Curriculum for

Diploma Programme in

ELECTRICAL ENGINEERING

(BATCH 2018)

For the State of Haryana

Prepared by:

Curriculum Development Centre

National Institute of Technical Teachers Training and Research
Sector 26, Chandigarh - 160 019

Haryana State Board of Technical Education
Bays 7-12, Sector 4
Panchkula-134 112

July, 2018

FIRST YEAR (Electrical Engineering)

Sr. No.	SUBJECTS	STUDY SCHEME HOURS / WEEK			CREDIT	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1*	English	2	-	2	6	40	25	65	60	3	50	3	110	175
1.2*	Applied Mathematics	3	1	-	7	40	-	40	60	3	-	-	60	100
1.3*	Applied Physics	2	1	2	7	40	25	65	60	3	50	3	110	175
1.4*	Applied Chemistry	2	-	1	5	40	25	65	60	3	50	3	110	175
1.5***	Fundamental of Electrical and Electronics Engg.	2	-	2	6	40	25	65	60	3	50	3	110	175
1.6*	Environmental Studies	2	-	1	5	40	25	65	60	3	50	3	110	175
1.7*	Engg. Graphics	-	-	3	3	40	25	65	60	3	25 (viva)	3	85	150
1.8*	Information Technology	-	-	2	2	-	50	50	-	-	50	3	50	100
1.9*	Internet of Things & Artificial Intelligence	-	-	2	2	-	50	50	-	-	100	3	100	150
1.10*	General Workshop Practice	-	-	3	3	-	50	50	-	-	50	3	50	100
#	Student Centered Activities(SCA)	-	-	2	2	-	25	25	-	-	-	-	-	25
Total		13	02	20	48	280	325	605	420	-	475	-	895	1500

*Common with other diploma programmes

*** Common with diploma in Computer Engineering, Electrical and Electronics Engg., Electronics and Communication Engg., Instrumentation and Control Engg, Medical Electronics

SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs, seminars, declamation contests, educational field visits, N.C.C., N.S.S., Cultural Activities and Disaster management etc.

THIRD SEMESTER : (ELECTRICAL ENGINEERING)

Sr. No.	SUBJECTS	STUDY SCHEME HOURS / WEEK		Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
3.1	Non Conventional Sources of Energy	4	-	4	25	-	25	100	3	-	3	100	125
3.2	Computer Applications in Electrical Engineering	-	2	1	-	25	25	-	-	50	3	50	75
3.3	Electrical and Electronics Engineering Materials	4	-	4	50	-	50	100	3	-	-	100	150
3.4	Electronics II	3	2	4	25	25	50	100	3	50	3	150	200
3.5	Electrical Engineering Design and Drawing-I	-	6	3	-	50	50	100	3	50	3	150	200
3.6	Electrical Workshop Practice – I	-	6	3	-	50	50	-	-	50	3	50	100
3.7	Estimating and Costing in Electrical Engineering	4	2	5	25	25	50	100	3	50	3	150	200
	Soft Skills- I	-	2	-	-	25	25	-	-	-	-	-	25
Total		**15**	**20**	**24**	**125**	**200**	**325**	**500**	**-**	**250**	**-**	**750**	**1075**

* Common Course with other diploma programmes

+ Includes 25 marks for viva-voce

FOURTH SEMESTER (ELECTRICAL ENGINEERING)

Sr. No.	SUBJECTS	STUDY SCHEME HOURS / WEEK		Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
4.1	Electrical Machines - I	4	2	5	25	25	50	100	3	50	3	150	200
4.2	Electrical Measuring Instruments and Instrumentation	4	2	5	25	25	50	100	3	50	3	150	200
4.3	Installation and Maintenance of Electrical Equipment	4	-	4	25	-	25	100	3	-	-	100	125
4.4	Digital Electronics	4	2	5	25	25	50	100	3	50	3	150	200
4.5	Electrical Engineering Design & Drawing-II	-	6	3	-	50	50	100	3	50 (Viva)	-	150	200
4.6	Electrical Workshop Practice–II	-	6	3	-	50	50	-	-	50	3	50	100
	Soft Skills -II	-	1	-	-	25	25	-	-	-	-	-	25
Total		**16**	**19**	**25**	**100**	**200**	**300**	**500**	**-**	**250**	**-**	**750**	**1050**

Industrial Training: After examination of 4th Semester, the students shall go for training in a relevant industry/field organization for a minimum period of 8 weeks and will prepare a diary. It shall be evaluated during 5th semester by his/her teacher Incharge for 100 marks. The students shall also prepare a report at the end of training and shall present it in a seminar, which will be evaluated for another 100 marks. This evaluation will be done by HOD and lecturer in charge – training in the presence of one representative from Industry/Sector Skill Council/Training and Placement Officer/Subject Expert from other institution.

FIFTH SEMESTER (ELECTRICAL ENGINEERING)

Sr. No.	SUBJECTS	STUDY SCHEME HOURS / WEEK		Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
Industrial Training		-	-	5	-	100	100	-	-	100	-	100	200
5.1	Electrical Machines – II	4	2	5	25	25	50	100	3	50	3	150	200
5.2	Electrical Power – I	4	-	4	50	-	50	100	3	-	-	100	150
5.3	Programmable Logic Controllers and Microcontrollers	5	2	6	25	25	50	100	3	50	3	150	200
5.4	+Elective	4	2	5	25	25	50	100	3	50	3	150	200
5.5	Utilization of Electrical Energy(UEE)	4	-	4	50	-	50	100	3	-	-	100	150
5.6	Minor Project Work	-	6	3	-	50	50	-	-	50	3	50	100
Soft Skills-III		-	2	-	-	25	25	-	-	-	-	-	25
Total		**21**	**14**	**32**	**175**	**275**	**425**	**500**	**-**	**300**	**-**	**800**	**1225**

