 Perform the operation of a Geyser

- 4.1 Select the necessary tools for disassemble & assemble the components of Geyser
- 4.2 Sketch the diagram
- 4.3 Select the different ranges of Geyser.
- 4.4 Connect the Geyser to the power source.
- 4.5 Observe the operation.

5 Perform the operation and maintenance of an Electric Kettle.

- 5.1 Select the necessary hand tools for disassemble and assemble the electrical components of the electric kettle.
- 5.2 Disassemble and assemble the electric kettle.
- 5.3 Sketch the diagram.
- 5.4 Connect into the power source.
- 5.5 Observe the operation.

6 Perform repair and maintenance of an oscillatory type fan.

- 6.1 Disassemble the different parts of the table fan/pedestal fan.
- 6.2 Observe the oscillatory mechanism of the oscillating type of fan.
- 6.3 Sketch the different parts of the fan.
- 6.4 Assemble the fan and connect to the power supply.
- 6.5 Observe the operation.

7 Perform repair and maintenance of a rechargeable (emergency) lamp.

- 7.1 Disassemble the rechargeable (emergency) lamp.
- 7.2 Sketch the different parts of the rechargeable lamp.
- 7.3 Test the battery of the lamp.
- 7.4 Check the parts to ensure its sound condition.
- 7.5 Repair and replace the defective parts, if any.
- 7.6 Reassemble the lamp and connect to the power source.
- 7.6 Observe the charging and discharging condition.

8 Perform repair and maintenance of an electric blower.

- 8.1 Disassemble the parts of the electric blower.
- 8.2 Sketch the main parts of the electric blower.
- 8.3 Check the parts to ensure the sound condition.
- 8.4 Repair or replace the defective parts, if any.
- 8.5 Reassemble the parts.
- 8.6 Connect the appliances to the power source.
- 8.7 Observe the operation.

9 Perform repair and maintenance of a vacuum cleaner.

- 9.1 Disassemble the parts of the vacuum cleaner.
- 9.2 Sketch the main parts of the vacuum cleaner.
- 9.3 Check the parts to ensure the sound condition.
- 9.4 Repair or replace the defective parts, if any.
- 9.5 Reassemble the parts.
- 9.6 Connect the appliances to the power source.
- 9.7 Observe the operation.

10 Study a dehumidifier.

- 10.1 Disassemble the dehumidifier.
- 10.2 Sketch the main parts of the dehumidifier.
- 10.3 Identify the major troubles with remedies.
- 10.4 Reassemble the parts.
- 10.5 Connect the dehumidifier to the power supply.
- 10.6 Observe the operation.

11 Perform repair and maintenance of a blender.

- 11.1 Disassemble the blender.
- 11.2 Sketch the main parts.
- 11.3 Identify the major faults generally occurred in a blender.
- 11.4 Assemble the blender.
- 11.5 Connect the blender to the power supply.
- 11.6 Observe the operation.

12 Perform repair and maintenance of a washing machine.

- 12.1 Identify the main parts of the washing machine.
- 12.2 Sketch the main parts of the washing machine.
- 12.3 Sketch the electrical circuit of the washing machine.
- 12.4 Draw the complete washing cycle of washing machine.
- 12.5 Disassemble the major components.
- 12.6 Make a visual observation.
- 12.7 Reassemble the parts.
- 12.8 Connect the washing machine to the power supply.
- 12.9 Observe the operation.

13 Perform repair and maintenance of electrical components of a refrigerator.

- 13.1 Identify the different parts of the refrigerator.
- 13.2 Identify the electrical components of the refrigerator.
- 13.3 Sketch the wiring circuit showing electrical control system.
- 13.4 Note down the maintenance procedure of a refrigerator.
- 13.5 Disassemble and assemble the thermostat control.
- 13.6 Connect into the power source.
- 13.7 Observe the operation.

14 Perform repair and maintenance of electrical components of air-conditioner.

- 14.1 List the main parts of the air-conditioner.
- 14.2 Sketch the main section namely fan with motor, filter, ducts and grill, air conditioning control, cooling unit and electrical control unit.
- 14.3 Sketch the wiring diagram.
- 14.4 Disassemble and assemble the electrical components of the air conditioner.
- 14.5 Connect the air conditioner to the power supply.
- 14.6 Observe the operation.

15 Perform maintenance and servicing of a microwave oven.

- 15.1 Disassemble the microwave oven.
- 15.2 Sketch the main parts of the microwave oven.
- 15.3 Make a visual study and test the different parts.
- 15.4 Sketch the electrical circuit diagram of the microwave oven.
- 15.5 List possible troubles with causes and remedies of a microwave oven.
- 15.6 Assemble the parts and connect the oven to the power source.
- 15.7 Observe the operation.

Reference Books:

- 1. Home appliances Service Guide – Edwin P. Anderson.
- 2. Study of electrical appliances and devices - K.B Bhatia
- 3. Electrical home appliances service manual -S. K . Gupta, Gt publication
- 4. Principle of Refrigeration - Dossat

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COMPUTER APPLICATION

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OBJECTIVES

- **SHORT DESCRIPTION**

DETAIL DESCRIPTION

1. Operate a personal Computer

1.1 Start up a Computer

- 1.1.1 *Peripherals* are checked and connected with system unit
- 1.1.2 Power cords / adapter are connected properly with computer and power outlets socket
- 1.1.3 Computer is switched on gently.
- 1.1.4 PC *desktop / GUI settings* are arranged and customized as per requirement.

1.2 Operate Computer

- 1.2.1 Files and folders are created.
- 1.2.2 Files and folders are *manipulated* as per requirement.
- 1.2.3 Properties of files and folders are viewed and searched.
- 1.2.4 Control panel settings are practiced.
- 1.2.5 *Memory devices* are formatted as per requirement.

1.3 Shutdown computer

- 1.3.1 unsaved file and folders are closed
- 1.3.2 Open software is closed and hardware devices are switched off.
- 1.3.3 Computer is switched off gently.
- 1.3.4 Power at the respective power outlets is switched off.

2. Type text and documents in English and Bangla.

2.1 Install the Typing Tutor software

- 2.1.1 Required *Hardware* and *software* are ready to use.
- 2.1.2 Typing tutor software are collected and selected
- 2.1.3 English Typing tutor software is installed.
- 2.1.4 Specialized Bangla Typing tutor software is installed.

2.2 Practice text typing in English and Bangla

- 2.2.1 Typing tutor software is started.
- 2.2.2 English Home key drilling are practiced systematically
- 2.2.3 Intermediate level typing speed(25 cps) are achieved.
- 2.2.4 Specialized Bangla Typing tutor / software are installed.
- 2.2.5 Bangla Home key typing are practiced systematically
- 2.2.6 Text documents are typed repeatedly for increasing typing speed.

2.3 Type documents

- 2.3.1 *Word processor* is started.
- 2.3.2 Text document are typed.
- 2.3.3 Intermediate level typing speed (30 cps) in English and (20 cps) in Bangla are achieved.

3. Operate Word Processing Application

3.1 Create documents:

- 3.1.1 Word-processing application are opened.
- 3.1.2 *Documents* are created.
- 3.1.3 Data are added according to information requirements.
- 3.1.4 Document templates Used as required.
- 3.1.5 Formatting tools are used when creating the document.
- 3.1.6 Documents are Saved to directory.

3.2 Customize basic settings to meet page layout conventions:

- 3.2.1 Adjust page layout to meet information requirements
- 3.2.2 Open and view different toolbars
- 3.2.3 Change **font format** to suit the purpose of the document
- 3.2.4 Change alignment and line spacing according to document information requirements
- 3.2.5 Modify margins to suit the purpose of the document
- 3.2.6 Open and switch between several documents

3.3 Format documents

- 3.3.1 Use formatting features and styles as required.
- 3.3.2 Highlight and copy text from another area in the document or from another active document
- 3.3.3 Insert headers and footers to incorporate necessary data
- 3.3.4 Save document in another **file format**
- 3.3.5 Save and close document to **a storage device**.

3.4 Create tables:

- 3.4.1 Insert standard table into document
- 3.4.2 Change cells to meet information requirements
- 3.4.3 Insert and delete columns and rows as necessary
- 3.4.4 Use formatting tools according to style requirements

3.5 Add images:

- 3.5.1 Insert appropriate **images** into document and customize as necessary
- 3.5.2 Position and resize images to meet document formatting needs

3.6 Print information and Shutdown computer:

- 3.6.1 **Printer** is connected with computer and power outlet properly.
- 3.6.2 Power is switched on at both the power outlet and printer.
- 3.6.3 Printer is installed and added.
- 3.6.4 Correct printer settings are selected and document is printed.
- 3.6.5 Print from the printer spool is viewed or cancelled and
- 3.6.6 Unsaved data is saved as per requirements.
- 3.6.7 Open software is closed and computer hardware devices are shut downed.
- 3.6.8 Power at the respective power outlets is switched off.

4. Operate Spreadsheet application

4.1 Create spreadsheets

- 4.1.1 Open spreadsheet application,
- 4.1.2 create spreadsheet files and enter numbers, text and symbols into cells according to information requirements
- 4.1.3 Enter **simple formulas and functions** using cell referencing where required
- 4.1.4 Correct formulas when error messages occur
- 4.1.5 Use a range of common tools during spreadsheet development
- 4.1.6 Edit columns and rows within the spreadsheet
- 4.1.7 Use the auto-fill function to increment data where required
- 4.1.8 Save spreadsheet to directory or folder

4.2 Customize basic settings:

- 4.2.1 Adjust page layout to meet user requirements or special needs
- 4.2.2 Open and view different toolbars
- 4.2.3 Change font settings so that they are appropriate for the purpose of the document
- 4.2.4 Change **alignment** options and line spacing according to spreadsheet **formatting features**
- 4.2.5 **Format** cell to display different styles as required
- 4.2.6 Modify margin sizes to suit the purpose of the spreadsheets
- 4.2.7 View multiple spreadsheets concurrently

4.3 Format spreadsheet:

- 4.3.1 Use formatting features as required
- 4.3.2 Copy selected formatting features from another cell in the spreadsheet or from another active spreadsheet

- 4.3.3 Use **formatting tools** as required within the spreadsheet
- 4.3.4 Align information in a selected cell as required
- 4.3.5 Insert headers and footers using formatting features
- 4.3.6 Save spreadsheet in another format
- 4.3.7 Save and close spreadsheet to **storage device**

4.4 Incorporate object and chart in spreadsheet:

- 4.4.1 Import an object into an active spreadsheet
- 4.4.2 Manipulate imported **object** by using formatting features
- 4.4.3 Create a chart using selected data in the spreadsheet
- 4.4.4 Display selected data in a different chart
- 4.4.5 Modify chart using formatting features

4.5 Create worksheets and charts

- 4.5.1 Worksheets are created as per requirement
- 4.5.2 Data are *entered*
- 4.5.3 **Functions** are used for calculating and editing logical operation
- 4.5.4 **Sheets** are formatted as per requirement.
- 4.5.5 **Charts** are created.
- 4.5.6 Charts/ Sheets are previewed.

4.6 Print spreadsheet:

- 4.6.1 Preview spreadsheet in print preview mode
- 4.6.2 Select basic printer options
- 4.6.3 Print spreadsheet or selected part of spreadsheet
- 4.6.4 Submit the spreadsheet to **appropriate person** for approval or feedback

|Operate Presentation Package:

4.7 Create presentations:

- 4.7.1 Open a presentation package application and create a simple design for a presentation according to organizational requirements
- 4.7.2 Open a blank presentation and add text and graphics
- 4.7.3 Apply existing styles within a presentation
- 4.7.4 Use presentation template and slides to create a presentation
- 4.7.5 Use various **Illustrations** and **effects** in presentation
- 4.7.6 Save presentation to correct directory

4.8 Customize basic settings:

- 4.8.1 Adjust display to meet user requirements
- 4.8.2 Open and view different **toolbars** to view options
- 4.8.3 Ensure **font settings** are appropriate for the purpose of the presentation
- 4.8.4 View multiple slides at once

4.9 Format presentation:

- 4.9.1 Use and incorporate organizational charts, bulleted lists and modify as required
- 4.9.2 Add **objects** and manipulate to meet presentation purposes
- 4.9.3 Import **objects** and modify for presentation purposes
- 4.9.4 Modify slide layout, including text and colors to meet presentation requirements
- 4.9.5 Use **formatting tools** as required within the presentation
- 4.9.6 Duplicate slides within and/or across a presentation
- 4.9.7 Reorder the sequence of slides and/or delete slides for presentation purposes
- 4.9.8 Save presentation in another **format**
- 4.9.9 Save and close presentation to disk

4.10 Add slide show effects:

- 4.10.1 Incorporate preset animation and multimedia effects into presentation as required to enhance the presentation
- 4.10.2 Add slide transition effects to presentation to ensure smooth progression though the presentation
- 4.10.3 Test presentation for overall impact
- 4.10.4 Use onscreen navigation tools to start and stop slide show or move between different slides as required

4.11 Print presentation and notes:

- 4.11.1 Select appropriate print format for presentation
- 4.11.2 Select preferred slide orientation
- 4.11.3 Add notes and slide numbers
- 4.11.4 Preview slides and spell check before presentation
- 4.11.5 Print the selected slides and submit presentation to appropriate person for feedback

5. Access Information using Internet and electronic mail

5.1 Access resources from internet

- 5.1.1 Appropriate internet **browsers** are selected and installed
- 5.1.2 Internet browser is opened and web address / URL is written/selected in /from address bar to access **information**.
- 5.1.3 **Search engines** are used to access information
- 5.1.4 Video / Information are Shared /downloaded / uploaded from / to web site/**social media**.
- 5.1.5 **Web based resources** are used.
- 5.1.6 Netiquette' (or web etiquette) principles are searched and followed

5.2 Use and manage Electronic mail

- 5.2.1 **Email services** are identified and selected to create a new email address
- 5.2.2 Email account is created
- 5.2.3 Document is prepared, attached and sent to different types of recipient.
- 5.2.4 Email is read, forwarded, replied and deleted as per requirement.
- 5.2.5 Custom email folders are created and **manipulated**
- 5.2.6 Email message is printed

65921

MATHEMATICS -2

T P C
3 3 4

OBJECTIVES

- To enable in solving the simultaneous equations with the help of determinant and matrix.
- To make understand the exponential series.
- To provide ability to apply the knowledge of differential calculus in solving problem like slope, gradient of a curve, velocity, acceleration, rate of flow of liquid etc.
- To enable to apply the process of integration in solving practical problems like calculation of area of a regular figure in two dimensions and volume of regular solids of different shapes.

SHORT DESCRIPTION

Algebra : Determinants, Matrix, Exponential Series.

Trigonometry : Inverse circular functions, Properties of triangle and solution of triangles.

- Differential Calculus** : Function and limit of a function, differentiation with the help of limit, differentiation of functions, geometrical interpretation of $\frac{dy}{dx}$, successive differentiation and Leibnitz theorem, partial differentiation.
- Integral Calculus** : Fundamental integrals, integration by substitutions, integration by parts, integration by partial fraction, definite integrals.

DETAIL DESCRIPTION

ALGEBRA :

1 Apply determinants to solve simultaneous equations.

- 1.1 Expand a third order determinant.
- 1.2 Define minor and co-factors.
- 1.3 State the properties of determinants.
- 1.4 Solve the problems of determinants.
- 1.5 Apply Cramer's rule to solve the linear equation.

2 Apply the concept of matrix.

- 2.1 Define matrix, null matrix, unit matrix, square matrix, column matrix, row matrix, inverse matrix, transpose matrix, adjoint matrix, rank of a matrix, singular matrix.
- 2.2 Explain equality, addition and multiplication of matrix.
- 2.3 Find the rank of a matrix.
- 2.4 solve the problems of the following types:
 - i) Solve the given set of linear equations with the help of matrix.
 - ii) Find the transpose and adjoint matrix of a given matrix.

3 Understand exponential series.

- 3.1 Define e.
- 3.2 Prove that e is finite and lies between 2 and 3.
- 3.3 Prove that $e^x = 1 + \frac{x}{L^1} + \frac{x^2}{L^2} + \frac{x^3}{L^3} + \frac{x^4}{L^4} \dots \text{to } \infty$
- 3.4 Solve problems of the following types :
 - i) $1 + \frac{1}{L^2} + \frac{1}{L^4} + \frac{1}{L^6} + \dots \text{to } \infty$
 - ii) $\frac{1}{L^2} + \frac{1+2}{L^3} + \frac{1+2+3}{L^4} + \frac{1+2+3+4}{L^5} + \dots \text{to } \infty$

TRIGONOMETRY

4 Apply the concept of inverse circular function.

- 4.1 Explain the term inverse circular function and principal value of a trigonometrical ratio.
4.2 Deduce mathematically the fundamental relations of different circular functions.
4.3 Convert a given inverse circular function in terms of other functions.
4.4 Prove mathematically

i) $\tan^{-1} x + \tan^{-1} y = \tan^{-1} \frac{x+y}{1-xy}$.

ii) $\tan^{-1} x + \tan^{-1} y + \tan^{-1} z = \tan^{-1} \frac{x+y+z-xyz}{1-xy-yz-zx}$

iii) $\sin^{-1} x + \sin^{-1} y = \sin^{-1} \left(x\sqrt{1-y^2} + y\sqrt{1-x^2} \right)$

iv) $2 \tan^{-1} x = \sin^{-1} \frac{2x}{1+x^2} = \cos^{-1} \frac{1-x^2}{1+x^2} = \tan^{-1} \frac{2x}{1-x^2}$

- 4.5 Solve problems of the following types.

- a) $2 \tan^{-1} \frac{1}{3} + \tan^{-1} \frac{1}{4} = \frac{\pi}{4}$
- b) $\cos \tan^{-1} \cot \sin^{-1} x = x$.
- c) Prove that the area of the segment cut from a circle of radius r by a chord at a distance d from the centre is given by

$$K = r^2 \cos^{-1} \frac{d}{r} - d\sqrt{r^2 - d^2}$$

5 Apply the principle of properties of triangles.

- 5.1 Prove the following identities :

i) $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R$.

ii) $a^2 = b^2 + c^2 - 2bc \cos A$

iii) $a = b \cos C - c \cos B$.

v) $\Delta = \frac{1}{2} bc \sin A$.

- 5.2 Establish the following.

a) $\tan \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$

b) $\tan \frac{B-C}{2} = \frac{b-c}{b+c} \cot \frac{A}{2}$

c) $\Delta = \frac{abc}{4R}$

- 5.3 Solve the problems of the following types:

- i) Prove $\cos(B-C) + \cos A = \frac{bc}{2R}$
- ii) An object experiences two forces F_1 and F_2 of magnitude 9 and 13 Newtons with an angle 100° between their directions. Find the magnitude of the resultant R .

DIFFERENTIAL CALCULUS

6 Understand the concept of functions.

- 6.1 Define constant, variable, function, domain, range
6.2 Solve problems related to functions.

7 Understand the concept of limits.

- 7.1 Define limit and continuity of a function.
7.2 Distinguish between $\lim_{x \rightarrow a} f(x)$ and $f(a)$.

7.3 Establish (i) $\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$

(ii) $\lim_{x \rightarrow 0} \frac{\tan x}{x} = 1$

8 Understand differential co-efficient and differentiation.

8.1 Define differential co-efficient in the form of

$$\frac{dy}{dx} = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

8.2 Find the differential co-efficient of algebraic and trigonometrical functions from first principle.

9 Apply the concept of differentiation.

9.1 State the formulae for differentiation:

- (i) sum or difference
- (ii) product
- (iii) quotient
- (iv) function of function
- (v) logarithmic function

9.2 Find the differential co-efficient using the sum or difference formula, product formula and quotient formula.

9.3 Find the differential co-efficient function of function and logarithmic function.

10 Apply the concept of geometrical meaning of $\frac{dy}{dx}$

10.1 Interpret $\frac{dy}{dx}$ geometrically.

10.2 Explain $\frac{dy}{dx}$ under different conditions

10.3 Solve the problems of the type:

A circular plate of metal expands by heat so that its radius increases at the rate of 0.01 cm per second. At what rate is the area increasing when the radius is 700 cm ?

11 Use Leibnitz's theorem to solve the problems of successive differentiation.

11.1 Find 2nd, 3rd and 4th derivatives of a function and hence find n-th derivatives.

11.2 Express Leibnitz's theorem

11.3 Solve the problems of successive differentiation and Leibnitz's theorem.

12 Understand partial differentiation.

12.1 Define partial derivatives.

12.2 State formula for total differential.

12.3 State formulae for partial differentiation of implicit function and homogenous function.

12.4 State Euler's theorem on homogeneous function.

12.5 Solve the problems of partial derivatives.

INTEGRAL CALCULUS

13 Apply fundamental indefinite integrals in solving problems.

13.1 Explain the concept of integration and constant of integration.

13.2 State fundamental and standard integrals.

13.3 Write down formulae for:

- (i) Integration of algebraic sum.
- (ii) Integration of the product of a constant and a function.

13.4 Integrate by method of substitution, integrate by parts and by partial fractions.

13.5 Solve problems of indefinite integration.

14 Apply the concept of definite integrals.

14.1 Explain definite integration.

14.2 Interpret geometrically the meaning of $\int_a^b f(x) dx$

14.3 Solve problems of the following types:

$$(i) \int_0^{\pi/2} \cos^2 x \, dx. \quad (ii) \int_0^1 \frac{(\sin^{-1} x)^2}{\sqrt{1-x^2}} \, dx$$

P* =Practical continuous assessment

SL No	Athour	Reference	Publication
		Title	
01	S. P Deshpande	Mathematics for Polytechnic Students	Pune Vidyarthi Graha Prakashan
02	H. K. Das	Mathematics for Polytechnic Students(Volume I)	S.Chand Prakashan
03	Shri Shantinarayan	Engg.Maths Vol I & II	S.Chand & Comp
04	Dr. B M Ekramul Haque	Higher Mathematics	Akshar Patra Prakashani
05	Md. Abu Yousuf	Differential & Integral Calculus	Mamun Brothers

65912**PHYSICS-1****T P C**
3 3 4**OBJECTIVES**

- To develop the students a background of basic science i.e. Physics required for understanding technological subjects.
- To develop a working knowledge of common engineering and industrial materials and to enable to determine through experiments the properties of such materials.
- To develop through experiments an understanding of fundamental scientific concept.
- To develop a basic knowledge and concept of physical properties of common engineering and industrial materials.

SHORT DESCRIPTION

Measurement, Units; Vector and Scalar quantities; Motion and Equations of motion; Force and Newton's Laws of motion; Gravity and Gravitation; Simple Harmonic motion; Hydrostatics; Surface tension and viscosity; Pressure, Sound; wave and sound Concepts and nature of sound, Velocity of sound, Ultrasonic.

DETAIL DESCRIPTION**THEORY :****1. PHYSICAL WORLD AND MEASUREMENT**

- 1.1. Nature of Physical World.
- 1.2. Scope and Excitement of Physics.
- 1.3. Few Terms about Physics.
- 1.4. Physics and other world of Technological Knowledge.
- 1.5. Principle of Measurement.
- 1.6. Fundamental and Derived Quantities and Units.
- 1.7. Dimensions of Units.
- 1.8. Errors in Measurement.

2. SCALAR AND VECTOR QUANTITIES

- 2.1 Define vector and scalar quantities with examples.
- 2.2 Show the various representations of the vector quantities; and representation of a vector by unit vector.
- 2.3 Find and explain the resultant of two vectors in different directions.
- 2.4 Resolve a vector into horizontal & vertical component.
- 2.5 Explain the dot and cross product of two vectors.
- 2.6 Define laws of triangle of vector.

3. MOTION AND EQUATIONS OF MOTION

- 3.1 Define rest and motion
- 3.2 Classify and explain of motion.
- 3.3 Define and explain displacement, speed, velocity, acceleration and retardation.
- 3.4 Deduce the relationship between displacement, velocity, acceleration and retardation from these definitions.
- 3.5 Motion of a Projectile.
- 3.6 Equation of motion of a freely moving body thrown obliquely vertically upward or motion of a projectile.
- 3.7 Define angular velocity and linear velocity with their units.
- 3.8 Deduce the relation between angular velocity and linear velocity.
- 3.9 Define centripetal and centrifugal force with examples.
- 3.10 Prove that centrifugal force = $\frac{mv^2}{r}$
- 3.11 State and explain the laws of falling bodies and mention the equation of motion of a body when it is projected vertically upwards or downwards.

4. NEWTON'S LAWS OF MOTION FORCE AND FRICTION

- 4.1 Define force.
- 4.2 State Newton's laws of motion.
- 4.3 Define different units of force and their correlation and also mention the dimension of force.
- 4.4 Prove $P=mv$, from Newton's 2nd law of motion.
- 4.5 Find out the resultant of parallel forces.
- 4.6 Define inertia and momentum**
- 4.7 State and prove the principles of conservation of momentum.
- 4.8 Define friction and describe the different kinds of friction.
- 4.9 Define the co-efficient of static friction.
- 4.10 Show that the co-efficient of static friction is equal to the tangent of angle of repose
- 4.11 State the merits and demerits of friction.

5. GRAVITY AND GRAVITATION

- 5.1 Define and explain the Kepler's Law.
- 5.2 Define gravity and gravitation.
- 5.3 Define and determine the gravitational constant (G) and also mention its units and dimension.
- 5.4 Define acceleration due to gravity ' g ' and also mention its units and dimension.
- 5.5 Discuss the variation of ' g ' at different places.
- 5.6 Define mass and weight with their units and dimension.
- 5.7 Distinguish between mass and weight.
- 5.8 Define and explain gravitational potential and escape velocity

6. SIMPLE HARMONIC MOTION (SHM)

- 6.1 Define Periodic and simple harmonic motion (SHM).
- 6.2 State the characteristics of SHM.
- 6.3 Describe a simple pendulum and a second pendulum.
- 6.4 Define effective length, amplitude, phase, complete oscillation, period of oscillation, frequency.
- 6.5 State and explain the laws of simple pendulum.
- 6.6 Motion of simple pendulum and it's time period.

7. WORK, POWER AND ENERGY

- 7.1 Define work, power and energy.
- 7.2 State the units and dimensions of work, power and energy.
- 7.3 State and prove the principle of the conservation of energy.
- 7.4 Define potential energy (PE) and kinetic energy (KE).
- 7.5 Derive the equation of potential and kinetic energy.
- 7.6 Recognize that the useful work can be found from:
$$\text{Efficiency} = \frac{\text{output work}}{\text{input work}} \times 100.$$

8. ELASTICITY

- 8.1 Name some of the general and special properties of matter.
- 8.2 Define Elasticity and Elastic limit.
- 8.3 Define perfectly elastic body and perfectly rigid body.
- 8.4 Define stress and strain with their units and dimensions.
- 8.5 State and explain the Hook's law.
- 8.6 Describe various kinds of modulus of elasticity.
- 8.7 Mention the units and dimensions of modulus of elasticity.
- 8.8 Define and explain Poisson's ratio.

9. HYDROSTATICS

- 9.1 Define pressure as force per unit area and state that it is measured in N/m^2 or Pascal.
- 9.2 State characteristics of liquid pressure.
- 9.3 Establish the pressure at a point in a fluid depend upon the density of the fluid, the depth in the fluid and acceleration due to gravity.
- 9.4 Surface tension and surface energy, Angle of contact.
- 9.5 Capillarity and theory of capillarity.
- 9.6 Viscosity and co-efficient of viscosity.
- 9.8 Necessity of viscosity.

10. WAVE AND SOUND

- 10.1 Wave and wave motion.
- 10.2 Transverse wave and longitudinal wave.
- 10.3 Some definitions relating waves.
- 10.4 Progressive wave and stationary waves.
- 10.5 Equation of progressive wave.
- 10.6 Sound and production of sound.
- 10.7 Sound is a longitudinal traveling wave.
- 10.8 Interference of sound: Constructive and Destructive interference.
- 10.9 Define beats and Mechanism of formation of beats.

11. SOUND AND VELOCITY OF SOUND

- 11.1 Identify that sound is produced by vibration and travels through a medium as a longitudinal wave.
- 11.2 Recognize that sound can be produced of different pitches (frequencies) & that the human ear has an audible frequency range covering approximately 20 Hz to 20 KHz.
- 11.3 State the approximate frequency range for
 - a. infrasonic sound, b. Ultrasonic (supersonic) sound.
- 11.4 Explain how sound is absorbed, reflected & refracted by different types of surface.
- 11.5 Describe the practical uses of echo sounding devices.
- 11.6 Define velocity of sound.
- 11.7 State the velocity of sound at NTP in still air.
- 11.8 Compare the effects of pressure, temperature & humidity on the velocity of sound in air.

PRACTICAL

1. Determine accurate diameter/side of an object using vernier calipers.
2. Measure the area of cross section of a wire by micrometer screw gage.
3. Measure the thickness of a glass plate by speedometer.
4. Verify the law of parallelogram of forces by a force board.
5. Draw L-T² graph and determine the value of "g" by using a simple pendulum.
6. Determine the coefficient of static friction.
7. Determine Young's modulus of a steel wire by Searle's apparatus.
8. Determine gravity of a solid heavier than and insoluble in water by hydrostatic balance.
9. Determine specific gravity of a liquid by specific gravity bottle.
10. Determine velocity of sound by resonance air column method.

REFERENCE BOOKS:

1. Higher Secondary Physics - First Part - by Dr. Shahjahan Tapan
2. A Text Book of Properties of matter -By N Subrahmanyam and Brij Lal
3. A Text Book of Sound -By N Subrahmanyam and Brij Lal
4. Higher Secondary Physics- First Part -by Prof. Golam Hossain Pramanik
5. Higher Secondary Physics- First Part -by Ishak Nurfungnabi

উদ্দেশ্য :

- মাতৃভাষা হিসেবে বাংলা ভাষার প্রকৃতি ও বৈশিষ্ট্য সম্পর্কে ধারণা লাভ। ভাষার ব্যবহারে প্রায়োগিক যোগ্যতা অর্জন।
- বাংলা সাহিত্য পঠন-পাঠনের মাধ্যমে জাতীয় চেতনা, দেশপ্রেম, মুক্তিযুদ্ধের চেতনা, শুদ্ধাচার, নীতি ও মূল্যবোধের উন্নয়ন ঘটানো।

সংক্ষিপ্ত বিবরণী :

মাতৃভাষা ও সৃজনশীলতা : বাংলা ভাষা রীতির বিচিত্রতা, বানান রীতি, পত্র রচনা এবং কবিতা, প্রবন্ধ, নাটক, উপন্যাস ও ছোট গল্প।
বিশদ বিবরণী:

১.বাংলা ভাষার প্রয়োগ:**ক)বাংলা ভাষা :**

ভাষার সংজ্ঞা, বাংলা ভাষা রীতি - সাধু, চলিত, আঞ্চলিক বা উপভাষা (সংজ্ঞা, বৈশিষ্ট্য, পার্থক্য ও উদাহরণ)

খ) বাংলা বানান রীতি ও শব্দ প্রয়োগ:

১.বাংলা একডেমির প্রমিত বানান রীতি, গ-ত্ব ও ষ-ত্ব বিধি

২. শব্দ ও শব্দের শ্রেণি বিভাগ (সংজ্ঞা, শব্দের গঠন, উৎস বা উৎপত্তি ও অর্থগত)

৩.বাক্য প্রকরণ ও গঠন রীতি (সংজ্ঞা, বাক্য গঠন এবং প্রকার)

গ) পত্র রচনা :

আবেদন পত্র (চাকুরি, ছুটি), চাকুরিতে যোগাদান পত্র, মানপত্র, আরকলিপি, সংবাদপত্রে প্রকাশের জন্য পত্র

২. বাংলা সাহিত্য:**ক. কবিতা :**

১.বঙ্গভাষা -মাইকেল মধুসূদন দত্ত

২. সোনার তরী - রবীন্দ্র নাথ ঠাকুর

৩. উমর ফারকক -কাজী নজরুল ইসলাম

৪. বাংলার মুখ আমি- জীবনানন্দ দাশ

৫. আসাদের শার্ট - শামসুর রাহমান

৬. স্বাধীনতা শব্দটি কি করে আমাদের হলো? - নির্মলেন্দু গুণ

খ. প্রবন্ধ :

১. অর্ধাঙ্গী -রোকেয়া সাখাওয়াত হোসেন

২. বইকেনা - সৈয়দ মুজতব আলী

গ. একাঙ্কিকা (নাটক): মানুষ-মুনীর চৌধুরী

ঘ. উপন্যাস: লালসালু - সৈয়দ ওয়ালী উল্লাহ

ঙ.ছোট গল্প:

১. হৈমতী - রবীন্দ্র নাথ ঠাকুর

২. একুশের গল্প - জহির রায়হান

৩. পাতালেহাসপাতালে - হাসান আজিজুল হক

ব্যবহারিক**১.নির্ধারিত বক্তৃতা :**

বাংলাদেশ ও বাংলালি সংস্কৃতি, বিভিন্ন জাতীয় দিবস (একুশে ফেব্রুয়ারি ও আন্তর্জাতিক মাতৃভাষা দিবস, স্বাধীনতা দিবস, বিজয় দিবস,জাতীয় শোক দিবস, মুজিব নগর দিবস, মহান মে দিবস)

প্রাতিষ্ঠানিক বক্তৃতা- নবাগত শিক্ষক/ছাত্রছাত্রীদের বরণ, গুরুত্বপূর্ণ ব্যক্তিবর্গের আগমন উপলক্ষে বক্তৃতা ।

২. উপস্থিত বক্তৃতা :

বিষয়বস্তু উন্মুক্ত

৩.আবৃত্তি :

১. মানুষ - কাজী নজরুল ইসলাম

২. আকাশ নীলা - জীবনানন্দ দাশ

৩. পল্লী জননী -জসীম উদ্দীন

৪. ছাত্তপত্র - সুকান্ত ভট্টাচার্য

৫. তোমাকে পাওয়ার জন্য হে স্বাধীনতা - শামসুর রাহমান

৬. নিষিদ্ধ সম্পাদকীয় - হেলাল হাফিজ

৪. বিতর্ক (নমুনা)

সংস্কৃতিই আধুনিক মানবের ধর্ম

তথ্য প্রযুক্তির অবাধ ব্যবহারই যুব সমাজের অবক্ষয়ের মূল কারণ

গতানুগতিক শিক্ষা নয় কর্মমুখ শিক্ষাই অর্থনৈতিক মুক্তির চাবিকাঠি

চালকের অসাবধনতাই সড়ক দুর্ঘটনার প্রধান কারণ

মুক্তিযুদ্ধের চেতনাই অসাম্প্রদায়িক বাংলাদেশ প্রতিষ্ঠার মূলমন্ত্র

প্রযুক্তির বিকাশই প্রকৃতি বিনাশের একমাত্র কারণ

৫. প্রতিবেদন প্রণয়ন ও উপস্থাপন:

স্থানীয় বিভিন্ন সমস্যা ও অনুসন্ধানী যে কোন বিষয়।

65712**ENGLISH**

T	P	C
2	0	2

Objectives:

After The Completion of the Course, Learners Will Be Able To Develop-

- Reading, Listening With Understanding
- The Fluency Of Speech
- Grammatical Accuracy With Emphasis On Spelling & Punctuation
- Creative Writing

Seen Comprehension: (Marks-20)

Unit	Lesson	Title
People Or Institutions Making History (Unit One)	1	Nelson Mandela ,From Apartheid Fighter To President
	2	The Unforgettable History
Food Adulteration(Unit Three)	1	Food Adulteration Reaches Height
	2	Eating Habit And Hazards
Human Relationship(Unit Four)	2	Love And Friendship
Environment And Nature (Unit Eight)	1	Water ,Water Everywhere
	5	Kuakata: Daughter Of The Sea
Greatest Scientific Achievement (Unit Thirteen)	1	Some Of The Greatest Scientific Achievements Of The Last 50 Years
	2	Science And Technology Against An Age- Old Disease
Art And Music (Unit Fourteen)	1	What Is Beauty?
	3	Crafts In Our Time
Tours And Travels (Unit Fifteen)	1	Travelling To A Village In Bangladesh
	4	The Wonders of Vilayet

N.B: The Unit Mentioned Refers To The Text Book (1st Paper) English For Today For Class 11- 12 By National Curriculum & Text Book Board, Dhaka.

Grammar (Marks-20)**1. (A) Uses of Articles.**

- (B) Uses of Tense *(Right Forms Of Verbs with Indicators)
- (C) Classify Verbs: (Regular and Irregular Verbs, Auxiliary, Principal, Finite, Non-Finite Verbs,)

2. Sentence:

- (A) Changing Sentences: (Assertive, Interrogative, Optative, Imperative, Exclamatory Simple, Complex and Compound), Comparison of Adjectives/Adverbs

- (B) Question Making: WH, Yes/No, Tag Question

3. Enrich Vocabulary: Synonyms, Antonyms; Suffix And Prefix.**4. Voice, Narration****5. Sentence Analysis:**

Study of Part of Speech, (Type Of Verbs-Regular and Irregular Verbs, Auxiliary and Principal Verb)
Study of Phrases and Clauses (Noun/ Adjective/ Verb/ Participle /Adverbial/ Prepositional Phrases and Principal /Sub Ordinate /Co Ordinate Clauses)

Free Writing (Marks -20)

1. Write Dialogues: (With Teacher, Principal, Shopkeeper, Hotel Manager, Station Master, Newcomer, Buyers, Doctor, Friend, Colleagues Etc).
2. Report Writing On Different Events/ Occasions/ Accidents.
3. Writing Situational Personal and Official Letters.
4. Writing Job Application with CV /Appointment Letter / Joining Letter
5. Write A Guided Paragraph With Questions.



BANGLADESH TECHNICAL EDUCATION BOARD
Agargoan, Dhaka-1207.

**4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)**

ELECTRICAL TECHNOLOGY
TECHNOLOGY CODE: **667**

3rd SEMESTER

**DIPLOMA IN ENGINEERING
PROBIDHAN-2016**

ELECTRICAL TECHNOLOGY (667)

3rd SEMESTER

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total	
						Theory		Practical			
						Cont. assess	Final exam	Cont. assess	Final exam		
1	66731	Electrical Circuits -2	3	3	4	60	90	25	25	200	
2	66732	Advance Electricity	2	3	3	40	60	25	25	150	
3	66733	Electrical Engineering Drawing	0	3	1	0	0	25	25	50	
4	65931	Mathematics -3	3	3	4	60	90	50	0	200	
5	65922	Physics -2	3	3	4	60	90	25	25	200	
6	65722	Communicative English	1	3	2	20	30	50	0	100	
7	65811	Social Science	3	0	3	60	90	0	0	150	
Total			15	18	21	300	450	200	100	1050	

66731

ELECTRICAL CIRCUITS – II

T P C
3 3 4

Objectives

After completion of these contents students will be able to acquire, achieve and develop:

- To provide knowledge and skill (to apply complex algebra) for AC circuits.
- To acquire knowledge and skills on resonance by varying inductance, Capacitance and frequency.
- To develop concept on Poly phase balanced power system.
- To achieve skills in measuring line and phase quantities in three phase supply.
- To assist in acquainting the concept of poly phase unbalanced power system.
- To develop the concept of non-sinusoidal waves.

SHORT DESCRIPTION

Complex algebra – application to AC circuits; RLC Parallel circuits; Expression for power and VAR; series resonance; Parallel resonance ; Poly phase system – 3-phase interconnection; Star connected system; Delta connected system; Balanced Power System; Unbalanced power system; Non-sinusoidal waves.

DETAIL DESCRIPTION

Theory :

1. Understand the application of complex algebra in RLC parallel circuit.

- 1.1 Compute the value of parameters of RLC parallel circuit in rectangular form of notation and polar form of notation.
- 1.2 Draw vector diagram of RLC parallel circuit.
- 1.3 Solve problems on RLC parallel circuit.
- 1.4 Define admittance, Susceptance and Conductance
- 1.5 Mention the units of Admittance, Susceptance and Conductance
- 1.6 Find the impedance, admittance, current and voltage in RLC parallel circuit.
- 1.7 Draw impedance/admittance triangle of RLC parallel circuit.
- 1.8 Solve problems on series and parallel AC circuit in rectangular form of notation and polar form of notation.

2. Understand the concept of power calculation on AC circuit.

- 2.1 Derive the Expression of power employing complex form.
- 2.2 Calculate VAR employing complex form.
- 2.3 Explain the conjugate method of calculating Apparent, active & Reactive power.
- 2.4 Sketch wave diagram for power of different AC circuits.

3. Understand the principle of resonance in series circuit.

- 3.1 Define resonance.
- 3.2 Define resonance in series circuit.
- 3.3 Mention various ways of securing resonance in series circuit.
- 3.4 Explain resonance curve when varying frequency.
- 3.5 Determine resonance frequency in series circuit.
- 3.6 Solve problems on resonance frequency in series circuit.

4. Understand the effect of bandwidth and Q-factor in series resonance.

- 4.1 Describe the resonance curve and bandwidth in series resonance.
- 4.2 Explain the effect of frequency upon reactance of the series resonance circuit.
- 4.3 Show the graphical representation of series resonance.
- 4.4 Explain resonance curve when varying inductance.
- 4.5 Explain resonance curve when varying capacitance.
- 4.6 Define Q-factor of a series resonance circuit.
- 4.7 List the applications of series resonance.
- 4.8 Solve problems related to series resonance.

5. Apply the principle of resonance in parallel circuit.

- 5.1 Define resonance in parallel circuit.
- 5.2 Describe the resonance curve and bandwidth in parallel resonance.
- 5.3 Determine the resonance frequency in parallel circuit with R-L and RC branch.

- 5.4. State the condition for resonance in parallel circuit with L & R in one branch and C only in other.
- 5.5. Show the graphical representation of parallel resonance.

6. Understand the effect of bandwidth and Q-factor in parallel resonance.

- 6.1 Define dynamic impedance and current magnification.
- 6.2 Describe the effect of Q-factor and bandwidth in parallel resonance circuit.
- 6.3 List the applications of series and parallel resonance.
- 6.4 Derive mathematical deduction of the exact and approximate formula for parallel resonance.
- 6.5 Compare resonance in series circuit with that in parallel circuit.
- 6.6 Solve problems on parallel resonance.

7. Understand the concept of poly phase power system.

- 7.1 Explain the term poly phase system.
- 7.2 List the advantages of poly phase power system over single-phase power system.
- 7.3 Discuss the generation of poly phase emf.
- 7.4 Sketch the wave diagram for a poly phase power system.
- 7.5 Draw vector diagram for a poly phase power system.

8. Understand the concept of expressing poly phase power system.

- 8.1 Describe the meaning of double subscript notation.
- 8.2 Identify the phase sequence of poly-phase system.
- 8.3 State the effects of reverse phase sequence.
- 8.4 Explain the methods of checking phase sequence.
- 8.5 Sketch the phase sequence diagram of 3-phase power system.