+Elective: To choose any one from the following:

5.4.1 Instrumentation 5.4.2 Auto Electrical 5.4.3 Solar Panel Installation and Maintenance

SIXTH SEMESTER (ELECTRICAL ENGINEERING)

Sr. No.	SUBJECTS	STUDY SCHEME HOURS / WEEK		Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		Th	Pr		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
6.1	Electrical Energy Conservation & Management	5	-	5	50	-	50	100	3	-	-	100	150
6.2	Electrical Power – II	4	3	5	25	25	50	100	3	50	3	150	200
6.3	Industrial Electronics and Control of Drives	4	3	5	25	25	50	100	3	50	3	150	200
6.4	*Entrepreneurship Development and Management	3	-	3	25	-	25	100	3	-	-	100	125
6.5	Major Project Work	-	12	5	-	100	100	-	-	100	3	100	200
Soft Skills - IV		-	1	-	-	25	25	-	-	-	-	-	25
Total		**16**	**19**	**27**	**125**	**175**	**300**	**400**	**-**	**200**	**-**	**600**	**900**

* **Common with other Diploma Programmes**

FIRST YEAR

(Annual System)

1.1 ENGLISH

L	T	P
2	-	2

RATIONALE

Knowledge of English Language plays an important role in career development. This subject aims at introducing basic concepts of communication besides laying emphasis on developing listening, speaking, reading and writing skills as parts of Communication Skill.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

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- Understand the importance of good communication
- Describe process of communication.
- Explain, Compare and re-write the types of communication
- Identify and match the parts of speech
- Rewrite sentences correctly
- Modify sentences and relate them with real life situations.
- Reproduce and match words and sentences in a paragraph.
- Re-write the sentences according to given situation.
- Relate and use various words using proper vocabulary and grammar.
- Write the various types of paragraphs, notices and composition on picture with appropriate format.

DETAILED CONTENTS

1. Basics of Communication (06 Hrs)

1.1. Definition and process of communication

1.2. Types of communication – Verbal (Listening, Speaking, Reading and Writing) and Non-verbal

2. Functional Grammar (22 Hrs)

2.1. Noun and Pronoun

2.2. Punctuation

2.3. Preposition

2.4. Conjunction

2.5. Tenses (verb (Main verb and Auxiliary verb)

3. Reading Skills (12 Hrs)

3.1. Unseen passage for comprehension. Based upon the passage, flowing aspects may be covered

- Questions from the passage
- One-word substitution
- Prefixes and Suffixes
- Antonyms and Synonyms etc.

4. Writing skills (30 Hrs)

4.1. Correspondence – Business and official
4.2. Notice, including Press Releases
4.3. Memos
4.4. Circular
4.5. Basics of Report Writing
4.6. Resume Writing
4.7. Writing E-mail
4.8. Paragraph writing
4.9. Picture composition

LIST OF PRACTICALS

1. Listening Exercises
2. Self and Peer Introduction
3. Debate
4. Situational Conversations: Offering - Responding to offers; Requesting – Responding to requests; Congratulating; Expressing sympathy and condolence; Apologizing and Forgiving; Complaining; Warning; Asking and giving information; Getting and giving permission; Asking for and giving opinions; Talking about likes and dislikes
5. Just a minute sessions – Extempore
6. Group Discussion
7. Newspaper reading
8. Mock Interviews: Telephonic and Personal

INSTRUCTIONAL STRATEGY

Student should be encouraged to participate in role play and other student centered activities in
class room and actively participate in listening exercises

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Communicating Effectively in English, Book-I by Revathi Srinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S.Chand & Company Ltd., Delhi.
4. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1.1, 2.1, 4.1	1st Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
B	20%	Unit 2.2, 4.2, 4.3	2nd Internal		
C	60%	Unit 1.2, 2.3 to 2.5 , 3, 4.4 to 4.9	FINAL	60%	

1.2 APPLIED MATHEMATICS

L	T	P
3	1	-

RATIONALE

Contents of this course provide fundamental base for understanding engineering problems and their solution algorithms. Contents of this course will enable students to use basic tools like logarithm, binomial theorem, partial fractions, matrices, t-ratios and co-ordinates for solving complex engineering problems with exact solutions in a way which involve less computational task. By understanding the logarithm, they will be able to make long calculations in short time and it is also a pre-requisite for understanding Calculus. Statistics is important for understanding of tolerances, quality assurance and quality control and it is also essential for data analysis.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Apply complex number in engineering problems.
- Apply permutation and combination to count without actual counting.
- Apply permutation and combination to understand binomial theorem.
- Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem.
- Resolve rational functions to partial fractions for the use in Integral Calculus.
- Use matrices to provide solution to engineering problems.
- Solve different problems using trigonometry.
- Understand the geometric shapes used in engineering problems by Co-ordinate Geometry.
- Explore the idea of location, graph, and linear relationships between two variables.
- Compute slope, the equation of tangent and normal to a curve at a point using differentiation.
- Find maximum and minimum values of a function by application of differential calculus..
- Calculate simple integration by using concepts of integration.
- Find the velocity from acceleration and displacement from velocity using integration.
- Evaluate area under curves by using definite integrals

- Calculate the area under a curve and axes.
- Calculate the approximate area under a curve by applying numerical integration using Trapezoidal and Simpson's rules.
- Solve engineering and industrial problems using differential equations.
- Apply differential Equations and numerical methods for higher learning of mathematics and engineering applications.

DETAILED CONTENTS

1. Algebra (30 Hrs)

- Law of Indices, Formula of Factorisation and expansion i.e. $(a+b)^2$, (a^3+b^3) etc.

- Partial fraction:- Definition of Polynomial fraction proper & improper fractions and definition of partial fractions. To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, only.

- Complex numbers: definition of complex number, real and imaginary parts of a complex number, Polar and Cartesian Form and their inter conversion, Conjugate of a complex number, modulus and amplitude, addition subtraction, multiplication and division of complex number.

- Determinants and Matrices – Evaluation of determinants (up to 3 order) by laplace method. Solution of equations (up to 3 unknowns) by Cramer's Rule. Definition of Matrices and types, addition subtraction and multiplication of Matrices (up to 2 order).

- Permutation, combination formula, Values of ${}^nP_r$ and ${}^nC_r$.

- Binomial theorem for positive integral index , General term, simple problems

2. Trigonometry (14 Hrs)

- Concept of angle: measurement of angle in degrees, grades, radians and their conversions.
- T-Ratios of standard angle (0^0,30^0,45^0etc) and fundamental Identities, Allied angles (without proof) Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa)

- Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.

3. Co-ordinate Geometry (12 Hrs)

- Point: Distance Formula, Mid Point Formula, Centroid of triangle and area of triangle.

- Straight line: Slope of a line, equation of straight line in various standards forms (without proof); (slope intercept form, intercept form, one-point form, two-point form, normal form, general form), angle between two straight lines.

- Circle: General equation of a circle and identification of centre and radius of circle. To find the equation of a circle, given:
  * Centre and radius
  * Coordinates of end points of a diameter

4. Differential Calculus (40 Hrs)

- Definition of function; Concept of limits (Introduction only) and problems related to four standard limits only.

- Differentiation of standard function (Only formulas), Differentiation of Algebraic function, Trigonometric functions, Exponential function, Logarithmic function

- Differentiation of sum, product and quotient of functions.

- Successive differentiation (up to 2nd order)

- Application of differential calculus in:

  (a) Rate measures
  (b) Maxima and minima

5. Integral Calculus (28 Hrs)

- Integration as inverse operation of differentiation with simple examples.

- Simple standard integrals, Integrations by parts and related Simple problems

- Evaluation of definite integrals with given limits.

Evaluation of $\int_0^{\pi/2} \sin^n x\, dx$, $\int_0^{\pi/2} \cos^n x\, dx$, $\int_0^{\pi/2} \sin^m x \cos^n x\, dx$

0 0 0

using formulae without proof (m and n being positive integers only) using pre-existing mathematical models.

- Applications of integration: for evaluation of area under a curve and axes (Simple problems where the limits are given).

- Numerical integration by Trapezoidal Rule and Simpson's $1/3^{rd}$ Rule using pre-existing mathematical models

6. Differential Equations (04 Hrs)

Definition, order, degree and linearity, of an ordinary differential equation. Solution of I^{st} order and I^{st} degree differential equation by variable separable method (Simple problems)

7. Statistics (12 Hrs)

- Measures of Central Tendency: Mean, Median, Mode
- Measures of Dispersion: Mean deviation from mean, Standard deviation
- Correlation coefficient and Coefficient of rank correlation (Simple problems)

INSTRUCTIONAL STATREGY

Activity based teaching and learning process using Mathematics lab consisting of physical models and computer based tools/software emphasising Practice => Theory => Practice.

Basic elements of algebra, trigonometry and co-ordinate geometry can be taught in the light of their applications in the field of engineering and technology. By laying more emphasis on applied part, teacher can also help in providing a good continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics related to Algebra, Trigonometry and Coordinate Geometry that the industry requires. Examples to be used should be related to engineering. Students should be able to relate to the actual use of these examples and the way mathematical calculations will help them in doing their job.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics Vol. I & II by S Kohli, IPH, Jalandhar
3. Applied Mathematics, Vol. I & II by SS Sabharwal & Dr Sunita Jain, Eagle Parkashan, Jalandhar
4. Engineering Mathematics, Vol I, II & III by V Sundaram et al, Vikas Publishing House (P) Ltd., New Delhi
5. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
6. Applied Mathematics I, by Archana Sharma, Lords Publications, Jalandhar.
7. Engineering Mathematics by Srimanta Pal and Subodh C. Bhunia; Oxford University Press, New Delhi
8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1	1st Internal	40%	40%(Combined in internal & final assessment)with minimum 25% marks in final assessment)
B	20%	Unit 2,3	2nd Internal		
C	60%	Unit 4,5,6,7	FINAL	60%	

1.3 APPLIED PHYSICS

L	T	P
2	1	2

RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content.

Note: Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

LEARNING OUTCOMES

After undergoing this subject, the students will be able to:

- Identify physical quantities, parameters and select their units for use in engineering solutions.
- Find units and dimensions of different physical quantities.
- Represent physical quantities as scalar and vectors.
- Use basic laws of motions,
- Analyse and design banking of roads and apply conservation of momentum principle to explain recoil of gun etc.
- Define work, energy and power and their units. Solve problems about work and power
    - State the principle of conservation of energy.
    - Identify forms of energy, conversion from one form to another.
    - Compare and contrast the physical properties associated with linear motion and rotational motion and give examples of conservation of angular momentum.
    - Describe the surface tension phenomenon and its units, applications, effects of temperature on surface tension.
    - Describe the viscosity of liquids.
    - Define stress and strain, modulus of elasticity.
    - State Hooke's law.
    - Measure temperature in various processes on different scales.
    - Distinguish between conduction, convection and radiation.
    - Use equipments like Vernier calliper, screw gauge, Spherometer.
- Differentiate between Transverse and Longitudinal, Periodic and Simple

Harmonic Motion.

- Explain the terms: frequency, amplitude, wavelength, wave velocity, frequency and relation between them.
- Explain various engineering and industrial applications of ultrasonics.
- Apply acoustics principles to various types of buildings to get best sound effect.
- Explain the laws of reflection and refraction of light.
- Explain total internal reflection as applied to optical fibers.