9. Understand the concept of poly phase for interconnection.

- 9.1 Express possible ways of interconnection of 3-phase power system.
- 9.2 Sketch the circuit diagram of star connected 3-phase 3-wire system.
- 9.3 List the application of 3-phase 3-wire star connected power system.
- 9.4 Sketch the circuit diagram of 3-phase 4-wire star connected power system.
- 9.5 List the application of 3-phase 4-wire star connected power system.
- 9.6 Draw the vector diagram of 3-phase 4-wire star connected power system.
- 9.7 Derive the relation between line and phase voltage and current in a balanced 3-phase 3-wire star connected power system.
- 9.8 Derive the relation between line and phase voltage and current in a balanced 3-phase 4-wire star connected power system.

10. Understand the concept of star connected power system.

- 10.1 Identify neutral wire in a 3-phase 4-wire star connected system.
- 10.2 Express the current in the neutral wire in an unbalanced 3-phase 4-wire star connected system.
- 10.3 Draw the phasor diagram of 3-phase 4-wire star connected system.
- 10.4 Derive the formulae $I_L = I_p$ and $V_L = \sqrt{3} V_p$
- 10.5 Calculate volt-ampere, power and power factor in a balanced 3-phase 4-wire star connected power system.
- 10.6 Solve problems on star connected (balanced and unbalanced) power system.

11. Understand the concept of delta connected power system.

- 11.1 Sketch the circuit diagram of 3-phase delta connected power system.
- 11.2 Draw the vector diagram of a 3-phase delta connected power system.
- 11.3 Express the deduction of the formula $V_L = V_p$ and $I_L = \sqrt{3} I_p$ for delta connected power system.
- 11.4 Enumerate the relation between line and phase current & voltage in a delta connected power system.
- 11.5 Calculate the volt-ampere, power and power factor in a 3-phase delta connected power system.
- 11.6 Compare the advantages of star connected system with those of delta connected power system.
- 11.7 Solve problems on delta connected balanced power system.

12. Understand the concept of unbalanced power system.

- 12.1 Express the meaning of unbalanced power system.
- 12.2 State and Explain Fortescue's theorem.
- 12.3 Explain the positive sequence of power system.

- 12.4. Explain the negative sequence of power system.
- 12.5. Explain the zero sequence of power system.
- 12.6. Explain the neutral current of unbalanced system.
- 12.7. Solve problems related to unbalanced system.

13. Understand the principle of non sinusoidal waves.

- 13.1 Define non-sinusoidal waves.
- 13.2 Explain non-sinusoidal waves as the sum of sine and cosine waves of different frequencies with graphical and mathematical representation.
- 13.3 Define harmonics.
- 13.4 Explain harmonics in the Y-system.
- 13.5 Explain harmonics in the ~~-sy~~^Δem
- 13.6 Calculate effective value of non-sinusoidal wave.
- 13.7 Explain power due to non-sinusoidal voltage and current.
- 13.8 Calculate volt-amperes due to non-sinusoidal voltage and current.

14. Understand power factor of non-sinusoidal waves.

- 14.1 Explain power factor due to non-sinusoidal waves.
- 14.2 Explain equivalent sine wave of non-sinusoidal wave.
- 14.3 Explain addition and subtraction of non-sinusoidal wave.
- 14.4 Solve problems related with non-sinusoidal wave.

Practical :

1. Determine resonance frequency and draw resonance curve from RLC series circuit. by changing frequency , Inductance, Capacitance.

- 1.1 Sketch the circuit diagram for RLC series resonance.
- 1.2 Select tools, equipment and materials for the experiment.
- 1.3 Connect the circuit according to the sketch.
- 1.4 Check all connection points before actual operation.
- 1.5 Record the readings from the meter applying power supply to the circuit.
- 1.6 Find the value of current, resistance, inductive reactance, capacitive reactance and impedance.

2. Determine resonant frequency in RLC parallel circuit and draw of resonance curve.

- 2.1 Sketch the circuit diagram for RLC parallel resonance.
- 2.2 Select tools, equipment and materials for the experiment.
- 2.3 Connect the circuit according to the sketch.
- 2.4 Check all connection points before actual operation.
- 2.5 Record the data from the meter applying power supply to the circuit.
- 2.6 Find current, resistance, inductive reactance, capacitive reactance and impedance.
- 2.7 Sketch the resonance curve with the frequency as abscise and current, resistance, inductive reactance, capacitive reactance and impedance as ordinate.

3. Demonstrate poly-phase system and phase sequence.

- 3.1 Sketch the circuit diagram of poly-phase system and phase sequence.
- 3.2 Select tools, equipment and materials for the experiment.
- 3.3 Switch on the poly-phase system of your laboratory.
- 3.4 Measure the phase voltages by voltmeter.
- 3.5 Observe the phase voltages by oscilloscope.
- 3.6 Compute phase sequence.
- 3.7 Note down the observations.

4. Measure line and phase voltage & current in 3-phase 4-wire star connected inductive load.

- 4.1 Sketch the circuit diagram for 3-phase star connected load.
- 4.2 Select the tools, Equipment and materials required for the experiment.
- 4.3 Connect the circuit according to the circuit diagram.
- 4.4 Check all connection points before connecting the power supply to the circuit.
- 4.5 Record the readings of the instruments.
- 4.6 Compare the recorded values with calculated values.
- 4.7 Note down the observations.

5. Measure line and phase current & voltage in 3-phase delta connected inductive load.

- 5.1 Sketch the circuit diagram for 3-phase delta connected load.
- 5.2 List the tools, equipment and materials required for the experiment.
- 5.3 Connect the circuit according to the circuit diagram.
- 5.4 Check all connection points before connecting the power supply to the circuit.
- 5.5 Record the readings of instruments.
- 5.6 Compare the recorded values with calculated values.
- 5.7 Note down the observations.

6. Construct vector diagram by measuring current, voltage and power in a balanced 3-phase star connected inductive load.

- 6.1 Sketch the circuit diagram for measuring power by 3-watt meters of a 3-phase star connected system.
- 6.2 Select tools, equipment and materials required for the experiment.
- 6.3 Connect the circuit according to the circuit diagram using proper equipment.
- 6.4 Check all connection points, equipment and instruments before actual operation.
- 6.5 Record the readings from the meters connected in the circuit.
- 6.6 Calculate the power from the formula $P_t = W_1 + W_2 + W_3$ and $3V_p I_p \cos \theta$
- 6.7 Draw the vector diagram using relevant data as obtained.
- 6.8 Note down the observations.

7. Construct vector diagram by measuring current, voltage and power in a balanced 3-phase delta connected inductive load.

- 7.1 Sketch the circuit diagram for measuring power by 3-watt meter method in a 3-phase delta connected load.
- 7.2 Select tools, equipment and materials for the experiment.
- 7.3 Connect the circuit according to the circuit diagram.
- 7.4 Check all connections before actual operation.
- 7.5 Record the reading from the meters used in the circuit.
- 7.6 Calculate the power from the formula $P_t = W_1 + W_2 + W_3$ and $P_t = \sqrt{3} V_L I_L \cos \theta$
- 7.7 Draw the vector diagram using relevant data.
- 7.8 Note down the observations.

8. Measure power and neutral current in a 3-phase, 4-wire unbalanced system.

- 8.1 Sketch the circuit diagram for measuring power and neutral current in 3-phase 4-wire unbalanced load.
- 8.2 Select tools, equipment and materials for the experiment.
- 8.3 Construct the circuit according to the circuit diagram.
- 8.4 Check all connections & instruments before actual operation.
- 8.5 Record the readings from the meters used in the circuit.
- 8.6 Calculate the power and neutral current.
- 8.7 Calculate the phase angles.
- 8.8 Note down the observations.

9. Measure line and phase voltage and current of a 3-phase star connected capacitive load.

- 9.1 Sketch the circuit diagram for measurement of line and phase voltage and current of a 3-phase star connected capacitive load.
- 9.2 Select tools, equipment and materials required for the experiment.
- 9.3 Construct the circuit as per diagram with proper instrument.
- 9.4 Record the readings from the meters used in the circuit.
- 9.5 Calculate the line and phase voltage & current from the formula $I_L = I_p$ and $V_L = \sqrt{3} V_p$
- 9.6 Note down the observations.

10. Measure line and phase current and voltage in 3-phase delta connected capacitive load.

- 10.1 Sketch the circuit diagram for measuring line and phase voltage and current of a balanced 3-phase delta connected capacitive load.
- 10.2 Select tools, equipment and materials required for the experiment.
- 10.3 Build up the circuit according to the circuit diagram.

- 10.4 Record the readings from the meters.
- 10.5 Calculate the line and phase voltage and current from the formula $V_L = V_P$ and $I_L = \sqrt{3} I_P$.
- 10.6 Note down the observations.

11 Measure 3-phase power by 3-watt meter method in a balanced 3-phase star connected capacitive load.

- 11.1 Sketch the circuit diagram for measuring 3-phase power by 3-watt meter method of a balanced 3-phase star connected capacitive load.
- 11.2 Select tools, equipment and materials required for the experiment.
- 11.3 Build up the circuit according to the circuit diagram.
- 11.4 Check all connections before actual operation.
- 11.5 Record the readings from the meters.
- 11.6 Calculate the power from the formula $P_t = W_1 + W_2 + W_3$ and $P_t = \sqrt{3} V_L I_L \cos\theta$
- 11.7 Draw the vector diagram using relevant data as obtained.
- 11.8 Note down the observations.

12. Measure 3-phase power by 3-watt meter method in a balanced 3-phase delta connected capacitive load.

- 12.1 Sketch the circuit diagram for measuring 3-phase power by 3-watt meter method in a balanced 3-phase delta connected capacitive load.
- 12.2 Select tools, equipment and materials required for the experiment.
- 12.3 Connect the circuit according to the circuit diagram.
- 12.4 Check all connection points before connecting to the power supply.
- 12.5 Record the readings from the meters.
- 12.6 Calculate the power from the formula $P_t = W_1 + W_2 + W_3$ and $P_t = \sqrt{3} V_L I_L \cos\theta$
- 12.7 Draw the vector diagram using relevant data as obtained.
- 12.8 Note down the observations.

13. Perform star-delta conversion in a power system.

- 13.1 Draw the circuit diagram of a balanced 3-phase star and delta connection.
- 13.2 Select tools, equipment and materials for the experiment.
- 13.3 Build up the circuit for star connection.
- 13.4 Check all connection points before actual operation.
- 13.5 Record the readings from the meters connected in the circuit.
- 13.6 Calculate the equivalent values of impedance in delta connection.
- 13.7 Build up a circuit with equivalent values of impedance in delta connection.
- 13.8 Record the reading for delta connection.
- 13.9 Compare the result.
- 13.10 Note down the observations.

REFERENCE BOOKS

1. A text book of Electrical Technology
– B. L Theraja.
2. Introduction to Electrical Engineering
– V. K. Mehta.
3. AC Circuit
–Kerchner & Corcoran.

66732

ADVANCE ELECTRICITY

T P C
2 3 3

OBJECTIVES

After completion of these contents students will be able to acquire, achieve and develop:

- To acquire knowledge and skills of Electrical house wiring.
- To develop the capacity to know constructional details and working principles of electric lamps.
- To develop understanding about earthing.
- To develop understanding about controlling and protective devices.
- To acquaint the principles of Electro-magnetic Induction.
- To familiarize Magnetism and magnetization

SHORT DESCRIPTION

Advance wiring; Electric lamps; Earthing; Controlling and Protective devices; Electro-magnetic Induction; Magnetism and Magnetization; Hysteresis and eddy current loss; Energy stored in magnetic field,

DETAIL DESCRIPTION

Theory:

1 Understand the Basic concept of electrical wiring.

- 1.1 List the different types of electrical house wiring.
- 1.2 Describe wiring of the high-rise residential building.
- 1.3 Describe wiring the high rise commercial building.
- 1.4 Explain the indoor and outdoor wiring.
- 1.5 Distinguish between indoor and outdoor wiring.
- 1.6 Draw the wiring layout plan of a residential building.
- 1.7 Draw the wiring layout plan of a commercial residential building.
- 1.8 Describe the electrical symbols used in electrical wiring.

2 Understand the constructional details and working principles of different types of traditional electric lamps.

- 2.1 Mention name of the different types of lamps.
- 2.2 Explain the working principle of tungsten filament lamp .
- 2.3 Describe constructional details of tungsten filament lamp.
- 2.4 Explain the working principle of a fluorescent lamp describing the function of the choke coil and starter.
- 2.5 Discuss advantages and disadvantages of fluorescent lamp.
- 2.6 Describe the detail circuit diagram of an electronically controlled fluorescent lamp.
- 2.7 Discuss the advantages of electronically controlled fluorescent lamp.

3 Understand the constructional details and working principles of modern electric lamps.

- 3.1 Explain the working principle of Sodium Vapour and Mercury Vapour lamps with circuit diagram.
- 3.2 Explain constructional details of Sodium Vapour & Mercury Vapour lamps.
- 3.3 List the uses of Sodium Vapour and Mercury Vapour lamps.
- 3.4 Explain working principle of a Compact Fluorescent lamp with circuit diagram.
- 3.5 Describe constructional details of a Compact Fluorescent lamp.
- 3.6 Explain working principle of a Light Emitting Diode (LED) lamp and LED tube light with circuit diagram.
- 3.7 Describe constructional details of LED lamp and LED tube light.
- 3.8 Explain working principle of Liquid Crystal Diode (LCD) lamp with circuit diagram.
- 3.9 Describe constructional details of LCD lamp.
- 3.10 Explain working principle of a Cold Cathode Filament lamp (CCFL)with circuit diagram.
- 3.11 Describe constructional details of a CCF lamp.

4 Understand the construction and uses of controlling and protective devices.

- 4.1 Explain the meaning and uses of SPST, SPDT, DPST, DPDT, TPST, Sliding switch, MCB and MCCB.
- 4.2 Describe the construction of MCB and its advantages.

- 4.3 Give reasons for the uses of a Lightening Arrester
- 4.4 Give reasons for the uses of a drop out fuse in distribution system.
- 4.5 Describe the Internal wiring of Combined socket with switch.
- 4.6 Describe the construction of Magnetic contactor.
- 4.7 Explain the Forward- Reverse speed control by using magnetic contactors.

5 Understand the concepts of earthing.

- 5.1 Discuss the factors to be considered in performing earthing.
- 5.2 Explain the working principles of pipe earthing with diagram.
- 5.3 Explain the working principles of plate earthing with diagram.
- 5.4 Explain the working principles of sheet earthing with diagram.
- 5.5 Explain the working principles of rod earthing with diagram.
- 5.6 Describe the principle and operation of earth tester.
- 5.7 Describe the method of measuring the earth resistance.
- 5.8 Explain the earth resistance range in different installation.

6 Understand the phenomenon of induced emf.

- 6.1 Explain dynamically induced emf.
- 6.2 Deduce the formula of dynamically induced emf.
- 6.3 Explain self induced emf.
- 6.4 Define Coefficient of self-induction by First, Second and Third method for self-inductance (L).
- 6.5 Apply the formula obtained by First, Second and Third Method to find L of iron core.
- 6.6 Explain Mutual Inductance (M).
- 6.7 Define coefficient of self-induction by First, Second and Third Method for (M).
- 6.8 Apply the formula obtained by First, Second and Third method to find out Mutual Inductance (M).
- 6.9 Solve problems related to dynamically and statically induced emf.

7 Understand the concept of Inductance and Co-efficient of coupling.

- 7.1 Explain co-efficient of coupling.
- 7.2 Deduce the expression for co-efficient of coupling.
- 7.3 Solve problems on mutual inductance and co-efficient of coupling.
- 7.4 Define the expression for inductance in series.
- 7.5 Derive the expression for inductance in series.
- 7.6 Solve problems on inductance in series.

8 Understand the principle of Magnetism and Magnetization.

- 8.1 Explain magnetization properties of materials.
- 8.2 Explain cycle of magnetization.
- 8.3 Draw magnetization (B-H) curve.
- 8.4 Mention applications of B-H curve.
- 8.5 State and explain Steinmetz's hysteresis law.
- 8.6 Derive the formula for hysteresis loss on the basis of the Steinmentz's law.
- 8.7 Solve problems on hysteresis loss related to Steinmentz's law.

9 Understand the concept of hysteresis loss. and eddy current loss with their minimization

- 9.1 Define magnetic hysteresis.
- 9.2 Explain hysteresis loss.
- 9.3 Explain hysteresis loop.
- 9.4 Determine areas of hysteresis loop.
- 9.5 Deduce the expression for energy loss in one cycle of magnetization per cubic meter.
- 9.6 State the uses of hysteresis loss curves.
- 9.7 Define eddy current loss.
- 9.8 Discuss the methods for minimization of eddy current loss.
- 9.9 Describe the expression for eddy current loss and hysteresis loss.
- 9.10 Solve problems related to eddy current loss.

10 Understand the concept of energy-stored in a magnetic fields.

- 10.1 Explain the principle of energy stored in a magnetic field.
- 10.2 Drive the expression for energy stored in a magnetic field.
- 10.3 Solve problems related to energy stored in a magnetic circuit.
- 10.4 Explain the lifting power of electromagnet.
- 10.5 Mention the application of lifting power of electromagnet.

- 11 Understand the concept of various kinds of special electrical circuit.**
- 11.1 Describe the working principle and construction of calling bell.
 - 11.2 Explain the working principle and construction of Alarm circuit.
 - 11.3 Describe the working principle and construction of light Dimmer.
 - 11.4 Explain the working principle and construction of Electronic Fan regulator circuit.
 - 11.5 Describe the working principle and construction of Electronic Choke coil.
- 12 Understand the concept of various kinds of Testing the Electrical House Wiring.**
- 12.1 Mention the different types of test for newly installed electrical house wiring.
 - 12.2 Explain the methods of Continuity test for electrical wiring.
 - 12.3 Describe the method of Polarity test for switches in electrical wiring.
 - 12.4 Describe the methods of short circuit test for electrical wiring.
 - 12.5 Explain the methods of Insulation resistance test for electrical wiring.
 - 12.6 Explain the methods of Earth test for electrical wiring.
- Practical:**
- 1 Show skill in connecting one lamp controlled from three different points.**
 - 1.1 Sketch a working diagram of one lamp controlled by three SPDT and one DPDT switches.
 - 1.2 Connect the circuit using required materials and equipment in wiring board.
 - 1.3 Test the connection of circuit by applying proper supply.
 - 1.4 Write a report on connecting one lamp controlled from three different points.
 - 2 Show skill in connecting one calling bell with four indicating lamps controlled from four points.**
 - 2.1 Sketch the working wiring diagram of one calling bell with four indicating lamps controlled by four push button switch.
 - 2.2 Connect the circuit using required materials and equipment in wiring board.
 - 2.3 Test the connection of the circuit by applying proper supply.
 - 2.4 Write a report connecting one calling bell with two indicating lamps controlled from two points.
 - 3 Show skill in connecting one lamp, one 2-pin socket and one fan in a circuit by channel wiring.**
 - 3.1 Draw the appropriate circuit diagram showing the location of lamp, fan, switches and socket.
 - 3.2 Connect lamp, fan and socket as per drawing.
 - 3.3 Connect the circuit with the supply.
 - 3.4 Switch on the lamp and fan and check the power socket with the help of a test lamp.
 - 3.5 Write a report on connecting one lamp, one socket and one fan in a circuit.
 - 4 Show skill in connecting two fluorescent lamps in parallel in a case/shade and controlled by one switches separately.**
 - 4.1 Draw the appropriate circuit diagram showing two fluorescent lamps in parallel and a one SPST tumbler switches.
 - 4.2 Wiring of the circuits according to diagram.
 - 4.3 Connect the circuit with the power supply.
 - 4.4 Switched on and observe.
 - 4.5 Write a report connecting two fluorescent lamps in parallel and controlled by one switch.
 - 5 Show skills in performing internal/ wiring and installing a combined socket with switch**
 - 5.1 Draw the internal diagram showing the internal connections.
 - 5.2 Connect the internal points as per diagram.
 - 5.3 Install the combined socket.
 - 5.4 Test the function of the combined socket.
 - 5.5 Write a report on installing a combined socket with switch.
 - 6 Show skill in connecting cutout, MCB/MCCB in a circuit.**
 - 6.1 Sketch a circuit diagram showing the location of cutout and MCB or MCCB separately with a load like heater or lamp.
 - 6.2 Connect the cutout/MCB/MCCB with the load as per drawing.
 - 6.3 Connect the circuit with the supply.
 - 6.4 Make necessary overloading the circuit by adding additional/excessive load or by short circuiting the load.
 - 6.5 Observe the operation of a MCB and MCCB or a cutout.
 - 6.6 Write a report on connecting cutout/MCB/MCCB in a circuit.
 - 8 Show skill in connecting one lamp, one 3-pin socket one fan in a circuit by surface conduit wiring.**
 - 8.1 Draw the circuit diagram in a paper
 - 8.2 Draw the layout diagram of wiring on the booth wall.

- 8.3 Cutting the wall according to diagram with identification of socket, switch board.
 - 8.4 Fix up the conduct pipe on the wall.
 - 8.5 Fastening the wall.
 - 8.6 Draw the proper size of cables or wires.
 - 8.7 Connect the switches, holders.
 - 8.8 Check the whole installation.
 - 8.9 Fitting the loads in proper position.
 - 8.10 Test the wiring.
 - 8.11 Supply and operate the load.
- 9. Show skill in installation of Plate earthing**
- 9.1 Sketch the proper earthing diagram.
 - 9.2 Estimate the list of materials.
 - 9.3 List the necessary tools, equipment and materials..
 - 9.4 Boring the G-I Plate
 - 9.5 Connect the earthing lead with plate
- 10. Perform skills for making a electronic calling bell**
- 10.1 Sketch the circuit for making a calling bell.
 - 10.2 List the necessary tools, equipment and materials.
 - 10.3 Connect the materials as per circuit diagram.
 - 10.4 Make and test the calling bell.
 - 10.5 Write a complete report of making the calling bell.
- 11. Perform skills for continuity test and short circuit test of wiring and polarity test of switches in an electrical installation**
- 11.1 Sketch the circuit for continuity test and short circuit test of wiring and polarity test of switches.
 - 11.2 List the necessary tools, equipment and materials.
 - 11.3 Connect the materials as per circuit diagram.
 - 11.4 Test continuity of the wiring.
 - 11.5 Test the short circuit of wiring.
 - 11.5 Test the polarity of the switches.
 - 11.6 Write a complete report for continuity test and polarity test.
- 12. Perform skills for Insulation resistance test and earthing test of electrical installation**
- 12.1 Sketch the circuit for insulation resistance test and earthing test.
 - 12.2 List the necessary tools, equipment and materials.
 - 12.3 Connect the materials as per circuit diagram.
 - 12.4 Test the insulation resistance by using Megger of wiring
 - 12.5 Test the earthing by using earth tester of the wiring.
 - 12.6 Write a complete report for insulation resistance test and earthing test.

REFERENCE BOOKS

- 1 Planning, Estimating of Electrical Installation
— J. B. Gupta
- 2 A text book of Electrical Technology
— B. L Theraja
- 3 Introduction to Electrical Engineering
----- V.K. Metha.

66733

ELECTRICAL ENGINEERING DRAWING

T P C
0 3 1

OBJECTIVES

After completion of these contents students will be able to acquire, achieve and develop:

- To acquaint with electrical engineering drawings.
- To develop skill in drawing isometric, oblique and orthographic views.
- To enable to interpret and skill to draw thread and fastening devices.
- To develop skill in drawing the symbols for electrical components and equipment.
- To develop skill in drawing the layout diagram of overhead distribution lines.
- To develop skill in drawing the layout diagram of a small sub-station.
- To enable to interpret the electrical layout diagram of a residential building.
- To enable and skill to draw Electrical circuit, plan with ECAD.

SHORT DESCRIPTION

After completion of these contents students will be able to acquire, achieve and develop: Drawing (elevation, plan and section) of electrical transmission and distribution line structure; Drawing of symbols used in electrical planning; Drawing of insulator used in overhead line; Drawing of pole mounted sub-station; Drawing of LT distribution line; Drawing electrical layout and single line wiring diagram of a small residential building; Using ECAD in electrical Drawing and circuit.

DETAIL DESCRIPTION

1 Construct first and third angle orthographic views.

- 1.1 Understand orthographic projection in first and third angle.
- 1.2 Choose minimum required number of views and complete orthographic Drawing of an object..
- 1.3 Draw three views of an object having hidden features.
- 1.4 Identify and draw the missing view and missing line in a drawing of a engineering object.

2 Draw Isometric Drawing.

- 2.1 Understand and draw the isometric drawing.
- 2.2 Draw an isometric circle.
- 2.3 Draw oblique views from orthographic views or actual object using isometric scale.
- 2.4 Put dimensions on isometric drawing.

3 Draw Oblique drawing.

- 3.1 Understand and draw the oblique drawing.
- 3.2 Draw an oblique circle.
- 3.3 Draw oblique views from orthographic views or actual object.
- 3.4 Put dimensions on oblique drawing.

4 Prepare the drawing conventions of thread fastening devices.

- 4.1 Draw the threads showing terminologies.
- 4.2 Draw different types of screw thread profile with correct proportions.
- 4.3 Draw the square/hexagonal headed bolt and nut with proper proportions showing conventional and simplified thread form.

5 Prepare the drawings of riveted and welded components.

- 5.1 Draw the riveted and welded components using conventions and symbols.
- 5.2 Draw a complete set of riveted joint and welded joint.

6 Develop the drawing of an electrical distribution line structure.

- 6.1 Draw the elevation, plan and section of a tubular steel pole used in LT distribution line.
- 6.2 Draw the elevation, plan and section of a concrete pole (RCC/PCC) of the following cross sections.
 - Circular
 - I-shaped
 - Rectangular
- 6.3 Draw the elevation plan and section of a wooden pole used in rural electrification.

7 Construct the symbols for the equipment, fittings and fixtures commonly used in electrical installations.

7.1 Draw the symbols for the following fittings and fixtures commonly used in electrical installation.

- | | |
|------------------------------------|----------------------------|
| ● Lamp (incandescent, fluorescent) | ● Choke coil |
| ● Lamp outlet | ● Starter (for tube light) |
| ● Ceiling rose | ● Cartridge fuse |
| ● Socket outlet
(2-pin & 3-pin) | ● Power outlet |
| ● Single way switch | ● Calling bell |
| ● Two way switch | ● MCB |
| ● Intermediate switch | ● MCCB |
| ● TP switch | ● Magnetic contactor |
| ● Change over switch | ● Indicating lamp |
| ● Ceiling fan | ● Earthing |
| ● Fan regulator | ● Micro switch |
| ● Combined switched socket | ● Exhaust fan |
| ● Distribution board | ● Renewable fuse |
| | ● Sub distribution board |

Draw the symbols for the following equipment used in electrical installation.

- | | |
|---|----------------------|
| ● OCB/VCB/CB | ● Relay |
| ● Transformer | ● Battery |
| ● Motor (DC, AC)
(3-phase & 1-phase) | ● Limit switch |
| ● Generator | ● Rectifier unit |
| ● Motor starter | ● Isolator |
| | ● Lightning arrestor |

8 Develop the drawing of insulators used in transmission and distribution line.

- 8.1 Draw the elevation, plan and section of a standard suspension type insulator.
- 8.2 Draw the elevation, plan and section of a 11 KV pin type insulator.
- 8.3 Draw the elevation plan and section of a shackle insulator used in LT distribution line.

9 Develop the plan of a pole mounted sub-station.

- 9.1 Draw the plan of a H-type pole structure.
- 9.2 Draw a transformer on the middle limb of the structure.
- 9.3 Sketch the dropout fuses on the top of the transformer.
- 9.4 Show the gang operated (GO) switch.
- 9.5 Show the incoming and outgoing lines.

10 Develop the drawing of a LT distribution line (11KV/0.4KV)

- 10.1 Draw the layout plan of a LT distribution line.
- 10.2 Draw the section of a pole showing the conductors.
- 10.3 Identify the line, neutral, earth and street lighting conductors.

11 Construct an electrical layout diagram and circuit diagram of a residential building.

- 11.1 Draw a layout diagram of a small residential building.
- 11.2 Show the electrical fittings and fixtures on the layout plan.
- 11.3 Show the switch boards, distribution boards, energy meter and protective devices in the section plan.
- 11.4 Sketch the section of the distribution board.
- 11.5 Sketch the section of a switch board.

12. Set up the drawing environment and drawing aids.

- 12.1 Start an ECAD Package and identify the different areas of ECAD screen.
- 12.2 Identify the menu bar, toolbar, drawing area and special windows for circuit simulation and testing purpose.
- 12.3 Familiarize with tools, toolkits and buttons (such as arrow, wire, text, delete etc)

- 12.4 Familiarize with workspace, conventions, preferences, shortcuts and hotkeys.
- 12.5 Place components such as resistors, transistors, power supply etc.
- 12.6 Save the drawing environment.
- 12.7 Exit from the ECAD package.

13. Draw and edit schematic Circuits.

- 13.1 Place devices (such as resistors, transistors, IC, power supply, grounds etc) in the workspace.
- 13.2 Reposition devices.
- 13.3 Edit devices with values and parameters.
- 13.4 Delete devices (if necessary).
- 13.5 Wire devices together.

14. Analyze a schematic Circuit.

- 14.1 Familiarize device meters, value sliders, goal seeker and circuit analyzer.
- 14.2 Add device meter to circuit diagram and set device meter values.
- 14.3 View Circuit voltage and current or digital logic level.
- 14.4 Change a device value and quickly analyze the circuit.
- 14.5 Perform DC and AC analysis of the circuit using circuit analyzer/oscilloscope.
- 14.6 Generate and print a frequency response graph.
- 14.7 Perform Digital analysis of a digital circuit.
- 14.8 Generate logic level graphs by using digital clock and oscilloscope.

15. Organize the drawing information on layers.

- 15.1 Identify the layer control options.
- 15.2 Create and name the layers.
- 15.3 Make the layer current and control layer visibility.
- 15.4 Freeze, lock and unlock the layers.
- 15.5 Set the layer color & line type.

65931**MATHEMATICS -3****T P C
3 3 4****AIMS**

- To enable to calculate the areas of regular polygons, hexagons, octagon, hydraulic mean depth (HMD) of a channel, area occupied by water of circular culvert. Excavation work.
- To provide the ability to calculate volume of regular solids like pyramid frustum of pyramid, prismoid, wedge and area of curved surfaces.
- To enable to use the knowledge of gradient of a straight line in finding speed, acceleration etc.
- To enable to use the knowledge of conic in finding the girder of a railway bridge, cable of a suspension bridge and maximum height of an arch.
- To make understand the basic concept and techniques of composition and resolution of vectors and computing the resultant of vectors.

• SHORT DESCRIPTION

Menstruation : Area of rectangles, squares, triangles, quadrilaterals, parallelograms, rhombus, trapezium, circle, sector, segment; Volume of rectangular solids, prism, parallelepiped, pyramids, cones, spheres, frustum of pyramid and cone; Area of curved surface of prism, Cylinder cone, pyramid and frustum of cone.

Co-ordinate Geometry: Co-ordinates of a point, locus and its equation, straight lines, circles and conic.

Vector: Addition and subtraction, dot and cross product.

DETAIL DESCRIPTION**MENSURATION:****1 Apply the concept of area of triangle.**

1.1 Find the area of triangle in the form,

i) $A = \frac{\sqrt{3}}{4} a^2$, a = length of a side of equilateral triangle.

ii) $A = \frac{c}{4} \sqrt{4a^2 - c^2}$, where a = length of equal sides, c = third side.

iii) $A = \sqrt{s(s-a)(s-b)(s-c)}$, where a, b, c = length of the sides of a triangle and $2s$ is the perimeter of the triangle.

1.2 Use formula in 1.1 to solve problems.

2 Apply the concept of finding areas of quadrilateral & Parallelogram & finding areas of rhombus & trapezium.

- 2.1 Define quadrilateral & Parallelogram.
- 2.2 Find the areas of quadrilateral when off sets are given.
- 2.3 Find the areas of a parallelogram.
- 2.4 Solve problems using above formulae.
- 2.5 Define rhombus & trapezium.
- 2.6 Find the areas of rhombus when the diagonals are given.
- 2.7 Find the areas of trapezium in terms of its parallel sides and the perpendicular distance between them.
- 2.8 Solve problems related to rhombus & trapezium.

3 Apply the concept of finding areas of regular polygon.

- 3.1 Define a regular polygon.
- 3.2 Find the area of a regular polygon of n sides, when

- i) The length of one side and the radius of inscribed circle are given.
 - ii) The length of one side and the radius of circumscribed circle are given.
- 3.3 Find the area of a regular.
- a) Hexagon
 - b) Octagon when length of side is given.
- 3.4 Solve problems of the following types:
A hexagonal polygon 6 m length of each side has a 20 cm width road surrounded the polygon. Find the area of the road.

4 Understand areas of circle, sector and segment.

- 4.1 Define circle, circumference, sector and segment.
- 4.2 Find the circumference and area of a circle when its radius is given.
- 4.3 Find the area of sector and segment of a circle.
- 4.4 Solve problems related to the above formulae.

5 Apply the concept of volume of a rectangular solid.

- 5.1 Define rectangular solid and a cube.
- 5.2 Find geometrically the volume of a rectangular solid when its length, breadth and height are given.
- 5.3 Find the volume and diagonal of a cube when side is given.
- 5.4 Solve problems with the help of 6.2 & 6.3.

6 Apply the concept of surface area, volume of a prism, parallelepiped and cylinder.

- 6.1 Define a prism, parallelepiped and a cylinder.
- 6.2 Explain the formulae for areas of curved surfaces of prism, parallelepiped and cylinder.
- 6.3 Explain the formulae for volume of prism, parallelepiped and cylinder when base and height are given.
- 6.4 Solve problems related to 7.2, 7.3.

7 Apply the concept of the surface area, volume of pyramid, cone and sphere.

- 7.1 Define pyramid, cone and sphere.
- 7.2 Explain the formula for areas of curved surfaces of pyramid, cone and sphere.
- 7.3 Explain the formula for volumes of pyramid, cone and sphere.
- 7.4 Solve problems related to 8.2, 8.3.

CO-ORDINATE GEOMETRY

8 Apply the concept of co-ordinates to find lengths and areas.

- 8.1 Explain the co-ordinates of a point.
- 8.2 State different types of co-ordinates of a point.
- 8.3 Find the distance between two points (x_1, y_1) and (x_2, y_2) .
- 8.4 Find the co-ordinates of a point which divides the straight line joining two points in certain ratio.
- 8.5 Find the area of a triangle whose vertices are given.
- 8.6 Solve problems related to co-ordinates of points and distance formula.

9 Apply the concept of locus & the equation of straight lines in calculating various Parameter.

- 9.1 Define locus of a point.
- 9.2 Find the locus of a point.
- 9.3 Solve problems for finding locus of a point under certain conditions.
- 9.4 Describe the Equation $x=a$ and $y=b$ and slope of a straight line.
- 9.5 Find the slope of a straight line passing through two points (x_1, y_1) and (x_2, y_2) .
- 9.6 Find the equation of straight lines:
 - (i) Point slope form.
 - (ii) Slope Intercept form.
 - (iii) Two points form.
 - (iv) Intercept form.

- (v) Perpendicular form.
- 9.7 Find the point of intersection of two given straight lines.
- 9.8 Find the angle between two given straight lines.
- 9.9 Find the condition of parallelism and perpendicularity of two given straight lines.
- 9.10 Find the distances of a point from a line.

10 Apply the equations of circle, tangent and normal in solving problems.

- 10.1 Define circle, center and radius.
- 10.2 Find the equation of a circle in the form:
- (i) $x^2 + y^2 = a^2$
 - (ii) $(x - h)^2 + (y - k)^2 = a^2$
 - (iii) $x^2 + y^2 + 2gx + 2fy + c = 0$
- 10.3 Find the equation of a circle described on the line joining (x_1, y_1) and (x_2, y_2) .
- 10.4 Define tangent and normal.
- 10.5 Find the condition that a straight line may touch a circle.
- 10.6 Find the equations of tangent and normal to a circle at any point.
- 10.7 Solve the problems related to equations of circle, tangent and normal.

11 Understand conic or conic sections.

- 11.1 Define conic, focus, Directorx and Eccentricity.
- 11.2 Find the equations of parabola, ellipse and hyperbola.
- 11.3 Solve problems related to parabola, ellipse and hyperbola.

VECTOR :

12 Apply the theorems of vector algebra.

- 12.1 Define scalar and vector.
- 12.2 Explain null vector, free vector, like vector, equal vector, collinear vector, unit vector, position vector, addition and subtraction of vectors, linear combination, direction cosines and direction ratios, dependent and independent vectors, scalar fields and vector field.
- 12.3 Prove the laws of vector algebra.
- 12.4 Resolve a vector in space along three mutually perpendicular directions
- 12.5 Solve problems involving addition and subtraction of vectors.

13 Apply the concept of dot product and cross product of vectors.

- 13.1 Define dot product and cross product of vectors.
- 13.2 Interpret dot product and cross product of vector geometrically.
- 13.3 Deduce the condition of parallelism and perpendicularity of two vectors.
- 13.4 Prove the distributive law of dot product and cross product of vector.
- 13.5 Explain the scalar triple product and vector triple product.
- 13.6 Solve problems involving dot product and cross product.

Reference

SL No	Athour	Title	Publication
01	G. V. Kumbhojkar	Companian to basic Maths	Phadke Prakashan
02	Murary R Spigel	Vector & Tensor Analysis	Schaum's Outline Series
03	Md. Abu Yousuf	Vector & Tensor Analysis	Mamun Brothers
04	Rahman & Bhattacharjee	Co-ordinate Geometry & Vector Analysis	H.L. Bhattacharjee
05	Md. Nurul Islam	Higher Mathematics	Akkhar Patra Prakashani

65922

PHYSICS-2

T P C
3 3 4

OBJECTIVES

- To develop a foundation in scientific principles and processes for the understanding and application of technology.
- To develop an understanding of fundamental scientific concepts through investigation and experimentation.
- To provide a common base for further studies in technology and science.
- To develop the basic knowledge of modern physics.

SHORT DESCRIPTION

Thermometry and Heat Capacity; Expansion of materials (effect of heat); Heat transfer; Humidity; Nature of heat and Thermodynamics; Photometry; Reflection of light; Refraction of light; Electron , photon and Radio activity; Theory of Relativity.

DETAIL DESCRIPTION

THEORY

1. THERMOMETRY AND HEAT CAPACITY

- 1.1 Define heat and temperature.
- 1.2 Mention the units of measurement of heat and temperature.
- 1.3 Distinguish between heat and temperature.
- 1.4 Identify the range of the Celsius scale determined by the boiling point and melting point of water
- 1.5 State the construction and graduation of a mercury thermometer.
- 1.6 Define specific heat capacity, thermal capacity and water equivalent with their units.
- 1.7 Prove the total heat gained by an object is equal to the sum of the heat lost by all the surrounding objects.
- 1.8 Explain the principle of calorimetry.
- 1.9 Define various kinds of specific latent heat.
- 1.10 Determine the latent heat of fusion of ice and latent heat of vaporization of water.
- 1.11 Determine the specific heat of a solid by calorimeter.

2. EFFECT OF HEAT ON DIMENSION OF MATERIALS

- 2.1 Show that different materials change in size at different amounts with the same heat source.
- 2.2 Explain the meaning of differential expansion in bimetallic strip, thermostats, compensated pendulum etc.
- 2.3 Explain the methods of overcoming problems caused by the expansion of materials in buildings, machinery, railway lines and bridges.
- 2.4 Mention the units co-efficient of linear, superficial and cubical expansion of solids.
- 2.5 Define the co-efficient of linear, superficial and cubical expansion of solids.
- 2.6 Relation between the co-efficient of linear, superficial and cubical expansion of solids.
- 2.7 Define real and apparent expansion of liquid.
- 2.8 Relation between the real and apparent expansion of liquid.

3. HEAT TRANSFER

- 3.1 Identify the phenomena of heat transferring from hot bodies to cold bodies.
- 3.2 Explain the methods of heat transfer by conduction, convection and radiation with examples of each type of transfer.
- 3.3 Define thermal conductivity (K) and Co-efficient of thermal conductivity.
- 3.4 Find the unit and dimension of Co-efficient of thermal conductivity.
- 3.5 List the factors which determine the quantity of heat (Q) flowing through a material.
- 3.6 Show that the quantity of heat flowing through a material can be found from
$$Q = \frac{KA(\theta_H - \theta_C)t}{d}$$
- 3.7 State Stefan-Boltzman Law and Wien's law.
- 3.8 State Newton's law of cooling.
- 3.9 Explain Green house effect.

4. HUMIDITY

- 4.1 Define Standard Temperature and Pressure.
- 4.2 Define Humidity, Absolute Humidity, Relative Humidity and Dewpoint.
- 4.3 Relation between vapour pressure and air pressure.
- 4.4 Determine Humidity by wet and dry bulb hygrometer.
- 4.5 Explain few phenomena related to hygrometry.

5. NATURE OF HEAT AND THERMODYNAMICS

- 5.1 Describe the caloric theory and kinetic theory of heat.
- 5.2 Explain the mechanical equivalent of heat.
- 5.3 State and Explain the first law of thermodynamics .
- 5.4 Explain Isothermal and adiabatic change.
- 5.5 Explain Specific heat of a gas, Molar specific heat or molar heat capacity.
- 5.6 Relate between pressure and volume of a gas in adiabatic Change $i, e; PV^\gamma = \text{const.}$
- 5.7 State and Explain Reversible process and irreversible process.
- 5.8 State & explain 2nd law of thermodynamics
- 5.9 Entropy: Definition, unit and significant.
- 5.10 Explain Change of entropy in a reversible and irreversible process.
- 5.11 Give an example of increase of entropy in irreversible process.

6. PHOTOMETRY

- 6.1 Define light, medium (transparent, translucent, opaque), luminous & non-luminous bodies, parallel, convergent & divergent of rays.
- 6.2 Show the travel of light in straight line.
- 6.3 Define photometry, luminous intensity, luminous flux, brightness and illuminating power.
- 6.4 Mention relation between luminous intensity & illuminating power.
- 6.5 Explain inverse square law of light.
- 6.6 Describe the practical uses of light waves in engineering.

7. REFLECTION OF LIGHT

- 7.1 Define mirror (plane & spherical), image (real & virtual) and magnification of images.
- 7.2 Describe the reflection of light.
- 7.3 State the laws of reflection of light.
- 7.4 Express the verification of laws of reflection.
- 7.5 Define pole, principal axis, center of curvature, radius of curvature, principal focus in case of concave & convex mirrors.
- 7.6 Find the relation between focal length & radius of curvature of a concave & convex mirror.
- 7.7 Express the general equation of concave and convex mirror.

8. REFRACTION OF LIGHT

- 8.1 Define refraction of light Give examples of refraction of light
- 8.2 State the laws of refraction and Express the verification of laws of refraction
- 8.3 Define absolute and relative refractive index and Relate absolute and relative refractive index
- 8.4 Explain the meaning of total internal reflection and critical angle and Relate total internal reflection and critical angle.
- 8.5 Give examples of total internal reflection.
- 8.6 Describe refraction of light through a prism.
- 8.7 Express the deduction of the relation between refractive index, minimum deviation and angle of the prism.
- 8.8 Define lens and mention the kinds of lens.
- 8.9 Identify and List uses of lens.
- 8.10 Express the deduction of the general equation of lens (Concave & convex).