- Define capacitance and its unit and solve simple problems using C=Q/V
- Explain the role of free electrons in insulators, conductors and semiconductors.
- Application of semiconductors as diode, rectifiers, concept of transistors
- Explain electric current as flow of charge, the concept of resistance, heating effect of current.
- State and apply Ohm's law.
- Calculate the equivalent resistance of a variety of resistor combinations.
- Apply the concept of light amplification in designing of various LASER based instruments and optical sources.
- Apply the use of optical fibre in medical field and optical fibre communication.

DETAILED CONTENTS

1. Units and Dimensions (11Hrs)

1.1 Definition of Physics, Physical quantities (Fundamental and derived),
1.2 Units: fundamental and derived units,
1.3 Systems of units: CGS, FPS, MKS, SI
1.4 Definition of Dimensions;
1.5 Dimensional formulae and SI units of physical quantities (distance, displacement, area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, pressure, surface tension, stress, strain)
1.6 Principle of homogeneity of dimensions
1.7 Dimensional equations, Applications of dimensional equations; checking of correctness of equation, Conversion of system of unit (force, work)

2. Force and Motion (14 Hrs)

2.1 Scalar and vector quantities –(Definition and examples),
2.2 Addition of Vectors, Triangle & Parallelogram Law (Statement only),
2.3 Scalar and Vector Product (statement and formula only)
2.4 Definition of Distance, displacement, speed, velocity, acceleration

2.5 Force and its units, concept of Resolution of force
2.6 Newton's Law of motion (Statement and examples),
2.7 Linear Momentum, conservation of momentum (Statement only), Impulse
2.8 Circular motion: definition of angular displacement, angular velocity, angular acceleration, frequency, time period; Relation between linear and angular velocity.
2.9 Centripetal and centrifugal forces(definition and formula only)
2.10 Application of centripetal force in Banking of roads (derivation for angle of banking)

3. Work, Power and Energy (08 Hrs)

3.1 Work (Definition, Symbol, Formula and SI units)
3.2 Energy (Definition and its SI units), Examples of transformation of energy.
3.3 Kinetic Energy (Formula, examples and its derivation)
3.4 Potential Energy (Formula, examples and its derivation)
3.5 Law of conservation of mechanical energy for freely falling bodies (With . Derivation)
3.6 Power (definition, formula and units)
3.7 Simple Numerical problems based on formula of Power

4 Rotational Motion (05 Hrs)

4.1 Rotational motion with examples
4.2 Definition of torque and angular momentum and their examples
4.3 Conservation of angular momentum (quantitative) and its examples
4.4 Moment of inertia and its physical significance, radius of gyration (definition, derivation and formula).

5. Properties of Matter (10 Hrs)

5.1 Definition of Elasticity, Deforming force, Restoring force, example of Elastic and plastic body,
5.2 Definition of Stress and strain with their types,
5.3 Hooke's law, Modulus of Elasticity (Young's, Bulk modulus and shear)
5.4 Pressure (definition, formula, unit), Pascals Law
5.5 Surface tension: definition, its units, applications of surface tension, effect of temperature on Surface tension
5.6 Viscosity: definition, units, effect of temperature on viscosity

5.7 Fluid motion, stream line and turbulent flow.

6. Heat and temperature (05 Hrs)

6.1 Definition of heat and temperature (on the basis of kinetic theory),
6.2 Difference between heat and temperature
6.3 Principles of measurement of temperature.
6.4 Modes of transfer of heat (Conduction, convection and radiation with examples).
6.5 Properties of heat radiation
6.6 Different scales of temperature and their relationship

7. Wave motion and its applications (09 Hrs)

7.1 Wave motion, transverse and longitudinal wave motion with examples, Terms used in wave motion like displacement, amplitude, time period, frequency, wavelength, wave velocity; relationship among wave velocity, frequency and wave length .
7.2 Simple Harmonic Motion (SHM): definition, examples
7.3 Cantilever (definition, formula of time period (without derivation).
7.4 Free, forced and resonant vibrations with examples
7.5 Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time.
7.6 Ultrasonics: Introduction and their engineering applications (cold welding, drilling, SONAR)

8. Optics (05 Hrs)

8.1. Reflection and refraction with laws, refractive index, lens formula (no derivation), power of lens (related numerical problems).
8.2. Total internal reflection and its applications, Critical angle and conditions for total internal reflection
8.3. Microscope, Telescope (definition)
8.4. Uses of microscope and telescope.

9. Electrostatics (09 Hrs)

9.1. Electric charge, unit of charge, conservation of charge.
9.2. Coulombs law of electrostatics,
9.3. Electric field, Electric lines of force (definition and properties), Electric field intensity due to a point charge.
9.4. Definition of Electric flux, Gauss law (Statement and derivation)
9.5. Capacitor and Capacitance (with formula and units), Series and parallel

combination of capacitors (simple numerical problems)

10. Current Electricity (08 Hrs)

10.1 Electric Current and its Unit, Direct and alternating current,
10.2 Resistance, Specific Resistance and Conductance (definition and units)
10.3 Series and Parallel combination of Resistances.
10.4 Ohm's law (statement and formula),
10.5 Heating effect of current, Electric power and its units
10.6 Kirchhoff's laws (statement and formula)

11 Electromagnetism (05 Hrs)

11.1. Introduction to magnetism, Types of magnetic materials. Dia, para and ferromagnetic materials with examples.
11.2. Magnetic field, magnetic intensity, magnetic lines of force, magnetic flux and their units
11.3. Electromagnetic induction (definition)

12. Semiconductor physics (08 Hrs)

12.1. Definition of Energy level, Energy bands,
12.2. Types of materials (insulator, semi conductor, conductor) with examples,
12.3. Intrinsic and extrinsic semiconductors, p-n junction diode and its V-I characteristics
12.4. Diode as rectifier – half wave and full wave rectifier (centre tap only)
12.5. Semiconductor transistor; pnp and npn (Introduction only), symbol.

13. Modern Physics (08 Hrs)

13.1. Lasers: full form, principle, spontaneous emission, stimulated emission, population inversion, engineering and medical applications of lasers.
13.2. Fibre optics: Introduction to optical fibers (definition, parts), applications of optical fibers in different fields.

13.3. Introduction to nanotechnology (definition of nanomaterials with examples) and its applications.

LIST OF PRACTICALS (To perform minimum fourteen experiments)

1. To find diameter of solid cylinder using a vernier calliper
2. To find internal diameter and depth of a beaker using a vernier calliper and hence find its volume.

3. To find the diameter of wire using screw gauge
4. To find thickness of paper using screw gauge.
5. To determine the thickness of glass strip using a spherometer
6. To determine radius of curvature of a given spherical surface by a spherometer.
7. To verify parallelogram law of forces
8. To determine the atmospheric pressure at a place using Fortin's Barometer
9. To determine force constant of spring using Hooke's law
10. Measuring room temperature with the help of thermometer and its conversion in different scale.
11. To find the time period of a simple pendulum
12. To determine and verify the time period of Cantilever
13. To verify ohm's laws by plotting a graph between voltage and current.
14. To verify laws of resistances in series combination.
15. To verify laws of resistance in parallel combination.
16. To find resistance of galvanometer by half deflection method
17. To verify laws of reflection of light using mirror.
18. To verify laws of refraction using glass slab.
19. To find the focal length of a concave lens, using a convex lens
20. To study colour coding scheme of resistance.

INSTRUCTIONAL STATREGY

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, exercises and viva-voce

RECOMMENDED BOOKS

1. Text Book of Physics for Class XI (Part-I, Part-II); N.C.E.R.T., Delhi
2. Applied Physics, Vol. I and Vol. II by Dr. HH Lal; TTTI Publications, Tata McGraw Hill, Delhi
3. Concepts in Physics by HC Verma, Vol. I & Vol.II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi

5. e-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
6. Practical Physics, by C. L. Arora, S Chand Publication

Websites for Reference:

http://swayam.gov.in

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
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B	20%	Unit 3,4,5	2nd Internal		
C	60%	Unit 6,7,8,9, 10,11, 12, 13	FINAL	60%	

1.4 APPLIED CHEMISTRY

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RATIONALE

The use of various chemical and chemical products in diverse technical and engineering field have repeatedly proved the importance of applied chemistry, which enhances its role to a new peak. On the other hand, ever increasing use of such materials will compel engineers, technocrats to acquire essential applied chemistry knowledge in order to select engineering material, which not only suit them but also provide more environmental compatibility. This situation demands principles of applied chemistry in diploma-engineering courses. Principles of Applied Chemistry will enable budding engineers and technocrats to develop scientific temper and appreciate physical, chemical and engineering properties of materials. Hence the subject of applied chemistry.

LEARNING OUTCOMES

After undergoing this subject, the students will able to:

- Classify matter based on state of aggregation.
- Calculate percentage composition of chemical compounds.
- Substantiate the laws and principles on which structure of atom is established.
- Prepared solution of required concentration.
- Understand pH and prepare buffer solution and understand their significance in industrial processes such as electrolysis, electrochemical machining of materials etc.
- Explain various characteristics of water.

- Explain cause and facture factors which adversely affecting natural water quality and remedial measure available for water purification to achieve water quality standards required for domestic, agriculture and industrial applications .
- Explain chemistry and technology of industrial metal extraction processes.
- Explain chemistry of fuel and relative advantages.
- Select most efficient fuel for engine and engineering applications.
- Explain mechanism of lubrication and their advantages.
- Explain the chemistry of various polymers and plastics.
- Verify suitability and select polymer/ plastic material for engineering applications.

DETAILED CONTENTS

1. Some Basic Concepts in Chemistry (8 Hrs)

1.1 General introduction: Importance and scope of chemistry.

1.2 Classification of matter:

a) Physical classification: Solid, Liquid and Gases (only definition with examples).

b) Chemical Classification: elements, compounds and mixture (Definition and examples Types of mixture excluded).

1.3 Definition of atom, molecule, symbol and significance of symbol.

1.4 Molecular Formula, Writing the formula of compounds containing Cl^-, OH^-, HCO_3^-, SO_4^{2-},CO_3^{2-} and NH_4^+, Na^+, K^+, Ca^{2+}, Mg^{2+}, Fe^{2+}, Zn^{2+}, Fe^{3+}, Al^{3+} ions

1.5 Calculation of molecular mass (Atomic mass of constituents should be provided), Calculation of mass percentage composition of elements in compound (Atomic masses of elements should be provided)

2. Structure of Atom (8 Hrs)

2.1 Fundamental particles of atom: electron, proton and neutron, charge and mass of electron, proton and neutron.

2.2 Bohr's model of atom (postulates only) i,e concept of orbit or shell.

2.3 Atomic number (Z), mass number (A), calculation of protons, electrons and neutrons in $^{A}_{z}X$.

2.4 Isotopes, isobars and isotones (definition with examples).

2.5 Concept of orbital (wave nature of electron), difference between orbit and orbital.

2.6 Principles of filling electrons in various orbital: a) Aufbau principle b) Hund's Rule of maximum multiplicity c) Pauli's exclusion principle.