9. ELECTRON, PHOTON AND RADIO-ACTIVITY

- 9.1 Describe Electrical conductivity of gases.
- 9.2 Describe Discharge tube.
- 9.3 Cathode ray : Definition and its properties
- 9.4 X-ray : Definition, properties & uses
- 9.5 Discuss Photo electric effect .
- 9.6 Derive Einstein's photo electric equation
- 9.7 Define and explain radio-activity.
- 9.8 Describe radio-active decay law.
- 9.9 Define half-life and mean-life of radio-active atoms.
- 9.10 Define nuclear fission and fusion.

10. THEORY OF RELATIVITY

- 10.1 Define Space, time and Mass.
- 10.2 Define rest mass.
- 10.3 Express the theory of relativity.
- 10.4 Explain special theory of relativity and its fundamental postulate.
- 10.5 Mention different Kinds of theory of relativity.
- 10.6 The Relativity of Length - Length contraction.
- 10.7 The Relativity of Time – Time dilation.
- 10.8 Deduce Einstein's mass -energy relation

PRACTICAL

1. Compare the operation of common thermometers.
2. Determine the co-efficient of linear expansion of a solid by Pullinger's apparatus.
3. Measure the specific heat capacity of various substances.(Brass, steel).
4. Determine the latent heat of fusion of ice.
5. Determine the water equivalent by calorimeter.
6. Compare the luminous intensity of two different light sources.
7. Verify the laws of reflection.
8. Find out the focal length of a concave mirror.
9. Determine the refractive index of a glass Slab.
10. Determine the angle of Minimum deviation and refractive index of a glass prism by using I-D graph.

REFERENCE BOOKS:

- | | |
|---|-----------------------------------|
| 1. Higher Secondary Physics – Second Part | - by Dr. Shahjahan Tapan |
| 2. A Text Book of Heat and Thermodynamics | - by N Subrahmanyam and Brij Lal |
| 3. A Text Book of Optics | - by N Subrahmanyam and Brij Lal |
| 4. Higher Secondary Physics -Second Part | - by Prof. Golam Hossain Pramanik |
| 5. Higher Secondary Physics -Second Part | - by Ishak Nur fungnabi |
| 6. Thermodynamics | - by K K Ramalingam |

65722

COMMUNICATIVE ENGLISH

T P C
1 3 2

Full Marks: 100 (Practical-50.Theoretical-50)

Introduction

This Course Will Provide A Unique Foundation In The Basic Level For Developing Listening, Speaking, Reading And Writing Skills Into Some Of More Specialized And Advanced Capabilities Of Basic Operation In Communication.

Theory Part

Total Mark: : 50
Continuous Assessment : 20
Final Exam : 30

Objectives:

After The Completion of the Module, Learners Will Be Able To Develop-

- # Creative Writing Ability
- # Transferring Information, Ideas And Knowledge
- # Communicative Competence Effectively In The Workplace Situation.

1.Comprehension For Reading Task (Mark:10)

(Text May Be Taken From Contemporary Journals, Editorial of News Papers Or From Online Resources)

Test Items:

1. MCQ (Guessing Meaning from Context)
2. Rearranging
3. Gap-Filling (With Clues or Without Clues)
4. Answering Questions
5. Summarizing

2. Composition (Mark: 20)

The Following Are The Topic Title Introduced For Writing Task:

1. Introduce Formal/Informal Greeting & Farewell
2. Describe The Idea Of Communication & Presentation Skills
3. Write Paragraph On The Basis Of Comparison and Contrast
4. Narrate Process, Stories And Interpreted Charts, Graphs.
5. Write Letters to the Print and Electronic Media
6. Write Letters of Advice, Complaints, Inquiry, Order and Cancellation
6. Prepare Seven Days Weather Report.
7. Make An Attractive Poster For The People Giving Advice To Protect The Environment.
8. Prepare A Series Of Questions About Personal Information, Place Of Interest, Foods, Hobby And Employment Opportunity.
9. Write Dialogue On The Following Situations
 - # About Exchanging Views With A Person And Introducing One Narrating Daily Activities
 - # Meeting At The Train Station & Asking Question About The Departure And Arrival Of The Train

To The Station Manager

- # Meeting at The Airport And Asking The Flight Schedule
- # Getting To The Hotel And Asking For A Reservation
- # Social Language for Telephonic Conversation
- # Talking About the Weather, Trips & Sight Seeing
- # Asking Permission and Making Request.
- # Talking About Office and Office Manner
- # Talking About Etiquette and Manner

10. Prepare Job Application With A Complete CV For Job Suitable For You.

Practical Part:

Objectives:

- 1. Communicate The Areas That Learners Encounter In Real Life Situation.**
- 2. Reinforce The Basic Language Skills Of Listening And Speaking.**
- 3. Integrate ICT As Tools In Learning Language.**

Course Content

Unit	Lesson	Title
1. Use Of Dictionary	Define Dictionary	1.1 Know How To Use A Dictionary 1.2 Learn At Least 10 Words In A Day With Correct Pronunciation (Follow The Link : Www.Marriumm-Englishdictionary.Com)
2. Basic Vocabulary Practice	Basic Words For Communication By ODGENS	2.1 Use 10 Most Common Formulas (Structure) To Write Correct Sentence. (Follow The Link: Www.Odgensbasicvocabulary.Com Www.Grammarly.Com)
3.Listening Skill Practice	Listen To The Audio Video Presentation On Current Real Life Situation	3.1 Practice Audio Video Conferencing Activities. 3.2. Communicate With The English Speaking People Online (Link: Www.Speaking24.Com)
4. Speaking Skill Practice (Self Interpretation)	Introduce Yourself With The Vocabulary Prescribed By ODGENS	4.1 Browse Vocabulary Related Phrases To Introduce You. (Link : Www.Youtube.Com/Let Me Introduce Myself)
5. Listening Skill Practice	Listen To The Weather Reports, Sports Commentary In The English TV Channels.	5.1 Prepare Seven Days Weather Report For The Place You Are Staying. 5.2. Make Some Attractive Poster To Protect The Environment.
6. Speaking Skill Practice	Identify Formal And Informal Social Language	6. 1 Practice Conversation Emphasizing On Greetings & Farewell (Link- Www.Esl.Guide@About.Com) 6.2 Take Part In Audio Video Conferencing Activities 6.3 Ask Questions About Personal Information, Place Of Interest, Food, Hobby, Employment Opportunity With Foreign Friends Using Social Media.
7. Writing Skill Practice	Develop Paragraph	7.1 Develop Paragraph On The Basis Of Comparison, Contrast And Analysis. Check Plagiarism Wordiness By The Correction Software (Www.Grammarly.Com) 7.2. Write E-Mail, Send And Reply E-Mail

8. Listening Skill Practice	Watch Short Films, Documentary And Listen To The English Music(With Lyric) To Practice In A Group	8.1 Listen To Hard Talk, Interview 8.2. Prepare A Series Of Questions To Interview A Celebrity 8.3. Down Load Documentary From Www.Youtube.Com/Education
9.Presentation	Define Presentation	9.1 Edutain/Entertain Yourself Preparing A Documentary In A Group With The Activities Done During The Period Of Class Hours In The Lab For Communicative English.

Evaluation:

Students Can Be Evaluated Individually Or In A Group On The Basis Of Performance Done In The Lab. Furthermore, They May Be Given Online Test Using Authenticated Websites Like Www.Britishcouncil.Org/Education/Blog/Podcast/News/Weather, Www.Englishteststore.Com, Www.Ieltsexam.Com.

Lab-Facilitator, 30 Students In A Group:

Physical Facility	Size (In Ft)	Area (In Sq Ft)
Class Room Cum Laboratory	15 × 20	300
Library	15 × 20	300
Wash Room	4 × 7	28

Lists Of Equipments And Resources For 30 Learners:

Personal Computers With Accessories	15
Projector Multimedia	01
Printer	01
Scanner	01
Modem	01
Essential Software	01 Set
Internet Connection For Each Computer	Broad Band/Dial Up
Camera (Digital)	01
Video Conferencing Equipments	01 Set
TV Card	01
Satellite Cable Connection	01
Head Phone	15
Related Books And Journals	01
First Aid Box	01

Reference:

Www.Britishcouncil.Org, Www.Marium-Websters.Com, Www.Compellingconversation.Com,
Www.Esl.Guide@About.Com, Www.Bbc.Com/News, Www.Speaking24.Com, Www.Itutor.Com,
Www.Ieltsexam.Com, Www.Englishteststore.Com, Www.Ginger.Com, Www.Grammarly.Com

(Note: This Course May Be Introduced After Fourth Semester Coz It Needs Some Maturity Of The Students To Adopt With The Course Materials And The Contents. These Themes Are Suggestive Not Prescriptive.)

65811

SOCIAL SCIENCE

T P C
3 0 3

OBJECTIVE

To provide opportunity to acquire knowledge and understanding on :

- importance of civics and its relationship with other social sciences
- The relationship of an individual with other individuals in a society
- social organizations, state and government
- rule of law, public opinion and political parties
- UNO and its roles
- The basic concepts and principles of economics and human endeavor in the economic system.
- The realities of Bangladesh economy and the current problems confronting the country.
- The role of Diploma Engineers in industries.
- our motherland and its historical background
- good citizenship through practicing our socio- economic culture
- liberation war and its background
- nationalism and life style of the nation

SHORT DESCRIPTION

Civics and Social Sciences; Individual and Society; Nation and Nationality; Citizenship; state and government; Law; Constitution; Government and its organs; public Opinion; Political Party; UNO and its organs; Scope and importance of Economics; Basic concepts of Economics- Utility, Wealth, Consumption, income wages, salary, value in use and savings; Production – meaning, nature, factors and laws; Demand and Supply; market equilibrium, national income, Current economic problems of Bangladesh; Role of Diploma Engineers in the economic development of Bangladesh; Occupations and career planning; Engineering team.

Part-1 (Civics)

1. Understand the meaning and scope of civics and inter relations of social sciences.

- 1.1 Define civics and social science.
- 1.2 Explain the importance of civics in the personal and social life of an individual.
- 1.3 Describe the relationship of all social science (civics, Economics, political science, Sociology, ethics)

2. Understand the relationship of the individual with the society, Nationality and nation, Rights and duties of a citizen.

- 2.1 Define the concept (individual, society, socialization, Nation, Nationality, citizen and citizenship).
- 2.2 State the relationship among the individuals in the society.
- 2.3 Discuss the methods of acquiring citizenship and state the causes of losing citizenship
- 2.4 Describe the rights of a citizen and state the need for developing good citizenship.

3. Appreciate the relationship between the state and government, law and organs of government.

- 3.1 Meaning the state, government and law
- 3.2 Discuss the elements of state.
- 3.3 Discuss the classification of the forms of government
- 3.4 Distinguish between cabinet form of Government and presidential form of government.
- 3.5 Describe the main organs of Government (legislature, Executive and judiciary)
- 3.6 Discuss the sources of law

4. Understand and the classification of constitution

- 4.1 Define the Constitution.
- 4.2 Explain the deferent form of Constitution
- 4.3 Explain state the salient feature of Bangladesh constitution.
- 4.4 Define the fundamental rights of Bangladesh constitution.
- 4.5 Meaning of human rights.

5. Understand the role of UNO in maintaining world peace

- 5.1 Explain the major functions of UNO.
- 5.2 State the composition and functions of General Assembly.
- 5.3 Describe the Composition and functions of Security Council.
- 5.4 Discuss the role of Bangladesh in the UNO.

6. Understand the role of Ethics values and good governance

- 6.1 Define the values, ethics and good governance.
- 6.2 Discuss the role of government to establish good governance

Part-2 (Economics)

1. Understand the fundamental concepts of economics.

- 1.1 Define the Microeconomics and Macroeconomics.
- 1.2 Discuss the definition of Economics as given by eminent economists.
- 1.3 Describe the importance of economics for Technical Student.
- 1.4 Define commodity, utility, value, wealth, consumption, income, savings, wages, value in use, value in exchange and salary.
- 1.5 Differentiate between value in use and value in exchange.
- 1.6 Explain wealth with its characteristics.

2. Understand the production process and the concept of the law of diminishing returns in the production process.

- 2.1 Discuss production mode and process
- 2.2 Explain the nature of different factors of production.
- 2.3 Discuss production function.
- 2.4 Discuss the law of diminishing returns.
- 2.5 State the application and limitations of the law of diminishing returns.
- 2.6 Describe the law of production (increasing constant and diminishing).

3. Understand the concept of demand, supply and utility.

- 3.1 Define the term, “demand and supply”.
- 3.2 Explain the law of demand and supply .
- 3.3 Draw the demand and supply curve.
- 3.4 Discuss Market equilibrium.
- 3.5 Define the utility, total and marginal utility
- 3.6 Illustrate the law of diminishing utility.
- 3.7 Explain the law of diminishing marginal utility

4. Understand national income.

- 4.1 Define nation income.
- 4.2 Explain how to measure national income.
- 4.3 Discuss GNP, GDP and NNP.
- 4.4 Discuss economic development and growth

5. Understand the current issues and the availability and use of natural resource in the development of Bangladesh

- 5.1 Define rural and urban economics.
- 5.2 Identify major problems of rural and urban economy.
- 5.3 Explain the migration of rural population to urban areas.
- 5.4 List of the Natural resource of Bangladesh and classify them according to sources of availability.
- 5.5 Explain the importance of the mine, forest and water resources and potential uses for sustainable development.

6. Role of a Diploma Engineer in the Development of Bangladesh Economy.

- 6.1 Explain the concept of the term, “Engineering team”
- 6.2 Identify the functions of Engineers, Diploma Engineers, craftsmen forming the engineering team.
- 6.3 Discuss the role of a Diploma Engineer in the overall economic development of Bangladesh.
- 6.4 Explain socio-economic status of a diploma Engineer.

Part-3 ((Bangladesh: History& Culture)

সংক্ষিপ্ত বিবরণী

ইতিহাস

- ইতিহাসের সংজ্ঞা।
- বাংলাদেশের আবহাওয়া ও অধিবাসী।
- বাংলায় ইংরেজ শাসন ক্ষমতালাভ ও প্রতিষ্ঠা।
- ত্রিপুর বিরোধী সশস্ত্র প্রতিরোধ আন্দোলন; সংস্কার আন্দোলন ও জাতীয়তাবাদেও বিকাশ এবং বাংলার নবজাগরণ; বঙ্গভঙ্গ ও বঙ্গভঙ্গ উত্তরকালে বাংলার রাজনীতি ও দেশ বিভাগ।
- পাকিস্তান আমলে বাংলাদেশ, বঙ্গবন্ধুর নেতৃত্বে বাংলাদেশের মুক্তি সংগ্রাম ও স্বাধীনতালাভ।

সংস্কৃতি

সংস্কৃতি, সভ্যতার সংজ্ঞা, সংস্কৃতির প্রকরণ, ভাষা আন্দোলন উত্তর বাংলার সংস্কৃতি, স্বাধীনতা উত্তর বাংলাদেশের সংস্কৃতির বিবর্তন, বাংলাদেশের সংস্কৃতিতে প্রত্নতাত্ত্বিক নির্দর্শন ও ক্ষুদ্র ন্যূত্তাত্ত্বিক গোষ্ঠীসমূহ।

সহায়ক পুস্তক

হক, মোজাম্বেল “পৌরনীতি” – হাসান বুক হাউস
প্রফেসর এমাজউদ্দিন “রাষ্ট্রবিজ্ঞান” আজিজিয়া লাইব্রেরী
আলী, মসুম “অর্থনীতি”
চক্রবর্তী, মনতোষ- “প্রিসিপলস অব ইকোনোমিক্স”
মার্শাল, আলফ্রেড,- “প্রিসিপলস অব ইকোনোমিক্স”
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রহিম, চৌধুরী, মাহমুদ ও ইসলাম, “বাংলাদেশের ইতিহাস (পরিবর্ধিত ও পরিমার্জিত)”; নওরোজ কিতাবিল্লান, আগস্ট, ১৯৯৯।
কে, আলী “বাংলাদেশের ইতিহাস”; আজিজিয়া বুক ডিপো, ২০০১।
সিরাজুল ইসলাম, “বাংলাদেশের ইতিহাস-১৭০৪-১৯৭১”; ১ম, ২য় ও ৩য় খন্দ; বাংলাদেশ এশিয়াটিক সোসাইটি, ফেব্রুয়ারি ২০০০।
কো-আত্তেনভা, পি, কতোভাসি, “ভারত বর্ষের ইতিহাস”; প্রগতি প্রকাশন, ১৯৯৮।
গোপাল হালদার; “সংস্কৃতির রূপালোক”; মুক্তধারা, মে ১৯৮৪।
মোতাহের হোসেন চৌধুরী, “সংস্কৃতি কথা”; নওরোজ কিতাবিল্লান, জানুয়ারি ১৯৯৮।
গোপাল হালদার, “বাংলা সাহিত্যের রূপরেখা-১ম ও ২য় খন্দ”; মুক্তধারা।



BANGLADESH TECHNICAL EDUCATION BOARD
Agargoan, Dhaka-1207.

**4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)**

ELECTRICAL TECHNOLOGY
TECHNOLOGY CODE: 667

4th SEMESTER

DIPLOMA IN ENGINEERING
PROBIDHAN-2016

ELECTRICAL TECHNOLOGY (667)

4th SEMESTER

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total	
						Theory		Practical			
						Cont. assess	Final exam	Cont. assess	Final exam		
1	66741	Electrical Installation Planning & Estimating	3	3	4	60	90	25	25	200	
2	66742	DC Machines	3	3	4	60	90	25	25	200	
3	66845	Industrial Electronics	2	3	3	40	60	25	25	150	
4	67045	Applied Mechanics	2	3	3	40	60	25	25	150	
5	66631	Programming Essentials	2	3	3	40	60	25	25	150	
6	65841	Business organization & Communication	2	0	2	40	60	0	0	100	
Total			14	15	19	280	420	125	125	950	

66741

Electrical Installation, Planning & Estimating

T P C

3 3 4

OBJECTIVES

To provide the student with an opportunity to acquire knowledge, skill and attitude in the area of planning and estimating of electrical installation with special emphasis on:

- Planning and preparation of estimate for an electrical installation.
- Internal wiring and service connection.
- Installation of electrical machines.
- Electricity act / rules and safety practices.

SHORT DESCRIPTION

Planning and estimating; Measurement book, price sheet, catalogue and schedule of labor rate; Illumination; Conductor size and current carrying capacity; Electricity Acts/Rules; Electrical codes; Internal wiring installation; Distribution line; Installation and winding of electrical machine/equipment; Testing electrical installation.

DETAIL DESCRIPTION

Theory:

1. Understand the concepts of electrical installation.

- 1.1 Explain electrical installation.
- 1.2 List the main types of electrical installations.
- 1.3 Define indoor and outdoor electrical installation.
- 1.4 Distinguish between indoor and outdoor electrical installation.

2. Understand the concept of planning of an electrical installation.

- 2.1 Define the term planning of an electrical installation.
- 2.2 Explain the necessity of planning of an electrical installation.
- 2.3 List the main categories of planning of an electrical installation.
- 2.4 List the factors to be considered for proper planning.
- 2.5 Calculate the electrical load of residential building, college building, student hostel an office building and 20 stored building.

3. Understand the concept of estimating of an electrical installation.

- 3.1 Discuss estimating of an installation.
- 3.2 Explain the necessity of estimating.
- 3.3 List the important steps for costing of an installation.
- 3.4 List the steps to be considered for preparing an estimate.

4. Understand MB writing, Price sheet and Schedule of labor rates.

- 4.1 Describe MB.
- 4.2 Explain the necessity of MB.
- 4.3 Identify the style of maintaining an MB.
- 4.4 Identify proper specifications for the required materials form catalogue.
- 4.5 Describe price sheet and schedule of labor rates.
- 4.6 Explain the necessity of price sheet and labor rates for an estimate.
- 4.7 Prepare a price sheet and a labor rate schedule.

5. Understand the concept of illumination.

- 5.1 Define illumination.
- 5.2 Define the terms Solid angle, Candela, Luminous flux, Luminous intensity, MSCP, MHSCP and different related factors
- 5.3 Explain the laws of illumination.
- 5.4 Calculate illumination required for different purposes.
- 5.5 Prepare a chart of illumination for different lamp system (including CFL, Incandescent, Fluorescent)
- 5.6 Solve problems related to illumination.

6. Understand the concept of lighting scheme.

- 6.1 Discuss direct lighting, indirect lighting, semi-direct and semi-indirect lighting.
- 6.2 Discuss the level of illumination required for different purposes.
- 6.3 Discuss the factors to be considered for designing a lighting scheme.
- 6.4 Design a lighting scheme.

7. Understand the principle of calculating current carrying capacity and determining the conductor size.

- 7.1 Describe the factors to be considered for determining the conductor size.
- 7.2 Calculate the current carrying capacity of a given circuit and the sub circuits.
- 7.3 Calculate Voltage and Voltage drop of conductor
- 7.4 Find the conductor size from the table.
- 7.5 Explain the meaning and utility of RM, RE and SWG.

8. Understand the electricity Act/Rules and utility of electrical codes.

- 8.1 List the main electricity rules of Bangladesh Electricity Act.
- 8.2 Describe the importance of electricity act/rules.
- 8.3 Explain the need for maintaining safety procedure against electrical hazards.
- 8.4 Explain the safety measures.
- 8.5 List the electrical codes of Bangladesh National Building Code (BNBC) and International Building code.
- 8.6 Explain different electrical codes of National Building Code and International Building code
- 8.7 State the advantages of using the electrical codes.

9. Understand the installation of internal wiring.

- 9.1 Explain internal wiring installation.
- 9.2 Describe the main types of internal wiring.
- 9.3 Prepare schedule of materials for channel, surface conduit, and concealed conduit wiring.
- 9.4 Sketch the layout plan for channel, surface conduit, and concealed conduit of small building.
- 9.5 Calculate the load of main circuit and sub circuits.
- 9.6 Select the sizes of wire, main switch, sub-main switches and switches.
- 9.7 Prepare a detail estimate for necessary materials and labor of installation of internal wiring.
- 9.8 Prepare a summary of the estimate.
- 9.9 Prepare an estimate by point method.

10. Understand the Service main.

- 10.1 Explain service main.
- 10.2 Prepare a schedule of materials for single phase service main
- 10.3 Prepare a schedule of materials for 3-phase service main.
- 10.4 Sketch the layout of 1-phase service connection required energy meter, DB & SDB
- 10.5 Sketch the layout of 3-phase service connection required energy meter, DB & SDB
- 10.6 Prepare a detail estimate for materials & Labor of 1-phase service connection.
- 10.7 Prepare a detail estimate for materials & Labor of 3-phase service connection

11. Understand the concept of earthing.

- 11.1 Describe earthing.
- 11.2 Explain the necessity of earthing.
- 11.3 Explain the methods of earthing for Single to 20-stored building.
- 11.4 Prepare an estimate for earthing for Single to 20-stored building
- 11.5 Explain the method of testing of an earthing installation.
- 11.6 List the desired value of earth resistance for different installations.

12. Understand wiring layout and schematic diagram of an electrical installation.

- 12.1 Sketch the layout plan for casing wiring of a small workshop showing lighting loads.
- 12.2 Sketch the layout plan for conduit wiring of a small workshop showing lighting loads.
- 12.3 Sketch the layout plan of casing wiring of the same workshop showing power loads.
- 12.4 Sketch the layout plan of conduit wiring of the same workshop showing power loads.

- 12.5 Sketch the layout plan for earth connection.
- 12.6 Calculate power loads and lighting loads respectively of main circuit and sub-circuits
- 12.7 Select the sizes of wire, main switch, sub-main switches, switches and distribution boards to lighting and power line respectively.
- 12.8 Prepare an estimate for the required materials and labour from the schedule.
- 12.9 Prepare an estimate for earth connections and earthing.
- 12.10 Prepare a summary of the estimate.

13. Understand the estimate of LT overhead distribution line.

- 13.1 Sketch the layout plan of a 400V, 3-phase, 4-wire overhead distribution line with street poles, conductors, insulators and other accessories.
- 13.2 Prepare a schedule of materials required for overhead line.
- 13.3 Prepare an estimate for required materials for one kilometer long overhead LT distribution line with the 5th wire for street lighting.
- 13.4 Prepare a schedule of labor for overhead LT distribution line.
- 13.5 Prepare an estimate for overhead LT distribution line.
- 13.6 Prepare a summary of the estimate

14. Understand the principle of installation of electrical machine and equipment.

- 14.1 Sketch the layout plan and single line wiring diagram of a motor connection
- 14.2 Identify the position of motor, main switch, starter and accessories in the diagram.
- 14.3 Calculate the distance of the motor, main switch and starter from the mains.
- 14.4 Determine the sizes of wire, main switch and starter for the installation.
- 14.5 Prepare the material cost.
- 14.6 Estimate labor charge.
- 14.7 Prepare the estimate adding contingencies.

15. Understand the principle of testing of electrical installation.

- 15.1 Describe the tests to be carried out after completion of wiring of a building.
- 15.2 Describe the tests to be performed after installation of a motor.
- 15.3 Describe the tests to be performed after installation of a transformer.
- 15.4 Sketch the developed diagrams of full pitch and fractional pitch winding of a three-phase induction motor.
- 15.5 Sketch the developed winding diagram of a single phase induction motor.
- 15.6 Estimate the required materials and costs for rewinding of a burnt out induction motor.
- 15.7 Describe the methods of testing winding of electrical machine.

PRACTICAL:

- 1. Measure the illumination level of a surface.**
 - 1.1 Select the lumen meter.
 - 1.2 Measure the illumination level in your wiring lab/ class room.
 - 1.3 Compare the obtained reading with the calculated value.
- 2. Plan and estimate for electrification of a class room.**
 - 2.1 Sketch the layout plan and single line wiring diagram of a class room.
 - 2.2 Sketch the wiring and circuit diagram.
 - 2.3 Indicate the positions of electrical fittings in the plan.
 - 2.4 Find out the sizes of wire and main switch from the calculated load of main circuit and sub-circuits following electricity rules.
 - 2.5 Measure the distances of fittings from the main board & BDB and find out the length of the wire.
 - 2.6 List the materials in the schedule and find out the cost.
 - 2.7 Add labor charges from the schedule with material cost for the summary of estimate.

3. Plan and estimate for electrification of a single storied residential building.

- 3.1 Sketch the layout plan of a single storied residential building of about 1250 square feet plinth area in a five decimal land with boundary wall and gate showing the position of electric pole for service connection.
- 3.2 Sketch the wiring and circuit diagrams and show the service connection.
- 3.3 Show the positions of electrical fittings in the plan.
- 3.4 Find out the size of wire, main switch, BDB, fuse or MCB from the calculated load of circuit and sub circuit.
- 3.5 Measure the distance of the fittings from the board to find out the length of wires.
- 3.6 List the materials in the schedule of materials and find out the cost.
- 3.7 Add labor charge from the schedule with the material cost for the summary of the estimate.

4. Plan and estimate for electrification of a multistoried building.

- 4.1 Sketch the elevation and floor plan of the building.
- 4.2 Sketch the wiring and circuit diagrams of a flat.
- 4.3 Show the positions of the fittings in a flat.
- 4.4 Find out the size of wires, main switch, fuse or MCB.
- 4.5 Measure the distance of the fittings from the board to find out the length of wire.
- 4.6 Identify the rising main and power distribution system.
- 4.7 Prepare the estimate for electrification of the building.

5. Plan and estimate for electrification of an electrical machine shop.

- 5.1 Sketch the layout plan and single line wiring diagram of the shop.
- 5.2 Sketch the wiring and circuit diagrams.
- 5.3 Indicate the positions of the fittings in the plan.
- 5.4 Find out the size of wires, main switch, fuse or MCB.
- 5.5 Measure the distance of the fittings from the board to find out the length of wire.
- 5.6 List the materials in the schedule of materials and find out the cost.
- 5.7 Add labor charge with the cost of material for the summary of estimate.

6. Perform Channel wiring.

- 6.1 Sketch the layout plan.
- 6.2 Sketch the wiring and circuit diagrams.
- 6.3 Indicate the positions of the fittings.
- 6.4 Find out the size of wire, main switch, fuse/MCB.
- 6.5 Measure the distance of the fittings from the main switch.
- 6.6 Estimate the cost including labour charges.
- 6.7 Mark the position of the fittings.
- 6.8 Fix up the rowel plugs on the wall.
- 6.9 Fix up boards and casing on wall.
- 6.10 Fasten wires.
- 6.11 Fix up switches and outlets.
- 6.12 Fix up the energy meter, cut-out MCB and main switch.
- 6.13 Connect power supply.

7. Determine cable size from cable catalogue.

- 7.1 Calculate the load of main circuits and sub-circuits of different installations.
- 7.2 Find out the corresponding suitable cable size from the catalogue allowing safety factor.
- 7.3 Find out the size of the cables by using SWG
- 7.4 Find out the size of the cables in respect of RM & RE

8. Install a single phase/three phase service connection.

- 8.1 Sketch the layout plan showing single line service connection from the nearest pole to the service entrance of the building.
- 8.2 Determine the total electrical load of the installation.
- 8.3 Measure the distance from the meter at premises to the nearest electric pole.

- 8.4 Prepare the material cost.
- 8.5 Add labor charges.
- 8.6 Add contingencies
- 8.7 Add lump sum for petty stores like cement, bricks and sand etc.
- 8.8 Prepare the summary of estimate.
- 8.9 Procure the materials and hand tools.
- 8.10 Fix up brackets, service pipe and insulators.
- 8.11 Draw two GI guard wires with carlings (use draw vice).
- 8.12 Draw the single core PVC wires through the pipe up to the meter inside the premises.
- 8.13 Connect one aerial fuse with the phase.

9. Perform the installation of three phase induction motor.

- 9.1 Sketch the layout plan and single line wiring diagram of the motor connection.
- 9.2 Indicate the position of the motor, main switch and starter.
- 9.3 Measure the distance of the motor, starter and main switch from the supply main.
- 9.4 Find out the sizes of wires, main switch and starter.
- 9.5 Prepare the material cost.
- 9.6 Add labor charges with the cost of materials for the summary estimate.
- 9.7 Add contingencies.
- 9.8 Following electricity rules connect the mains and operate the motor.
- 9.9 Install the components and connect to the power source and observe the performance.

10. Re-wind of a single phase induction motor

- 10.1 Calculate the size of conductor, number of coils and number of turns in a coil.
- 10.2 Sketch the develop winding diagram of the induction motor.
- 10.3 Make necessary grouping on the basis of the layout plan for winding.
- 10.4 Find out the types and sizes of wire required for the winding.
- 10.5 Determine the number of turns required on the basis of the coil grouping per phase and layer of winding.
- 10.6 Estimate the cost involved to rewind the motor.
- 10.7 Collect required tools and materials to rewind the motor.
- 10.8 Rewind the motor.
- 10.9 Energize the motor after performing necessary tests.
- 10.10 Measure the RPM of the motor.

11. Re-wind a three phase induction motor.

- 11.1 Calculate the number of coils, size of conductor and number of turns in a coil of the motor.
- 11.2 Sketch the developed diagram for winding of the induction motor.
- 11.3 Make necessary grouping of coils.
- 11.4 Find out the types and sizes of wire required for the windings.
- 11.5 Determine the number of turns required on the basis of the coil grouping per phase and layer of winding.
- 11.6 Estimate the cost involved to rewind the motor.
- 11.7 Collect required tools and materials to rewind the motor.
- 11.8 Rewind the motor performing all the steps sequentially.
- 11.9 Energize the motor after performing necessary tests.
- 11.10 Measure the RPM of the motor.

12. Perform Installation of an earthing.

- 12.1 Select earth electrode, earth continuity conductor & other necessary materials.
- 12.2 Place the earth electrode into the ground after digging hole.
- 12.3 Put coal & salt into the hole.
- 12.4 Take out the continuity conductor from the earth electrode.

13. Prepare plan and estimate of a short distribution line.

- 13.1 Take the measurements of the route of the proposed distribution line.
- 13.2 Sketch the route showing substation, pole and consumer.
- 13.3 Prepare estimate.

14. Test an electrical installation (machine/equipment) before commissioning.

- 14.1 Select the machine/equipment to be tested.
- 14.2 Test continuity of the winding of the machine/equipment by AVO meter.
- 14.3 Test the insulation resistance within the coils by Megger.
- 14.4 Test the insulation resistance with the coils and body of the machine/equipment by Megger.
- 14.5 Measure the resistance of the earth point which will be connected to the body of the machine/equipment.

REFERENCE BOOKS:

1. Electrical Installation Planning & Estimating – J. B. Gupta.
2. Electrical Installing Planning and Costing – Uppal.
3. National Building Code.
4. PWD Rate Schedule.

66742

DC Machines

**T P C
3 3 4**

OBJECTIVES:

To provide the student with an opportunity to acquire knowledge, skill and attitude in the area of DC Machines with special emphasis on:

- Promote knowledge and skill on Cell & Battery and the process of electroplating.
- Provide understanding on DC generator.
- Develop knowledge and skill on DC motor.
- Maintain knowledge on characteristics of DC generator.
- Develop knowledge on electric traction.

SHORT DESCRIPTION

Cell and Battery: Principle, construction, uses and maintenance; Electroplating; DC Generator: Principle, construction, winding, losses, efficiency, characteristics and parallel operation; DC Motor: Principle, construction, torque/speed curves, efficiency, speed control, starting and tests; Electric traction.

DETAIL DESCRIPTION

Theory:

- 1. Understand the construction of different types of cell and battery.**
 - 1.1 Describe the construction of dry cell and its chemical reaction.
 - 1.2 Illustrate the construction of alkaline batteries.
 - 1.3 Describe the construction of lead acid battery and its chemical reaction.
- 2. Understand the features of battery charging.**
 - 2.1 Name the types of battery charging system.
 - 2.2 Describe the charging procedure of battery by 220-230VAC source.
 - 2.3 Explain the procedure of slow charging.
 - 2.4 Describe the procedure of quick charging.
 - 2.5 Describe the procedure of preparing electrolyte.
 - 2.6 Outline the construction of dry charged battery.
 - 2.7 Explain the charging procedure of sulfated battery.
 - 2.8 Describe the process of charging more than one battery at a time.
- 3. Understand the efficiency and testing of batteries.**
 - 3.1 Describe the internal resistance and efficiency of a battery.
 - 3.2 Explain ampere – hour (A - H) rating of battery.
 - 3.3 Solve problems related with internal resistance affecting terminal voltage.
 - 3.4 List factors on which the capacity of a battery depends.
 - 3.5 Describe the procedures of testing a storage battery by hydrometer, voltmeter and ammeter.
 - 3.6 State the maintenance and routine inspection procedure of a battery.
- 4. Understand the process of electroplating.**
 - 4.1 State fundamental principles of electroplating.
 - 4.2 State Faraday's laws of electrolysis.
 - 4.3 Describe briefly the process of extraction and refining of metals.
 - 4.4 State a simple method of producing copper plating upon a carbon brush.
 - 4.5 Describe electro-deposition process.
 - 4.6 Identify power supply for electrolytic process adopted in electroplating.
- 5. Understand the working principle of DC generator.**
 - 5.1 State generator principle.

- 5.2 Mention the types or Classification of DC generator.
- 5.3 Mention the conditions for generation of emf in a single coil generator.
- 5.4 Describe the constructional details of a DC generator.
- 5.5 Explain the functions of different parts/components of a DC generator.
- 5.6 Sketch the magnetic circuit of a DC generator.
- 5.7 Express the deduction of the emf equation of a DC generator.
- 5.8 List the various losses in a DC generator.
- 5.9 Explain power stages of a DC generator.
- 5.10 Express the condition for maximum efficiency.
- 5.11 Solve problems relating to DC generator.

6. Understand the principle of winding of DC generator.

- 6.1 Define the terms pole pitch, coil pitch, front pitch, back pitch, average pitch and commutation pitch.
- 6.2 Describe lap and wave winding.
- 6.3 Sketch the developed diagram of simplex and duplex (lap and wave) winding.
- 6.4 Name at least four major differences between the lap and wave windings.

7. Understand the armature reaction and commutation of DC generator.

- 7.1 Explain armature reaction.
- 7.2 Describe the effect of armature reaction.
- 7.3 State de-magnetizing and cross magnetizing.
- 7.4 Explain the action of commutation.
- 7.5 Identify the value of reactance voltage.
- 7.6 Mention the methods of improving commutation.
- 7.7 Explain the necessity of interpoles and compensating winding.
- 7.8 State the need for equalizing bar and rings.

8. Understand the principle of excitation.

- 8.1 Explain the excitation of DC generator.
- 8.2 Explain the necessity of excitation.
- 8.3 Mention self excited and separately excited generator.
- 8.4 Describe the condition for excitation.

9. Understand the characteristics of DC generator.

- 9.1 Explain the process of building up voltage of shunt generator.
- 9.2 State the critical resistance and critical speed for shunt generator.
- 9.3 Plot the terminal voltage Vs load current characteristic curve of shunt generator.
- 9.4 State the reasons for decreasing terminal voltage with increasing load.
- 9.5 Plot the internal and external characteristic curve of DC shunt, series and compound generator.
- 9.6 Solve related problems relating to shunt generator

10. Understand the concept of voltage regulation and efficiency of a DC generator.

- 10.1 Explain the formula for voltage regulation of a DC generator.
- 10.2 Discuss the importance of voltage regulation of DC generator.
- 10.3 Solve problems relating to voltage regulation of DC generator.
- 10.4 Express the formula for efficiency of a DC generator.
- 10.5 Solve problems relating to efficiency of a DC generator.

11. Understand the principle of parallel operation of DC generator.

- 11.1 State the need for parallel operation of DC generator (shunt, series and compound)
- 11.2 List the conditions for parallel operation of DC generator.
- 11.3 Discuss the condition of sharing loads in DC generators operating in parallel.
- 11.4 Draw the circuit diagram of two long shunt compound generators connected in parallel.
- 11.5 Calculate the load shared by individual machine at the time of parallel operation.

12. Understand the working principle of DC motor.

- 12.1 Explain the working principle of DC motor.
- 12.2 Mention the types or Classification of DC Motor.

- 12.3 Explain generator action of motor.
- 12.4 Explain the significance of the back emf.
- 12.5 Express the deduction of voltage equation of motor.
- 12.6 Define the term torque (mentioning its unit), running torque and break down torque.
- 12.7 Express the deduction of equation for speed of DC motor (for series and shunt motors).
- 12.8 Plot the torque/speed curve of series, shunt and compound motors.

13. Understand losses and efficiency.

- 13.1 State the losses in DC motor.
- 13.2 Calculate the efficiency of DC motor from a given data.
- 13.3 Explain the power stages of DC motor.

14. Understand the starting methods and speed control of DC motor.

- 14.1 Describe the factors controlling the speed of DC motor.
- 14.2 Discuss the general methods of speed control of DC motor.
- 14.3 Explain speed control of shunt, series and compound motor.
- 14.4 Mention the merits and demerits of rheostat control method.
- 14.5 Describe electric braking of shunt and series motor.
- 14.6 Explain the necessity of a starter for DC motor.
- 14.7 Describe three point and four point starter used in DC motor.
- 14.8 Explain the heating and cooling of DC machine.
- 14.9 Explain brake test and no-load test of DC motor.

15. Understand the system of electric traction.

- 15.1 State the meaning of electric traction.
- 15.2 Describe the system of electric traction.
- 15.3 List the characteristics of an ideal traction system.
- 15.4 Describe the feeding and distribution system for tram ways and trolley buses.
- 15.5 Explain the diesel electric drive, battery electric drive and electric drive of locomotives.
- 15.6 Explain the working principle of tram ways and trolley buses.
- 15.7 Explain the DC system used in traction.
- 15.8 Explain the reasons for using DC series motor for traction purpose.

16. Understand the concept of speed control of traction motors.

- 16.1 Explain different methods of speed control of DC traction motors.
- 16.2 Explain starting methods and speed control of DC series motor.
- 16.3 Explain starting method of 3-phase induction motor used in traction.
- 16.4 Explain speed control system of 3-phase induction motor used in traction.
- 16.5 Explain different braking systems.
- 16.6 Explain the systems of supplying power in electric traction.

PRACTICAL:

1. Charge a lead acid battery.

- 1.1 Sketch the connection diagram for constant potential/Constant current method of charging.
- 1.2 Identify the equipment and materials for charging a lead acid battery.
- 1.3 Record the readings by measuring the terminal voltage of the discharged battery and specific gravity of electrolytes.
- 1.4 Connect the positive and negative terminal of the battery to the positive and negative terminals of the charger respectively.
- 1.5 Set the charging voltage and switch on the charger.
- 1.6 Record the readings by measuring the specific gravity of electrolyte and the terminal voltage of the battery.

2. Measure the internal resistance of a battery.

- 2.1 Sketch necessary circuit diagram.
- 2.2 Connect a resistance (known value) with the battery.
- 2.3 Record the readings by measuring the voltage and current of the battery.
- 2.4 Calculate the internal resistance of a battery

3. De-assemble and re-assemble the parts of a DC generator/ DC motor.

- 3.1 Select the necessary tools required for de-assembling and re-assembling the parts of DC generator/ DC motor.
- 3.2 Identify at least ten main parts of the generator/motor.
- 3.3 Sketch at least ten main parts of the generator/motor.
- 3.4 Re-assemble the parts of the generator/motor.
- 3.5 Connect the generator/motor to the proper power source.
- 3.6 Start the generator/motor.

4. Develop 4 poles, 24 slots; double layer lap winding (simplex & duplex) of a DC generator.

- 4.1 Select pole pitch, back pitch, front pitch and commutator pitch for the generator.
- 4.2 Sketch the developed winding diagram (simplex and duplex) showing the position of carbon brushes.
- 4.3 Select the coil turns, coil number and coil grouping for the winding.
- 4.4 Select the sizes and types of wires required for the winding.
- 4.5 Construct required number of coils.
- 4.6 Insert the coils into the slot using the proper insulation.
- 4.7 Connect the coils in proper way.
- 4.8 Test the winding step by step.
- 4.9 Note down the observations.

5. Develop a 4 poles, 16 slots, double layer wave winding (simplex & duplex) of a DC generator.

- 5.1 Identify pole pitch, back pitch, front pitch, commutator pitch.
- 5.2 Sketch the developed winding diagram (simplex & duplex) showing the position of carbon brushes.
- 5.3 Determine the number of turns required on the basis of coil grouping and layer of winding.
- 5.4 Determine the size and type of wires required for the winding.
- 5.5 Perform winding.

6. Determine generated emf of a DC shunt generator.

- 6.1 Sketch the required diagram of the shunt generator.
- 6.2 Set the experiment as per diagram.
- 6.3 Start the generating set and build up the voltage.
- 6.4 Measure the developed emf by starting the generator.
- 6.5 Record the required data.
- 6.6 Plot the I_f versus V_g curve from the data.

7. Plot the V_L - I_L characteristic curves of a shunt generator.

- 7.1 Sketch the required diagram for the experiment.
- 7.2 List the materials, meters and equipment required for the experiment.
- 7.3 Connect all the meters and equipment as per diagram.
- 7.4 Record the necessary readings from the meters.
- 7.5 Plot the V_L - I_L curve from the data.

8. Plot the V_L - I_L characteristic curve of a series generator.

- 8.1 Sketch the required diagram for the experiment.
- 8.2 List the required instruments & materials.
- 8.3 Connect all the meters and equipment as per diagram.
- 8.4 Record the necessary readings from the meters.
- 8.5 Plot the V_L - I_L curve from the data.

9. Plot the V_L - I_L characteristic curve of a compound generator.

- 9.1 Sketch the required diagram for the experiment.
- 9.2 List the required instruments & materials.
- 9.3 Connect all the meters and equipment as per diagram.
- 9.4 Record the necessary readings from the meters.
- 9.5 Plot the V_L - I_L curve from the data.

10. Run the two DC shunt generators in parallel.

10.1 Sketch the required diagram.

10.2 List tools and materials required for the experiment.

10.3 Connect the machines as per diagram.

10.4 Check connection and start incoming machine.

10.5 Observe the voltage of incoming machine and compare this with bus bar voltage.

10.6 Switch on the incoming machine with the bus bar when it is ready.

11. Run a small size DC shunt motor and control its speed.

11.1 Sketch the required diagram.

11.2 List tools and materials required.

11.3 Connect the machine as per diagram.

11.4 Start the machine.

11.5 Regulate speed of the motor.

12. Start a DC compound motor by a four point starter.

12.1 Sketch the required diagram for the experiment.

12.2 List the tools and materials required.

12.3 Connect the machine as per diagram.

12.4 Start the motor with the help of four point starter.

REFERENCE BOOKS:

1. A Text Book of Electrical Technology – B. L. Theraja

2. Electrical Machines – Siskind

3. DC Machines – Samadder & Gongopadhyay

4. A course in Electrical Power – J. B. Gupta

5. Automotive Electrical Equipment – H.W. Crouse, P.L. Kohli

66845

INDUSTRIAL ELECTRONICS

T P C

2 3 3

AIMS

- To develop the knowledge and skill on using semiconductor diode in power electronics.
- To familiarize with power switching device.
- To develop the knowledge & skill on inverter , Chopper & Cycloconverter
- To familiarize dc and ac control drive.
- To develop knowledge & skill on photo diode, Photo Transistor & Photo Resistor .
- To develop knowledge & skill on Solar Power system.
- To develop knowledge & skill on UPS, IPS & AVR.
- To develop knowledge & skill on electronic safety system.

SHORT DESCRIPTION

Power switching devices, Semiconductor diode in power electronics, Inverter, Chopper , Cycloconverter , Control of ac and dc drives, Photo diode , Photo Transistor , Photo Resistor , Solar Power system , UPS,IPS , AVR & safety system

DETAIL DESCRIPTION

Theory:

1. Understand the Concept of Power Electronics and Power diode.

- 1.1 Define the term power electronics.
- 1.2 Mention the scope and application of power electronics.
- 1.3 List the merits and demerits of power electronics.
- 1.4 Mention the types of power semiconductor devices.
- 1.5 List the characteristics of different types of Power diode.
- 1.6 Mention the V-I characteristics of series connected diodes.
- 1.7 Mention the V-I characteristics of parallel connected diodes.

2. Understand the features of power Transistor.

- 2.1 Classify power transistor.
- 2.2 Describe the construction and operation of IGBT.
- 2.3 Compare IGBT with MOSFET.
- 2.4 Mention the application of IGBT.
- 2.5 Describe the construction and operation of MCT.

3. Understand the features of GTO

- 3.1 Describe the construction of GTO.
- 3.2 Mention turn-on and turn-off process of GTO.
- 3.3 Identify Gold-doped and anode-shorted GTO.
- 3.4 Compare between GTO and thyristor.

4. Understand the features of Inverter.

- 4.1 Define inverter.
- 4.2 Mention the basic principle of line-commuted and force commuted inverter.
- 4.3 Describe the operation of single-phase line-commutated full-controlled inverter.
- 4.4 Describe the operation of three-phase line-commutated full-controlled inverter.
- 4.5 Explain single-phase parallel-capacitor commutated inverter.
- 4.6 Describe the operation of single-phase parallel inverter with feedback diodes.
- 4.7 Describe the operation of single-phase series inverter.
- 4.8 Describe the operation of three phase forced-commutated bridge inverter.

5. Understand the features of choppers.

- 5.1 Define chopper.
- 5.2 Mention the principle of operation of chopper.

5.3 Describe the operation of voltage step-down chopper.

5.4 Explain the operation of voltage step-up chopper.

5.5 Explain the operation of ac chopper.

6. Understand the features of cycloconverter.

6.1 Define cycloconverter.

6.2 Mention the types of cycloconverter.

6.3 Describe the operation of single phase/single phase (mid-point and bridge configuration) cycloconverter.

6.4 Analyze the operation of three phase / single phase (circulating and non circulating type) cycloconverter.

6.5 Describe the operation of a three phase/three phase cycloconverter.

7. Understand the features of dc drives.

7.1 Define electric drive.

7.2 Mention the elements of electric drive using power electronic converter.

7.3 State the basic performance equation of dc motor.

7.4 Explain the principle of operation of single phase (a) Half wave converter drive (b) full wave semi converter drive, (c) full wave full converter drive.

7.5 Explain the principle of operation of three phases (a) Half wave converter drive (b) full wave semi converter drive, (c) full wave full converter drive.

8. Understand the Features of photo resistors , photo diodes and Photo transistors

8.1 Describe the basic structure of photo resistors , photo diodes and photo transistors

8.2 Explain the operating principles of photo resistors, photo diodes and photo transistors.

8.3 List typical application of photo resistors, photo diodes and photo transistors.

8.4 Explain a block Diagram showing how photo Detectors used in speed measuring system

8.5 Explain the operation of photo diode & photo transistor switching circuit.

9. Understand Solar Power System.

9.1 Define Photovoltaic (PV) effect.

9.2 Describe the operation of a solar cell.

9.3 List the materials suitable for solar cell.

9.4 Discuss series/parallel operation in solar panel.

9.5 Mention the types of PV power system.

9.6 Describe the operation of various types of charge controllers.

10. Understand the features of induction and dielectric Heating.

10.1 Define induction and dielectric heating.

10.2 Describe the principle of induction and dielectric heating.

10.3 List the effects of frequency on induction and dielectric heating.

10.4 Mention the effects of source voltage on induction and dielectric heating.

10.5 Describe the factors for choosing frequency of induction and dielectric heating.

10.6 List the advantages and applications of Induction and dielectric heating.

11. Understand the Features of Power Supply

11.1 Explain the principle and operation of SMPS with block and circuit diagram.

11.2 Explain the principle and operation of UPS and IPS with block diagram.

11.3 Explain the principle and operation of automatic voltage regulator (AVR).

12. Understand the features of safety system.

12.1 Define electronic safety system and Fire Sensor.

12.2 Mention the types of Fire sensor.

12.3 Explain the operation of the Fire detection system with block diagram.

12.4 Describe the operation of touch and non touch type person (thief) detector using infrared detection system with block diagram.

Practical:

1. Determine the V-I characteristics of series/parallel connected diodes.

- 1.1 Select an appropriate circuit, required materials, tools and equipments for the experiment.
- 1.2 Connect the circuit as per diagram with meters.
- 1.3 Check the circuit and switch on the power supply.
- 1.4 Record the data for V-I curve.
- 1.5 Plot the curve.

2. Determine the V-I characteristics of IGBT.

- 2.1 Select an appropriate circuit, required materials, tools and equipments for the experiment.
- 2.2 Connect the circuit as per diagram with meters.
- 2.3 Check the circuit and switch on the power supply.
- 2.4 Record the data for I-V curve.
- 2.5 Plot the curve.

3. Determine the V-I characteristics of GTO.

- 3.1 Select an appropriate circuit, required materials, tools and equipments for the experiment.
- 3.2 Connect the circuit as per diagram with meters.
- 3.3 Check the circuit and switch on the power supply.
- 3.4 Record the data for I-V curve.
- 3.5 Plot the curve.

4. Study the operation of inverter circuit.

- 4.1 Select an appropriate circuit for experiment.
- 4.2 Select required tools, equipments and materials.
- 4.3 Connect the circuit as per diagram with Oscilloscope.
- 4.4 Check the connection and switch on the power supply.
- 4.5 Observe the output wave shapes of the circuit.

5. Construct the step down & step up operation of dc choppers.

- 5.1 Select an appropriate circuit for experiment.
- 5.2 Select required tools, equipments and materials.
- 5.3 Connect the circuit as per diagram.
- 5.4 Check the connection and switch on the power supply.
- 5.5 Measure the input and output voltage.

6. Study the operation of Cycloconverter.

- 6.1 Select an appropriate circuit for experiment.
- 6.2 Select required tools, equipments and materials.
- 6.3 Connect the circuit as per diagram.
- 6.4 Check the connection and switch on the power supply.
- 6.5 Measure the input and output frequency with Oscilloscope/frequency counter.

7. Determine the V-I characteristics curve of photo diode/photo transistor.

- 7.1 Select an appropriate circuit, required materials, tools and equipments for the experiment.
- 7.2 Connect the circuit as per diagram with meters.
- 7.3 Check the circuit and switch on the power supply.
- 7.4 Record the data for I-V curve with different light intensity.
- 7.5 Plot the curve.

8. Study the operation of a Solar system.

- 8.1 Select an appropriate Solar system for experiment.
- 8.2 Select required tools, equipments and materials.
- 8.3 Connect the circuit as per diagram.
- 8.4 Check the connection.
- 8.5 Observe output condition.

9. Study the operation of SMPS.

- 9.1 Select an appropriate SMPS.
- 9.2 Select required tools, equipments and materials.
- 9.3 Switch on the power supply.
- 9.4 Vary input voltage and observe output voltage.

10. Study the operation of UPS/IPS.

- 10.1 Select an appropriate UPS/IPS.
- 10.2 Select required tools, equipments and materials.
- 10.3 Switch on the power supply.
- 10.4 Disconnect main supply and observe output condition.

11. Visit a place where fire safety system is used.

REFERENCES:

- 1 Power Electronics Hand Book - Muhammad H. Rashid
- 2 Industrial Electronics and Control - Biswanath Paul
- 3 Industrial and Power Electronics - G. K. Mithal, Dr. Maneesha Gupta
- 4 Power Electronics - Dr. P. S. Bhimbra
- 5 Introduction to Power Electronics- Denis Fewson

67045

Applied Mechanics

T P C
2 3 3

AIMS:

- To facilitate understanding the fundamental of units and their conversions.
- To provide the understanding of force, effect of the force, composition and resolution of forces and computing the resultant force & couple
- To provide the understanding of parallel forces
- To provide understanding the centroid and enable to computing the center of gravity & the moment of inertia.
- To enable to understand the laws of friction and the coefficient of friction & the ability of computing frictional forces of reactions of surfaces.
- To provide to understanding of deriving support reactions and types of loading of beam and trusses.
- To facilitate the understanding of work, power, energy.

SHORT DESCRIPTION

Applied mechanics and unit conversion, Composition and resolution of forces. Moment and their applications. Equilibrium of force and couples, centroid, center of gravity and moment of inertia. Friction, support reactions, frame and truss, projectiles, work, power and energy.

Theory:

1. Understand Fundamental of Mechanics.

- 1.1. Define mechanics.
- 1.2. Classify applied mechanics.
- 1.3. Importance of units in the engineering field.
- 1.4. Discuss the conversion of units.
- 1.5. Illustrate the fundamental mathematics (algebra, trigonometry & calculus) used in mechanics.

2. Understand the composition and resolution of forces.

- 2.1. State the effect and characteristics of a force.
- 2.2. Mention different system of forces.
- 2.3. Define resultant force and composition of forces.
- 2.4. Find the resultant force graphically and analytically.
- 2.5. State the laws of forces.
- 2.6. Define resolution of a force.
- 2.7. State the principle of resolution of force.
- 2.8. Express the deduction of the formula for finding the resolved part of a component.
- 2.9. Find the magnitude and position of the resultant force graphically and analytically
- 2.10. Solve problems related to resultant force.

3. Understand the aspects of moment of forces and couples.

- 3.1. Define moment of force and mention the units of moment.
- 3.2. Identify the clockwise and anticlockwise moment.
- 3.3. State the Varignon's principle of moments.
- 3.4. State the laws of moments.
- 3.5. Define and classify the lever.
- 3.6. State and classify parallel force.
- 3.7. Define and classify a couple.
- 3.8. Solve problems related to moment of forces and couple.

4. Understand the aspects of equilibrium of forces.

- 4.1. State the principles of equilibrium of forces.
- 4.2. State the Lame's theorem.
- 4.3. Express the derivation of Lame's theorem.
- 4.4. Describe different methods of the equilibrium of coplanar forces and non-coplanar forces.
- 4.5. Explain the conditions of equilibrium.
- 4.6. Mention the various types of equilibrium of forces.
- 4.7. Solve problems related to equilibrium of forces.

5. Understand the concept of centroid and center of gravity.

- 5.1. Define center of gravity and centroid.
- 5.2. Distinguish between center of gravity and centroid.
- 5.3. Explain the methods of finding out centroid of simple geometrical figure.
- 5.4. Identify the axis of reference and axis of symmetry.
- 5.5. Determine the centroid of rectangle, triangle, semicircle, geometrically and by integration.
- 5.6. Determine the centroid of plain geometrical figure by principle of first moments.
- 5.7. Calculate the centroid of various composite areas.
- 5.8. Calculate the center of gravity of solid bodies.

6. Understand the application of moment of inertia.

- 6.1. Explain the term moment of inertia and the units of moment of inertia.
- 6.2. Express the derivation of the formulae for moment of inertia of an area.
- 6.3. Describe the methods for finding out the moment of inertia.
- 6.4. Find the moment of inertia of simple areas by the method of integration.
- 6.5. State and proof of the theorem of perpendicular axis as applied to moment of inertia.
- 6.6. State the parallel axis theorem in the determination of moment of inertia of areas.
- 6.7. Explain the radius of gyration and section modulus.
- 6.8. Calculate the moment of inertia and section modulus of composite sections and simple solid bodies.

7. Understand the principles and application of friction

- 7.1. Define friction.
- 7.2. Identify the types of friction.
- 7.3. Advantage and disadvantage of friction.
- 7.4. State the laws of static and dynamic friction.
- 7.5. Explain the angle of friction.
- 7.6. Explain coefficient of friction.
- 7.7. Explain free body diagrams of a body lying on horizontal, inclined and vertical surfaces.
- 7.8. Determine the frictional force of a body lying on horizontal and inclined surfaces.

8. Understand the fundamentals of support reaction on beams and Truss

- 8.1. Explain support reactions.
- 8.2. Identify types of beam.
- 8.3. Explain the types of loading on beams.
- 8.4. Determine the support reactions of simple and cantilever beam with different loading condition.
- 8.5. Define the support reactions of roller supported beam.
- 8.6. Define frame.
- 8.7. Identify the frames and trusses with their end supports.
- 8.8. State the method of finding support reactions and forces on the member of the frame.
- 8.9. Calculate the support reactions and forces on different end support of simple truss by joint method and section method.

9. Understand the aspects of work, power and energy.

- 9.1. Define work, power and energy.
- 9.2. State the units of work, power and energy.

- 9.3. Explain the work done in rotation.
- 9.4. Mention the types of engine power.
- 9.5. Define and classify engine efficiency.
- 9.6. Mention types of energy.
- 9.7. Explain the derivation of the equation of kinetic & potential energy.
- 9.8. Solve problems related to work, power and energy.

10. Understand the aspect of stress and strain.

- 10.1 Define stress, strain, modulus of elasticity, Poisson's ratio and principle of shear stress.
- 10.1. Explain the stress in composite bar, stress in nuts and bolts, stress due to change in temperature.
- 10.2. Describe the linear and lateral strain.
- 10.3. Explain the stress strain diagram.
- 10.4. Solve problems on stress and strain.

PRACTICAL:

1. Determine the resultant force by using force board.

- 1.1 Set up the force board.
- 1.2 Set up the accessories on the force board.
- 1.3 Find the resultant force.
- 1.4 Calculate the magnitude of resultant force.
- 1.5 Compare the calculated values with experimental values.

2. Determine the compression load using crane boom.

- 2.1 Set up the crane boom.
- 2.2 Set up the accessories on the crane boom.
- 2.3 Find the compression load on the jib.
- 2.4 Calculate the compression analytically.
- 2.5 Compare the experimental values with analytical values.

3. Determine the equilibrium force by using Kennon force table.

- 3.1 Set up the Kennon force table.
- 3.2 Set up the accessories on the Kennon force table.
- 3.3 Find the magnitude and direction of a force establishing equilibrium.
- 3.4 Calculate the magnitude and direction of equilibrium force.
- 3.5 Compare the calculated values with experimental values.

4. Determine the center of a triangular lamina.

- 4.1 Select a triangular lamina and a plumb bob.
- 4.2 Set up the plumb bob.
- 4.3 Find the center point of the triangular lamina.

5. Determine the center of gravity of solid body.

- 5.1 Select solid bodies such as solid rod, step rod and body with cut out holes.
- 5.2 Select a fulcrum.
- 5.3 Set up the fulcrum.
- 5.4 Find the center point.
- 5.5 Compare the analytical values with experimental values.

6. Determine the co-efficient of friction.

- 6.1 Set up the friction apparatus.
- 6.2 Select the materials of which coefficient of friction are to be determined.
- 6.3 Place the materials over each other.
- 6.4 Raise one end of the body until the other body slides down.
- 6.5 Find the angle of friction.
- 6.6 Find the co-efficient of friction.

- 7. Determine the action of load on the member of simple frame or truss.**
 - 7.1 Select two members of which one end roller and other end pin point.
 - 7.2 Select a tension spring.
 - 7.3 Make a unit as a simple frame or truss.
 - 7.4 Apply the load.
 - 7.5 Read the tension load on spring.
- 8. Determine the torque of engine by prony brake.**
 - 8.1 Set up the prony brake with the engine flywheel.
 - 8.2 Tighten the hand wheel of prony brake.
 - 8.3 Measure the length of torque arm.
 - 8.4 Start the engine.
 - 8.5 Take the reading of spring scale.
 - 8.6 Find the torque of engine.
 - 8.7 Compare the calculated values with the manufacturers' recommended values.
- 9. Determine the BHP of an engine by chassis dynamometer.**
 - 9.1 Place the vehicle on chassis dynamometer.
 - 9.2 Start the vehicle engine.
 - 9.3 Transmit power at different gear position.
 - 9.4 Find the B. H. P. of the engine by chassis dynamometer at different speeds.
 - 9.5 Compare the experimental value with the manufactures' recommended value.

REFERENCE BOOKS

- | | |
|--------------------------|----------------|
| 1 Applied Mechanics | — R. S. Khurmi |
| 2 Applied Mechanics | — R. K. Jain |
| 3 Applied Mechanics | — Fairries |
| 4 Analytical Mechanics | — Faires& Nash |
| 5 Mechanics of Materials | — Morgan |

66631

Programming Essentials

T P C
2 3 3

OBJECTIVES

- To develop knowledge and skill on programming Basics.
- To develop knowledge and skill to create, compile, debug & execute a program.

SHORT DESCRIPTION

Basics of programming Language; Basics of Python; Variables; Data types; Strings; Operators; Decision making and Looping statements; Lists; Tuples; Functions; File operations;

DETAIL DESCRIPTION

Theory:

1. Basics of Programming.

- 1.1. State Computer Program and Programming.
- 1.2. Explain Programming Language and its classification.
- 1.3. State Generation of Programming Languages.
- 1.4. Describe Translator Program.
- 1.5. Uses of Computer Programs.
- 1.6. Describe Algorithm and Flowchart.
- 1.7. Prepare Algorithm and Flowchart for simple problems.
- 1.8. Explain the Process of Program Planning.

2. Basics of Python.

- 2.1. Describe the History of Python.
- 2.2. Explain the features of Python.
- 2.3. Describe the Structure of Python Program.
- 2.4. State Identifiers and Keywords.
- 2.5. State Lines, Indentation, Multi-Line Statements and Multiple Statements on a Single Line.
- 2.6. State Quotation and Comments in Python.
- 2.7. State Command Line Arguments.

3. Variable and Data Types.

- 3.1. Assigning Values to Variables.
- 3.2. State Multiple Assignments.
- 3.3. Describe Standard Data Types.
- 3.4. Explain Data Type Conversion.

4. STRINGS.

- 4.1. State Accessing Values in Strings and Updating Strings.
- 4.2. Uses of Escape Characters.
- 4.3. Explain String Special Operators and String Formatting Operator.
- 4.4. Describe Triple Quotes and Unicode String.
- 4.5. Write Simple programs using strings.

5. PYTHON OPERATORS.

- 5.1. State Operators and their types.
- 5.2. Describe Arithmetic Operators, Comparison Operators and Logical Operators.
- 5.3. State Assignment Operators, Bitwise Operators and Membership Operators Identity Operators.
- 5.4. Explain Operators Precedence.

6. DECISION MAKING.

- 6.1. Describe the conditional and unconditional branching flow.
- 6.2. Explain If Statement and If...else Statement.
- 6.3. State the nested if Statement.
- 6.4. Write simple program using if, if...else and nested if.

7. LOOPS.

- 7.1. Describe the conditional and unconditional Looping flow.
- 7.2. State for Loop.
- 7.3. State While Loop.
- 7.4. Explain The Infinite Loop and Nested Loops.
- 7.5. State Break, Continue and pass Statement.
- 7.6. Write simple program using for and while loop.

8. LISTS

- 8.1. Define Lists and its type.
- 8.2. Assigning Values in Lists.
- 8.3. Explain Updating and Deleting List Elements.
- 8.4. State Basic List Operations.
- 8.5. Explain Built-in List Functions and Methods.
- 8.6. Write simple program using Lists.

9. TUPLES

- 9.1. Assigning Values in Tuples.
- 9.2. Explain Updating and Deleting Tuple Elements.
- 9.3. Describe Basic Tuples Operations.
- 9.4. State No Enclosing Delimiters.
- 9.5. Explain Built-in Tuple Functions.
- 9.6. Write simple program using Tuples.

10. FUNCTIONS

- 10.1. Defining a Function.
- 10.2. State Calling a Function.
- 10.3. Explain Passing by Reference Versus Passing by Value.
- 10.4. Describe Function Arguments.
- 10.5. Uses of Date and Time Functions.
- 10.6. Write simple program using functions.

11. FILES I/O

- 11.1. Printing to the Screen.
- 11.2. Reading Keyboard Input.
- 11.3. Uses of input Function.
- 11.4. Describe Opening and Closing Files.
- 11.5. Explain Reading and Writing Files.

PRACTICAL:

Perform skill to create, compile, debug & execute programs to solve specific problems.

1. Simple programs using basic structure of a programming Language (Python).

- 1.1. A program for printing a message.
- 1.2. A program for adding two integer numbers.

2. Simple programs using variables

- 2.1. A program to calculate the average of a set of N numbers.
- 2.2. A program to convert the given temperature in Fahrenheit to Celsius and vice versa.
- 2.3. A program to calculate the area of a circle.
- 2.4. Write similar programs using variables.

3. Programs using operators

- 3.1. A program to convert days to months and days.
- 3.2. A program to calculate the area of a triangle.
- 3.3. A program to compare two integer numbers.
- 3.4. Write similar programs using operators.

4. Programs using Branching Statements.

- 4.1. A program to select and print the largest of the three numbers.
- 4.2. A program to compute the roots of a quadratic equation.
- 4.3. Write similar programs using Branching Statements.

5. Programs using Looping Statements

- 5.1. A program to print odd or even numbers from 1 to 100.
- 5.2. A program to find the maximum or minimum number from a set of numbers
- 5.3. A program for searching prime numbers.
- 5.4. Write similar programs using Loop Statements.

6. Programs using Lists.

- 6.1. A program to sort numbers in ascending or descending order using one dimensional array.
- 6.2. A program to print numbers in two dimensional forms.
- 6.3. Write similar programs using Lists.

7. Programs using functions.

- 7.1. A program to calculate the area of a triangle using function.
- 7.2. A program that uses a function to sort an array of integers.
- 7.3. A program to calculate factorial of any integer using recursive function.
- 7.4. Write similar programs using functions.

8. Programs using files.

- 8.1. A program to store information to or to read information from file.
- 8.2. Write similar programs using files.

REFERENCE BOOKS:

- 1. Learning Python – Mark Lutz
- 2. Website List:
 - <http://python.howtocode.com.bd>
 - <http://www.learnpython.org>
 - <http://pythontutor.com>

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Business Organization & Communication

T P C

2 0 2

AIMS:

- To be able to understand the basic concepts and principles of business organization.
- To be able to understand the banking system.
- To be able to understand the trade system of Bangladesh.
- To be able to understand the basic concepts of communication and its types, methods.
- To be able to perform in writing, application for job, complain letter & tender notice.

SHORT DESCRIPTION:

Principles and objects of business organization; Formation of business organization; Banking system and its operation; Negotiable instrument; Home trade and foreign trade. Basic concepts of communication Communication model & feedback; Types of communication; Methods of communication; Formal & informal communication; Essentials of communication; Report writing; Office management; Communication through correspondence; Official and semi- official letters.

DETAIL DESCRIPTION:

Theory:

1 Concept of Business organization.

- 1.1 Define business.
- 1.2 Mention the objects of business.
- 1.3 Define business organization.
- 1.4 State the function of business organization.

2 Formation of Business organization.

- 2.1 Define sole proprietorship, partnership, Joint Stock Company, and co-operative
- 2.2 Describe the formation of sole proprietorship, partnership, joint stock Company, & co operative.
- 2.3 Mention the advantages and disadvantages of proprietorship, partnership and Joint Stock Company.
- 2.4 State the principles of Co operative & various types of Co operative.
- 2.5 Discuss the role of co-operative society in Bangladesh.

3 Basic idea of Banking system and negotiable instrument.

- 3.1 Define bank.
- 3.2 State the service rendered by bank.
- 3.3 Describe the classification of bank in Bangladesh.
- 3.4 State the functions of Bangladesh Bank in controlling money market.
- 3.5 State the functions of commercial Bank in Bangladesh
- 3.6 Mention different types of account operated in a bank.
- 3.7 Mention how different types of bank accounts are opened and operated.
- 3.8 Define negotiable instrument.
- 3.9 Discuss various types of negotiable instrument.
- 3.10 Describe different types of cheque.

4 Home & foreign trade

- 4.1 Define home trade.
- 4.2 Describe types of home trade.
- 4.3 Define foreign trade.
- 4.4 Mention the advantages and disadvantages of foreign trade.
- 4.5 Discuss the import procedure & exporting procedure.
- 4.6 Define letter of credit.
- 4.7 Discuss the importance of foreign trade in the economy of Bangladesh.

5 Basic concepts of communication

- 5.1 Define communication & business communication.
- 5.2 State the objectives of business communication.
- 5.3 Describe the scope of business communication.
- 5.4 Discuss the essential elements of communication process.

6 Communication model and feedback.

- 6.1 Define communication model.
- 6.2 State the business functions of communication model.
- 6.3 Define feedback.
- 6.4 State the basic principles of effective feedback.

7 Types and Methods of communication.

- 7.1 Explain the different types of communication;-
 - a) Two-way communication
 - b) Formal & informal communication
 - c) Oral & written communication
 - d) Horizontal & vertical communication
 - e) external & internal communication
 - f) Spoken & listening communication.
- 7.2 Define communication method.
- 7.3 Discuss the various methods of communication.
- 7.4 Distinguish between oral and written communication.

8 Essentials of communication.

- 8.1 Discuss the essential feature of good communication.
- 8.2 Describe the barriers of communication.
- 8.3 Discuss the means for overcoming barriers to good communication.

9 Report writing.

- 9.1 Define report, business report & technical report.
- 9.2 State the essential qualities of a good report.
- 9.3 Describe the factors to be considered while drafting a report.
- 9.4 Explain the components of a technical report.
- 9.5 Prepare & present a technical report.

10 Office management.

- 10.1 Define office and office work.
- 10.2 State the characteristics of office work.
- 10.3 Define filing and indexing.
- 10.4 Discuss the methods of filing.
- 10.5 Discuss the methods of indexing.
- 10.6 Distinguish between filing and indexing.

11 Official and semi-official letters.

- 11.1 State the types of correspondence.
- 11.2 State the different parts of a commercial letter.
- 11.3 Define official letter and semi-official letter.
- 11.4 Prepare & present the following letters: Interview letter, appointment letter, joining letter and application for recruitment. Complain letters, tender notice.

REFERENCE BOOK:

- 1.উচ্চ মাধ্যমিক ব্যবসায়নীতি ও প্রয়োগ -মোহাম্মদ খালেকুজ্জামান
- 2.উচ্চ মাধ্যমিক ব্যাংকিং ও বীমা -প্রফেসর কাজী নুরুল ইসলাম ফারুকী
- 3.আধুনিক কারবার পদ্ধতি -লতিফুর রহমান
- 4.কারবার যোগাযোগ ও সচিবের কার্যপদ্ধতি -প্রফেসর লতিফুর রহমান ও প্রফেসর কাজী নুরুল ইসলাম ফারুকী
- 5.ব্যবসায়িক যোগাযোগ এবং অফিসের কর্মপ্রণালী -ড. এম. এ. মানান
- 6.ব্যবসায় যোগাযোগ – মোহাম্মদ খালেকুজ্জামান ও মোঃ মুশাররফ হোসেন চৌধুরী
7. Business organization & management- M.C. Shukla
8. Business organization & management- R.N. Gupta



BANGLADESH TECHNICAL EDUCATION BOARD
Agargaon, Dhaka-1207

**4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)**

ELECTRICAL TECHNOLOGY
TECHNOLOGY CODE: **667**

5th SEMESTER

DIPLOMA IN ENGINEERING
PROBIDHAN-2016

ELECTRICAL TECHNOLOGY (667)

5th SEMESTER

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total	
						Theory		Practical			
						Cont. assess	Final exam	Cont. assess	Final exam		
1	66751	Electrical & Electronic Measurement -I	3	3	4	60	90	25	25	200	
2	66752	Generation of Electrical Power	3	3	4	60	90	25	25	200	
3	66753	Renewable Energy	2	3	3	40	60	25	25	150	
4	66856	Digital Electronics & Microprocessor	2	3	3	40	60	25	25	150	
5	69054	Environmental Studies	2	0	2	40	60	-	-	100	
6	65851	Accounting Theory & Practice	2	3	3	40	60	50	-	150	
Total			14	15	19	280	420	175	125	950	

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Electrical & Electronic Measurement-I

T P C

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OBJECTIVES

Upon completion of this contents students will be able to achieve and acquire knowledge, skill and attitude in the area of Electrical and Electronic measurement-1 with special emphasis on;

- Accuracy, precision, sensitivity and error in electrical measuring instruments.
- Concept of operation of different types of electrical measuring instruments.
- Selection of correct type of meters for particular measurement.
- Measurement of power of single phase and three phase system.
- Concept of operation of energy meter.

SHORT DESCRIPTION

Fundamentals of measurements; Indicating instruments; Digital instruments; Current & voltage measuring instruments; Measurement of electrical power; Energy meters.

DETAIL DESCRIPTION

Theory:

1. Recognize the basic concept of measurements.

- 1.1 Define measurements of electrical quantities.
- 1.2 Discuss significance of measurements.
- 1.3 Describe the terms accuracy, precision, sensitivity and resolution or discrimination.
- 1.4 Distinguish between accuracy and precision.
- 1.5 Demonstrate errors in measurements.
- 1.6 State true value, loading effect, static error or absolute error, relative error, static correction, limiting error and percentage limiting error.
- 1.7 Describe the loading effects due to shunt connected instruments.
- 1.8 Explain the loading effects due to series connected instruments.
- 1.9 Solve problems related to errors in measurement.

2. Interpret the classification of measuring instrument.

- 2.1 Describe measuring instrument.
- 2.2 Name different types of measuring instruments.
- 2.3 Demonstrate absolute and secondary instruments.
- 2.4 List secondary instruments according to their mode of operation and functions.
- 2.5 Explain indicating, recording and integrating instruments.
- 2.6 Describe the various effects of current or voltage utilized in measuring instrument upon which their operation depends.

3. Understand the principle of operation of indicating instruments.

- 3.1 List different types of torque applied in indicating instrument which act upon their moving system.
- 3.2 Describe deflecting torque and controlling torque.
- 3.3 Explain spring control and gravity control system.
- 3.4 Distinguish between spring control and gravity control system.
- 3.5 Explain damping torque.
- 3.6 State different types of damping systems.
- 3.7 Compare air friction damping, fluid friction damping and eddy current damping
- 3.8 Solve problems related to spring control and gravity control system.

4. Perceive the constructional features of measuring instruments.

- 4.1 Name the essential parts of measuring instruments.
- 4.2 Describe the parts of the instrument such as supporting, moving system, balancing, permanent magnets, pointer, scale, zero-adjuster, cases, etc.
- 4.3 Discuss the torque weight ratio.
- 4.4 Explain the principle of operation of ammeter and voltmeter.
- 4.5 Distinguish between the working principle of ammeter and voltmeter.
- 4.6 List the various types of ammeter and voltmeter.

5. Interpret the principle of operation of moving iron instruments.

- 5.1 Describe the construction and working principle of moving iron attraction type instruments.
- 5.2 Derive the torque equation of moving iron attraction type instruments.
- 5.3 Describe the construction and working principle of repulsion type moving iron instrument.
- 5.4 Derive the torque equation of repulsion type moving iron instrument.
- 5.5 List the advantages and disadvantages of moving iron instruments.
- 5.6 Discuss errors in moving iron instruments.
- 5.7 Solve problems related to of moving iron instruments.

6. Conceive the principle of operation of moving coil instruments.

- 6.1 Describe the construction and working principle of permanent magnet moving coil instruments.
- 6.2 Derive the torque equation of the moving coil instrument.
- 6.3 Mention the advantages and disadvantages of permanent magnet moving coil instruments.
- 6.4 Describe the construction and working principle of dynamometer type moving coil instruments.
- 6.5 Indicate the arrangement of coils of dynamometer type instruments for measurements of current and voltage.
- 6.6 Discuss the errors of moving coil instruments.
- 6.7 Solve problems related to torque equation of moving coil instruments.

7. Understand the principle of operation of electrostatic voltmeter.

- 7.1 Describe the construction and working principle of a quadrant type voltmeter.
- 7.2 Describe the construction and working principle of attracted disc type voltmeter.
- 7.3 Mention the advantages of electrostatic voltmeter.
- 7.4 List the limitations of electrostatic voltmeter.
- 7.5 Mention the uses of electrostatic voltmeter.

8. Recognize the operation of dynamometer type wattmeter.

- 8.1 Describe the construction and principle of operation of dynamometer type wattmeter.
- 8.2 List the advantages of dynamometer type wattmeter.
- 8.3 Specify the disadvantages of dynamometer type wattmeter.
- 8.4 Compare induction type wattmeter with dynamometer wattmeter.

9. Conceive the operation of induction type wattmeter.

- 9.1 Describe the construction of induction type wattmeter.
- 9.2 Describe the principle of operation of induction type wattmeter.
- 9.3 List the advantages of induction type wattmeter.
- 9.4 List the disadvantages of induction type wattmeter

10. Interpret the concept of measurement of single phase power.

- 10.1 Derive the equation, $P = EI \cos\theta$.
- 10.2 Demonstrate the circuit diagram connecting wattmeter in a single phase circuit.

10.3 Explain the errors involved in connecting wattmeter in a single phase circuit.

10.4 Mention the function of compensating coil in wattmeter connection.

10.5 Solve problems on error calculation in single phase power measurement.

11. Apply the principle of power measurement in three phase circuit.

11.1 List the method for the measurement of power in three phase circuit.

11.2 Describe the method for measurement of three phase power by two wattmeter.

11.3 Derive the equation for power and power factor in two wattmeter method.

11.4 Describe the method of three phase power measurement by one watt meter.

11.5 Describe the method of 1-Φ reactive power measurement by single phase VAR meter.

11.6 Describe the method of 3- Φ reactive power measurement.

11.7 Solve problems for the calculation of power and power factor.

12. Recognize the operation of energy meter.

12.1 Describe the principle of operation of energy meter.

12.2 List the different types of energy meter.

12.3 Explain the working principle of motor meter.

12.4 Describe the construction and working principle of mercury motor meter.

12.5 Explain mercury meter modified as watt hour meter.

12.6 Explain the friction compensation in mercury motor meter.

12.7 Describe the construction and working principle of induction motor meter.

12.8 Explain errors in induction motor meter.

12.9 Describe working principle of poly phase induction type energy meter.

12.10 Sketch the connection diagram of poly phase induction type energy meter.

13. Perceive the concept of testing of energy meter.

13.1 Explain the necessity of testing of energy meter.

13.2 List the apparatus required for testing of energy meter.

13.3 State the methods of testing of energy meter.

13.4 Explain the short period testing using a standard wattmeter.

13.5 Solve problems related to energy meter testing.

14. Conceive the concept of digital instrument and digital display.

14.1 Explain the principle of operation of digital instruments.

14.2 Describe the advantages of digital instruments.

14.3 Compare digital instruments with the Analog instruments.

14.4 Mention the different types of digital display system.

14.5 Describe seven segment display and 3×5 dot matrix display.

14.6 Demonstrate the construction of liquid crystal display.

14.7 Express the operation of gas discharge plasma display.

14.8 Explain resolution in digital meter and sensitivity of digital meters.

15. Interpret the concept of digital voltmeter and digital energy meter.

15.1 Explain the operation of transistor voltmeter (TVM).

15.2 Describe the operation of ramp type digital voltmeter (RDVM).

15.3 Enumerate the operation of successive approximation digital voltmeter.

15.4 Describe the principle of operation of digital single phase energy meter

15.5 Describe the block diagram of a digital single phase energy meter

15.6 Explain the principle of operation of digital three phase energy meter

15.7 Describe the block diagram of a digital three phase energy meter.

15.8 Explain the basic information about prepaid metering system.

PRACTICAL:

1. Find various types of measuring instruments.

1.1 Select at least eight different measuring instruments.

1.2 Identify the types of given instruments for measuring electrical quantities.

1.3 Observe the ranges of instruments.

2. Study the operation of indicating, integrating, recording and digital instruments.

2.1 Choose one indicating, one integrating, one recording and one digital instrument.

2.2 Select the tools and materials required.

2.3 Connect each instrument to the supply system with proper load, if necessary.

2.4 Observe the operation of moving system of each instrument.

3. Observe the parts of different types of measuring instruments.

3.1 Select two types of measuring instruments.

3.2 Disassemble the magnet, moving iron parts, controlling and damping parts, pointer, scale and case.

3.3 Analyze the balancing system of the moving parts.

3.4 Assemble the parts as original.

4. Select the correct type of ammeter and voltmeter.

4.1 Collect some ammeters and voltmeters.

4.2 Collect required numbers of tools to open ammeters and voltmeter.

4.3 Disassemble the parts of the instrument.

4.4 Identify the controlling and damping system.

4.5 Identify the parts of the meter.

4.6 Identify the types of meter.

4.7 Reassemble the meters

5. Study the wattmeter.

5.1 Select proper tools and wattmeter.

5.2 Disassemble the different parts of the wattmeter.

5.3 Identify the different parts of the wattmeter.

5.4 Identify the types of wattmeter.

5.5 Reassemble the wattmeter.

6. Measure the single phase power by ammeter, voltmeter and wattmeter.

6.1 Sketch the circuit diagram for measuring single phase power by ammeter, voltmeter and wattmeter.

6.2 List and collect tools, equipment and materials required.

6.3 Prepare the circuit according to the circuit diagram using necessary equipment.

6.4 Check the circuit before energizing.

6.5 Record the meter readings.

6.6 Calculate the power and power factor from the data obtained.

6.7 Determine error from calculation.

6.8 Draw vector diagram from the data obtained.

7. Measure the three phase power by two wattmeter method.

- 7.1 Draw the circuit diagram for measuring power by two wattmeter of a three phase system.
- 7.2 List and collect tools, equipment and materials for the experiment.
- 7.3 Prepare the circuit according to the circuit diagram using required equipment.
- 7.4 Check the circuit before energizing.
- 7.5 Record the reading from the meters.
- 7.6 Calculate the power and power factor.
- 7.7 Determine error from calculation.
- 7.8 Draw vector diagram using relevant data as obtained.

8. Measure the three phase power by one wattmeter method.

- 8.1 Sketch the circuit diagram for measuring power by one wattmeter of a three phase system.
- 8.2 List and collect tools, equipment and materials for the experiment.
- 8.3 Prepare the circuit according to the circuit diagram using proper equipment.
- 8.4 Check the circuit before energizing it.
- 8.5 Record the reading from the meter.
- 8.6 Calculate the power.
- 8.7 Draw vector diagram using relevant data as obtained.

9. Study the different parts of an energy meter.

- 9.1 Select one energy meter and tools required.
- 9.2 Disassemble the different parts of the energy meter.
- 9.3 Identify the parts of the meter.
- 9.4 Identify the type of the energy meter.
- 9.5 Reassemble the meter.

10. Measure the energy of a single phase circuit by energy meter.

- 10.1 Sketch the circuit diagram for measuring energy in a single phase circuit by energy meter.
- 10.2 Select tools, equipment, materials and a load.
- 10.3 Connect the equipment as per the circuit diagram.
- 10.4 Record reading from the meter.

11. Measure the energy of a three phase circuit by a three phase energy meter.

- 11.1 Sketch the circuit diagram.
- 11.2 Select and collect tools, equipment, materials and a three phase load.
- 11.3 Connect the equipment according to the circuit diagram.
- 11.4 Record reading from the meter.

12. Test an energy meter for finding its error.

- 12.1 Draw the circuit diagram for testing an energy meter.
- 12.2 Select an energy meter and one wattmeter.
- 12.3 Select and collect tools, equipment and materials for the experiment.
- 12.4 Prepare the circuit according to the circuit diagram.
- 12.5 Record reading from the meter.
- 12.6 Calculate the error from the reading.

13. Measure the energy of a single phase circuit by single phase digital energy meter.

- 13.1 Sketch the circuit diagram.
- 13.2 Connect the equipment as per the circuit diagram.
- 13.3 Record the reading from the meter.

14. Measure the energy of a three phase circuit by single phase digital energy meter.

- 14.1 Sketch the circuit diagram.
- 14.2 Connect the equipment as per the circuit diagram.
- 14.3 Record the reading from the meter.