2.7 Electronic configuration of atoms (upto Z=30)

3. Chemical Bonding
(5 Hrs)

3.1 Valence electrons, Lewis symbol.

3.2 Octet rule (Limitation excluded).

3.3 Chemical bond (definition) and its type.

3.4 Electrovalent or Ionic Bond with example of NaCI,

3.5 Covalent Bonding in H_2, O_2

4. Solution
(8 Hrs)

4.1 Definition of solution, Binary solution, aqueous solution.

4.2 Definition of solute, solvent.

4.3 Definition of acid and base and salt.

4.4 Definition of acidity and basicity.

4.5 Concentration of solution

4.6 Modes of expressing concentration of solution

a) Strength

b) Molarity (M)

c) Normality (N) and

d) simple numerical problems based on (a) and (b)

4.7 Definition of pH and industrial application of pH. (Numericals excluded)

5. Electrochemistry.
(8 Hrs)

5.1 Electronic concept of oxidation, reduction

5.2 Definition of terms electrolyte, non electrolyte with example

5.3 Types of electrolytes: strong and weak with examples

5.4 Definition of electrolysis.

5.5 Faradays laws of electrolysis

5.6 Industrial applications of electrolysis: Electroplating, electrolytic refining, electrometallurgy.

6. General Principles of extraction of metals
(8 Hrs)

6.1 Metals and Non-metals (definition)

6.2 Definition of Mineral, Chief ores of iron, aluminum and copper.

6.3 Definition of metallurgy, types of metallurgy

6.4 General Steps of metallurgy

a) Crushing

b) Pulverization of ore

c) Concentration or purification of ore:

i) Gravity separation method ii) froth flotation method.

d) Oxidation of ore:

i) Roasting ii) Calcination

e) Reduction:

i) Smelting (Pyrometallurgy) and ii) Electrolytic reduction

f) Refining of Metal:

i) Electrolytic refining

6.5 Definition of alloy, types of alloys and purpose of alloying.

7. Fuel
(8Hrs)

7.1 Definition of fuel, classification of fuel a) on the basis of physical state b) on the basis of source.

7.2 Definition of calorific value

7.3 Characteristics of good fuel, advantages of gaseous fuel over solid fuels.

7.4 Coal- Proximate analysis of coal and its importance.

7.5 Fuel quality rating- octane number and cetane number (definition only)

7.6 Gaseous fuel: Composition, calorific value and application of CNG, LPG and biogas.

8. Water
(8 Hrs)

8.1 Type of water: Soft and hard water.

8.2 Types of hardness of water

8.3 Units of hardness of water: ppm, mg/L (with simple numericals).

8.4 Disadvantages of using hard water in boiler. a) Scale and sludge formation b) Boiler Corrosion c) Caustic embrittlement

8.5 Qualities of drinking (potable) water

9. Lubricants
(4 Hrs)

9.1 lubricant and lubrication.

9.2 Functions of lubricants.

9.3 Classification of lubricants: solid, semisolid and liquid lubricants with examples.

9.4 Type of lubrications – hydrodynamic and boundary lubrication with illustrative diagrams.

9.5 Properties of lubricants

a) Physical properties- viscosity, viscosity index, cloud point, pour point, flash point, fire point, oiliness

b) Chemical properties- TAN or TAV (Total acid number), emulsification, aniline point and iodine value.

10. Polymer and Plastic
(5 Hrs)

10.1 Definition of polymer, Monomer, Degree of Polymerization

10.2 Monomer and uses of PE, PVC, PS, Teflon, Nylon-66, Bakelite

10.3 Brief introduction to addition and condensation polymers with suitable examples

(PE, PVC, PS, Teflon, Nylon-66, Bakelite).

10.4 Definition of plastics, thermoplastic and thermosetting polymer with example, difference between thermoplastic and thermosetting polymers.

10.5 Uses of polymer and plastic in daily life and in industries.

LIST OF PRACTICALS

1. Volumetric analysis and apparatus used their in.
2. To prepare standard solution of oxalic acid (N/20).
3. To determine the strength of given sodium hydroxide solution by titrating against standard oxalic acid (N/10) solution using phenolphthalein as indicator.
4. Gravimetric analysis and apparatus used their in.
5. To determine the percentage of moisture in given sample of coal.
6. To determine the percentage of ash in given sample of coal.
7. To determine the percentage of volatile and non volatile substance in given mixture.
8. To determine the viscosity of lubricant by using Redwood viscometer.

9. To determine total acid number (TAN) or Total acid value of given lubricant (liquid).
10. Detection of iron metal in the given solution of rust.

INSTRUCTIONAL STRATEGY

Teachers may take help of various models and charts while imparting instructions to make the concept clear. Awareness of the contents should be done through examples using you-tubes and subsequent discussions. More emphasis should be laid on discussing and explaining practical applications of various chemical process and reactions. In addition, students should be encouraged or motivated to study those processes in more details, which may find practical application in their future professional career.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, exercises and viva-voce

RECOMMENDED BOOKS

1. Chemistry in Engineering by J.C. Kuricose & J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry by P.C. Jain & Monika Jain, Dhanapat Rai Publishing Company, New Delhi.
3. Eagle's Applied Chemistry - I by S. C. Ahuja & G. H. Hugar, Eagle Prakashan, Jalandhar.
4. Engineering Chemistry – A Text Book by H. K. Chopra & A. Parmar, Narosa Publishing House, New Delhi.
5. Engineering Chemistry by Dr.Himanshu Pandey, Goel Publishing House, Meerut, India.

6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

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1.5 FUNDAMENTAL OF ELECTRICAL & ELECTRONICS ENGG

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RATIONALE

A diploma holder may be involved in various jobs ranging from preventive maintenance of electrical installation to fault location. In addition, he/she may be working in testing laboratories where he/she uses measuring instruments. To carry out these and similar jobs effectively, knowledge of basic concepts, principles and their applications is very essential. This course will enable the students to understand the basic concepts and principles of DC and AC fundamental, ac circuits, batteries, electromagnetic induction, voltage and current sources etc. This subject gives the knowledge of fundamental concepts and principles of basic electronics and aims at providing the students with basic understanding of various types of materials such as conductors, semiconductors and insulators, extrinsic and intrinsic semi-conductors, p-n junction, need of rectifiers, significance and use of filters in rectifiers, basic structure and working principle of LEDs, LCD; working of Transistors in various configurations; fundamental knowledge of FETs and MOSFETs etc. and their applications. The teacher should give emphasis on understanding of concepts by explaining the various terms used in the subject. Practical exercises have been included in order to reinforce various concepts

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Identify and able to take readings on various electrical equipments(voltmeter, ammeter, CRO, wattmeter, multi-meter)
- Determination of voltage-current relationship in a DC circuit under specific physical conditions
- Measure resistance of an ammeter and a voltmeter
- Verify DC circuits (Thevenin and Norton’s Theorem), Superposition nodal analysis, Maximum Power Transfer Theorem
- Verify Kirchhoff's Current and Voltage Laws in a dc circuit
- Find the ratio of inductance of a coil having air-core and iron-core respectively and to observe the effect of introduction of a magnetic core on coil inductance
- Measure power and power factor in a single phase R-.L-.C. Circuit and calculation of active and reactive powers in the circuit. After undergoing the subject, the students will be able to take readings on various electronics equipments(multimeter, CRO, signal generator, LCR meter)
- Plot the VI characteristics of pn junction diode and Zener diode
- Measure voltage gain, input and output impedance in a single state CE amplifier circuit.

- Fabricate half wave, full wave and bridge rectifier and observe waveforms of each
- Plot the waveforms of the rectifier circuit with different filters
- Plot input and output characteristics of transistor in CB and CE mode
- Plot the characteristics of FET based amplifier
- Measure voltage gain, input and output impedance in a single state CE amplifier circuit.

take readings on various electronics equipments(multi meter, CRO, signal generator, LCR meter)

DETAILED CONTENTS

1. Overview of DC Circuits (05 hrs)
   - 1.1 Simple problems on series and parallel combination of resistors and capacitors with their wattage consideration,
   - 1.2 Application of Kirchhoff's current law and Kirchhoff's voltage law to simple circuits. Star – Delta connections and their conversion.

2. DC Circuit Theorems (05 hrs)

   Thevenin's theorem, Norton's theorem, application of network theorems in solving D.C. circuit problems. Superposition nodal analysis, Mesh analysis, Maximum Power Transfer Theorem.

3. Voltage and Current Sources (04 hrs)
   - 3.1 Concept of voltage source, symbol and graphical representation characteristics of ideal and practical sources.
   - 3.2 Concept of current sources, symbol, characteristics and graphical representation of ideal and practical current sources.

4. Semiconductor Physics (06 hrs)
   - 4.1 Review of basic atomic structure and energy levels, concept of insulators, conductors and semi conductors, atomic structure of Germanium (Ge) and Silicon (Si), covalent bonds
   - 4.2 Concept of intrinsic and extrinsic semi conductor, process of doping.
   - 4.3 Energy level diagram of conductors, insulators and semi conductors; minority and majority charge carriers.
   - 4.4 P and N type semiconductors and their conductivity, effect of temperature on conductivity of intrinsic semi conductors.

5. Semiconductor Diode (08 hrs)
   - 5.1 PN junction diode, mechanism of current flow in PN junction, forward and reverse biased PN junction, potential barrier, drift and diffusion currents, depletion layer, concept of junction capacitance in forward and reverse biased condition.

5.2 V-I characteristics, static and dynamic resistance and their value calculation from the characteristics.

5.3 Application of diode as half-wave, full wave and bridge rectifiers. Peak Inverse Voltage, rectification efficiencies and ripple factor calculations, shunt capacitor filter, series inductor filter, LC and π filters.

5.4 Types of diodes, characteristics and applications of Zener diodes. Zener and avalanche breakdown

6. Electro Magnetic Induction (06 hrs)

6.1 Concept of electro-magnetic field produced by flow of electric current, magnetic circuit, concept of magneto-motive force (MMF), flux, reluctance, permeability, analogy between electric and magnetic circuit.

6.2 Faraday's laws of electro-magnetic induction, principles of self and mutual induction, self and mutually induced e.m.f, simple numerical problems.

6.3 Concept of current growth, decay and time constant in an inductive (RL) circuit.

6.4 Energy stored in an inductor, series and parallel combination of inductors.

7. Batteries (05 hrs)

7.1 Basic idea of primary and secondary cells

7.2 Construction, working principle and applications of Lead-Acid, Nickel-Cadmium and Silver-Oxide batteries

7.3 Charging methods used for lead-acid battery (accumulator)

7.4 Care and maintenance of lead-acid battery

7.5 Series and parallel connections of batteries

7.6 General idea of solar cells, solar panels and their applications

7.7 Introduction to maintenance free batteries

8. AC Fundamentals (05 hrs)

8.1 Concept of alternating quantities

8.2 Difference between ac and dc

8.3 Concepts of: cycle, frequency, time period, amplitude, instantaneous value, average value, r.m.s. value, maximum value, form factor and peak factor.

8.4 Representation of sinusoidal quantities by phasor diagrams.

8.5 Equation of sinusoidal wave form for an alternating quantity and its derivation

8.6 Effect of alternating voltage applied to a pure resistance, pure inductance and pure capacitance.

9. AC Circuits (06 hrs)

9.1 Concept of inductive and capacitive reactance

9.2 Alternating voltage applied to resistance and inductance in series.

9.3 Alternating voltage applied to resistance and capacitance in series.

9.4 Introduction to series and parallel resonance and its conditions

9.5 Power in pure resistance, inductance and capacitance, power in combined RLC circuits. Power factor, active and reactive power and their significance, definition and significance of power factor.

9.6 Definition of conductance, susceptance, admittance, impedance and their units

10. Introduction to Bipolar-Transistors (06 hrs)

10.1 Concept of a bipolar transistor, its structure, PNP and NPN transistors, their symbols and mechanism of current flow; Current relations in a transistor; concept of leakage current;

10.2 CB, CE, CC configurations of a transistor; Input and output characteristics in CB and CE configurations; input and output dynamic resistance in CB and CE configurations; Current amplification factors. Comparison of CB, CE and CC Configurations;

10.3 Transistor as an amplifier in CE Configuration; concept of DC load line and calculation of current gain and voltage gain using DC load line.