REFERENCE BOOKS

1. Electrical Measurement and Measuring Instruments - U.A. Bakshi,A.V Bakshi.
2. Electrical Measurement and Measuring Instruments - M.L. Anand
3. Measurement & Measuring Instruments - Goldings
4. A course in Electrical and Electronic measurements and instrumentation - A. K. Sawhney.
5. A Text Book of Electrical Technology - B.L. Theraja
6. Electric Instrumentation - H. S. Kalsi

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Generation of Electrical Power

T P C

3 3 4

OBJECTIVES

Upon completion of contents students will be able to achieve and acquire knowledge, skill and attitude in the area of Generation of Electrical Power with special emphasis on;

- Overview of Electrical power and energy
- Main features of power generation.
- Power plant economics.
- Authorities responsible for generation of electrical energy in Bangladesh.

SHORT DESCRIPTION

Sources of energy; Power plants: Types & working principle; Selection of power plants & site; Power plant economics and Authority for generating power.

DETAIL DESCRIPTION

Theory:

1. Concept of power and energy.

- 1.1State the concept of sources of Energy
- 1.2List the common sources of energy.
- 1.3Describe the different types of energy.
- 1.4Discuss the concept of conventional sources of Energy
- 1.5Mention the conventional sources of energy available in Bangladesh with their locations.

2. Clarify the types and characteristics of power plants.

- 2.1Investigate the concept of power plant engineering
- 2.2Describe basic operation of a power plant.
- 2.3Explain the importance of power plants.
- 2.4Describe the uses of power plants.
- 2.5Name the different types of power plants.
- 2.6Mention the names of power plants of Bangladesh with their location and rating.

3. Realise the working principal and details of Boiler.

- 3.1Define Boiler.
- 3.2Explain the different types of Boiler.
- 3.3Describe the Construction and working principle of water tube boiler.
- 3.4Describe the Construction and working principle of fire tube boiler.
- 3.5Explain the working principle of boiler auxiliaries and accessories.
- 3.6Discuss the feed water treatment process.

4. Perceive of the principle of operation of a steam power plant.

- 4.1Explain the working principle of a steam power plant.
- 4.2Enumerate the different types of vapour cycle with P-V diagram.
- 4.3Describe the different types of steam generator.

4.4 Explain the working principle of steam generator.

4.5 Describe the working principle of different types of steam turbine including starting and shutdown procedure.

4.6 Sketch a schematic diagram of a steam power plant and label its different sections.

5. Understand the principle of operation of a Diesel power plant.

5.1 Explain the working principle of a Diesel power plant.

5.2 Identify the areas of application of diesel power plant.

5.3 Describe the constructional features of a modern diesel engine used for a diesel generating station.

5.4 Point out starting and stopping procedure of a diesel generator.

5.5 Illustrate the fuel storage and handling method for large scale diesel power plant.

6. Familiarize the principle of operation of Gas turbine power plant.

6.1 Explain working principle of simple open cycle gas turbine with P-V diagram.

6.2 Describe working principle of simple closed cycle gas turbine with P-V diagram

6.3 Demonstrate the different types of Gas turbine.

6.4 Sketch a schematic diagram of a gas turbine power plant and label its different sections.

6.5 Identify the applications of a gas turbine power plant in Bangladesh.

6.6 List the advantages and disadvantages of a gas turbine power plant.

7. Recognize the operation of a hydro-electric power plant.

7.1 Explain the working principle of a hydro-electric power plant.

7.2 Describe different types of hydro-electric power plants with sketches.

7.3 Define catchment area.

7.4 Interpret different sections of a hydro-electric power plant with schematic diagram.

7.5 Describe different types of water turbine generally used in hydro-electric plant.

7.6 Explain the governing principle of a water turbine with a schematic diagram.

7.7 Solve problems related to hydro-electric power plant.

8. Interpret the principle of operation of a nuclear power plant.

8.1 Explain the elements of a nuclear power station with schematic diagram.

8.2 Illustrate the chain reaction.

8.3 List the name of four types of reactor used in a nuclear power station.

8.4 Explain the constructional features of each type of reactor.

8.5 Describe the working principle of each type of reactor.

8.6 Identify the advantages & disadvantages of nuclear power plant.

8.7 List large nuclear power plants in the world.

8.8 Analyze the nuclear power plant established in Bangladesh.

9. Perceive the process of selection of a power plant and its site.

9.1 List the different factors to be considered for selecting a steam, diesel, hydro-electric, gas and nuclear power plant.

9.2 Mention the factors to be considered for selecting the site for a steam, diesel, hydro-electric, gas turbine and nuclear power plant.

9.3 Sketch the different power plants of Bangladesh with their types, capacities and location in a map.

10. Conceive the concept of power plant economics.

10.1 Describe plant depreciation.

10.2 List the factors influencing the rate or tariff designing of electrical energy.

10.3 Describe the different method of rate or tariff for electrical energy.

- 10.4 Demonstrate the operating costs of a Steam, Diesel, and Gas power plant.
- 10.5 Describe the operating costs of a hydro-electric and nuclear power plant.
- 10.6 Point out the advantages of interconnection of different power plants.
- 10.7 Solve problems related to rate or tariff of electrical energy.

11. Realize the concept of Load management.

- 11.1 Outline the effects of variable loads on power generation economy.
- 11.2 Discuss the following terms: Ideal and actual load curve, annual load curve, peak load, load factor, maximum demand, demand factor, capacity factor, use factor and diversity factor.
- 11.3 Explain load despatch, centre-capacity and load scheduling.
- 11.4 Describe off peak and peak-hour
- 11.5 Explain load shading and load management.
- 11.6 Solve problems related to power plant economics

12. Recognize authority for generating bulk and consumer supply of electrical power.

- 12.1 Identify the authorities for power supply in Bangladesh.
- 12.2 Explain grid system.
- 12.3 List the functions of public & private sector in the field of power generation in Bangladesh.
- 12.4 Draw the organogram of Rural Electrification Board (REB) and BPDB with its consumers.
- 12.5 Describe the operation of DPDC, OZOPADICO, NWPGCO, NWPDCO, EGCB, RPCL, APSCO etc.
- 12.6 Identify the jurisdiction of Dhaka Electric Supply Company (DESCO).
- 12.7 Identify the function and jurisdiction of Power Grid Company of Bangladesh (PGCB).
- 12.8 Describe the existing private sector power station in Bangladesh and their future growth.

PRACTICAL:

1. Select a particular type of power plant in an area.

- 1.1 Assess the probable load of the proposed locality for which the power station is supposed to be installed.
- 1.2 List the existing communication system of the area.
- 1.3 Assess the cost of land in the area.
- 1.4 Make a topographic survey of the area.
- 1.5 Find the location of the sources and nature of energy available for the area.
- 1.6 Select the type of power plant for the area.
- 1.7 Justify the reasons for selecting the power plant.

2. Select size, type and rating of a generator for a particular power plant.

- 2.1 Survey the electrical load of the area to be electrified by the power plant.
- 2.2 Select a power plant on the basis of economy of the power sources available.
- 2.3 Specify the size of the power plant on the basis of load survey.
- 2.4 Determine the voltage rating of the power plant on the basis of distribution.
- 2.5 Justify the reasons for the selection made.

3. Locate the main power plants of Bangladesh with sources of natural energy by tracing a map of Bangladesh.

- 3.1 Trace a map of Bangladesh showing important places.
- 3.2 Locate the power plants and power sources symbolically in the map.
- 3.3 Write the name of the places where the power plants and power sources are located.
- 3.4 Indicate the rivers adjacent to the power plants.
- 3.5 Show the legends demonstrating the symbols.

4. Perform the dismantle and reassemble a boiler.

- 4.1Select and collect the tools.
- 4.2Read the manual carefully.
- 4.3Dismantle the boiler.
- 4.4Identify the different parts.
- 4.5Clean the tubes with steel brush.
- 4.6Clean inside of the boiler with cotton waste.
- 4.7Reassemble carefully the dismantled parts.
- 4.8Sketch a neat diagram showing all parts of the boiler.

5. Operate a diesel electric power plant.

- 5.1Collect the required instruments for starting a diesel electric power plant.
- 5.2Check all accessories.
- 5.3Check fuel level and cooling water.
- 5.4Check the specific gravity of the electrolyte of the storage battery.
- 5.5Start the engine coupled with generator.
- 5.6Verify the metering panel and gauges.
- 5.7Run the generator at no load.
- 5.8Increase engine speed with gradually apply electrical load.
- 5.9Record all meters and gauge readings.
- 5.10 Record voltmeter reading at rated speed.

6. Operate a turbine.

- 6.1Identify the different components of the turbine.
- 6.2Follow all instructions and precautions for starting the turbine and make it ready for starting.
- 6.3Start and operate the turbine for warming up and gradually increase the speed to rated RPM.
- 6.4Couple the turbine with load.
- 6.5Record the relevant data.
- 6.6Observe all precautions and shut down the turbine.
- 6.7Deduce the BHP of the turbine.

7. Plot the load curve of a power plant.

- 7.1Collect data of a particular power plant.
- 7.2Process the supplied data of a particular power plant for a given period.
- 7.3Plot a load curve according to the processed data on a graph with suitable scale.
- 7.4Locate peak load from load curve.

8. Plot load duration curve of a power plant.

- 8.1Collect data of a particular power plant.
- 8.2Process the supplied data of a particular power plant for a given period.
- 8.3Plot a load duration curve according to the processed data on a graph with suitable scale.
- 8.4Show the peak hour from load duration curve
- 8.5Calculate the utility factor.

9. Find average load and load factor from the load curve.

- 9.1Observe the load curves, chronological and load duration curves plotted before.
- 9.2Find the average load of the plant using relevant formula and proper information from the curves.
- 9.3Locate Maximum demand and calculate cumulative load from load curve.
- 9.4Calculate load factor, utility factor and capacity factor by using load curve.
- 9.5Justify load factor, utility factor and capacity factor according to the national standard.

10. Sketch the layout diagram of a known power plant.

- 10.1 Visit a nearby power station.
- 10.2 Identify the different sections of the power plant.
- 10.3 Sketch the layout diagram of different sections of the plant visited.
- 10.4 Prepare a neat integrated sketch of the layout diagram of the plant visited.

11. Download and present video clips for different types of power plant operation.

- 11.1 Search and download clips of power plant operation.
- 11.2 Present the video clips of each power plant operation.
- 11.3 Show the feedback from presentation.

REFERENCE BOOKS

1. Power Plant Engineering – G R Nagpal Thirteenth Edition 1994
2. Power Plant Engineering – Fredrick T Morse
3. A Course in Power Plant Engineering – S Domkunowar
4. Principle of Power System – V K Mehta
5. Hand Book of Energy Technology, Trends and Perspection – V Daniel Hunt
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Renewable Energy

T P C
2 3 3

OBJECTIVES

Upon completion of these content students will be able to achieve and acquire knowledge, skill and attitude in the area of Renewable Energy with special emphasis on;

- Overview of renewable energy.
- Main features of renewable energy generation.
- Challenges and problems associated with the use of renewable energy in Bangladesh.
- Availability and implementation of potential renewable energy.

SHORT DESCRIPTION

Sources of Renewable energy; Types of renewable energy; Solar energy, Wind power, Fuel cells, Biomass, Geo-thermal and alternative fuels for transportation.

DETAIL DESCRIPTION

Theory:

1. Overview of Renewable energy.

- 1.1 Concept of Renewable energy
- 1.2 Discuss historical overview of renewable energies.
- 1.3 State brief description of green power.
- 1.4 Describe the different sources of renewable energy.
- 1.5 Assess renewable energy systems for their environmental, economic and Political impacts.
- 1.6 List global renewable energy scenario and scenario of Bangladesh.

2. Understand the concept of non conventional renewable energy sources.

- 2.1 List non conventional renewable energy sources.
- 2.2 Discuss potential renewable energy sources of Bangladesh.
- 2.3 Describe measurement of solar radiation and solar radiation at earth surface.
- 2.4 Explain the uses of solar radiation (solar P-V submersible water pumping, solar cooker, solar P-V home lighting for rural application, solar P-V charging station, solar P-V powered Refrigerator, solar dryer and commercially used generation of electrical energy).
- 2.5 Mention four types of solar electric application

3. Conceive the concept of solar power generation.

- 3.1 Discuss solar insolation and heat transfer
- 3.2 Describe operating principle of solar cell.
- 3.3 Demonstrate different types of solar cell.
- 3.4 Describe principle of solar thermal power generation.
- 3.5 Explain solar collector: solar pool heater, solar hot water heaters, solar air panels and transpired air collectors.
- 3.6 Discuss passive solar heating and Day lighting.
- 3.7 Illustrate solar active space heating and solar cooling.
- 3.8 Enumerate sizing, storage of energy and system efficiency.

4. Interpret wind energy generation.

- 4.1 Discuss the concept of wind energy conversion system.
- 4.2 Interpret small scale system, intermediate scale system and large scale system of wind energy generation.
- 4.3 Describe the different components of wind machine.
- 4.4 Demonstrate different types of wind machines.
- 4.5 Discuss different types of wind energy conversion system.
- 4.6 Point out wind energy prospects of Bangladesh (coastal regions).

5. Recognize Photovoltaic's Cells.

- 5.1 Discuss the basic principles of Photovoltaic's cell.
- 5.2 Mention the types of Photovoltaic's cell.
- 5.3 Describe the photo voltaic energy conversion system
- 5.4 Describe the application of photo voltaic energy conversion system -Residential, Community and central station.
- 5.5 State the environmental impacts of fossil fuels vs. photovoltaic's and fuel cells.

6. Perceive Fuel Cells.

- 6.1 Discuss the concept of Fuel cell.
- 6.2 Mention the types of Fuel cell.
- 6.3 Describe the proton exchange membrane fuel cell (PEMFC) and phosphoric acid fuel cell (PAFC).
- 6.4 Describe the solid acid fuel cell (SAFC) and alkaline fuel cell (AFC).
- 6.5 Describe the High Temperature Fuel Cell: Solid Oxide Fuel Cell (SOFC), [Molten carbonate fuel cells](#) (MCFC) etc.
- 6.6 Mention the uses of PEMFC, PAFC, SAFC, SOFC, MCFC and AFC.

7. Conceive Biomass and Geothermal energy generation.

- 7.1 Discuss the concept of Biomass energy system.
- 7.2 Mention the sources of Biomass.
- 7.3 List the Biomass yields.
- 7.4 Explain Biomass conversion system: Thermal, Chemical, Biochemical and Electrochemical conversion.
- 7.5 Brief the Geothermal energy.
- 7.6 Describe different types of Geothermal energy.
- 7.7 Explain Geothermal electricity production and Geothermal heat pumps.

8. Realize non conventional sources of energy.

- 8.1 Describe wave energy generation.
- 8.2 Describe tidal energy generation.
- 8.3 Describe Ocean thermal energy conversion (OTEC).

9. Understand non conventional sources of energy.

- 9.1 State the concept of Waste-to-Energy (Municipal Solid Waste)
- 9.2 Sketch the block diagram and mention the steps how waste to energy plant works.
- 9.3 List the advantages of Waste-to-Energy (Municipal Solid Waste).
- 9.4 Analyze economic and environmental impact for sample Renewable Energy.
- 9.5 State the barriers to implementation of renewable energies and its remedies.

10. Recognize the transportation and alternative fuels.

- 10.1 Define alternative fuels for transportation.
- 10.2 Identify the alternative fuels for transportation.
- 10.3 Describe utility of hydrogen, ethanol, bio-diesel and propane as alternative fuels.
- 10.4 Explain benefit and challenges for using alternative fuels.
- 10.5 Mention the environmental impact of conventional fuels vs alternative fuels for transportation.

PRACTICAL:

1. Evaluate a solar energy system for its cost effectiveness.

- 1.1 Visit a nearby solar plant.
- 1.2 Identify the different sections of the plant.
- 1.3 Prepare a neat integrated sketch of the layout diagram of the plant visited.
- 1.4 Evaluate cost effectiveness of a solar energy plant.

2. Measure open circuit voltage and short circuit current of a solar panel.

- 2.1 Select the appropriate solar panel, Battery, Cable, multi-meter etc.
- 2.2 Identify the different part of solar panel.
- 2.3 Complete the connection according to circuit diagram.
- 2.4 Record data in the table.

3. Measure voltage and current for series and parallel combination of solar panel.

- 3.1 Select the appropriate solar panel, Battery, Cable, multi-meter etc.
- 3.2 Connect the three or more solar panel in series.
- 3.3 Record data in the table
- 3.4 Connect the three or more solar panel in parallel.
- 3.5 Record data in the table.

4. Prepare a circuit for DC lighting system by solar panel.

- 4.1 Select the appropriate solar panel, controller, Battery, Cable, multi-meter, etc.
- 4.2 Identify the different section of dc lighting system.
- 4.3 Make the connection according to circuit diagram.
- 4.4 Measure the dc voltage.
- 4.5 Develop another circuit diagram for charging a mobile by solar panel.

5. Prepare a circuit for AC lighting system by solar panel.

- 5.1 Sketch a circuit diagram for AC lighting system by solar panel.
- 5.2 Select the appropriate solar panel, controller, Battery, inverter, Cable, multi-meter etc.
- 5.3 Identify the different section of AC lighting system.
- 5.4 Complete connection according to circuit diagram.
- 5.5 Measure the AC voltage.

6. Design a photovoltaic system.

- 6.1 Calculate the electrical load of a nearby area.
- 6.2 Select the appropriate rating of cell, Battery, Cable etc.
- 6.3 Sketch the layout diagram.
- 6.4 Connect the components properly.
- 6.5 Draw the current-voltage curve and power-voltage curve.

7. Sketch the layout diagram of a wind power plant.

- 7.1 Visit a nearby wind plant.
- 7.2 Identify the different sections of the plant.
- 7.3 Prepare a neat integrated sketch of the layout diagram of the plant visited.

8. Measure the voltage of alkaline fuel cell (AFC).

- 8.1 Select the appropriate alkaline fuel cell (AFC), Battery, Cable, multi-meter, etc.
- 8.2 Record the data before charging.
- 8.3 Connect the alkaline fuel cell (AFC) with a charger.
- 8.4 Record the data after charging.

9. Find out which organic waste produce more biogas.

- 9.1 Collect different type of waste from municipal.
- 9.2 Keep the waste in a lab.
- 9.3 Measure the biogas for different wastes.
- 9.4 Record the data in the table.

10. Measure the power of a fuel cell

- 10.1 Set the fuel cell in the normal way.
- 10.2 Connect the voltmeter to the cell and measure the no load voltage
- 10.3 Complete the connection according to diagram.
- 10.4 Record the data in a table.
- 10.5 Calculate the power from table.

11. Download and present video clips for different types of non conventional energy.

- 11.1 Search and download clips of non conventional energy.
- 11.2 Present the video clips of each non conventional energy.
- 11.3 Show the feedback from presentation.

REFERENCE BOOKS

- 1. Renewable Engineering Sources and Conversion Technology - – NK Bansal, Manfred klee mann Michel (Megam Hill)
 - 2. Principle of Power System – V K Mehta
 - 3. Hand Book of Energy Technology, Trends and Perspection – V Daniel Hunt
 - 4. Photovoltaic Technology For Bangladesh – Editors: AKM Sadral Islam, D G Infield
 - 6. Renewable energy, Technology, economics and environment; – Martin Kaltschmitt
 - 7. Renewable Electricity and the Grid – [Godfrey Boyle](#)
 - 8. [Solar Electricity Handbook IPCC](#)
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Digital Electronics & Microprocessors

T P C
2 3 3

OBJECTIVES

Upon completion of this content student will be able to achieve and acquire knowledge, skills and attitude in the area of Digital Electronics and Microprocessors special emphasis on:

- Number system, Binary arithmetic and codes
- Logic gates and Sequential logic circuits
- Semiconductor memories, A/D and D/A converters
- Microprocessors

SHORT DESCRIPTION

Basic Digital Circuits; Numbers systems and codes; Combinational logic circuits; Flip-flops and shift registers; Counters; A/D and D/A converters; Semiconductor memories; 8085, 8086 microprocessors.

DETAILS DECEPTION

Theory:

1. Understand Number systems and codes.

- 1.1 Describe binary, octal and Hexadecimal Number systems.
- 1.2 Convert one number system to another.
- 1.3 Compute binary, Octal and hexadecimal arithmetic.
- 1.4 Describe BCD Code, Excess- 3 Code, Gray Code, Alphanumeric Codes.
- 1.5 Convert one type of code to another.
- 1.6 Describe the method of error detection and correction by using Parity bit.
- 1.7 Describe the function of Hamming code.
- 1.8 Describe the applications of codes.

2. Understand the basic digital circuits.

- 2.1 Describe the digital signals.
- 2.2 State the main features of digital systems.
- 2.3 Describe AND, OR, NOT, NAND, NOR and XOR operations.
- 2.4 Describe the realization of basic logic operations using NAND and NOR gates.
- 2.5 Describe the Boolean algebraic theorems.
- 2.6 Simplify the logic expressions by using Boolean algebra.
- 2.7 Simplify the logic expressions by using Karnaugh map (up to 4 Variables).
- 2.8 Describe the characteristics of digital ICs.
- 2.9 Describe different types of digital logic families.

3. Understand Combinational Logic circuits.

- 3.1 Describe the operation of a digital multiplexer and demultiplexer.
- 3.2 Describe the operation of half adder and full adder.
- 3.3 Describe the operation of half subtractor and full subtractor.
- 3.4 Explain the function of arithmetic logic unit (ALU) with block diagram.
- 3.5 Describe the operation of digital comparators.
- 3.6 Describe the function of parity generator/checkers.
- 3.8 Describe the function of priority encoders and BCD-to-7 segment decoder with block diagram.

4. Understand Flip-Flops and shift registers.

- 4.1 Describe the operation of a sequential circuit with block diagram.
- 4.2 Describe the working principle of clocked SR flip-flop, D-type flip-flop and T-type flip-flop J-K flip-flop, Master-slave flip-flop.
- 4.3 State the applications of flip-flops.
- 4.4 Describe the function of registers.
- 4.5 Describe the operation of shift registers.
- 4.6 Mention the applications of shift registers.
- 4.7 List some common ICs used as flip-flops and shift registers.

5. Understand the Counters.

- 5.1 Describe the operation of ripple or asynchronous counters.
- 5.2 Describe the principle of UP/DOWN counters.
- 5.3 Describe the modulus of the Counter.
- 5.4 Describe the operation of synchronous counters.
- 5.5 Explain the function of universal counter.
- 5.6 Describe the principle of ring counter.
- 5.7 List some common ICs used as a counter with block diagram.

6. Understand D/A converter.

- 6.1 Mention the principle of level conversion.
- 6.2 Describe the principle of D/A conversion.
- 6.3 Mention the types of D/A converter.
- 6.4 Explain the operation of a binary weighted D/A and R-2R ladder D/A converter.
- 6.5 State the terms – resolution, percentage of resolution, accuracy.
- 6.6 Offset error and settling time as specification of D/A converter.
- 6.7 State the application field of D/A converter.
- 6.8 List the application of popular D/A converter ICs.

7. Understand A/D converter.

- 7.1 State the principle of A/D conversion.
- 7.2 List the type of A/D converter.
- 7.3 State the working principle of 3-bit parallel A/D converter.
- 7.4 Describe the operation of Digital Ramp A/D converter
- 7.5 Explain the principle of operation of successive approximation, dual slope and Flash A/D converter.
- 7.6 State the terms – resolution, accuracy, and conversion time as specification of A/D converter.
- 7.7 List the applications of popular A/D converter ICs.
- 7.8 Describe the operation of sample & hold circuits and its application.

8. Understand the features of Semiconductor Memories.

- 8.1 Describe the operation of a memory device with block diagram.
- 8.2 Describe the concept of READ and WRITE operation of memories.
- 8.3 Mention the classification of memories.
- 8.4 Mention the characteristics of memories.
- 8.5 Explain the principle of sequential memory.
- 8.6 Mention the characteristics of ROM, PROM, EPROM, EEPROM and Flash memory.
- 8.7 Mention the principle of static and dynamic RAM.
- 8.8 List some commercial memory ICs.

9. Understand the features of Microprocessor.

- 9.1 Define Microprocessor.
- 9.2 List 8-bit, 16-bit, 32 bit and 64-bit Microprocessors.
- 9.3 Describe the architecture of 8085 microprocessor.
- 9.4 Describe the pin diagram and function of each pin of Intel 8085 microprocessors.
- 9.5 Describe the registers of Intel 8085 microprocessors.
- 9.6 Describe the block diagram of a micro computer.
- 9.7 Differentiate between microprocessors and micro computer.

10. Understand the Programming of 8085 Microprocessors.

- 10.1 Describe the instruction set of 8085 microprocessors.
- 10.2 Explain the addressing modes of Intel 8085 microprocessors.
- 10.3 Mention the simple programs using 8085 instructions.

11. Understand the 8085 Microprocessors system.

- 11.1 Define Bus multiplexing.
- 11.2 Explain the process of multiplexing AD₇ -AD₀ bus using latch.
- 11.3 Describe the technique of generate control signals.
- 11.4 Mention the function of interrupt controls and serial I/O controls.
- 11.5 Differentiate between memories mapped I/O and standard I/O.
- 11.6 Discuss the function of programmable peripheral Interface (PPI), programmable DMA controller and programmable interrupt controller (PIC).
- 11.7 Discuss the function of Programmable Interval Timer and Programmable Communication Interface.
- 11.8 Draw an 8085 based micro computer system.

12. Understand the features of 16-bit Microprocessors.

- 12.1 Describe the architecture of 8086 microprocessor.
- 12.2 Describe the pin diagram and function of each pin of Intel 8086 microprocessors.
- 12.3 Describe the registers of Intel 8086 microprocessors.
- 12.4 Explain the addressing modes of the Intel 8086 microprocessors.
- 12.5 Mention the simple programs using the 8086 instructions.

PRACTICAL:

1. Verify the truth tables of logic gates (OR, AND, NOT, NAND & NOR)

- 1.1 Select logic gate ICs.
- 1.2 Select appropriate circuits, required tools, equipments and materials.
- 1.3 Insert the selected IC to the Breadboard.
- 1.4 Connect the circuits as per diagram on trainer board.
- 1.5 Switch on the DC power supply,
- 1.6 Verify the truth tables.

2. Show the operation of NAND & NOR gate as universal gates.

- 2.1 Select logic gate IC of NAND gate & NOR gate.
- 2.2 Select appropriate circuits, required tools, equipments and materials.
- 2.3 Insert the selected IC to the Breadboard.
- 2.4 Connect the circuits as per diagram for AND OR & NOT gate on trainer board.
- 2.5 Switch on the DC power supply,
- 2.6 Verify the truth tables of AND OR & NOT gate operation.

3. Verify the functions of half adder & half sub tractor.

- 3.1 Select ICs.
- 3.2 Draw the pin diagram and internal connection.
- 3.3 Draw appropriate circuits.
- 3.4 Select required tools, equipments and materials.
- 3.5 Connect the circuits as per diagram on trainer board.
- 3.6 Switch on the DC power supply,
- 3.7 Verify the truth tables.

4. Verify the functions of full adder & full sub tractor.

- 4.1 Select ICs.
- 4.2 Draw the pin diagram and internal connection.
- 4.3 Draw appropriate circuits.
- 4.4 Select required tools, equipments and materials.
- 4.5 Connect the circuits as per diagram on trainer board.
- 4.6 Switch on the DC power supply.
- 4.7 Verify the truth tables.

5. Verify the truth table of different J-K flip-flops.

- 5.1 Select appropriate ICs.
- 5.2 Draw the pin diagram and internal connection.
- 5.3 Draw appropriate circuits.
- 5.4 Select required tools, equipments and materials.
- 5.5 Connect the circuits as per diagram on trainer board.
- 5.6 Switch on the DC power supply.
- 5.7 Verify the truth tables.

6. Verify the operation of Shift register.

- 6.1 Select a SIPO shift register IC.
- 6.2 Connect the SIPO shift register circuits on Digital Trainer Board.
- 6.3 Apply clock input pulse to the circuit and observe the operation.
- 6.4 Select a PISO shift register IC.
- 6.5 Connect the PISO shift register circuits on Digital Trainer Board.
- 6.6 Apply clock input pulse to the circuit and observe the operation.

7. Verify the operation of Binary counter.

- 7.1 Select 4-Bit ripple counter IC.
- 7.2 Connect the Up/Down ripple counter circuit on Digital Trainer Board
- 7.3 Apply clock input pulse to the circuit and observe the operation of up-counting and down counting.
- 7.4 Select MOD-10 counter IC.
- 7.5 Connect the Decade counter circuit on Digital Trainer Board.
- 7.6 Apply clock input pulse to the circuit and observe the Decade operation.

8. Verify the operation of D/A converter.

- 8.1 Select a D/A converter IC.
- 8.2 Connect a ladder R/2R D/A converter circuit on Digital Trainer Board.
- 8.3 Apply input data and clock pulses to the different input of the circuit.
- 8.4 Observe the operation of the circuit and detect the output result of D/A converter.

9. Verify the operation of A/D converter.

- 9.1 Select an A/D converter IC.
- 9.2 Connect a 3-bit parallel A/D converter circuit on Digital Trainer Board.
- 9.3 Apply input data and clock pulses to the different input of the circuit.
- 9.4 Observe the operation of the circuit and detect the output result of A/D converter.

10. Verify the operation of SRAM & DRAM.

- 10.1 Select a SRAM IC.
- 10.2 Connect Static RAM circuit on Digital Trainer Board.
- 10.3 Apply input data and clock pulse to the circuit.
- 10.4 Observe the operation of the circuit and stored memory data in to the SRAM.
- 10.5 Select a DRAM IC.
- 10.6 Connect Dynamic RAM circuit on Digital Trainer Board.
- 10.7 Apply input data and clock pulse to the circuit.
- 10.8 Observe the operation of the circuit and stored memory data in to the DRAM.

11. Verify the operation of a EPROM .

- 11.1 Select an EPROM IC.
- 11.2 Connect EPROM circuit on Digital Trainer Board.
- 11.3 Apply input data and clock pulse to the circuit.
- 11.4 Observe the operation of the circuit and stored memory data in to the **EPROM**.

12. Verify the operation of 8085 Microprocessor.

- 12.1 Select 8085 microprocessor trainer board.
- 12.2 Solve simple arithmetic & logical problems.
- 12.3 Monitor the result in to the Matrix display/LCD display.
- 12.4 Solve simple I/O problems.

REFERENCE

1. Digital fundamentals - Floyed
2. Modern Digital Electronics - R.P. Jain
3. Microprocessor Architecture, Programming and Applications withr 8085 - Ramesh S Gaonkar

69054

Environmental Studies

T P C

2 0 2

AIMS

- To be able to understand the basic concepts of environment and environmental pollution.
- To be able to understand the concepts of ecology and ecosystems
- To be able to understand the basic concepts of environmental degradation relating to industrial production.
- To be able to understand the major environmental issues and problems.
- To be able to understand legislative measures to protect environment.

SHORT DESCRIPTION

Basic concepts of environment; natural resources; biogeochemical cycling; ecology and ecosystem; air; water; soil; solid waste management; development and environment; global environmental challenges; legislative protection of environment.

DETAIL DESCRIPTION

Theory:

1. Understand the multidisciplinary nature of environmental studies.

- 1.1. Define environment, nature, pollution, pollutant, contaminant.
- 1.2. Describe the scope of environmental studies.
- 1.3. Describe the importance of environmental studies.
- 1.4. Describe the formation and structure of the Earth.
- 1.5. Describe the earth's natural system.
- 1.6. Describe the changing attitudes to the natural world.
- 1.7. Mention the main components of environment.
- 1.8. Define natural and man-made environment.
- 1.9. Distinguish between natural and man-made environment.

2. Understand the natural resources.

- 2.1. Define natural resources.
- 2.2. Classify natural resources.
- 2.3. Describe forest resources.
- 2.4. Describe water resources.
- 2.5. Describe mineral resources.
- 2.6. Describe food resources.
- 2.7. Describe energy resources.
- 2.8. Describe land resources.
- 2.9. Describe environmental problem relating to resources use.
- 2.10. Describe the role of an individual in conservation of natural resources.

3. Understand the biogeochemical cycling.

- 3.1. Define biogeochemical cycle.
- 3.2. Describe hydrologic cycle.
- 3.3. Describe carbon cycle.
- 3.4. Describe nitrogen cycle.
- 3.5. Describe oxygen cycle.
- 3.6. Describe phosphorus cycle.
- 3.7. Describe sulfur cycle.
- 3.8. Describe nutrient cycle.

4. Understand the ecology and ecosystem.

- 4.1. Define ecology and ecosystem.
- 4.2. Structure and function of an ecosystem.
- 4.3. Describe the components of ecosystem.
- 4.4. Explain the stability of ecosystem.
- 4.5. Describe ecological factors.
- 4.6. Describe interdependency between abiotic and biotic component.
- 4.7. Describe the meaning of following terms: species, population, community, ecological succession, community periodicity, climax community, ecological niche, habitat, plankton, nekton, ecological indicator, evolution, adaptation, producers, consumers, decomposers, food chains, food webs, ecological pyramids, bio-concentration, bio-magnification, biodiversity, threatened species, endanger species, extinct species, exotic species, biodiversity conservation and biogeography.
- 4.8. Describe energy flow in the ecosystem.
- 4.9. Describe the ecosystem of pond, ocean, estuary, grassland, cropland, forest, desert and mangrove.

5. Understand the air as a component of environment.

- 5.1. Define air.
- 5.2. Describe the composition of the clean dry atmospheric air at ground level.
- 5.3. Describe the atmospheric structure.
- 5.4. Define air pollution.
- 5.5. Describe major air pollutants and their impacts.
- 5.6. Describe the sources of air pollutants.
- 5.7. Explain the formation of photochemical smog and its effects.
- 5.8. Describe the effects of air pollution on vegetation, animal, human health and materials and resources.
- 5.9. Define sound and noise.
- 5.10. Describe the classification of sound.
- 5.11. Describe the effects of noise.

6. Understand the water as a component of environment.

- 6.1. Define water.
- 6.2. Describe the characteristics of water.
- 6.3. Describe the sources of water.
- 6.4. Describe the uses of water.
- 6.5. Explain that the water is a universal solvent.
- 6.6. Define water pollution, biological oxygen demand (BOD), effluent treatment plant (ETP).
- 6.7. Describe the sources of water pollution.
- 6.8. Describe the effects of water pollution.

7. Understand the soil as a component of environment.

- 7.1. Define soil.
- 7.2. Describe the constituents of soil.
- 7.3. Define soil pollution.
- 7.4. Describe causes soil degradation.
- 7.5. Describe the sources of soil pollution.
- 7.6. Describe the effects of soil pollution.

8. Understand the concept of solid waste management.

- 8.1. Define solid waste, refuse, garbage, rubbish, trashes, demolition and construction waste, e-waste, agricultural waste, pathological waste, radioactive waste, hazardous waste, 3R, 4R.

- 8.2. List the sources of solid waste.
- 8.3. Mention the classification of solid waste.
- 8.4. Mention the methods of collection of solid waste.
- 8.5. Describe the recycling of solid wastes.
- 8.6. Describe resource recovery from solid waste.
- 8.7. Describe the potential method of disposal of solid waste.
- 8.8. Describe control measures of urban and industrial wastes.

9. Understand the development and environment.

- 9.1. Define environmental ethics and environmental stress.
- 9.2. Describe environmental stress.
- 9.3. Define sustainable development.
- 9.4. Define urbanization.
- 9.5. Describe the causes of urbanization.
- 9.6. Describe the effects of urbanization on environment.
- 9.7. Define industrialization.
- 9.8. Describe the causes of industrialization.
- 9.9. Describe the effects of industrialization on environment.

10. Understand the global environmental challenges.

- 10.1. Define greenhouse gas and greenhouse effects.
- 10.2. Make a list of greenhouse gases and their contribution on greenhouse effects.
- 10.3. Describe the causes and consequences of greenhouse effects.
- 10.4. Describe acid rain.
- 10.5. Describe importance of ozone layer.
- 10.6. Define ozone depleting substances (ODS).
- 10.7. Describe ozone layer depletion mechanism.
- 10.8. Describe hazardous waste.
- 10.9. Describe chemicals pesticides.
- 10.10. Describe radioactive pollution.
- 10.11. Describe natural disaster.

11. Understand the legislative protection of environment.

- 11.1. Define environmental impact assessment (EIA) and environmental auditing (EA).
- 11.2. Mention environmental act and legislations prescribed for air, noise, water, soil and wild life protection.
- 11.3. Describe environmental conservation act 1995 in Bangladesh.
- 11.4. Describe the environment conservation rule 1997 in Bangladesh.
- 11.5. Describe the environmental framework in Bangladesh.
- 11.6. Describe The Montreal Protocol and The Kyoto Protocol.
- 11.7. Describe role of an individual in prevention of pollution.

REFERENCES:

1. Fundamentals of Environmental Studies, Mahua Basu and S. Xavier, Cambridge.
2. Ecology and Environment, P.D. Sharma, Rastogi Publications.
3. Basics of Environmental Science, Michael Allaby, Routledge.
4. Environmental Science, Jonathan Turk and Amos Turk, Saunders golden sunburst series.

65851

Accounting Theory & Practice

T P C
2 3 3

AIMS

- To be able to understand the principles and practices of book keeping and accounting.
- To be able to understand the procedures of general accounting, financial accounting and their applications.
- To be able to understand the concept of income tax , VAT & Public works accounts.

Course Outlines

Concept of book keeping and accounting; Transactions; Entry systems; Accounts; Journal; Ledger; Cash book; Trial balance; Final accounts; Cost account & financial accounting; Income Tax; Public works accounts.

DESCRIPTION;

Theory

1. Concept of book keeping and accounting.

- 1.1 Define book keeping and accountancy.
- 1.2 State the objectives & of book keeping.
- 1.3 State the advantages of book keeping.
- 1.4 Differentiate between book keeping and accounting.
- 1.5 State the necessity and scope of book keeping and accounting.

2. Transactions Analysis.

- 2.1 Define transactions and business transaction.
- 2.2 Describe the characteristics of transaction.
- 2.3 Discuss the classification of transaction.

3. Entry system of Accounting.

- 3.1 State the aspects of transactions.
- 3.2 Define single & double entry system ..
- 3.3 Discuss the principles of double entry system.
- 3.4 Distinguish between single entry and double entry system of book keeping.
- 3.5 Justify whether double entry system is an improvement over the single entry system.

4. Classification of accounts.

- 4.1 Define accounts.
- 4.2 State the objectives of accounts.
- 4.3 Illustrate different type of accounts with example.
- 4.4 Define “Golden rules of Book keeping”.
- 4.5 State the rules for “Debit” and “Credit” in each class of accounts.
- 4.6 Define accounting cycle.

5. Journal.

- 5.1 Define Journal.
- 5.2 State the functions of Journal.
- 5.3 Mention the various names of Journal.
- 5.4 Interpret the form of Journal.

6. Ledger.

- 6.1 Define ledger.
- 6.2 Interpret the form of ledger.
- 6.3 State the functions of ledger.
- 6.4 Distinguish between Journal and Ledger.
- 6.5 Explain why ledger is called the king of all books of accounts.
- 6.6 Explain the following terms: Balance, Balancing; Debit balance; credit balance.

7. Cash book & Its Classification.

- 7.1 Define cash book.
- 7.2 Classification of cash book.
- 7.3 Explain cash book as both Journal and Ledger.
- 7.4 Define discount.
- 7.5 Explain the different types of discount.

8. Trial balance.

- 8.1 Define trial balance.
- 8.2 State the object of a trial balance.
- 8.3 Discuss the methods of preparation of a trial balance.
- 8.4 Explain the limitations of a trial balance.
- 8.5 Prepare trial balance from given ledger balance. (practical)

9. Final accounts.

- 9.1 State the components of final account.
- 9.2 Distinguish between trial balance and balance sheet.
- 9.3 Select the items to be posted in the trading account, profit & loss account and the balance sheet.
- 9.4 State the adjustment to be made from the given information below or above the trial balance.
- 9.5 Explain the following terms: revenue expenditure; capital expenditure; depreciation; annuity method diminishing balance method, machine hour method

10. Cost and financial accounting.

- 10.1 Define financial accounting.
- 10.2 State the objectives of financial accounting.
- 10.3 Define cost accounting.
- 10.4 State the elements of direct cost and indirect cost.
- 10.5 Discuss the capital budgeting
- 10.6 Explain the following terms:
 - a. Fixed cost b. Variable cost c. Factory cost d. Overhead cost e. Process cost f. Direct cost g. Operating cost h. Standard cost

11. Income Tax

- 11.1 Define Income Tax.
- 11.2 State the objects of Income Tax.
- 11.3 Classification of assesses.
- 11.4. Taxable income of assesses.
- 11.5 Tax rebate.
- 11.6 Explain the following terms: Income tax year; assessment year, NBR.

12. Public works accounts.

- 12.1 State the important aspects of public works accounts.
- 12.2 Describe the main features of public works accounts.
- 12.3 Define Value Added Tax (VAT)
- 12.4 State the merits and demerits of VAT.
- 12.5 Explain the following terms : Revenue ; Grant ; Bill; Voucher.

PRACTICAL

1. Identify the transaction from given statements stating reasons.
2. Determine Debtor (Dr) and Creditor (Cr.) from given transactions applying golden rules.
3. Journalize from given transactions.
4. Prepare ledger from given transactions.
5. Prepare double column cash book from given transactions showing balances.
6. Prepare triple column cash book from given transaction and find out the balances.
7. Prepare analytical and imprest system of cash book.
8. Prepare trial balance from the given ledger balance.
9. Prepare trading account, profit & loss account and balance sheet from the given trial balance & other information.
10. Prepare cost sheet showing prime cost, factory cost, cost of production, total cost and selling price.

REFERENCE BOOKS

- | | |
|-------------------------------|--------------------------|
| 1. Book-keeping & Accounting | - Prof. Gazi Abdus Salam |
| 2. Principles of Accounting | - Hafiz uddin |
| 3. Cost Accounting | - Prof. Asimuddin Mondol |
| 4. হিসাবরক্ষণ ও হিসাববিজ্ঞান | - পরেশ মণ্ডল |
| 5. উচ্চ মাধ্যমিক হিসাববিজ্ঞান | - হক ও হোসাইন |
| 6. আয়কর | - ড. মনজুর মোরশেদ |



BANGLADESH TECHNICAL EDUCATION BOARD
Agargaon, Dhaka-1207

**4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)**

ELECTRICAL TECHNOLOGY
TECHNOLOGY CODE: **667**

6th SEMESTER

DIPLOMA IN ENGINEERING
PROBIDHAN-2016

ELECTRICAL TECHNOLOGY

6th SEMESTER

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total	
						Theory		Practical			
						Cont. assess	Final exam	Cont. assess	Final exam		
1	66761	Alternating Current Machines 1	3	3	4	60	90	25	25	200	
2	66762	Electrical & Electronic Measurement-2	2	3	3	40	60	25	25	150	
3	66763	Transmission and Distribution of Electrical Power-1	3	3	4	60	90	25	25	200	
4	66867	Communication Engineering	2	3	3	40	60	25	25	150	
5	66868	Micro Controller & PLC	2	3	3	40	60	25	25	150	
6	65852	Industrial Management	2	0	2	40	60	0	0	100	
Total			14	15	19	280	420	125	125	950	

AIMS

After completion of the course students will be able to acquire knowledge, skills and attitude in the area of Alternating Current Machines emphasizes on:

- Power transformer.
- Auto transformer.
- 3-phase induction motor.

SHORT DESCRIPTION

Transformer : principle of operation & construction, emf equation, transformation ratio, losses, equivalent resistance, leakage reactance, tests, regulation, efficiency, three phase connection, auto transformer, parallel operation, Three-phase induction motor: working principle, construction, magnetic field, torque, energy stage, tests, starting and speed control.

DETAIL DESCRIPTION**Theory:**

- 1 **Understand working principle and construction of transformer.**
 - 1.1 Define transformer.
 - 1.2 Explain the working principle of a transformer.
 - 1.3 Describe the construction of a transformer.
 - 1.4 Identify the materials used for a transformer construction.
 - 1.5 List different types of transformers.
 - 1.6 Describe Core type, Shell type and Spiral core type transformer.
 - 1.7 Compare between the core type and shell type transformer.
- 2 **Perceive the emf equation, transformation ratio and Losses of transformer.**
 - 2.1 Define emf equation, transformation ratio of transformer
 - 2.2 Derive the emf equation of transformer.
 - 2.3 Explain voltage ratio, current ratio and transformation ratio.
 - 2.4 List the losses of transformer.
 - 2.5 Interpret Hysteresis loss, Eddy current loss, Core loss and Copper loss.
 - 2.6 Solve problems on emf equation.
- 3 **Interpret the principle of operation of transformer on no-load condition and load condition.**
 - 3.1 Explain no-load operation of transformer.
 - 3.2 Define no-load voltage, current, mutual flux, no load power factor.
 - 3.3 Draw the vector diagram of a transformer on no load condition.
 - 3.4 Solve problems related to no load test.
 - 3.5 Explain operation of a transformer on load condition.
 - 3.6 Draw the vector diagram of transformer on lagging, leading and unity power factor.
 - 3.7 Solve problems related to transformer on load.
- 4 **Understand equivalent circuit of transformer, magnetic leakage and leakage reactance of transformer.**
 - 4.1 Draw the equivalent circuit and vector diagram of a transformer.
 - 4.2 Explain the equivalent circuit of a transformer.
 - 4.3 Derive the equivalent resistance of a transformer referred to primary.
 - 4.4 Calculate the equivalent resistance of a transformer referred to secondary.
 - 4.5 Explain magnetic leakage of transformer.
 - 4.6 List the disadvantages of magnetic leakage.
 - 4.7 Calculate leakage reactance of transformer in terms of primary and in terms of secondary.
 - 4.8 Solve problems on equivalent circuit of transformer, leakage reactance and impedance of transformer.

- 4.9 Define percentage resistance, reactance and impedance.
- 4.10 Express the deduction of the equation for percentage resistance, reactance and impedance.
- 5 Realize the open circuit test, short circuit test and voltage regulation of transformer**
- 5.1 Describe open circuit test.
 - 5.2 Describe short circuit test.
 - 5.3 Draw the vector diagrams.
 - 5.4 Solve problems related to open and short circuit test.
 - 5.5 Define voltage regulation.
 - 5.6 Express the deduction of the equation for voltage regulation at unity, lagging and leading power factor.
 - 5.7 Solve problems related to voltage regulation.
- 6 Understand the efficiency and cooling system of transformer.**
- 6.1 Derive the formula for calculation of efficiency of transformer.
 - 6.2 Explain the factors affecting core loss and copper loss of the transformer.
 - 6.3 Deduce the equation for maximum efficiency.
 - 6.4 Evaluate the variation of efficiency with power factor.
 - 6.5 Define all day efficiency and mention the formula of all day efficiency.
 - 6.6 Solve problems on efficiency, maximum efficiency and all day efficiency.
 - 6.7 Explain the necessity of cooling system of transformer.
 - 6.8 Describe the methods of cooling system the transformer.
 - 6.9 Narrate the transformer oil and its properties.
- 7 Realize the construction and Principle of operation of three phase transformer.**
- 7.1 Describe the construction of three phase transformer.
 - 7.2 List various methods of connection of 3-phase transformer and their applications.
 - 7.3 Describe the methods of star-star, delta-delta, star-delta and delta-star connection.
 - 7.4 Outline open delta connection or V-V connection.
 - 7.5 Describe Scott or T-T connection.
 - 7.6 Explain the application of V-V and T-T connection.
 - 7.7 Draw the connection of 3-phase to 2-phase and vice-versa.
- 8 Comprehend the principle of auto-transformer.**
- 8.1 Describe auto-transformer.
 - 8.2 Explain the terms transformed power and conducted power.
 - 8.3 List the advantages and disadvantages of auto-transformer.
 - 8.4 Convert a Two-winding transformer to auto-transformer.
 - 8.5 Mention the uses of auto-transformer.
 - 8.6 Solve problems related to auto-transformer.
- 9 Understand the principle of parallel operation of transformer.**
- 9.1 Describe the purpose of polarity test.
 - 9.2 Describe the subtractive and additive polarity.
 - 9.3 Illustrate the test to determine the polarity of a transformer
 - 9.4 Explain the purpose of parallel operation.
 - 9.5 List the conditions for parallel operation.
 - 9.6 Describe the parallel operation of transformers with equal voltage ratio.
 - 9.7 Explain the specification on the name plate of a transformer.
 - 9.8 Solve problems related to parallel operation.
- 10 Realize the principle and construction of 3-phase induction motor.**
- 10.1 Explain the general principle of induction motor.
 - 10.2 Distinguish between induction motor and conduction motor.
 - 10.3 List various types of induction motor with their applications.
 - 10.4 Mention different parts of a 3-phase induction motor.
 - 10.5 Describe the construction of stator of an induction motor.

10.6 Narrate the construction of squirrel cage rotor, double squirrel cage rotor and phase wound rotor of induction motor.

10.7 Explain the purpose of skewing the rotor bars in a squirrel cage rotor.

10.8 Define slip and slip speed.

10.9 Express the derivation of the equation $f_r = s \times f$ and $N_r = \frac{120f}{P}(1-s)$

10.10 Outline rotor voltage, rotor current and rotor power.

10.11 Solve problems related to slip. .

11 Recognize the concept of development of rotating magnetic field and torque in rotor.

11.1 Explain the development of rotating magnetic field for three phase induction motor.

11.2 Express the deduction of the formula $\Phi_R = 1.5\Phi_m$.

11.3 Demonstrate the principle of rotation of a 3-phase motor.

11.4 Clarify starting torque, running torque and maximum torque.

11.5 Explicit the deduction of the equation of starting torque, running torque and maximum torque.

11.6 Describe the condition for maximum torque at running and starting condition.

11.7 Mention the relation between torque and rotor power factor.

11.8 Explain the relation between torque and speed.

11.9 Draw the torque speed curve.

11.10 Explain the effect of changing the voltage on torque and speed.

12 Perceive the concept of Power stages of induction motor.

12.1 List the losses in 3-phase induction motor.

12.2 Indicate different stages of power developed in an induction motor.

12.3 Solve Energy stages related problems.

13 Understand the equivalent circuit and maximum Power output of an induction motor.

13.1 Explain the equivalent circuit of an induction motor.

13.2 Clarify maximum power output of an induction motor.

13.3 Express the deduction of the maximum power output $R_L = Z_o$

14 Realize the principle of starting of a 3-phase induction motor.

14.1 Explain the purpose of starter.

14.2 List the starters used for starting 3-phase induction motor.

14.3 Describe the direct On-line starter method, Start-delta starter method (manual and automatic), Auto transformer starter method of starting squirrel cage induction motor.

14.4 Illustrate the rheostat method of starting slip ring induction motor. .

15 Understand the principle of speed control of induction motor.

15.1 List the methods of speed control of 3-phase induction motor.

15.2 Describe speed control by changing applied voltage, changing applied frequency and changing stator poles.

15.3 Describe rheostat control method, concatenation method & injecting emf in rotor circuit method.

Practical:

1 Observe and determine the transformation ratio of a single phase transformer.

1.1 Inspect a single phase transformer.

1.2 Sketch the circuit diagram.

1.3 List the tools, equipments & materials for the experiment.

1.4 Connect the equipment according to the circuit diagram.

1.5 Apply the voltage to the high side and connect the load to the low side.

1.6 Tabulate the readings from the instruments and calculate the transformation ratio from

$$\text{the formula: } a = \frac{V_p}{V_s} = \frac{I_s}{I_p}$$

2 Perform the open circuit test of single phase transformer.

2.1 Draw the circuit diagram.

- 2.2 List the tools, equipment & materials required.
- 2.3 Connect the equipment according to the diagram.
- 2.4 Connect the low side of its rated supply voltage keeping high side open.
- 2.5 Record the readings of the instruments.
- 2.6 Calculate I_o , I_{μ} , I_w , R_o and X_o .
- 2.7 Draw no load vector diagram using the data obtained.

3 Perform the short circuit test of a single phase transformer.

- 3.1 Sketch the required circuit diagram.
- 3.2 List tools, equipment & materials required.
- 3.3 Connect the equipment according to the circuit diagram keeping high side to the source.
- 3.4 Short circuit the low side by a low resistance wire.
- 3.5 Energize the circuit by applying reduced voltage and increase the voltage until it takes full load of current.
- 3.6 Record the instrument readings.
- 3.7 Observe copper loss and calculate and find Re' , Xe' & Ze' .

4 Determine the voltage regulation of single phase transformer by direct loading.

- 4.1 Sketch the necessary circuit diagram.
- 4.2 List the tools, equipment & materials required.
- 4.3 Connect the meters according to the diagram.
- 4.4 Connect the source to the primary keeping the secondary open and record no load voltage (V_o).
- 4.5 Connect full load on the secondary & record the load voltage.
- 4.6 Calculate the voltage regulation from the formula:

$$\% \text{ Voltage Reg.} = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100$$

5 Perform the polarity test of a single phase transformer.

- 5.1 Draw the required circuit diagram.
- 5.2 Collect tools, equipment & materials required.
- 5.3 Connect the equipment according to the diagram.
- 5.4 Connect the circuit to the source.
- 5.5 Record the voltmeter readings.
- 5.6 Determine whether it is additive or subtractive polarity.

6 Perform parallel operation of two single phase transformers.

- 6.1 Draw the circuit diagram.
- 6.2 Collect tools, equipment & materials required.
- 6.3 Connect the equipment according to the circuit diagram with proper polarity.
- 6.4 Energize the circuit and connect the load to the secondary.
- 6.5 Record the energy shared by each transformer.

7 Perform transformer banking.

- 7.1 Collect the tools, equipment and materials required.
- 7.2 Draw the circuit diagram of Y-Y, Y-Δ, Δ-Δ and Δ-Y banking respectively.
- 7.3 Connect the equipment according to the diagram separately.
- 7.4 Record the meter readings for each case separately.
- 7.5 Calculate the voltage ratio in each case.

8 Perform V-V and T-T connection of transformer banking.

- 8.1 Collect the tools, equipment and materials required.
- 8.2 Draw the circuit diagram of V-V connection respectively.
- 8.3 Draw the circuit diagram of T-connection respectively.
- 8.4 Connect the equipment according to the diagram separately.
- 8.5 Record the meter readings for each case separately.
- 8.6 Calculate the voltage ratio in each case.

- 9 Perform the operation of auto-transformer and determining its transformation ratio.**
- 9.1 Sketch the circuit diagram.
 - 9.2 Collect tools, equipment & materials required.
 - 9.3 Connect the equipment according to the circuit diagram.
 - 9.4 Energize the circuit and tabulate the meter readings.
 - 9.5 Calculate transformation ratio, conducted power & transformed power.
- 10 Perform the identification of the parts of a three phase induction motor.**
- 10.1 Select a 3-phase induction motor.
 - 10.2 Collect different tools required for the experiment.
 - 10.3 List different parts of a 3-phase induction motor.
 - 10.4 Dismantle the parts of the motor.
 - 10.5 Identify different parts and make sketch of each part. .
 - 10.6 Assemble the dismantled parts.
- 11 Start a 3-phase induction motor by manual Star-delta starter.**
- 11.1 Take a 3-phase squirrel cage induction motor.
 - 11.2 Collect the equipment & tools required.
 - 11.3 Draw the working diagram to perform the experiment.
 - 11.4 Connect the starter with the motor as per diagram.
 - 11.5 Start the motor with the starter: first in star and then in delta position.
 - 11.6 Measure the speed of the motor with tachometer.
 - 11.7 Calculate slip of the motor.
- 12 Start a 3-phase induction motor by Star-delta starter using PLC.**
- 12.1 Take a 3-phase squirrel cage induction motor.
 - 12.2 Collect the equipment & tools required.
 - 12.3 Draw the working diagram to perform the experiment.
 - 12.4 Connect the starter with the motor as per diagram.
 - 12.5 Push the start button to start the motor automatically first in star and then in delta position.
 - 12.6 Measure the speed of the motor with tachometer.
 - 12.7 Calculate slip of the motor.

REFERENCE BOOKS

1. Electrical Machines by
 - Charles. S. Siskind
2. A text book of Electrical Technology
 - B. L Theraja and A.K Theraja.
3. Electrical Machine
 - J B Gupta
4. Electrical Machines
 - M.V. Deshpande

AIMS

To provide the student with opportunities to acquire knowledge, skills and attitude in the area of Electrical Measurement and Measuring Instruments with special emphasizes on:

- Extension of instrument range
- Operation of instrument transformer.
- Measurement of the resistance of various ranges.
- The concept of operation of meters for measurement of frequency and Power factor,

SHORT DESCRIPTION

Extension of instrument ranges: instrument range; Ammeter shunt, Voltmeter multiplier; Instrument transformer: construction and use of CT & PT; Measurement of resistance: Low resistance, Medium resistance and High resistance; Multimeter; Digital instrument; Frequency Meter: Principle of measurement, construction and operation; Energy factor meter: Construction and principles of operation; Digital energy factor meter;

DETAIL DESCRIPTION**Theory:****1 Understand extension of instrument range.**

- 1.1 List different types of instrument for which extension is required.
- 1.2 Explain the principles and necessity for extension of instrument range.
- 1.3 Describe the ammeter shunt for DC circuit.
- 1.4 Express the deduction of the relation: $R_{sh} = \frac{R_m}{N-1}$
- 1.5 Explain ammeter shunt for AC circuit.
- 1.6 Solve problems relating to ammeter shunt.
- 1.7 Describe voltmeter multiplier and the swamping resistance
- 1.8 Explain voltmeter multiplier for AC instrument.
- 1.9 Solve problems relating to voltmeter multiplier.

2 Perceive the concept of Instrument transformer.

- 2.1 Describe current transformer (CT) and potential transformer (PT).
- 2.2 List the applications of current transformer and potential transformer.
- 2.3 Explain the advantages and disadvantages of CT and PT.
- 2.4 Describe the burdens of instrument transformer.
- 2.5 Define Knee point, excitation curve and class of CT.
- 2.6 Compare instrument transformer with Power transformer.

3 Realize the concept of current transformer (CT) and potential transformer (PT).

- 3.1 Describe the construction of current transformer.
- 3.2 Draw and explain the connection and vector diagram of current transformer.
- 3.3 Determine actual current ratio, ratio error and phase angle error.
- 3.4 Explain the characteristics of current transformer.
- 3.5 Narrate the classes of accuracy in instrument transformer.
- 3.6 Outline the effect of open circuited secondary of current transformer.
- 3.7 Describe the construction and use of clip on ammeters.
- 3.8 Explain the construction of potential transformer.
- 3.9 Sketch and explain the connection diagram with line and vector diagram of PT.
- 3.10 Draw the circuit showing CT, PT and Watt meter with 1-phase and 3-phase load.

- 4 Recognize the measurement of resistance.**
- 4.1 Classify resistance.
 - 4.2 Explain low, medium and high range of resistance.
 - 4.3 List the methods of measurement of low resistance.
 - 4.4 Describe the measurement of low resistance by ammeter- voltmeter method.
 - 4.5 Determine the low resistance by Kelvin's double bridge method.
 - 4.6 Solve problems on Kelvin's double bridge method.
- 5 Interpret the measurement of medium resistance.**
- 5.1 List the methods for measurement of medium resistance.
 - 5.2 Describe Wheatstone bridge method to measure the medium resistance.
 - 5.3 Mention the advantages of Wheatstone bridge method.
 - 5.4 Discuss the precaution in measuring medium resistance by Wheatstone bridge method.
 - 5.5 Solve problems related to Wheatstone bridge method.
- 6 Understand the measurement of high resistance.**
- 6.1 Describe dielectric test of insulating materials.
 - 6.2 List the methods to measure high resistance measurement.
 - 6.3 Describe the guard wire method of measurement of high resistance.
 - 6.4 Explain the construction and working principle of a Megger.
 - 6.5 Describe the method of measurement of high resistance Using a Megger.
 - 6.6 State the uses of Megger.
 - 6.7 Describe measurement of earth resistance using earth tester.
- 7 Perceive the Multimeter.**
- 7.1 Explain the circuit of analog Multimeter.
 - 7.2 Describe the construction of analog Multimeter.
 - 7.3 Specify the construction of digital Multimeter.
 - 7.4 Describe the uses of Multimeter.
- 8 Illustrate the method of measurement of frequency and frequency meter**
- 8.1 Name the methods of measuring frequency.
 - 8.2 Explain the principle of mechanical resonance and electrical resonance.
 - 8.3 Construct the variation of impedance of an inductive circuit with the variation of supply frequency.
 - 8.4 Mention different types of frequency meter.
 - 8.5 Explain the construction and working principle of electrical resonance frequency meter.
 - 8.6 Describe the construction and working principle of Weston frequency meter.
- 9 Understand the operation of digital frequency meter.**
- 9.1 Describe the principle of operation of digital frequency meter.
 - 9.2 Sketch the block diagram of a digital frequency meter.
 - 9.3 Describe each block of a digital frequency meter.
 - 9.4 Describe the function of time base selector in digital frequency meter.
 - 9.5 Draw and Explain the operation of logic diagram of a digital frequency meter.
- 10 Realize the construction and principle of operation of power factor meter.**
- 10.1 List different types of energy factor meter.
 - 10.2 Describe construction and principle of operation of single phase dynamometer type power factor meter.
 - 10.3 Narrate the construction and principle of operation of three phase dynamometer type power factor meter.
 - 10.4 Describe the principle of operation of digital power factor meter.
 - 10.5 Draw the block diagram of a digital power factor meter.
 - 10.6 Describe each block of a digital power factor meter.
- 11 Understand the principle of high voltage measurement and testing.**
- 11.1 Describe the high voltage measurement of electrical quantities.
 - 11.2 List the equipment for high voltage measurement.
 - 11.3 Describe the sphere gap method of high voltage measurement.

- 11.4 Describe the potential divider method of high voltage measurement.
- 11.5 Mention the advantages of sphere gap method of high voltage measurement.
- 11.6 Mention the disadvantages of sphere gap method of high voltage measurement.

12 Understand the principle and operation of oscilloscope.

- 12.1 State the basic principle of oscilloscope.
- 12.2 Mention the types of oscilloscope.
- 12.3 Mention the important features of cathode ray oscilloscope
- 12.4 Describe the block diagram of oscilloscope.
- 12.5 Describe the operation of dual trace oscilloscope.
- 12.6 Describe the operation of digital oscilloscope.
- 12.7 Describe the Procedure of measurement voltage, current, phase & frequency using CRO.
- 12.8 Describe frequency and phase angle measurement using Lissagous Pattern.

Practical:

1 Determine the shunt resistance of an ammeter for extension of its range.

- 1.1 Sketch the circuit diagram for determining the shunt resistance of an ammeter.
- 1.2 Collect the tools, equipment and materials required.
- 1.3 Prepare the circuit according to the circuit diagram using proper equipment.
- 1.4 Check the equipment setting and connection before connecting Power supply.
- 1.5 Record the readings from the meter.
- 1.6 Calculate the value of shunt resistance.

2 Measure the value of resistance of a voltmeter multiplier.

- 2.1 Sketch the circuit diagram for determining the resistance of voltmeter multiplier.
- 2.2 Connect the tools, equipment and materials required.
- 2.3 Prepare the circuit according to the circuit diagram.
- 2.4 Check the circuit before connecting Power supply.
- 2.5 Record the reading from the meter.
- 2.6 Calculate the value of resistance of the multiplier.

3 Perform the handling of instrument transformer.

- 3.1 Select the current transformer and potential transformer.
- 3.2 Select required tools, equipment and materials.
- 3.3 Draw the circuit diagram.
- 3.4 Connect the equipment according to the circuit diagram.
- 3.5 Check all connection before supplying Power to the circuit.
- 3.6 Records reading from the meter and calculate the transformation ratio.

4 Prepare the excitation curve using CT (Current transformer).

- 4.1 Select the current transformer.
- 4.2 Select required tools, equipment and materials.
- 4.3 Draw the circuit diagram.
- 4.4 Connect the equipment according to the circuit diagram.
- 4.5 Check all connection before supplying Power to the circuit.
- 4.6 Record data by varying input current.
- 4.7 Plot the excitation curve.
- 4.8 Point out the Knee point and types of CT.

5 Measure of low resistance by Ammeter–Voltmeter method.

- 5.1 Draw the circuit diagram for the measurement of low resistance by ammeter-voltmeter method.
- 5.2 Connect the tools, equipment and materials required.
- 5.3 Prepare the circuit according to the circuit diagram using proper equipment.
- 5.4 Check the circuit before connecting Power supply.
- 5.5 Record the meter readings.
- 5.6 Calculate the resistance from the meter readings.

- 6 Perform the measurement of earth resistance by earth tester.**
- 6.1 Sketch the circuit diagram for the measurement of earth resistance by earth tester.
 - 6.2 Select a earth tester and required tools, equipment and materials.
 - 6.3 Connect the equipment according to the circuit diagram.
 - 6.4 Measure the earth resistance from the reading of the earth tester.
- 7 Perform the measurement of medium resistance by Wheatstone bridge.**
- 7.1 Draw the circuit diagram for measuring medium resistance by Wheatstone bridge.
 - 7.2 Select tools, equipment and materials required.
 - 7.3 Prepare the circuit according to the circuit diagram.
 - 7.4 Check all the connection before connecting Power supply.
 - 7.5 Record the meter readings.
 - 7.6 Calculate the value of unknown resistance.
- 8 Perform the measurement of high resistance by a Megger.**
- 8.1 Select a high resistance.
 - 8.2 Select a Megger.
 - 8.3 Connect the resistance with the Megger.
 - 8.4 Measure the resistance from the reading of the Megger.
- 9 Measure the frequency by a frequency meter.**
- 9.1 Sketch the circuit diagram.
 - 9.2 Select a frequency meter.
 - 9.3 Select tools, equipment and materials.
 - 9.4 Connect the frequency meter to the supply or circuit whose frequency is to be measured.
 - 9.5 Measure the supply frequency from the meter.
- 10 Perform the measurement of Power factor by a Power factor meter.**
- 10.1 Sketch the circuit diagram for measurement of Power factor of a load by a Power factor meter.
 - 10.2 Select the tools, equipment and materials required.
 - 10.3 Prepare the circuit according to the circuit diagram by using proper equipment.
 - 10.4 Check the circuit before connecting power supply.
 - 10.5 Record power factor from the power factor meter.
- 11 Perform the measurement of voltage, current and frequency by cathode ray oscilloscope (CRO).**
- 11.1 Draw the circuit diagram for the measurement of voltage, current and frequency by CRO.
 - 11.2 Select the tools, equipment and materials required.
 - 11.3 Connect the equipment setting and connection according to the circuit diagram.
 - 11.4 Measure the voltage, current and frequency of the circuit by CRO.
 - 11.5 Prepare a report on it.

REFERENCE BOOKS

1. Electrical Measurements & Measuring Instruments
- Golding & Widdis.
2. A Course in Electrical & Electronic Measurements and Instrumentation
- A.K Sawhney
3. A Text Book of Electrical Technology (volume-I)
- B.L Theraja and A.K Theraja
4. Measurement of measuring Instrument

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J.B.

Gupta

AIMS

To provide the students with opportunities to acquire knowledge, skills and attitude in the area of transmission and distribution electrical power with special emphasizes on:

- Different types of transmission and distribution systems of electrical power.
- Comparison of different types of transmission and distribution systems.
- Electrical and Mechanical design of overhead lines.
- Survey of transmission and distribution line routes.
- Voltage regulation and Efficiency of transmission lines.

SHORT DESCRIPTION

Different systems of transmission; Aspect of transmission system; Mechanical design of overhead lines: support of overhead lines; conductors & conductor materials; Insulators; Effect of sag; Methods for survey of transmission/distribution line route; Voltage distribution of suspension insulator; Corona; Erection of poles and drawing of conductors of overhead lines; Electrical design of overhead line: Resistance of the line conductor; Skin effect of transmission line; Effect of inductance on transmission line; Effect of capacitance of overhead transmission line; Voltage regulation and efficiency of short transmission line.

DETAIL DESCRIPTION**Theory:****1 Understand different systems of transmission of electrical power.**

- 1.1 Explain the transmission and distribution system of electrical power.
- 1.2 Categorize various systems of transmission and distribution of electrical power.
- 1.3 Define Feeder and Distributor.
- 1.4 Compare between Feeder & Distributor.
- 1.5 Distinguish between overhead and underground transmission and distribution system.
- 1.6 Explain the advantages of high voltage transmission over low voltage transmission.
- 1.7 Compare the cost of conductor of different overhead systems.
- 1.8 Compare the cost of conductor of underground system with overhead system.
- 1.9 Describe the process of choosing the working voltage for transmission and distribution system.
- 1.10 Calculate the most economic working voltage for transmission of electrical power.

2 Perceive different aspects of transmission system.

- 2.1 Express the equation for the most economic size of conductor using Kelvin's law.
- 2.2 Describe the limitations of the application of Kelvin's law to find out the economic size of the conductor.
- 2.3 Solve problems on Kelvin's law.
- 2.4 Explain the term system losses.
- 2.5 List the factors involved in system loss.
- 2.6 Explain how the system losses can be minimized.
- 2.7 Discuss the most economic power factor.
- 2.8 Derive the equation for most economic power factor.
- 2.9 Solve problems on most economic power factor.

3 Recognize the supports of overhead lines.

- 3.1 Mention the main components of overhead lines.
- 3.2 Categorize the line supports.
- 3.3 Describe different types of line supports.
- 3.4 Mention the characteristics of line supports.
- 3.5 Explain the vibration dampers.

- 4 Interpret the conductors and conductor materials.**
- 4.1 List different types of line conductors used in overhead transmission and distribution lines.
 - 4.2 Mention at least five properties of conductor materials.
 - 4.3 Compare the properties of Copper, Aluminum and ACSR conductors.
- 5 Realize the line insulators and their characteristics.**
- 5.1 List different types of insulators.
 - 5.2 Specify various types of insulating materials.
 - 5.3 Describe the properties of insulating materials.
 - 5.4 Explain the Pin and Suspension type insulators.
 - 5.5 Compare the advantages and disadvantages of Pin and Suspension type insulator.
 - 5.6 Mention the uses of different types of insulators.
 - 5.7 List the causes of failure of insulators.
 - 5.8 Explain different types of test of insulators.
- 6 Understand sag and its effect.**
- 6.1 Explain the sag of transmission line.
 - 6.2 List the factors affecting the sag.
 - 6.3 Explain the spacing between conductors and span length.
 - 6.4 Derive the formula to calculate the sag of conductors between two poles of equal height.
 - 6.5 Derive the formula to calculate the sag of conductors between two poles of unequal heights considering effect of ice and wind pressure.
 - 6.6 Solve problems on sag of transmission lines.
 - 6.7 Explain the effects of vibration on the transmission line and prevention of vibration.
 - 6.8 Describe the measure for the prevention of vibration.
- 7 Perceive the methods for survey of transmission / distribution line route.**
- 7.1 List the Surveying Instruments required to survey of transmission / distribution lines.
 - 7.2 Explain the uses, errors and accuracy of surveying instruments.
 - 7.3 Describe the process of measuring the angles by compass, level and Theodolite.
 - 7.4 Enumerate leveling, alignment, surveying and pegging of the route.
 - 7.5 Explain the methods of measuring vertical and horizontal heights of T/D.
 - 7.6 List the principle factors in routing overhead energy lines.
- 8 Understand the voltage distribution of suspension insulator.**
- 8.1 Explain string efficiency.
 - 8.2 Describe the methods of improving string efficiency.
 - 8.3 Solve problems on string efficiency.
 - 8.4 Deduce the equation of voltage distribution across each unit of a string of suspension insulators.
 - 8.5 Describe the methods of voltage grading in suspension insulators.
 - 8.6 Illustrate the methods of equalization of voltage of suspension insulators by guard ring.
 - 8.7 Solve problems on voltage distribution and voltage grading.
- 9 Understand the phenomenon of corona.**
- 9.1 Define corona of overhead transmission line.
 - 9.2 Discuss the effect of corona.
 - 9.3 Explain at least four factors that affect corona.
 - 9.4 Describe the advantages and disadvantages of corona.
 - 9.5 Express the derivation of the relation for disruptive critical voltage, visual critical voltage and energy loss due to corona.
 - 9.6 Discuss the methods for minimizing corona.
- 10 Recognize the erection of poles / towers and drawing of conductors of overhead line.**
- 10.1 Describe the procedure of erection of poles of overhead transmission / distribution line.
 - 10.2 Explain the procedure of erection of towers of overhead transmission line.
 - 10.3 Describe the procedure of fixing cross arm and insulator.
 - 10.4 Interpret the drawing of conductors of overhead lines.
 - 10.5 Narrate the erection of stay / guy wire.

- 11 View the resistance of line conductor.**
- 11.1 Describe the line constants of transmission line.
 - 11.2 Express the deduction of the equation for calculating resistance of the line conductor.
 - 11.3 Solve problems on the resistance of the line conductor.
- 12 Understand the skin effect of transmission line.**
- 12.1 Explain the skin effect of transmission line.
 - 12.2 Express the equation for calculating skin effect.
 - 12.3 Describe the proximity effect.
- 13 Realize the effect of inductance on transmission line.**
- 13.1 Explain the flux linkage of a conductor due to internal and external flux.
 - 13.2 Express the deduction of the equation for inductance of a single phase and three phase overhead transmission line in terms of Geometrical Mean Distance (GMD) and Geometrical Mean Radius (GMR).
 - 13.3 Solve problems on inductance of single phase and three phase lines.
 - 13.4 Describe the inductance of three-phase line with double circuit.
 - 13.5 Explain the transposition of line conductors.
- 14 Understand the effect of capacitance of overhead transmission line.**
- 14.1 Explain the electric potential of a transmission line.
 - 14.2 Express the derivation of the equation to calculate the capacitance of single phase and three phase overhead transmission line.
 - 14.3 Solve problems on capacitance of single phase and three phase overhead transmission line.
 - 14.4 Explain the capacitance of double circuit three phase overhead line.
 - 14.5 Narrate Ferranti effect.
- 15 Interpret the voltage regulation and efficiency of short transmission line.**
- 15.1 Classify overhead transmission line.
 - 15.2 Express the equation to calculate the voltage regulation of overhead short transmission line.
 - 15.3 Derive the equation to calculate efficiency of overhead short transmission line.
 - 15.4 Identify the effect of load energy factor on voltage regulation and efficiency of overhead short transmission line.
 - 15.5 Draw vector diagram of a short transmission line.
 - 15.6 Solve problems on voltage regulation and efficiency of overhead short transmission line.

Practical:

- 1 Make a table for cost of conductor by considering same distance and voltage level.**
 - 1.1 Select different types of conductor.
 - 1.2 Fix up distance and voltage level.
 - 1.3 Collect price list of conductors.
 - 1.4 Prepare a table.
- 2 Survey and estimate the electrical loads of an area.**
 - 2.1 Select the area / section of which the electrical loads are to be surveyed.
 - 2.2 Observe and record the load of each point of the area.
 - 2.3 Calculate the average load of a specific area and the sub-area.
 - 2.4 Calculate the load of main circuit and sub-circuits.
- 3 Plot the chronological load curve, integrated load curve, actual load curve and ideal load curve.**
 - 3.1 Collect the data from data table of experiment number one.
 - 3.2 Plot the chronological load curve
 - 3.3 Draw the integrated load curve.
 - 3.4 Sketch the actual load curve.
 - 3.5 Draw the ideal load curve.
- 4 Perform the calculation of most economical Power factor (graphically).**
 - 4.1 Select the formula to calculate the most economical Power factor.
 - 4.2 Collect the data from a typical mathematical problem.
 - 4.3 Calculate the most economical power factor.

- 5 Perform the selection of economical voltage for generation, transmission and distribution of electrical energy.**
 - 5.1 Select generating voltage.
 - 5.2 Choice voltage for transmission and distribution of electrical power.
 - 5.3 Specify required type of insulators and poles.
- 6 Prepare the layout diagram of an electrical project.**
 - 6.1 Draw the layout of the selected electrical project.
 - 6.2 Sketch the complete wiring diagram of the electrical project showing transmission line, distribution line and service mains.
 - 6.3 Indicate the energy source.
- 7 Perform the identification of different components of LT and HT over head lines.**
 - 7.1 Identify the components of LT over head lines.
 - 7.2 Specify the components of HT over head line.
 - 7.3 Follow safety practices.
 - 7.4 Prepare a report.
- 8 Perform the measurement of the horizontal distance between poles.**
 - 8.1 Collect the instruments/ equipment commonly used in surveying.
 - 8.2 Measure the horizontal distance between poles over different ground conditions by using tape, chain and Total station
 - 8.3 Record the measurement of distance.
 - 8.4 Plot the line route showing the measurements.
- 9 Perform the measurement of the angles and heights of poles / towers by using Theodolite/ Total station.**
 - 9.1 Select the instruments for measuring angles and heights of poles.
 - 9.2 Measure horizontal angles.
 - 9.3 Measure vertical angles.
 - 9.4 Measure vertical heights of poles / towers.
- 10 Perform the measurement of sag of a transmission / distribution line.**
 - 10.1 Set the Theodolite/Total station in first position and measure the angle.
 - 10.2 Set the Theodolite/Total station in second position and measure the angle.
 - 10.3 Calculate the sag of a transmission / distribution line using Theodolite/Total station.
 - 10.4 Prepare a report.

REFERENCE BOOKS

1. A Course in Electrical Energy
 - J B Gupta.
2. Principles of Energy System
 - V K Mehta.
3. Transmission & Distribution of Electrical Power
 - H. Cotton.
4. Electrical Energy system 3rd Revised Edition
 - Ashfaq Husain

AIMS

To provide the students with opportunities to acquire knowledge, skills and attitude in the area of communication engineering with special emphasizes on:

- Various types of modulation demodulation
- Radio receiver and transmitter
- Telephone system
- Digital communication system
- Communication switching system
- Optical fiber communication
- Satellite communication
- Modem and mobile communication

SHORT DESCRIPTION

Communication networks; Modulation; Demodulation Receiver and Transmitter; Telephone system; Digital communication; Communication switching system; Optical fiber; Satellite communication; Digital Communication, Modem and mobile communications.

DETAIL DESCRIPTION**Theory:****1 Understand the features of communication network.**

- 1.1 Mention the allocation of frequency bands for various communication systems.
- 1.2 Explain the nature of Audio, Video, Digital data.
- 1.3 Explain Channel band width and Channel capacity.
- 1.4 Describe different types of internal and external noise, noise figure and SNR (signal to noise ratio).
- 1.5 State the variety of communication networks.
- 1.6 State the nature of satellite communications.
- 1.7 Basic communication system with block diagram.

2 Understand the features of modulation.

- 2.1 Explain the Amplitude Modulation.
- 2.2 Drive the equation for the amplitude modulated wave.
- 2.3 Define Modulation index, depth of modulation, SSB, SSB-SC, DSB, DSB-SC and VSB modulation.
- 2.4 Derive the equation for frequency modulated wave (without analysis of Besel function).
- 2.5 State the meaning of the terms Modulation index, Maximum frequency deviation and Deviation ratio of FM wave.
- 2.6 Difference between Amplitude and Frequency modulation.
- 2.7 Explain the PPM, PDM and PWM signals and describe its application.
- 2.8 State the principles of Multiplexing and Demultiplexing.
- 2.9 Explain the principles of FDM and TDM with block diagram.

3 Understand the Modulator and Demodulator.

- 3.1 Explain the principles of operation of Collector modulator, Base modulator, Balanced modulator, Suppressed carrier balanced modulator and Varactor diode modulator (without equation deduction).
- 3.2 State the basic principles of SSB-SC generation and QAM.
- 3.3 Mention the methods of AM detection.
- 3.4 Explain the operation of a Linear (diode) detector.

- 3.5 Mention the methods of FM detection.
- 3.6 Explain the working principle of various FM detectors.
- 3.7 List the advantages of Ratio detector over Foster seely discriminator circuit.

4 Understand the features of radio Receiver and Transmitter.

- 4.1 Explain the block diagram of AM transmitter.
- 4.2 Explain the operation of SSB transmitter with block diagram.
- 4.3 Explain the block diagram of Super heterodyne AM receiver with wave form.
- 4.4 Explain the block diagram of Armstrong system FM transmitter.
- 4.5 Explain the sensitivity, Selectivity, Fidelity and Signal to Noise Ratio (SNR).

5 Understand the features of a telephone system.

- 5.1 State telephone system.
- 5.2 Describe the working principle of modern a Modern telephone hand set transmitter and receiver (without deduction of equation).
- 5.3 Describe the operation of automatic subscriber telephone set.
- 5.4 Describe advantages & disadvantages of side tone.
- 5.5 Describe the tones used in automatic telephone.
- 5.6 Describe about a digital telephone set.
- 5.7 Define different types of telephone exchange.

6 Understand the concept of Digital communication.

- 6.1 State the advantages of Digital communication.
- 6.2 Describe the sampling theorem.
- 6.3 Describe the quantization and coding principle of PCM.
- 6.4 Mention different types of media used for data transmission.
- 6.5 Describe the function of line driver and line receiver.
- 6.6 Describe synchronous and asynchronous mode of data transfer.
- 6.7 Describe the function of USART.

7 Communication switching system.

- 7.1 Define communication switching.
- 7.2 Mention different types of communication switching (analog and digital).
- 7.3 Functions of switching system.
- 7.4 Characteristics of switching system.
- 7.5 Describe centralized and distributed stored program (SPC) switching system.
- 7.6 Define the following: Message, Circuit and Packet switching, STS and TST switching.
- 7.7 Mention the different types of cables and connectors.

8 Understand Optical Fiber.

- 8.1 Define Optical Fiber.
- 8.2 Basic block diagram of Optical communication system.
- 8.3 Construction of optical fiber.
- 8.4 Advantages and disadvantages of optical fiber.
- 8.5 Mention different types of light sources and detectors of optical fiber.
- 8.6 Describe different types of optical fiber splices.

9 Understand the satellite communication.

- 9.1 Discuss the principles of satellite communication.
- 9.2 Describe the advantages of satellite communication.
- 9.3 Describe satellite earth station with block diagram.
- 9.4 Describe the working principle of VSAT.
- 9.5 Describe the applications of various satellites.
- 9.6 List different locations of satellite earth station in Bangladesh.
- 9.7 Describe the status and features of Bangabandhu Satellite-I.

- 10 Understand the digital communications.**
- 10.1 Describe the working principle of Facsimile.
 - 10.2 Function of MODEM in data communication.
 - 10.3 State the application of digital communication network.
 - 10.4 Describe the local area network.
 - 10.5 Describe the wide area network.
 - 10.6 Describe Ethernet.
 - 10.7 Define ISDN, SDH, STN, SONET, FDDI, Internet and WWW, WAP, VOIP.

11.Understand the Mobile communications.

- 11.1 State the mobile communication systems.
- 11.2 List the application of mobile communication.
- 11.3 Describe the simple Mobile Network system.
- 11.4 Describe the function of base station of mobile communication system.
- 11.5 Define GSM, CDMA, FDMA, WIMAX, Bluetooth, Wi-fi.
- 11.6 Describe briefly 1G, 2G, 3G, 3.5G, 4G and 5G.

12. Recognize Supervisory Control and Data Acquisition (SCADA) system

- 12.1 Define Supervisory Control and Data Acquisition
- 12.2 Describe General features of SCADA system
- 12.3 Explain Functions and Applications of SCADA Networks
- 12.4 Narrate Structure of a SCADA Communications Protocol
- 12.5 Illustrate a Prototype View of SCADA Systems
- 12.6 SCADA Communication protocols: Past, Present and Future.
- 12.7 Describe Reliability, Redundancy and Safety Issues of SCADA system.

Practical:

- 1 Study the operation of Amplitude modulator.**
 - 1.1 Select the required equipment, tools and materials.
 - 1.2 Connect the circuit and equipment.
 - 1.3 Input different modulations and carrier signals.
 - 1.4 Record the required data.
 - 1.5 Calculate the modulation index for each set of data.
- 2 Study the operation of Frequency modulator.**
 - 2.1 Select the required equipment, tools and materials.
 - 2.2 Setup the circuit board and the equipment.
 - 2.3 Input the proper signals.
 - 2.4 Make the proper adjustment.
 - 2.5 Observe the FM wave.
- 3 Study the operation of Amplitude demodulator.**
 - 3.1 Select the required equipment, tools and materials.
 - 3.2 Connect the circuit and equipment.
 - 3.3 Input different modulated signals.
 - 3.4 Observe the output wave.
- 4 Study the operation of Frequency demodulator.**
 - 4.1 Select the required equipment, tools and materials.
 - 4.2 Setup the circuit board and the equipment.
 - 4.3 Input the proper signals.
 - 4.4 Make the proper adjustment.
 - 4.5 Observe the output wave.

- 5 Study the Super heterodyne AM radio receiver.**
 - 5.1 Select a radio receiver and required tools & materials.
 - 5.2 Identify the circuit diagram of receiver.
 - 5.3 Make the list of the components.
 - 5.4 Trace the circuit of the receiver.
- 6 Study the modern telephone hand set transmitter and receiver.**
 - 6.1 Select a modern telephone set.
 - 6.2 Identify the transmitting and receiving section.
 - 6.3 Make a list of components.
- 7 Study the Optical Fiber communication system.**
 - 7.1 Select the required equipment, tools and materials.
 - 7.2 Identify the transmitting and receiving section.
 - 7.3 Connect the circuit and equipment.
 - 7.4 Observe the output.
- 8 Study the Optical Fiber joints and couplers.**
 - 8.1 Select required tools & materials.
 - 8.2 Make Optical Fiber joints.
 - 8.3 Test the joint.
- 9 Study the satellite home receiving system.**
 - 9.1 Select required tools & materials.
 - 9.2 Connect the satellite receiver with antenna and TV receiver.
 - 9.3 Adjust the channel frequency.
 - 9.4 Observe different channels.
- 11 Field visit for gathering practical experience on SCADA system.**
 - 11.1 Make a communication with the authority of PGCB.
 - 11.2 Arrange a field visit.
 - 11.3 Prepare a report on **SCADA system**.

The student will visit the nearest automatic telephone exchange, digital telephone exchange, Grameen phone network system, Bangladesh Railway, Ground satellite station and VSAT.

REFERENCE BOOKS

1. Introduction to Telecommunication
Marion Cole
2. Mobile Communications
John Schiller
3. Satellite Communications
DC Agarwal
4. Optical Fiber and Fiber Optic Communication system
Subir Kumar Sarker.
5. Mobile and Personal Communication System and Service
Raj Pandya.
6. Cellular Mobile system Engineering
Saleh Faruque.

66868

MICROCONTROLLER AND PLC

**T P C
2 3 3**

AIMS

To provide the students with opportunities to acquire knowledge, skills and attitude in the area of Microcontroller and PLC emphasizes on:

- The Fundamentals of microcontroller.
- The features of the 8051 microcontroller.
- The architecture of 8051 microcontroller.
- Develop C language program for the 8051 microcontroller.
- Understand I/O port Programming.
- Understand the Timer and Counter of the 8051.
- Interfacing LCD and Real world devices.
- Relay logic control
- Ladder diagram elements and programming.

SHORT DESCRIPTION

Fundamentals of microcontroller, hardware of 8051, instruction set, Assembly language programming, C programming, Timer, Interrupt, DC motor interfacing, Stepper motor interfacing, interfacing LCD display, Relay logic control, Fundamentals of PLC, PLC ladder diagram programming, Inter relay, Jump and Call, Timer and Counter.

DETAIL DESCRIPTION

Theory:

1 Understand the Fundamentals of Micro controller.

- 1.1 Define Microcontroller.
- 1.2 Mention the types of Microcontroller.
- 1.3 Compare CISC and RISC.
- 1.4 Mention the field of Microcontroller applications.
- 1.5 List the commercial Microcontrollers with salient features
- 1.6 Mention the criteria for choosing a microcontroller

2 Understand Features and Architecture of the Intel 8051 Microcontroller.

- 2.1 Define 8051 family.
- 2.2 Mention the features of the Intel 8051 microcontroller and PIC.
- 2.3 Compare the features of different member of the 8051 family.
- 2.4 Describe the simplified Block diagram of the Intel 8051 microcontroller.
- 2.5 Explain the programming model of the 8051 microcontroller.
- 2.6 Describe the memory organization of the 8051 microcontroller mentioning the function of SFR, Register bank, bit addressable & general purpose RAM.
- 2.7 State the function of each flag of the PSW register.
- 2.8 Explain the pins and signals of the 8051 microcontroller.
- 2.9 Describe the Clock and Reset circuits of the 8051.
- 2.10 Compare Atmel 89C2051 and 89C4051 with 8051.

3 Understand Programming 8051 using C programming.

- 3.1 Mention the reasons for writing program in C.
- 3.2 List C data types and operators for 8051
- 3.3 Describe creating time delay in C.
- 3.4 Write program in C for sending data to port, Accessing code ROM, Data serialization and Interrupt operation.

4 Understand the 8051 Timer and Counter

- 4.1 List the function of a timer.
- 4.2 Discuss the mode of operation of a timer.
- 4.3 Describe the function of each bit of TMOD & TCON Register.

- 4.4 Write code for setting timer in different mode.
- 4.5 Explain the procedure of starting, stopping and controlling timer.
- 4.6 Calculate the initial value of timer for creating a certain delay.
- 4.7 Write subroutine for creating delay of certain amount of time using Timer.
- 4.8 Develop program for generating square wave.
- 4.9 Describe the Timer as an event counter.

5 Understand the Interrupt of the 8051 Microcontroller.

- 5.1 List the source of interrupt of the 8051.
- 5.2 Define Interrupt service routine (ISR).
- 5.3 Mention the interrupt priority and vector locations.
- 5.4 Describe each bit of the interrupt enable (IE) register.
- 5.5 Describe the procedure of enabling and disabling interrupt.
- 5.6 Mention the steps in executing an interrupt.
- 5.7 Describe the register protection during interrupt.
- 5.8 Describe External Hardware, Timer and Serial communication Interrupt.
- 5.9 State the common problem with interrupt.

6 Understand LCD and Real world Interfacing.

- 6.1 Describe the pin diagram of LCD.
- 6.2 Describe the Instruction register, data register and busy flag.
- 6.3 List the LCD command codes,
- 6.4 Write Program for displaying data to LCD.
- 6.5 Describe the organization of a matrix Keyboard.
- 6.6 Explain the steps to detect and identify the key pressed.
- 6.7 Describe interfacing ADC/DAC chips to the 8051.
- 6.8 Develop program for Speed control a DC motor, a Stepper motor, display a word by DOT matrix display.

7 Understand PLC and its Input output (I/O) module.

- 7.1 Define PLC.
- 7.2 Describe Historical background of a PLC.
- 7.3 Mention the difference between PLC and computer.
- 7.4 Explain the block diagram of a PLC.
- 7.5 Mention the configuration of a PLC.
- 7.6 Define I/O module.
- 7.7 Mention the functions of input and output module.

8 Recognize Switch, Sensors and Relays.

- 8.1 Define Switch, Sensors and Relay.
- 8.2 Mention various types of Switches using symbol and narrate it briefly.
- 8.3 Classify the Sensors.
- 8.4 Explain Photo sensor, Proximity sensor, RTD and thermocouple.
- 8.5 Define Relay.
- 8.6 Describe the types of relay with symbol.
- 8.7 Illustrate internal structure and pin configuration of Relay.

9 Understand the PLC Ladder Diagram Programming.

- 9.1 List the PLC languages defined by International Electro-technical Commission (IEC).
- 9.2 Define ladder diagram.
- 9.3 Identify the standard IEC symbols used for input and output devices.
- 9.4 Mention the notation used for I/O address.
- 9.5 Draw the ladder diagram for Logic functions, latching and multiple outputs.

10 Understand the Internal Relay (IR), Jump, Call and Comparator in PLC.

- 10.1 State the meaning of Internal relay.
- 10.2 Describe the method of using internal relay.
- 10.3 Mention the different ways of expressing internal relay addresses.
- 10.4 Describe the one-shot and Set/Reset operation.

- 10.5 Discuss the conditional Jump in ladder diagram.
- 10.6 Describe the use of subroutine in ladder diagram.
- 10.7 Discuss the comparator instruction in ladder diagram.
- 10.8 Draw the ladder diagram for Logic functions, latching and multiple outputs.

11 Understand the Timer and Counter in PLC.

- 11.1 State the necessity of Timer and Counter in PLC.
- 11.2 Describe the types of Timer with symbol.
- 11.3 Explain the function of Timer in PLC.
- 11.4 Classify the types of Counter with symbol.
- 11.5 Narrate the counter application in PLC Programming.
- 11.6 Draw the ladder diagram for Blinking light, Automatic Traffic light control, Batch mixing operation control, Water level control.

12 Perceive the 4th Industrial revolution.

- 12.1 State the necessity of realizing 4th Industrial revolution.
- 12.2 Mention the major factors need to considering the 4th Industrial revolution .
- 12.3 Define Robotics and its application
- 12.4 Explain Big Big data and information.
- 12.5 Describe cloud computing.
- 12.6 Discuss about Cyber physical system

Practical:

- 1 Test a program to take a value of X and get the value of X^2 and see the output on port P2.**
 - 1.1 Draw the flow chart of the program.
 - 1.2 Start an IDE .
 - 1.3 Type the program.
 - 1.4 Save the program.
 - 1.5 Compile the program
 - 1.6 Run the Simulator and observe the execution of the program.
- 2 Develop and test a program for displaying 0 to 9 using 7-Segment display.**
 - 2.1 Draw the Flow chart of the program.
 - 2.2 Type and save the program.
 - 2.3 Compile the program.
 - 2.4 Download the Hex code program to 8051 code memory.
 - 2.5 Construct the circuit.
 - 2.6 Energy the circuit and observe the output.
- 3 Develop and test a program for Interfacing LCD.**
 - 3.1 Draw the Flow chart of the program.
 - 3.2 Type and save the program.
 - 3.3 Compile the program.
 - 3.4 Download the Hex program to 8051 code memory.
 - 3.5 Construct the circuit.
 - 3.6 Energy the circuit and observe the output.
- 4 Develop and test a program to Interface a DC Motor.**
 - 4.1 Draw the Flow chart.
 - 4.2 Type and save the program.
 - 4.3 Compile the program.
 - 4.4 Download the Hex program to 8051 code memory.
 - 4.5 Construct the circuit.
 - 4.6 Energy the circuit and observe the output.

- 5 Develop and test a program to Interface a Stepper Motor.**
 - 5.1 Draw the Flow chart of the program.
 - 5.2 Type and save the program.
 - 5.3 Compile the program.
 - 5.4 Download the Hex program to 8051 code memory.
 - 5.5 Construct the circuit.
 - 5.6 Energy the circuit and observe the output.
- 6 Develop and test a program for automatic Star-Delta starter for a three phase induction motor using PLC.**
 - 6.1 Draw the ladder diagram.
 - 6.2 Sketch a connection diagram with PLC and I/O devices
 - 6.3 Upload the program in PLC.
 - 6.4 Test the program.
- 7 Develop and test a program for automatic forward-reverse of a three phase induction motor using PLC.**
 - 7.1 Draw the ladder diagram.
 - 7.2 Sketch a connection diagram with PLC and I/O devices
 - 7.3 Upload the program in PLC.
 - 7.4 Test the program.
- 8 Develop and test a program for automatic traffic light control using PLC.**
 - 8.1 Draw the ladder diagram.
 - 8.2 Sketch the connection diagram with PLC and I/O devices
 - 8.3 Upload the program in PLC.
 - 8.4 Test the program.
- 9 Develop and test a program for water level control using PLC.**
 - 9.1 Draw the ladder diagram.
 - 9.2 Sketch the connection diagram with PLC and I/O devices
 - 9.3 Upload the program in PLC.
 - 9.4 Test the program.
- 10 Develop and test a program for Batch mixing using PLC.**
 - 10.1 Draw the ladder diagram.
 - 10.2 Sketch the connection diagram with PLC and I/O devices
 - 10.3 Upload the program in PLC.
 - 10.4 Test the program.

REFERENCE BOOKS

1. The 8051 Microcontroller and Embedded system
- Mazidi
2. The 8051 Microcontroller
- I. Scott MacKenzie
3. 8051 Tutorial
- Donal Heffernan
4. 8051 Microcontrollers . An Applications-Based Introductio
David Calcutt
- Fred Cowan
-Hassan Parchizadeh
5. Microcontrollers Theory and Application
- Ajay V Deshmukh
6. Modern Control Technology Components and Systems.
- Kilian
7. Programmable Logic Controllers.
- W. Bolton
8. Programmable Logic Controllers: Programming Methods and Applications.
- John R. Hackworth
- Frederick D. Hackworth, Jr.
9. Basic Instrumentation System & Programmable Logic Controller.
- Umesh Rathore.

65852

INDUSTRIAL MANAGEMENT

**T P C
2 0 2**

AIMS

- To be able to develop the working condition in the field of industrial or other organization.
- To be able to understand develop the labor management relation in the industrial sector.
- To be able to develop the management techniques in the process of decision making.
- To be able to manage the problems created by trade union.
- To be able to understand Planning
- To be able to perform the marketing.
- To be able to maintain inventory.

Course Outline

Basic concepts of management; Principles of management; Planning, Organization, Scientific management; Span of supervision; Motivation; Personnel management and human relation; Staffing and manpower planning ; Training of staff; Concept of leadership; Concepts and techniques of decision making; Concept of trade union; Inventory control; Economic lot size ; Break even analysis; Trade Union and industrial dispute, Marketing;

1 Basic concepts & principles of management.

- 1.1 Define management and industrial management.
- 1.2 State the objectives of modern management.
- 1.3 Describe the scope and functions of management.
- 1.4 State the principles of management.
- 1.5 State the activity level of industrial management from top personnel to workmen.
- 1.6 Describe the relation among administration, organization & management.

2. Concept of Planning

- 2.1 Define Planning
- 2.2 Discuss the importance of Planning
- 2.3 Discuss the Types of Planning.
- 2.4 Discuss the steps in Planning

3 . Concepts of organization and organization structure.

- 3.1 Define management organization.
- 3.2 State the elements of management organization.
- 3.3 Describe different forms of organization structure.
- 3.4 Distinguish between line organization and line & staff organization.
- 3.5 Distinguish between line organization and functional organization.
- 3.6 Describe the features, advantages and disadvantages of different organization structure.

4. Concept of scientific management.

- 4.1 Define scientific management.
- 4.2 Discuss the basic principles of scientific management.
- 4.3 Explain the different aspects of scientific management.
- 4.4 Discuss the advantages and disadvantages of scientific management.
- 4.5 Describe the difference between scientific management and traditional management.

5. Concept of span of supervision.

- 5.1 Define span of supervision and optimum span of supervision.
- 5.2 Discuss the considering factors of optimum span of supervision.
- 5.3 Discuss advantages and disadvantages of optimum span of supervision.
- 5.4 Define delegation of authority.
- 5.5 Explain the principles of delegation of authority.
- 5.6 Explain the terms: authority, responsibility and duties.

6 . Concept of motivation.

- 6.1 Define motivation.
- 6.2 Discuss the importance of motivation.
- 6.3 Describe financial and non-financial factors of motivation.
- 6.4 Special Motivational Techniques.
- 6.5 Discuss the motivation theory of Maslow and Harzberg.
- 6.6 Differentiate between theory-X and theory-Y.

7. Concept of leadership.

- 7.1 Define leadership.
- 7.2 Discuss the importance and necessity of leadership.
- 7.3 Discuss the functions of leadership.
- 7.4 Describe the qualities of a leader.

8. Basic concepts and techniques of decision making.

- 8.1 Define decision making.
- 8.2 Discuss the importance and necessity of decision making.
- 8.3 Discuss different types of decision making .
- 8.4 Describe the steps in decision making.

9 .Concept of personnel management and human relation.

- .9.1 Define personnel management.
- .9.2 Discuss the functions of personnel management.
- .9.3 Define staffing.
- .9.4 Define recruitment and selection of employees.
- .9.5 Describe various sources of recruitment of employees.
- .9.6 Describe the methods of selection of employees.
- .9.7 Define training and orientation of employee.
- .9.8 Discuss the importance and necessity of training.
- .9.9 Discuss the various methods of training of workmen, technicians and executive personnel.

10. Concept of inventory control & Economic lot size

- 10.1 Define inventory.& inventory control.
- 10.2 Describe the function of inventory control.
- 10.3 Define Economic lot size and the Method of determination of economic lot size.
- 10.4 Discuss the effects of over supply and under supply.
- 10.5 Explain the following terms :
 - Bin card or Bin tag.
 - Purchase requisition.
 - Store requisition.
 - Material transfer note.
 - First in first out (FIFO).
 - Last in first out(LIFO).
 - Safety stock
 - Lead time

11. Concept of Break Even Point(BEP)

- 11.1 Define Break Even Point and Break Even Chart.
- 11.2 Describe the method of determination of BEP
- 11.3 Explain the terms :
 - Break even analysis.
 - Fixed cost.
 - Variable cost

12 . Concept of Marketing

- 12.1 Define marketing.
- 12.2 Discuss the function of marketing.
- 12.3 State the objectives of marketing.
- 12.4 Explain the terms :
 - Purchase
 - Brand
 - Producer
 - Consumer
 - Customer
 - Copyright
 - Trade mark
- 12.5 Discuss product life -cycle and marketing strategies in different stages of a product life-cycle

13. Concept of trade union and industrial dispute

- 13.1 Define trade union.
- 13.2 Mention the objectives of trade union.
- 13.3 Discuss the function of trade union.
- 13.4 Describe different types of trade union.
- 13.5 Define industrial dispute
- 13.6 Discuss different type of industrial dispute

REFERENCE BOOKS

- 1.Dr. Md. Mainul Islam and Dr. Abdul Awal Khan-Principles of Management, Bangladesh Open University.2. Mohammad Mohiuddin-Personnel Management and Industrial Relation, NIDS Publication Co. Dhaka. 3.সুফিয়া বেগম, মো: জাহেরুল হক ও সুপ্রিয়া ভট্টাচার্য-
ব্যবস্থাপনা এর মৌলিক ধারণা, ব্যতিক্রম প্রকাশনী ঢাকা।Matz Usry-Cost Accounting:
Planning & Control.



BANGLADESH TECHNICAL EDUCATION BOARD
Agargaon, Dhaka-1207

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)

ELECTRICAL TECHNOLOGY
TECHNOLOGY CODE: **667**

7th SEMESTER

**DIPLOMA IN ENGINEERING
PROBIDHAN-2016**

ELECTRICAL TECHNOLOGY (667)

7th SEMESTER

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total	
						Theory		Practical			
						Cont. assess	Final exam	Cont. assess	Final exam		
1	66771	Alternating Current Machines-2	3	3	4	60	90	25	25	200	
2	66772	Electrical Engineering project	0	6	2	0	0	50	50	100	
3	66773	Switch Gear & Protection	3	3	4	60	90	25	25	200	
4	66774	Transmission and Distribution of Electrical Power-2	3	3	4	60	90	25	25	200	
5	66775	Testing and Maintenance of Electrical Equipment	1	3	2	20	30	25	25	100	
6	66863	Instrumentation and Process Control	2	3	3	40	60	25	25	150	
7	65853	Innovation & Entrepreneurship	2	0	2	40	60	0	0	100	
Total			14	21	21	280	420	175	175	1050	

66771**Alternating Current Machines – 2**

T P C

3 3 4

AIMS

To provide the student with an opportunity to acquire knowledge, skill and attitude in the area of alternating current machines with special emphasis on:

- Alternator
- Synchronous motor
- Single phase motor
- Motor control

SHORT DESCRIPTION

Alternators: Principle, construction, emf equation, effect of load on alternator; voltage regulation, parallel operation and starting procedure of alternator; Synchronous motor: Operation, torques and excitation, Phase swinging, Starting method and uses, Power factor correction; Single phase motor: Operation of single phase motor; Operation of AC commutator motor; Motor control: Speed control of single phase motor; Starting of three phase induction motor; Controlling speed of three phase induction motor.

DETAIL DESCRIPTION**Theory:****1. Understand the principle of alternator.**

- 1.1 Define Alternator
- 1.2 Explain the principle of alternator.
- 1.3 Differentiate between Alternator and DC generator.
- 1.4 Describe the methods of excitation of alternator.
- 1.5 Explain the rating of alternator.

2. Perceive the constructional features of alternators.

- 2.1 List the main parts of alternator.
- 2.2 Explain the advantages of stationary armature.
- 2.3 Describe the stator frame & stator core.
- 2.4 Classify rotor of alternator.
- 2.5 Describe salient pole type rotor and cylindrical type rotor.
- 2.6 Describe damper winding.
- 2.7 Describe three phase armature windings of single layer and double layer type.
- 2.8 Explain pitch factor and distribution factor.
- 2.9 Explain fractional pitch, full pitch, half coiled winding and whole coiled winding.
- 2.10 List the advantages of fractional pitch winding.
- 2.11 Solve problems related to pitch factor & distribution factor.

3. Understand the principle of emf equation.

- 3.1 Describe emf equation.
- 3.2 Define Harmonics: fundamental, 3rd harmonic and 5th harmonic.
- 3.3 Explain the effect of pitch factor and distribution factor on harmonics.
- 3.4 Solve problems related to emf equation.

4. Evaluate the effect of load and no load condition of an alternator.

- 4.1 Describe alternator on no load.
- 4.2 Describe the effect of resistance and leakage reactance on an alternator.
- 4.3 Explain the effect of armature reaction on emf of alternator.
- 4.4 Explain synchronous reactance and synchronous impedance.
- 4.5 Draw the vector diagram of a loaded alternator.
- 4.6 Describe resistance test, no-load test / open circuit test and short circuit test of alternator.
- 4.7 Solve problems related to synchronous reactance and synchronous impedance.

5. Understand the principle of voltage regulation and efficiency of alternator.

- 5.1 Define voltage regulation.
- 5.2 Explain voltage regulation at unity power factor, lagging power factor and leading power factor.
- 5.3 Solve problems related to voltage regulation of alternator.
- 5.4 List the losses occurred in alternator.
- 5.5 Explain the losses and efficiency of alternator.
- 5.6 Solve problems on losses and efficiency of alternator.

6. Understand the principle of parallel operation and starting procedure of alternators.

- 6.1 Define the term synchronizing.
- 6.2 Describe the purposes of synchronizing alternators.
- 6.3 List the conditions for synchronizing.
- 6.4 Describe the dark & bright lamp methods of synchronizing three phase alternator.
- 6.5 Explain the method of paralleling the alternators by synchroscope.
- 6.6 Explain synchronizing current and synchronizing power.
- 6.7 Explain the effect of unequal voltage on synchronizing two alternators.
- 6.8 Describe the distributions of load between two alternators in parallel.
- 6.9 Describe the steps of starting an alternator.

7. Understand the principle of operation of synchronous motor.

- 7.1 Define synchronous motor.
- 7.2 Explain the principle of operation of synchronous motor.
- 7.3 Describe the effect of increase in load of synchronous motor with vector diagram.

8. Understand the torques and excitation of a synchronous motor.

- 8.1 Describe different types of torque.
- 8.2 Explain the effect of excitation on armature current and power factor with vector diagram.
- 8.3 Construct V-curves.
- 8.4 Explain V-curves.
- 8.5 Describe the different point and position of V- curve in respect of power factor

9. Predict the hunting or phase swinging of synchronous motor.

- 9.1 Explain hunting or phase swinging.
- 9.2 List the disadvantages of hunting.
- 9.3 Explain the disadvantages
- 9.4 Remedies of hunting.

10. Perceive the starting method and uses of synchronous motor.

- 10.1 List the methods of starting synchronous motor.
- 10.2 Describe the procedures of starting a synchronous motor.
- 10.3 Compare synchronous motor with induction motor.
- 10.4 Mention the field of application of synchronous motor.

11. Understand the principle of power factor corrections.

- 11.1 Define synchronous condenser.
- 11.2 Distinguish between synchronous motor and synchronous condenser.
- 11.3 Explain the methods of power factor corrections with the help of synchronous motor and synchronous condenser.
- 11.4 Solve problems on power factor correction related to synchronous condenser.

12. Understand the principle of operation of AC commutator motor.

- 12.1 Describe the principle of operation of Schrage (poly phase commutator motor) motor.
- 12.2 Application of Schrage motor.
- 12.3 Mention the advantages and disadvantages of Schrage motor

13. Understand the principle of operation of single phase motor.

- 13.1 Explain why single phase motor is not self starting.
- 13.2 Describe double revolving field theory and cross magnetizing field theory.
- 13.3 List the methods of making single phase motor self starting.
- 13.4 Describe standard split phase motor
- 13.5. Describe capacitor motor and double capacitor motor.
- 13.6 Describe shaded pole motor & repulsion motor.
- 13.7 Describe hysteresis motor, universal motor, reluctance motor & AC series Motor
- 13.8 Explain the losses and efficiency of single phase motor.
- 13.9. Understand the working principle of stepper motor.
- 13.10 Explain Types, advantages and application of stepper motor

14. Interpret Starting and Speed Control of Single Phase Induction Motor.

- 14.1 Understand the principle of speed control of single phase motor.
- 14.2 List the methods of speed control of single phase motor.
- 14.3 Describe the methods of speed control of single phase motor.
- 14.4 Describe the method of reversing the direction of rotation of single phase induction motor using timers and relays.

15. Paraphrase the Starting and Speed Control of Three Phase Induction Motor.

- 15.1 Describe the operation of three phase induction motor by auto-transformer action using relay and timer.
- 15.2 Describe the methods of reversing the direction of rotation of three phase induction motor using relay and timer.
- 15.3 Describe the methods of controlling speed of three phase induction (squirrel cage) motor by reduced voltage method using relays and timers.
- 15.4 Describe the methods of controlling speed of three phase induction (wound rotor) motor by inserted resistance.

PRACTICAL

1. Perform the winding of stator of an alternator.

- 1.1 Find pole pitch, pitch factor, distribution factor for developing 4 pole, 3-phase, 36 slots double layer winding of alternator.
- 1.2 Draw the developed winding diagram.
- 1.3 Draw the connection diagram for star connection.
- 1.4 Make a stator winding of an alternator.

2 Perform the resistance test of an alternator.

- 2.1 Select the required tools, equipment, machine and materials.
- 2.2 Draw circuit diagram for the test.
- 2.3 Connect the instruments according to the circuit diagram.
- 2.4 Check the prepared circuit.
- 2.5 Energize the circuit with power supply.
- 2.6 Tabulate instrument readings.
- 2.7 Calculate ohmic value of coil resistance and effective value of resistance.

3. Perform the open circuit test of an alternator.

- 3.1 List and collect the required tools, equipment, machine and materials.
- 3.2 Draw the circuit diagram for the test.
- 3.3 Connect the instruments according to the circuit diagram.
- 3.4 Check the prepared circuit.
- 3.5 Connect the circuit with the power supply.
- 3.6 Tabulate instrument readings.
- 3.7 Draw E_g and I_f curve.

4. Perform the short circuit test of an alternator.

- 4.1 List and collect the required tools, equipment, machine and materials.
- 4.2 Draw the circuit diagram.
- 4.3 Connect the instruments according to the circuit diagram.
- 4.4 Check the developed circuit.
- 4.5 Connect the circuit with the power supply.
- 4.6 Tabulate the instrument readings.
- 4.7 Calculate synchronous reactance and impedance.
- 4.8 Draw I_a and I_f curves.

5. Determine voltage regulation of an alternator through synchronous impedance method.

- 5.1 List and collect the required tools, equipment, machine and materials.
- 5.2 Draw the circuit diagram.
- 5.3 Connect the instruments according to the circuit diagram.
- 5.4 Check the prepared circuit.
- 5.5 Connect the circuit with the power supply.
- 5.6 Verify I_f and observe the voltage at the terminals.
- 5.7 Tabulate instrument readings and calculate voltage regulation.

6. Determine voltage regulation of an alternator using different types of load (Resistive, Inductive and Capacitive load).

- 6.1 List and collect the required tools, equipment, machine and materials.
- 6.2 Draw the circuit diagram.
- 6.3 Connect the instruments according to the circuit diagram.
- 6.4 Check the circuit.
- 6.5 Connect the prepared circuit with the power supply.
- 6.6 Tabulate the instrument reading.
- 6.7 Calculate the regulation.

7. Perform the parallel operation of alternators by bright lamp method.

- 7.1 List and collect the required tools, equipment, machine and materials.
- 7.2 Draw the circuit diagram.
- 7.3 Connect the equipment according to the circuit diagram.
- 7.4 Start the prime mover.
- 7.5 Check the generating voltages and phase sequences.
- 7.6 Adjust the speed of the incoming machine.
- 7.7 Close the switch at the full bright condition of the lamp.

8. Perform the operation of synchronous motor and draw V-curves by changing field excitation.

- 8.1 List and collect the required tools, equipment, machine and materials.
- 8.2 Draw the circuit diagram.
- 8.3 Connect the instruments according to the diagram.
- 8.4 Check the circuit.
- 8.5 Change the field excitation.
- 8.6 Tabulate armature and field current.
- 8.7 Draw the V-curve.

9. Start the three phase induction motor (squirrel cage) by auto-transformer starter using relay and timer.

- 9.1 Collect tools, equipment and materials required.
- 9.2 Draw connection diagram of the power, control and signal circuit.
- 9.3 Connect motor, relays, timer etc, according to the circuit diagram.
- 9.4 Apply voltage to the circuit.
- 9.5 Observe the operation of the motor.
- 9.6 Follow safety rules.

10. Start three phase induction motor (wound-rotor) by stepped resistance method using relay and timer.

- 10.1 Collect tools, equipment and materials required.
- 10.2 Draw the connection diagram of the power, control and signal circuit.
- 10.3 Connect motor, relays and timer according to the circuit diagram.
- 10.4 Apply voltage to the circuit.
- 10.5 Observe the operation of the motor.
- 10.6 Follow safety rules.

11. Perform reversing the direction of rotation of three phase induction motor using relay and timer.

- 11.1 Collect tools, equipment and materials required.
- 11.2 Draw circuit diagram of the power, control and signal circuits.

- 11.3 Connect motor, relay, timer etc. to the circuit.
- 11.4 Apply voltage to the circuit.
- 11.5 Observe the operation of the motor.
- 11.6 Change the direction of rotor.
- 11.7 Follow safety practices.

12. Operate a single phase capacitor motor with a regulator.

- 12.1 List the tools and equipment required for the experiment.
- 12.2 Sketch a working diagram.
- 12.3 Identify two sets of coil of the motor.
- 12.4 Connect two sets of coil and capacitor in series with the proper set of coil so that the air blows downward.
- 12.5 Connect the regulator with the fan and supply power.
- 12.6 Change the direction of rotation of the motor by changing the connection.

13. Start a shaded pole induction motor (on crow model).

- 13.1 Draw the working diagram of the experiment.
- 13.2 List the required tools and equipment.
- 13.3 Connect the motor according to the diagram.
- 13.4 Energize the motor with the supply voltage.
- 13.5 Measure the speed by tachometer.
- 13.6 Calculate the slip of the motor.

REFERENCE BOOKS

1. Direct Current and Alternating Current Machines – Charles S. Siskind
2. Alternating Current Machines – B F Puchstein, T C Lioyd, A G Conrad.
3. A Text Book of Electrical Technology - B.LTheraja
4. Electrical Machincs – Desh pand

66772

Electrical Engineering Project

T P C

0 6 2

AIMS

To provide the student with an opportunity to acquire knowledge, skill and attitude in the area of electrical project with special emphasis on :

- Design and construction of electrical appliances, equipment and machineries.
- Developing innovative ideas of the students and put them in action.
- Improve operation of electrical equipment through original thinking.

SHORT DESCRIPTION

Electrical projects based on the availability of materials and facilities in the Institutes and market. Possible projects may be the improvement of design and construction of electromagnetic fan regulator, electronic fan regulator, choke coil, electronic ballast, power supply unit, solar power system, inverter, small transformer, small motor starter, water level controller, rewinding of single phase motor and three phase induction motor. New ideas leading to actual construction will be given due importance.

DETAIL DESCRIPTION

1. Design and construct fan regulator (Electromagnetic type).

- 1.1 Study the different manufacturer's literature, catalogue or manuals.
- 1.2 Sketch the working drawing and circuit diagram.
- 1.3 Select the materials and size of the core and core.
- 1.4 Collect the tools, equipment and materials required for construction of a fan regulator.
- 1.5 Construct core, base slider, forma and covers of the fan regulator.
- 1.6 Wind the wire on the former to manufacture coil.
- 1.7 Insert core in the wound former and test the winding.
- 1.8 Warp winding with cotton tape and insert ampere tubes and connect terminals in tapping.
- 1.9 Apply varnish to fill the core and winding and Bake the winding and core
- 1.10 Analyze the construction cost and Compare the design & construction of fan regulator with that of manufactured.

2. Design and construct fan regulator (Electronic type).

- 2.1 Study different manufacturers literature/manuals or catalogues.
- 2.2 Select the speed regulating circuits for construction of fan regulator.
- 2.3 List materials & accessories required.
- 2.4 Construct circuit with proper connection.
- 2.5 Test the constructed circuit.
- 2.6 Set the base and cover.
- 2.7 Analyze the construction cost.
- 2.8 Prepare a report.

3. Design and construct choke coil.

- 3.1 Study different manufacturer's literature / catalogue or manuals.
- 3.2 Sketch the detail working drawing and circuit diagram.
- 3.3 Select the core materials, wires, size & shape of core, tools and equipment.
- 3.4 Construct core, base and cover for the project work.
- 3.5 Make a former and wind the wire for winding.
- 3.8 Insert the core in the wound former and Test the winding.

- 3.9 Warp the winding with the ampere cloth and Insert terminals into the ampere tube.
- 3.10 Connect the terminals and apply varnish and Fix up the wound former on the metal case.
- 3.11 Connect the choke with the tube light and observe its performance.
- 3.12 Measure the power factor.
- 3.13 Analyze the cost of making the choke.
- 3.14 Prepare a detail report on the project.

4. Design and construct electronic ballast.

- 4.1 Study the different manufacturer's literature / catalogue or manuals.
- 4.2 Select ballast power for 40W / 20W tube light.
- 4.3 Draw the circuit diagram of the ballast.
- 4.4 Fix up the components necessary for the ballast.
- 4.5 Connect the ballast with the tube light and observe its performance.
- 4.6 Compare the energy cost of electronic ballast with electromagnetic one.
- 4.7 Prepare a detail report on the project.

5. Design and construct a power supply unit.

- 5.1 Study different manufacturer's literature / catalogue or manual.
- 5.2 Draw the circuit diagram and working diagram.
- 5.3 List the materials required for manufacturing power supply unit.
- 5.4 Calculate the INPUT / OUTPUT voltage rating of a power supply unit.
- 5.5 Prepare a PCB regarding the circuit
- 5.6 Insert the components on the PCB as per circuit diagram and solder them.
- 5.7 Fix up the PCB and other components.
- 5.8 Test the PSU.
- 5.9 Analyze the design and construction.
- 5.10 Prepare a complete report on the project.

6. Design and construct a emergency light.

- 6.1 Study different manufacturer's literature / catalogue or manuals.
- 6.2 Calculate the input and output rating and develop the detail specification.
- 6.3 Draw the circuit diagram and working diagram.
- 6.4 Select the materials required for manufacturing the emergency light.
- 6.5 Fix up the components.
- 6.6 Connect power and observe the performance.
- 6.7 Analyze the cost of construction.
- 6.8 Prepare a report on the project.

7. Design and construct a battery charger.

- 7.1 Study different manufacturer's literature / catalogue or manuals.
- 7.2 Draw the circuit diagram and working diagram.
- 7.3 Select the materials required for manufacturing the battery charger.
- 7.4 Calculate the input / output related data for battery charger.
- 7.5 Fix up all components.
- 7.6 Connect power and observe the performance.
- 7.7 Analyze the cost of construction.
- 7.8 Prepare a report on the project.

8. Construct a solar power system.

- 8.1 Study different manufacturer's literature / catalogue or manuals.
- 8.2 Select the output power of the plant.
- 8.3 Draw the layout diagram of the solar plant.
- 8.4 Select the materials required for manufacturing the solar plant.
- 8.5 Develop the circuit.
- 8.6 Fix up all the components accordingly.
- 8.7 Analyze the cost of the plant.
- 8.8 Compare per unit production cost with conventional energy plants.
- 8.9 Prepare a report on the project.

9. Construct an inverter.

- 9.1 Study the related catalogue or manuals.
- 9.2 Select the rating of the inverter.
- 9.3 Draw the circuit diagram.
- 9.4 Prepare the required PCB.
- 9.5 Insert the components on the PCB and solder them.
- 9.6 Construct a metal case and place the PCB into the case.
- 9.7 Identify the input / output terminals.
- 9.8 Test the inverter (Harmonic components of current and power factor.)
- 9.9 Analyze the cost of the inverter.
- 9.10 Prepare a report on the project.

10. Design and construct a small transformer.

- 10.1 Study the manufacturer's catalogue / manuals and other relevant literatures.
- 10.2 Select the rating of a small transformer and materials and size of the core.
- 10.4 Calculate the wire size and number of turns for both sides of winding.
- 10.5 List the materials required for construction of the transformer.
- 10.6 Draw the working drawing for the core and Construct the core and former for windings.
- 10.7 Wind wire on the former, Insert core in the former and Test the windings.
- 10.8 Warp winding with cotton tape, Apply varnish to the winding and bake.
- 10.9 Fix the transformer into the metal case and Fix up the terminals on the case.
- 10.10 Test the transformer on no-load and on-load.
- 10.11 Analyze the cost for manufacturing the transformer.

11. Perform design and construction of a small motor starter (electronic).

- 11.1 Study the related catalogue / manuals and literatures.
- 11.2 Select the size, rating & type of motor starter and materials required for manufacture the starter
- 11.3 Draw circuit diagram and working drawing.
- 11.4 Prepare required PCB and Insert the components on the PCB and solder them.
- 11.5 Construct a metal case and place the PCB into the case and Fix up bush nut for connecting terminals and power line.
- 11.6 Connect the starter with motor and Connect power supply and observe the performance.
- 11.7 Analyze the cost of construction of motor starter.
- 11.8 Analyze the design and construction of the motor starter.

12. Design and construct water level controller.

- 12.1 Study the catalogue / manuals and other related books / publications.
- 12.2 Design the water level controller circuit.
- 12.3 Draw the circuit diagram.
- 12.4 List the materials required for the construction.
- 12.5 Sketch the layout plan for the construction of water level controller.
- 12.6 Construct the water level controller.
- 12.7 Connect the controller with motor and float in water tank.
- 12.8 Test the performance of controller.
- 12.9 Analyze the cost of construction.
- 12.10 Analyze the design and construction.

13. Design and construct Instant power supply (IPS)

- 13.1 Study different manufacturer's literature/catalogue or manuals.
- 13.2 Calculate the input/output voltage rating of an instant power supply.
- 13.3 Draw the CKT. Diagram.
- 13.4 List the materials required for manufacturing IPS.
- 13.5 Prepare the PCB according to the circuit diagram.
- 13.6 Insert the Components on the PCB as Per circuit diagram and solder them.
- 13.7 Fix up the PCB and other components.

14. Re-wind a single phase motor.

- 14.1 Disassemble a single phase motor.
- 14.2 Select the winding materials, tools & equipment for winding of motor
- 14.3 Draw the winding diagram of motor.
- 14.4 Remove the existing damaged winding and Count the number of turns and weight the removed coil
- 14.5 . Lean and wash the slots by petrol and Make a former and winding of coil on former.
- 14.6 . Insert the leather weight paper into the slot of stator of the motor and Place the coil in the slots of the core.
- 14.7 Joint the coil as per winding diagram and Put ampere tube in terminals.
- 14.8 Test the winding for continuity, insulation resistance, short circuit, open circuit and earth or body.
- 14.9 Warp the coil with cotton tape and Apply varnish and bake the coils.
- 14.10 Assemble the motor and Connect power and test the performance of the motor.
- 14.11 Analyze the cost of rewinding of motor.

15. Rewind 3-phase induction motor.

- 15.1 Disassemble the stator of the motor.
- 15.2 Take out the coil from the stator and Count the number of turns of one of the damaged coil.
- 15.3 Measure the size of wire of the damaged coil.
- 15.4 Select tools, equipment and materials for winding.
- 15.5 Construct former and Wound the coils on former for making coils.
- 15.6 Clean and wash the slots and
- 15.7 Insert the insulating paper and coils into the slots of stator of the motor.
- 15.8 Make group connection and Test the winding of each group for open circuit, short circuit & body on earth

15.9 Warp the ends of coils with cotton tape and Connect the terminals of the group to the terminal posts of the terminal box.

15.10 Apply varnish on winding and bake and Connect the motor with power line and Test the motor.

15.11 Analyze the cost of rewinding.

REFERENCE BOOKS

1. Electrical Charger & IPS – Sharma.
2. Basic Motor Dynamo Fan – S. Mondal.
3. AC and DC Motor winding Practical- K.B Bhatia.
4. Motor winding with single phase and three phase Motor Data – S.K. Gupta.
5. Basic Practical Knowledge – M.M. Khoibar Ali.
6. Hobby Electronics - দেবালীয় বন্দোপাধ্যায়া।
7. ইলেক্ট্রনিক্সের কথা মজার প্রজেক্ট- সৌমেন কুমার সাহা।

66773

Switch Gear & Protection

T P C

3 3 4

AIMS

To provide the student with an opportunity to acquire knowledge, skill and attitude in the area of switchgear and protection with special emphasis on :

- Busbar and sub-station equipment.
- Circuit breakers and relays.
- Protection system for busbar, alternators, transformer, feeder and transmission line.
- Protection against over voltage.
- Sub station.

SHORT DESCRIPTION

Switch gear; Electrical faults; Busbar arrangements; Short circuit current calculation; power system stability; Current limiting reactors; Fuses; Circuit breakers; Relays; Protection of alternator & transformer; Protection of feeder & transmission line; Busbar protection; Over-voltage on transmission line; Protection against lightning; Sub-station.

DETAIL DESCRIPTION

Theory:

1. Understand the concepts of switch gear.

- 1.1 Define switch gear.
- 1.2 Discuss the importance of switch gear protection of electrical system.
- 1.3 List different types of switch gear.
- 1.4 Mention the switch gear equipment.

2. Paraphrase the concepts of electrical faults.

- 2.1 Define electrical faults.
- 2.2 Name the different types of faults in electrical power system.
- 2.3 Discuss the causes of faults in electrical power system.
- 2.4 Describe different types of faults in electrical power system.

3. Perceive the concepts of busbar arrangements.

- 3.1 Define busbar.
- 3.2 Describe different types of busbar.
- 3.3 Mention different types of busbar arrangements.
- 3.4 Explain different types of busbar arrangements.
- 3.5 Mention different types of faults in busbar.

4. Interpret the short circuit current calculation.

- 4.1 Define short circuit faults.
- 4.2 Describe the causes of short circuit fault.
- 4.3 Name different types of short circuit fault.
- 4.4 Mention the steps for symmetrical fault calculations.
- 4.5 Distinguish between symmetrical and unsymmetrical fault.
- 4.6 Explain the method of calculation of short circuit current.
- 4.7 Distinguish between per unit method and percentage method.

4.8 Discuss the advantages of per unit methods of short circuit current calculation

4.9 Solve problems on short circuit current calculation.

5. Perceive the power system stability.

5.1 Define stability.

5.2 Describe transient, dynamic and steady state stability.

5.3 Define and mention the application of swing equation

5.4 Discuss the factors affecting transient stability.

5.5 Explain the method of improving transient stability.

5.6 Analyze the effect of sudden change in mechanical input.

6. Understand the principle of operation of current limiting reactors.

6.1 Define current limiting reactor.

6.2 Describe the principle of operation of current limiting reactor.

6.3 Discuss different types of current limiting reactors with diagram.

6.4 List the advantages and disadvantages of different types of current limiting reactor (CLR).

6.5 Solve problems related to the current limiting reactor (CLR).

7. Recognize the operation and construction of fuses.

7.1 Describe the principle of operation of fuses.

7.2 List different types of fuses.

7.3 Describe the current ratings of fusing element, fusing factor and breaking capacity.

7.4 Classify fuses according to the construction and current carrying capacity.

7.5 Describe the constructional features of the following fuses:

a. High Rupturing Capacity (HRC) fuse.

b. Carbon Tetrachloride (CTC) fuse.

c. Dropout fuse.

d. Horn gap fuse.

8. Perceive the concept of construction and operation of circuit breaker.

8.1 Define circuit breaker.

8.2 Describe the principle of operation of a circuit breaker and its function.

8.3 Describe arc and the process of its production & extinguishment.

8.4 Describe the construction and the principle of operation of the following circuit breakers:

a. Plain-break type circuit breaker.

b. Oil Circuit Breaker (OCB)

c. Low oil content circuit breaker.

d. Air Circuit Breaker (ACB).

e. Gas [Sulphur-Hexafluoride, SF₆] circuit breaker.

f. Vacuum Circuit Breaker (VCB).

g. Magnetic actuator type Circuit Breaker

8.5 Compare between Gas circuit breaker (GCB) and Vacuum Circuit Breaker (VCB).

8.6 Describe the mountings and ratings of a circuit breaker.

8.7 Explain miniature types of circuit breaker such as MCB, MCCB.

8.8 Describe the principle of operation of an automatic recloser(auto reclosr) and Isolator.

8.9 Compare among the circuit breaker, auto-recloser, fuse and isolator.

8.10 Solve problems on ratings of circuit breaker

9. Clarify the features of relay.

- 9.1 Define relay.
- 9.2 Classify the relays on the basis of construction, principle of operation, mode of use, qualities and the timing characteristics.
- 9.3 Describe the principle of operation and construction of the following protective and control relays:
 - a. Solenoid and plunger type relay.
 - b. Induction type over current relay.
 - c. Reverse power relay.
 - d. Directional over load relay.
 - e. Thermal relay.
 - f. Buchholz relay.
 - g. Differential relay.
 - h. Induction type impedance or distance relay.
 - i. Numeric Relay
 - j Earth fault (EF)and Restricted Earth fault Relay(REF)
- 9.4 Describe control and relay panel.
- 9.5 List the factors to be considered for the maintenance of a relay.

10. Understand the principle of protection of alternator and transformer.

- 10.1 List the major features of good protective gears for alternators and transformers.
- 10.2 List the major faults that may occur in alternator and transformer.
- 10.3 Describe Merz-Price protection of alternator.
- 10.4 Describe Merz-Price protection of transformer.
- 10.5 Solve problems on transformer protection (Merz-Price system).
- 10.6 Describe the reverse power protection of alternators by reverse power relay.
- 10.7 Describe the internal fault protection of transformer by Buchholz relay.

11. Perceive the principle of protection of feeder and transmission line.

- 11.1 Describe the time graded protection of radial feeder.
- 11.2 Describe the reverse power and over load protection of parallel feeders by over current and reverse power relay.
- 11.3 Describe Merz-Price voltage balance system for protection of feeder for internal (in between the relay set) fault.
- 11.4 Explain Translay system of protection for internal (in between the relay set) fault of feeder.
- 11.5 Describe the over load protection of transmission lines by definite distance relay.
- 11.6 Discuss the over load protection of transmission line by time distance relay.

12. Understand the principle of static relays and protections.

- 12.1 Define static relay.
- 12.2 List the advantages of static relays.
- 12.3 Describe amplitude comparator.
- 12.4 Explain level detector.
- 12.5 Describe static-time-lag over current relay.
- 12.6 Analysis busbar protection by static relay.
- 12.7 Describe busbar protection by saturable reactor protection system

13. Paraphrase the causes and effects of over voltage on a transmission line.

- 13.1 Describe surge.
- 13.2 Explain the resonance in transmission line.
- 13.3 Explain the switching effect.
- 13.4 Describe the causes of insulation failure and its effect.
- 13.5 Discuss the arcing earth.
- 13.6 Describe the construction and function of peterson coil.
- 13.7 Explain lightning and its effect.
- 13.8 Classify the lightning strokes.
- 13.9 Explain electrostatic induction.

14. Perceive the system of protection against lightning.

- 14.1 Describe the protective function and principle of operation of a lightning arrester.
- 14.2 Distinguish between lightning arrester, surge diverter and surge absorber.
- 14.3 Describe the construction and principle of operation of the following lightning arresters:
 - a. Rod gap
 - b. Horn gap
 - c. Expulsion type
 - d. Oxide film
 - e. Thyrite
- 14.4 Explain the protective function of a condenser or diverter.
- 14.5 Explain the function of Ferranti Surge Absorber.
- 14.6 Explain the function of ground wire.

15. Realize the utility and function of a sub-station.

- 15.1 Describe the function and importance of a sub station as a part of the power supply system.
- 15.2 Distinguish between indoor and outdoor sub-station.
- 15.3 List the factors to be considered in selecting the site of a sub- station.
- 15.4 Sketch the layout plan of an indoor sub-station.
- 15.5 List different components of an indoor sub station.
- 15.6 Mention the functions of the components of an indoor sub-station.
- 15.7 Sketch the layout plan of an indoor sub-station.
- 15.8 List different components of an outdoor sub-station and describe their function.

16. Understand the concept of Gas Insulated Sub Station(GIS)

- 16.1 Define Gas Insulated Sub Station (GIS)
- 16.2 Familiarize with different parts of a Gas Insulated Sub Station (GIS)
- 16.3 List the advantage of Gas Insulated Sub Station (GIS)
- 16.4 Compare between Air Insulated Sub Station & Gas Insulated Sub Station
- 16.5 Describe Gas monitoring system of a Gas Insulated Sub Station
- 16.6 Describe Gas handling process and precaution about quality of GAS.

Practical:

1. Categorize different types of fuses and measure the current carrying capacity of HRC fuse.

- 1.1 Identify and sort out different type of fuses from a given number of fuses.
- 1.2 Sketch different parts of HRC fuse.
- 1.3 Select a HRC fuse for a particular electrical circuit.

1.4 Connect the selected HRC fuse to the circuit.

1.5 Increase the load and measure the fusing current.

2. Perform the identification of different parts of an Air blast Circuit Breaker (ACB) with tripping their mechanism.

2.1 Identify different parts of an Air blast Circuit Breaker (ACB) with its moving and fixed contacts.

2.2 Sketch the main parts of the ACB.

2.3 Turn on and Turn off the ACB manually and observe its make and break mechanism.

2.4 Sketch the connection diagram of the ACB in a circuit and connect physically according to the diagram.

2.5 Read the name plate of the ACB and record its current rating.

2.6 Check the breaking operation during abnormal condition of the ACB by making a short circuit.

3. Perform the identification of different parts of an Vacuum Circuit Breaker (VCB) and observe the tripping mechanism.

3.1 Identify different parts of a VCB with special stress on its moving and fixed contacts.

3.2 Sketch the main parts of a VCB.

3.3 Turn-on and Turn-off the VCB manually and observe its make and break mechanism.

3.4 Check the oil level of the VCB.

3.5 Draw the connection diagram of the VCB in a circuit..

3.6 Connect the CB according to the diagram.

3.7 Read the name plate of the VCB and note down its current rating.

3.8 Check the breaking operation during abnormal condition of the VCB by making a short circuit

4. Perform the identification of different parts of a Sulphur- Hexafluoried (SF_6) Gas Circuit breaker and observe their tripping mechanism.

4.1 Identify different parts of a SF6 circuit breaker with its moving and fixed contacts.

4.2 Sketch the main parts of the SF6 circuit breaker.

4.3 Turn-on and Turn-off the GCB (Gas circuit Breaker) manually and observe its make and break mechanism.

4.4 Connect the GCB according to the diagram.

4.5 Read the name plate of the GCB and record its current rating.

4.6 Check the breaking operation during abnormal condition of the GCB by making a short circuit.

5. Perform the operation and identification of different parts of an induction type over current relay (IOR).

5.1 Identify, sketch and level different parts of an induction type over current relay.

5.2 Draw the circuit diagram of the Induction type Over current Relay (IOR).

5.3 Sketch the diagram of the mimic trip circuit consists of a 1.5 V dry cell and small torch light bulb simulating the tripping arrangement.

5.4 Connect the relay (IOR) according to the circuit diagram and set the load current and allow it to work beyond the set value of load current.

5.5 Observe the operation of the relay and the simulation tripping.

6. Sketching the layout of the electrical sub-station situated in campus and understanding its operation.

6.1 Identify different protective devices, equipment and accessories of the sub station.

6.2 Note the rating of transformer, circuit breaker, isolator, CT & PT, HT & LT switch gear.

6.3 Sketch the front view of the panel board.

6.4 Draw the block diagram of the sub-station showing all the components.

6.5 Draw the single line diagram of the sub-station.

6.6 Sketch the layout diagram of the sub-station.

7. Visit an outdoor distribution sub-station situated near to the institute campus and prepare a report.

- 7.1 Identify the in-coming and out-going line of the sub-station.
- 7.2 Identify different equipments, their ratings and positions in the sub-station.
- 7.3 Read the name plate and record all the information including the feeder capacity.
- 7.4 Draw the front view of the control panel.
- 7.5 Sketch the layout of the sub-station showing the position of all the components by block diagram.
- 7.6 Draw the single line diagram of the outdoor sub-station.
- 7.7 Submit a complete technical report of the study visit.

8. Study a widely used lightning arrester.

- 8.1 Identify different components of thyrite lightning arrester or any type of given lightning arrester.
- 8.2 Sketch the cross sectional view of the given lightning arrester and label its different components.

9. Visit a nearest grid sub-station of the national grid system and submit a report.

- 9.1 Identify the incoming and outgoing lines.
- 9.2 Identify different equipment, their ratings and positions in the sub- station.
- 9.3 Read the name plate of the sub-station equipment and record all the information.
- 9.4 Draw the front view of the control panel.
- 9.5 Draw the layout of the sub-station showing the positions of all the components by block.
- 9.6 Draw the single line diagram of the grid sub-station.
- 9.7 Submit a complete technical report of the study visit.

10. Study the catalogue and write the report.

- 10.1 Collect commercial catalogue and price list of switch gear and protective devices from different local and foreign manufactures.
- 10.2 Study the collected literature.
- 10.3 Draw a standard specification for the required switch gear.
- 10.4 Submit a technical report based on the information of the collected papers.

REFERENCE BOOKS

- 1 Switch Gear & Protection - S. Rao.
- 2 Electrical Power - J. B. Gupta.
- 3 Principles of Power System - V. K. Mehta.
- 4 Modern Power System - Nagrath Kothari.
- 5. Fundamental of switchgear and Protection - J. B. Gupta

66774

Transmission & Distribution of Electrical Power –2

**T P C
3 3 4**

AIMS

To provide the student with an opportunity to acquire knowledge, skills and attitude in the area of transmission and distribution of electrical power with special emphasis on :

- Performance calculation of medium and long transmission line.
- DC and AC distribution system.
- Diagnosing faults of transmission and distribution line and measures for repair.
- Underground cable.

SHORT DESCRIPTION

Medium and long transmission line; High Voltage DC transmission; DC distribution system; AC distribution system; Underground cables; Laying & jointing of underground cables; Insulation resistance and dielectric stress of UG cables; Capacitance in underground cables; Cable faults localization; Operation and maintenance of distribution line; Insulation resistance measurement; Grid system.

DETAIL DESCRIPTION

Theory:

1. Analyze the effect of line constants of medium transmission line.

- 1.1 Describe the effect of line constants of medium transmission line.
- 1.2 Express the equation for sending end voltage and current by end-condenser method, nominal T method and nominal π method for medium transmission line.
- 1.3 Draw the phasor diagrams of end-condenser method, nominal T method and nominal π method for medium transmission line.
- 1.4 Solve problems on end-condenser method, nominal T method and nominal π method for medium transmission line.

2. Evaluate the effect of line constants of long transmission line.

- 2.1 Describe the effects of line constants of long transmission line.
- 2.2 Analyze long transmission line (Rigorous method of solution).
- 2.3 Solve problems related to long transmission line.
- 2.4 Prepare the list of Application of rigorous method in long transmission line.

3. Analyze the high voltage DC transmission.

- 3.1 Describe the high voltage DC transmission system.
- 3.2 State the limitations of AC transmission.
- 3.3 Discuss the economic comparison between AC and DC transmission system.
- 3.4 List the advantages of HVDC.
- 3.5 List the disadvantages of HVDC.
- 3.6 Classify HVDC links.
- 3.7 List the fields of application of HVDC.
- 3.8 Discuss Grid interconnected system between Bangladesh and India

4. Enumerate the DC distribution system.

- 4.1 Describe the classification of distribution system.
- 4.2 Describe DC distribution.
- 4.3 List different types of distributors.

- 4.4 List different types of loading.
- 4.5 Describe DC distributor fed at one end.
- 4.6 Describe DC distributor fed at both ends.
- 4.7 Describe uniformly loaded distributor.
- 4.8 Describe ring distributor.
- 4.9 Solve problems on different types of distribution system.

5. Understand the AC distribution system.

- 5.1 List different types of AC distribution system.
- 5.2 Express the equation for sending end voltage of AC distributors.
- 5.3 Solve problems on sending end voltage of AC distributor.
- 5.4 Explain the methods employed for the solution of network problem of interconnected system.
- 5.5 Solve problems on 3-φ, 4 wire, Y-connected unbalanced loads.

6. Understand the construction, insulating materials and types of underground cables.

- 6.1 Define underground cables.
- 6.2 List the advantages and types of underground cables.
- 6.3 List the insulating materials used in underground cables
- 6.4 Describe the construction of low, high and super high voltage single phase and three phase underground cables.
- 6.5 Explain the insulating materials for cables.
- 6.6 List the properties of insulating materials for cables.
- 6.7 Describe the measurement of insulation resistance of cable.
- 6.8 Identify different sizes of cable.
- 6.9 List the causes of failure of underground cable.
- 6.10 Describe aerial cables and submarine cables.

7. Perceive the laying and jointing of underground cable

- 7.1 Explain different methods of underground cable laying.
- 7.2 Explain the method of terminating underground cables.
- 7.3 Describe the heat shrink type and cold shrink type of cables jointing.
- 7.4 Describe care and protection to be taken while doing jointing and terminating the cables.

8. Analyze the insulation resistance and dielectric stress in a single core cable and three core cable

- 8.1 Describe the insulating resistance of single core cable.
- 8.2 Express the equation for insulation resistance of single core cable.
- 8.3 Solve problems on insulation resistance in single core cable.
- 8.4 Deduce the equation for dielectric stress in a single core cable.
- 8.5 Solve problems on dielectric stress in a single core cable.
- 8.6 Describe the insulation resistance of a three core cable.
- 8.7 Express the equation for insulation resistance of three core cable.
- 8.8 Express the equation for dielectric stress in a three core cable.
- 8.9 Solve problems on insulation resistance of three core cable and dielectric stress in a three core cable.

9. Understand the concept of capacitance in underground cable.

- 9.1 Describe the capacitance of single core cable.
- 9.2 Express the equation for capacitance of single core cable.
- 9.3 Solve problems on capacitance of single core cables.
- 9.4 Describe the capacitance of a three core underground cable.
- 9.5 Express the equation for the capacitance of three core cable.
- 9.6 Solve problems on capacitance of three core cable.
- 9.7 Describe the grading of cables.
- 9.8 Deduce the equation of grading of cables.
- 9.9 Solve problems on grading of cables of a single core cable.

10. Perceive the cable faults and their localization.

- 10.1 List different types of cable faults.
- 10.2 Explain the causes of cable faults.
- 10.3 Describe different methods of locating cable faults.
- 10.4 Express the equation for locating the faults by Blavier test.
- 10.5 Express the equation for locating faults by Murray Loop test and Varley Loop test.
- 10.6 Solve problems on locating faults of cable.

11. Understand the operation of distribution line.

- 11.1 Sketch the circuit diagram of the distribution system.
- 11.2 Explain the operation of panel board of transmission system.
- 11.3 Describe load dispatch centre (LDC).
- 11.4 Explain the operation of a distribution system.

12. Analyze the features of maintenance work of distribution line.

- 12.1 Identify the damage and faults in the distribution line during routine (weekly/monthly) inspection or at the time of emergency.
- 12.2 Describe the procedure of repairing the damage and faults in the line.
- 12.3 Find the causes for damage and faults occurred.
- 12.4 Prepare the list of tools and materials for the repair work.
- 12.5 Discuss the function of personal protective equipment used for repair and maintenance of distribution line.

13. Enumerate the methods of measuring insulation resistance of the system when power is on.

- 13.1 Describe in brief the method of measuring the insulation resistance of the system when the power is ON.
- 13.2 Express the deduction of the equation for measuring the insulation resistance of the system when the power is ON.
- 13.3 Solve problems on measuring insulation resistance when power is ON.
- 13.4 Discuss the safety procedures for measuring insulation resistance of the line when power is ON.

14. Understand the grid system.

- 14.1 Describe grid system.
- 14.2 Explain in brief the necessity of grid system.
- 14.3 List different types of grid system.
- 14.4 Identify the advantages of grid system.
- 14.5 Outline the grid system of Bangladesh.
- 14.6 Outline the grid system of some advanced countries.

Practical:

1. Sketch the layout diagram of panel board.

- 1.1 Sketch the layout of panel board.
- 1.2 Identify different sections of the panel board.
- 1.3 Prepare a list of equipment and instruments of panel board with specification.

2. Measure the insulation resistance of low tension (LT) cables by Megger.

- 2.1 Select and collect tools, equipment and cables
- 2.2 Draw the circuit diagram of for connecting Megger
- 2.3 Connect as per the CKT diagram.
- 2.4 Perform the experiment to measure the insulation resistance of low tension cables.
- 2.5 Record the data and calculate the value
- 2.6 Follow safety practices.

3. Measure the insulation resistance of High tension (HT)cables by Megger.

- 3.1 Select and collect tools, equipment and cables
- 3.2 Draw the circuit diagram of for connecting Megger
- 3.3 Connect as per the CKT diagram.
- 3.4 Perform the experiment to measure the insulation resistance of high tension cables.
- 3.5 Record the data and calculate the value
- 3.6 Follow safety practices.

4. Draw the cross sectional view of different types of underground cable.

- 4.1 Select and collect different types of cables
- 4.2 Study the cross section of underground cable.
- 4.3 Draw the cross sectional views of different types of underground cables.

5. Locate ground fault by Murray loop test for underground cable.

- 5.1 Select and collect tools, equipment and cables
- 5.2 Draw the circuit diagram of Murray loop test for ground fault.
- 5.3 Connect as per the CKT diagram.
- 5.4 Perform experiment to locate the ground fault.
- 5.5 Record the data and calculate the value.
- 5.6 Follow safety practices.

6. Locate short circuit fault of underground cables by Murray loop test.

- 6.1 Select and collect tools, equipment and cables
- 6.2 Draw the circuit diagram of Murray loop test for short circuit fault.
- 6.3 Connect as per the CKT diagram.
- 6.4 Perform experiment to locate the short circuit fault.
- 6.5 Record the data and calculate the value.
- 6.6 Follow safety practices.

7. Perform the experiment to measure the insulation resistance of the system when power is ON.

- 7.1 Select and collect tools, equipment and cables
- 7.2 Draw the circuit diagram for the experiment.
- 7.3 Connect as per the CKT diagram.
- 7.4 Perform experiment to measure the insulation resistance.
- 7.5 Calculate insulation resistance from the data.
- 7.6 Follow safety practices.

8. Perform the experiment to locate the underground cable ground fault by Varley loop test.

- 8.1 Select and collect tools, equipment and cables
- 8.2 Sketch the diagram of Varley loop test for ground fault.

- 8.3 Connect as per the CKT diagram.
 - 8.4 Locate the ground fault by experiment.
 - 8.5 Record the data and calculate the value.
 - 8.6 Follow safety practices.
- 9. Perform the experiment to locate the under ground cable short circuit fault by Varley loop test.**
- 9.1 Select and collect tools, equipment and cables
 - 9.2 Sketch the diagram of Varley loop test for short circuit fault.
 - 9.3 Connect as per the CKT diagram.
 - 9.4 Locate the short circuit fault by experiment.
 - 9.5 Record the data and calculate the value.
 - 9.6 Follow safety practices.
- 10. Perform the experiment to locate the under ground cable fault by Blavier test.**
- 10.1 Select and collect tools, equipment and cables
 - 10.2 Draw the diagram of Blavier test for underground cable fault.
 - 10.3 Connect as per the CKT diagram.
 - 10.4 Record the data and calculate the value.
 - 10.5 Locate the underground fault by experiment.
 - 10.6 Follow safety practices.

REFERENCE BOOKS

1. A Course in Electrical Power - J. B. Gupta.
2. Principles of Power System - V. K. Mehta.
3. Electrical Power System (3rd Revised Edition) - Ashfaq Husain
4. EHV-AC & HV DC Transmission Engineering and Practice – S. Rao.
5. A Text Book of Electrical technology – B.L Theraja and A. K Theraja.
6. Solution of Electrical Problems – B.L. Theraja.

66775 Testing & Maintenance of Electrical Equipment	T P C
	1 3 2

Aims

To provide the students opportunities to acquire knowledge, skills and attitude in the area of Testing and Maintenance of electrical equipment with the special emphasizes on:

- Trouble shooting and maintenance of electrical equipment,
- Faults findings and remedy the faults of Battery, DC Generators, DC motors,
- Faults findings and remedy the troubles Transformers, Induction motors, Alternators,
- Faults findings and remedy the troubles Synchronous motor and Circuit breaker

Short description

Trouble shooting and maintenance of electrical equipment, Identification of trouble and remedy the troubles of Battery, DC Generators, DC motors, Identification of trouble and remedy the troubles of Transformers, Induction motors, Alternators, Identification of trouble and remedy the troubles Synchronous motor and Circuit breaker

Detail Description**Theory****1. Identify the hand tools and equipment for trouble shooting and maintenance of electrical equipment.**

- 1.1Mention the name of hand tools and their uses
- 1.2Name the equipment used for trouble findings and trouble shooting for electrical appliances and electrical machines
- 1.3Name the equipment used for trouble findings and trouble shooting for electrical machines

2. Find the trouble and repair the troubles of Batteries, DC Generator and DC Motors

- 2.1Identify the troubles of Batteries
- 2.2Explain the troubles of the storage Batteries
- 2.3Describe the process of repair and maintenance of storage batteries
- 2.4Identify the Faults of DC Generator and Dc Motor
- 2.5Explain the faults of the Dc Generator and Dc Motor
- 2.6Describe the process of repair and maintenance of DC Generator and Dc Motor

3. Indicate the faults and remedy the faults of single phase and three phase transformer.

- 3.1List the name the Faults of single phase Transformer
- 3.2Explain the faults of single phase Transformer
- 3.3Describe the process of repair and maintenance of single phase Transformer
- 3.4Mention the Faults of three phase Transformer
- 3.5Explain the faults of three phase Transformer
- 3.6Describe the process of repair and maintenance three phase Transformer

4. Outline the probable faults of single phase and three phase Induction motor.

- 4.1List the name the Faults of single phase Induction Motor
- 4.2Illustrate the faults of single phase Induction Motor
- 4.3Describe the process of repair and maintenance of single phase Induction Motor
- 4.4Mention the Faults of three phase Induction Motor
- 4.5Explain the faults of three phase Induction Motor
- 4.6Demonstrate the process of repair and maintenance three phase Induction Motor

5. Recognize the trouble and remedy the troubles of Alternators and Synchronous motors

- 5.1List the name the Faults of Alternators
- 5.2Illustrate the faults of Alternators
- 5.3Describe the process of repair and maintenance of Alternators
- 5.4Mention the Faults of Synchronous motors
- 5.5Explain the faults of Synchronous motors
- 5.6Demonstrate the process of repair and maintenance Synchronous motors

6. Express the trouble and remedy the troubles of Circuit breaker

- 6.1List the name the Faults of Circuit breaker
- 6.2Illustrate the faults of Circuit breaker
- 6.3Describe the process of repair and maintenance of Circuit breaker

Practical

1. Identify the tools and equipment for testing and Maintenance of electrical works

- 1.1List the hand tools used in electrical testing
- 1.2Mention the name of electrical maintenance equipment
- 1.3Draw and write down the operation of electrical maintenance equipment
- 1.4Perform the operation of each electrical maintenance equipment

2. Perform the different test of Battery

- 2.1Mention the name of the probable test of storage Battery
- 2.2Draw the circuit diagram
- 2.3Collect tools and equipment
- 2.4Measure the emf of each cell of storage Battery
- 2.5Measure the specific gravity of the electrolyte of storage battery
- 2.6Record the reading of test data.

3. Measure emf generation of DC Generator

- 3.1Collect the tools and equipment for measuring emf
- 3.2Draw circuit diagram and connect for measuring emf
- 3.3Measure the emf of a dc generator
- 3.4Mention the reasons of failure of emf generation

4. Detect the causes of failure of running DC motors

- 4.1Mention the different tests for finding the faults of DC Motor
- 4.2Identify the mechanical faults of DC motor
- 4.3Find the electrical faults of DC Motor
- 4.4Draw circuit diagram and connect for continuity test
- 4.5Perform the continuity test of the DC motor
- 4.6Perform the short circuit test of DC Motor

5. Perform different routine test of a Three Phase Distribution Transformer

- 5.1List the causes of overheating of a Transformer
- 5.2List the name of different test of a Transformer
- 5.3 Draw circuit diagram and connect for continuity test of transformer
- 5.3Perform Winding Resistance & continuity test of a Transformer
- 5.4Perform Vector Group test of a Transformer
- 5.5Perform the Insulation resistance test o a Transformer
- 5.6Record the test data and result

6. Point out the faults of an Induction motors

- 6.1 Detect the faults of an Induction Motor
- 6.2 Mention the mechanical faults of an Induction Motor
- 6.3 Mention the Electrical faults of an Induction Motor
- 6.4 Collect the tools and equipment for testing an Induction Motor
- 6.5 Perform continuity test by using Megger, Avometer and Test lamp of an Induction motor
- 6.6 Perform insulation resistance between two coils and between phase and earth test of an Induction motor

7. Determine causes of failure of emf generation of an Alternators

- 7.1 Collect the tools and equipment for measuring emf
- 7.2 Draw circuit diagram and connect for measuring emf
- 7.3 Measure the emf of an Alternator
- 7.4 Mention the reasons of failure of emf generation of an Alternators
- 7.5 Mention the mechanical faults of an Alternator
- 7.6 Mention the Electrical faults of an Alternator

8. Detect the troubles and remedy the troubles Synchronous motor

- 8.1 Detect the faults of an Synchronous Motor
- 8.2 Mention the mechanical faults of an Synchronous Motor
- 8.3 Mention the Electrical faults of an Synchronous Motor
- 8.4 Collect the tools and equipment for testing an Induction Motor
- 8.5 Perform continuity test by using Megger, Avometer and Test lamp of an Synchronous motor
- 8.6 Perform insulation resistance between two coils and between phase and earth test of an Synchronous motor

9. Determine the common faults of High Voltage Circuit Breaker

- 9.1 Mention the name of different test of a HV Circuit Breaker
- 9.2 Collect the tools and equipment for testing the HV Circuit Breaker
- 9.3 Draw circuit diagram and connect for insulation resistance test for HVCB
- 9.4 Perform the Insulation resistance test by using megger
- 9.5 Record the data and result of the Insulation resistance test

10. Perform the testing of HV circuit breaker

- 10.1 Mention the name of different faults of a HV Circuit Breaker
- 10.2 Collect the tools and equipment for testing the HV Circuit Breaker
- 10.3 Draw circuit diagram and connect for insulation resistance test for HVCB
- 10.4 Perform the Contact resistance test with micro-ohm tester.
- 10.5 Record the data and result of the Insulation resistance test

Reference Books

1. Basic Practical knowledge- M. M. Khoibar Ali
2. AC and DC Motor winding practical - K. B. Bhatia
3. Electrical Equipment: Testing and Maintenance - A.S.Gill
4. Testing Commissioning Operation & Maintenance of Electrical Equipment - S. Rao
5. Installation Maintenance and Repair of Electrical Machines and Equipment - Madhavi Gupta

66863 INSTRUMENTATION & PROCESS CONTROL**T P C**
2 3 3**OBJECTIVES**

Upon completion of these content student will be able to achieve and acquire knowledge, skills and attitude in the area of instrumentation and process control with special emphasis on:

- Transducer
- Signal conditioning
- Recorders.
- Measuring techniques of special quantities
- Data acquisition
- Control theory
- Servo control

SHORT DESCRIPTION

Transducers; Passive transducer; Self generating type transducer; Measuring technique by transducer; Signal conditioning; Recorders; Measuring techniques of special quantities; Data acquisition; Control theory; Servo control;

DETAIL DESCRIPTION**Theory:****1. Understand the basic features of transducers.**

- 1.1 Define transducer and sensor.
- 1.2 Mention different types of transducer and sensor.
- 1.3 Describe difference between transducers and sensors
- 1.4 Describe the parameters of electrical transducer.
- 1.5 Describe the factors to be considered in selecting a transducer.
- 1.6 Describe mechanical devices as primary detector.
- 1.7 Mention the different electrical phenomena employed in transducers.

2 Understand the features of passive transducers.

- 2.1 Describe the operation of different types of resistive transducers.
- 2.2 Explain the basic principle of strain gauges
- 2.3 Describe the working principle of resistance thermometer.
- 2.4 Describe the construction of different types of thermistor.
- 2.5 Describe the working principle of inductive transducer.
- 2.6 Describe the construction and working principle of linear variable differential transformer (LVDT)
- 2.7 Describe the displacement measurement by using LVDT.
- 2.8 Describe the construction and working principle of Rotary variable differential transformer (RVDT)
- 2.9 Describe the working principle of pressure inductive transducer.
- 2.10 Describe the working principle of pressure capacitive transducer.

3 Understand the features of self-generating type transducers.

- 3.1 Describe the working principle of Piezoelectric transducers
- 3.2 Explain the basic principle of photo emissive, photoconductive and photo voltaic cell.
- 3.3 Define seebeck effect.
- 3.4 Describe the construction of thermocouples and thermopile.
- 3.5 Explain the working principle of thermocouple and thermopile.

- 3.6 Describe the concept of digital encoding transducer
- 3.7. Describe the principle and operation of optical displacement transducer.
- 3.8 Describe the principle and operation of photo optic transducer.

4 Understand the measuring technique by using transducers.

- 4.1 Describe the weight measuring technique by load cell (pressure cell).
- 4.2 Explain the basic principle of resistance temperature detector (RTD).
- 4.3 Explain the basic principle of reluctance pulse pick-up.
- 4.4 Describe the working principle of magnetic flow meter.
- 4.5 Describe the sound intensity measurement technique by capacitor microphone.
- 4.6 Describe the liquid level measurement technique by dielectric gauge.
- 4.7 Explain synchro system.
- 4.8 Describe the angular displacement measurement technique by synchro system.

5 Understand the concept of signal conditioning.

- 5.1 Describe signal conditioning system with block diagram.
- 5.2 Explain the basic principles of DC and AC signal conditioning system.
- 5.3 Explain the basic principle of data conversion system.
- 5.4 Describe the operation of an instrumentation amplifier.
- 5.5 Describe the basic principle of instrumentation system.
- 5.7 Describe telemetry with block diagram.

6 Understand the features of recorders.

- 6.1 State the necessity of recorder in instrumentation system.
- 6.2 State different types of recorders.
- 6.3 Describe the principle of operation of strip chart recorder.
- 6.4 Describe the principle of operation of X-Y recorder (galvanometer and null type).
- 6.5 Describe the principle of operation of magnetic recorder.
- 6.6 Describe the principle of operation of digital recorder.

7 Understand the measuring techniques of special quantities.

- 7.1 Describe the method of Temperature, compensation and cancellation Techniques.
- 7.2 Describe the method of measurement of pressure using electrical transducer
- 7.3 Describe the method of measurement of torque by using different method such as by inductive transducer, digital method.
- 7.4 Describe the method of measurement of temperature by using thermometer, thermocouple.
- 7.5 Describe the method of measurement of flow by electromagnetic flow meter.
- 7.6 Describe the method of measurement of humidity by humidity hygrometers

8 Understand the concept of data acquisition.

- 8.1 Define data acquisition.
- 8.2 Describe the component of analog and digital data acquisition system.
- 8.3 Describe the principle single channel and multi channel data acquisition system.
- 8.4 Describe the basic principle of operation of data logger.
- 8.5 Describe the method of data transmission.
- 8.6 Describe the digital recording and use of recorder in digital system.

9 Understand the concept of control theory.

- 9.1 Mention the types of control systems.
- 9.2 Define open loop & closed loop control system.
- 9.3 State the meaning of transfer lag.
- 9.4 Describe two-step & three step control systems.
- 9.5 Describe proportional, derivative and integral control.
- 9.6 Explain compound control system such as PI, PD, DI & PID control.
- 9.7 Mention the advantages & disadvantages of proportional, derivative and integral control system.

10 Understand the concept of servo control.

- 10.1 Describe the construction of DC servo, AC servo, stepper motor, electrical modulator, hydraulic servomotor and hydraulic modulator.
- 10.2 Describe the principle of operation of DC servo & AC servo stepper motor, electrical modulator, hydraulic servomotor and hydraulic modulator.
- 10.3 Describe the basic concepts of DC position control with servo system.
- 10.4 Describe the idea of AC position control with synchro sensing element.
- 10.5 Describe Online and Offline computer control system with block diagram.

Practical :**1. Measure the displacement by linear variable resistance transducer.**

- 1.1 Select a potentiometer and required tools & materials.
- 1.2 Couple the object with sliding contact to the potentiometer.
- 1.3 Build up the circuit for measurement of displacement.
- 1.4 Switch on the power supply.
- 1.5 Measure input and output voltage of the potentiometer.
- 1.6 Measure the displacement or force using appropriate formula.

2. Measure the temperature by resistance thermometer.

- 2.1 Select a resistance thermometer (such as platinum resistance thermometer) and a heat source with mounting facility and required tools & materials.
- 2.2 Measure the thermometer resistance at room temperature.
- 2.3 Record the temperature of heat source.
- 2.4 Make the temperature of the source steady.
- 2.5 Measure the resistance of the thermometer.
- 2.6 Calculate the temperature using appropriate formula.

3. Determine the temperature coefficient of thermistor.

- 3.1 Select a thermistor and required tools & equipment.
- 3.2 Connect the thermistor with measuring equipment.
- 3.3 Provide a temperature regulated heat source for the thermistor.
- 3.4 Rise temperature in step and measure the corresponding resistance of the thermistor.
- 3.5 Plot the data for temperature versus resistance characteristics.
- 3.6 Observe the graph.

4. Measure the thickness of a material by capacitive transducer.

- 4.1 Select an appropriate capacitive transducer with required tools and materials.
- 4.2 Set up the materials to measure the thickness between the plates of the capacitor.
- 4.3 Connect the meter and source as required.
- 4.4 Switch on the power supply.
- 4.5 Measure the capacitance between two plates.
- 4.6 Calculate the thickness using appropriate data and formula.

5. Measure the displacement by linear variable differential transformer (LVDT).

- 5.1 Select an iron core, wire and required tools & equipment.
- 5.2 Construct a LVDT with an iron core and coil with one primary and secondary keeping iron movable.
- 5.3 Connect the primary with AC source.
- 5.4 Connect the two secondary with the oscilloscope.
- 5.5 Move the iron core from left to right.
- 5.6 Observe the wave shapes.
- 5.7 Observe the null position.
- 5.8 Measure the voltage increasing or decreasing with core movement or displacement.

6. Measure the temperature by thermocouple.

- 6.1 Select a thermocouple (such as iron-constant) and required tools & materials.
- 6.2 Connect one end of the thermocouple to a voltmeter with proper arrangement.
- 6.3 Apply heat on the other end of the thermocouple in the fire.
- 6.4 Observe the reading of the meter.
- 6.5 Calibrate the meter for temperature.
- 6.6 Measure the temperature.

7. Measure the strain by strain gauge.

- 7.1 Select a strain gauge bridge and required tools & materials.
- 7.2 Attach the strain gauge at the point where strain or torque is to be measured.
- 7.3 Apply strain.
- 7.4 Read the change in the resistance due to strain.
- 7.5 Calculate the value of strain or torque using appropriate formula.

8. Measure the light intensity by photocell.

- 8.1 Select a photoelectric device, light source and required tools & materials.
- 8.2 Construct the circuit with photoelectric device.
- 8.3 Separate the light source from the photoelectric device with a window having small aperture which is controlled by force summing member of the pressure transducer.
- 8.4 Open the aperture for the photoelectric device.
- 8.5 Measure the change in output.
- 8.6 Measure the light intensity.

9. Measure the vibration by piezoelectric transducer.

- 9.1 Select a Piezoelectric crystal and necessary tools & materials.
- 9.2 Construct the circuit for piezoelectric pickup.
- 9.3 Set up the object whose displacement or pressure is to be measured to the appropriate crystal plane.
- 9.4 Energize the circuit and measure the voltage and hence measure the displacement or pressure.

10. Study the operation of magnetic tape recorder.

- 10.1 Select a magnetic tape recorder.
- 10.2 Observe the tape transport mechanism.
- 10.3 Identify the electronic components of magnetic tape recorder.
- 10.4 Observe the recording and playback operation.

11. Study the operation of PID control system.

- 11.1 Select required tools & materials.
- 11.2 Construct the circuit as per diagram.
- 11.3 Adjust all the controls properly.
- 11.4 Observe the operation of PID control system.

12. Study the operation of closed loop speed control with DC servo system.

- 12.1 Select required equipment, tools & materials.
- 12.2 Construct the circuit as per diagram.
- 12.3 Change the input signal.
- 12.4 Observe mechanism of control.

Reference Books:

1. Mechanical and Industrial Measurement
-R. K. Jain
2. Control Engineering
-Nole M. Morris
3. Feedback Control System Analysis & Synthesis
-J.J.D Azzo
4. Industrial Electronics
-G. K. Mithal
5. Electrical and Electronic Measurement and Instrumentation
-A.K. Sawhney
6. Elements of Electronic Instrumentation and Measurement
-Joseph J. Carr
7. Electronic Instrumentation -HS Kalsi
8. Control system Engineering -Nagrath and Gopal

AIMS

- To be able to understand the concept of entrepreneurship & entrepreneur.
- To be able to understand the concept of environment for entrepreneurship.
- To be able to understand the sources of venture ideas in Bangladesh.
- To be able to understand the project selection.
- To be able to understand business planning.
- To be able to understand the insurance and premium.
- To be able to understand the MDG & SDG.

SHORT DESCRIPTION

Concepts of entrepreneurship & entrepreneur; Entrepreneurship & economic development; Environment for entrepreneurship; Entrepreneurship in the theories of economic growth; Sources of ventures ideas in Bangladesh; Evaluation of venture ideas; Financial planning; Project selection; Self employment; Entrepreneurial motivation; Business plan; Sources of assistance & industrial sanctioning procedure; Concept of SDG; SDG 4,8 .

DETAIL DESCRIPTION**Theory :****1. Understand the basic concept of entrepreneurship & entrepreneur.**

- 1.1 Define entrepreneurship & entrepreneur.
- 1.2 Discuss the characteristics and qualities of an entrepreneur.
- 1.3 Mention the classification of entrepreneur.
- 1.4 Discuss the necessity of entrepreneurship as a career.
- 1.5 Discuss the prospect of entrepreneurship development in Bangladesh.

2. Understand the concept of entrepreneurship and economic development.

- 2.1 Define economic development.
- 2.2 Discuss the economic development process.
- 2.3 Discuss the capital accumulation or rate of savings.
- 2.4 Discuss the role of entrepreneur in the technological development and their introduction into production Process.
- 2.5 Discuss the entrepreneur in the discovery of new product.
- 2.6 Discuss the discovery of new markets.

3. Environment for entrepreneurship development:

- 3.1 Define the micro environment.
- 3.2 Discuss individual income, savings and consumption.
- 3.3 Define macro environment.
- 3.4 Discuss political, socio-cultural, economical, legal and technological environment.
- 3.5 Difference between micro and macro environment .

4. Understand the concept of entrepreneurship in the theories of economic growth.

- 4.1 Define entrepreneurship in the theories of economic growth.
- 4.2 Discuss the Malthusian theory of population and economic growth.
- 4.3 Discuss the stage theory of growth.
- 4.4 Discuss the Schumpeterian theory of economic development.
- 4.5 Discuss the entrepreneurship motive in economic development.

5. Understand the sources and evaluation of venture ideas in Bangladesh.

- 5.1 Define sources of venture ideas in Bangladesh.
- 5.2 Discuss different types of sources of venture ideas in Bangladesh.
- 5.3 Define evaluation of venture ideas.
- 5.4 Discuss the factors that influence the selection of venture idea.

6. Understand the concept of project selection and financial planning.

- 6.1 Define project.
- 6.2 Discuss the idea of project.
- 6.3 Describe the guide lines for project ideas.
- 6.4 Discuss the sources of project ideas.
- 6.5 Discuss the evaluation of project ideas.

- 6.6 Describe the technical aspect of project.
- 6.7 Define financial planning.
- 6.8 Discuss the long term financial plan.
- 6.9 Discuss the short term financial plan.

7. Understand the concept of self employment.

- 7.1 Define self employment.
- 7.2 Describe different types of employment.
- 7.3 Describe the importance of business as a profession.
- 7.4 Discuss the reasons for success and failure in business.

8. Understand the business plan and the concept of the environment for entrepreneurship.

- 8.1 Define business plan.
- 8.2 Describe the importance of business plan.
- 8.3 Discuss the contents of business plan.
- 8.4 Define environment of business.
- 8.5 Describe the factors which effect environment on entrepreneurship

9. Understand the concept of sources of assistance & industrial sanctioning procedure.

- 9.1 Define sources of assistance.
- 9.2 Describe different types of sources of assistance.
- 9.3 Discuss the aid of sources.
- 9.4 Discuss the industrial policy.
- 9.5 Define foreign aid.

10. Understand the insurance and premium.

- 10.1 Define insurance and premium
- 10.2 Describe the essential conditions of insurance contract.
- 10.3 Discuss various types of insurance.
- 10.4 Distinguish between life insurance and general insurance.

11. Understand the concept of Sustainable Development Goals (SDG)

- 11.1 Define Sustainable development
- 11.2 State UN targets of MDG
- 11.3 State UN targets of SDG
- 11.4 Describe the importance of SDG
- 11.5 Explain the objectives of SDG
- 11.6 State the Challenges to achieve SDGs
- 11.7 Explain the actions to face the challenges of SDGs
- 11.8 State the of 7th 5 years plan
- 11.9 Mention the link of 7th 5 years plan with SDGs
- 11.10 Write down the 5 ps of sustainable development goals

12. Understand SDG 4,8 and 17

- 12.1 Describe SDG 4 and its targets
- 12.2 State the elements of Quality education for TVET
- 12.3 Describe the gender equality and equal access of TVET for economic growth
- 12.4 Describe SDG 8 and its targets
- 12.5 Explain Green development, Green Economy, Green TVET & Green Jobs
- 12.6 Explain the role an entrepreneur for achieving SDG

Reference book :

- 1. A hand book of new entrepreneur-by p.c jain.
- 2.A manual on business opportunity Identification and selection-by j.B patel and S S modi.
- 3.Uddokta unnyoyan Nirdeshika -Md.Sabur khan.
- 4.Entrepreneurship- bashu and mollik.
- 5.Business Entrepreneurship-kage faruke.
- 6. Website, Youtube and Google