11. Transistor Biasing Circuits (04 hrs)

Concept of transistor biasing and selection of operating point. Need for stabilization of operating point. Different types of biasing circuits.

12. Field Effect Transistors (05 hrs)

Construction, operation and characteristics of FETs and their applications.

12.1 Construction, operation and characteristics of a MOSFET in depletion and enhancement modes and its applications.

12.2 CMOS - advantages and applications

12.3 Comparison of JFET, MOSFET and BJT.

13. Introduction to Electrical Machines (05 hrs)

13.1 Transformers : Principal of operation, construction detail of single phase transformer, turns ratio , efficiency, loses in a transformer.

13.2 DC machine : principal of operation, construction of DC motor and generator, Characteristics of different types of DC machines , Starter .

13.3 AC machines : Principal and working of synchronous machines, single phase induction motor

LIST OF PRACTICALS

1. Operation and use of measuring instruments viz voltmeter, ammeter, CRO, Wattmeter, multi-meter and other accessories
2. Measurement of resistance of an ammeter and a voltmeter
3. Verification of following Theorems:-
   a. Thevenin's theorem,
   b. Norton's theorem,
4. Observation of change in resistance of a bulb in hot and cold conditions, using voltmeter and ammeter.
5. Verification of Krichhoff's Current and Voltage Laws in a dc circuit
6. To find the ratio of inductance of a coil having air-core and iron-core respectively and
   to observe the effect of introduction of a magnetic core on coil inductance
7. Charging and testing of a lead - acid storage battery.
8. Measurement of power and power factor in a single phase R-.L-.C. circuit and calculation of active and reactive powers in the circuit.
9. Plotting of V-I characteristics of a PN junction diode & Zener diode
10. Observe the output of waveform using
    a. Half-wave rectifier circuit using one diode
    b. Full-wave rectifier circuit using two diodes
    c. Bridge-rectifier circuit using four diodes
11. Plotting of the wave shape of full wave rectifier with
    a. Shunt capacitor filter
    b. Series inductor filter
12. Plotting of input and output characteristics and calculation of parameters of transistors in CE configuration.
13. Plotting of input and output characteristics and calculation of parameters of transistors in CB configuration.
14. Plotting of V-I characteristics of a FET.
15. To determine the efficiency of single phase Transformer

RECOMMENDED BOOKS

1. Electrical Technology by BL Theraja, S Chand and Co, New Delhi
2. Basic Electrical and Electronics Engineering by SK Sahdev; Dhanpat Rai and Sons, New Delhi

3. Experiments in Basic Electrical Engineering by SK Bhattacharya, KM Rastogi; New Age
International (P) Ltd.; Publishers New Delhi
4. Principles of Electrical Engineering by BR Gupta, S Chand and Co, New Delhi
5. Basic Electrical Engineering by JB Gupta; SK Kataria and Sons, New Delhi
6. Basic Electrical Engineering by D.R Arora, Ishan Publications
7. Basic Electronics and Linear Circuit by NN Bhargava and Kulshreshta, Tata McGraw Hill Publishing Co, New Delhi.
8. Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi
9. Electronic Components and Materials by SM Dhir, Tata McGraw Hill Publishing Co, New Delhi
10. Electronic Devices and Circuits by Bhupinder Jit Kaur; Modern Publishers, Jalandhar
11. Electronics – I by DR Arora, North Publications, Jalandhar

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C	60%	Unit 6 to 13	FINAL	60%	

1.6 ENVIRONMENTAL STUDIES

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RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the ecosystem and controlling pollution by various control measures. He should also be aware of environmental laws related to the control of pollution. He should know how to manage the waste. Energy conservation is the need of hour. He should know the concept of energy management and its conservation.

LEARNING OUTCOMES

After undergoing the subject, the student will be able to:

- Comprehend the importance of ecosystem and sustainable
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abetment of pollution.
- Explain environmental legislation acts.
- Define energy management, energy conservation and energy efficiency
- Demonstrate positive attitude towards judicious use of energy and environmental protection
- Practice energy efficient techniques in day-to-day life and industrial processes.
- Adopt cleaner productive technologies
- Identify the role of non-conventional energy resources in environmental protection.
- Analyze the impact of human activities on the environment

DETAILED CONTENTS

1. Introduction (4 Hrs)
   - Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non renewable.

2. Air Pollution (12 Hrs)
   - Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.

3. Water Pollution (16 Hrs)
   - Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O_2, BOD,

COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

4. Soil Pollution (14 Hrs)
   - Sources of soil pollution
   - Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste
   - Effect of Solid waste
   - Disposal of Solid Waste- Solid Waste Management

5. Noise pollution (8 Hrs)
   - Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.

6. Environmental Legislation (10 Hrs)
   - Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).

7. Impact of Energy Usage on Environment (6 Hrs)
   - Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings.

LIST OF PRACTICALS

1. Determination of pH of drinking water
2. Determination of TDS in drinking water
3. Determination of TSS in drinking water
4. Determination of hardness in drinking water
5. Determination of oil & grease in drinking water
6. Determination of alkalinity in drinking water
7. Determination of acidity in drinking water
8. Determination of organic/inorganic solid in drinking water
9. Determination of pH of soil

10. Determination of N&P (Nitrogen & Phosphorus) of soil
11. To measure the noise level in classroom and industry.
12. To segregate the various types of solid waste in a locality.
13. To study the waste management plan of different solid waste
14. To study the effect of melting of floating ice in water due to global warming

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies like expert lectures, seminars, visits to green house, effluent treatment plant of any industry, rain water harvesting plant etc. may also be organized.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests

RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Kataria and Sons, New Delhi.

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C	60%	Unit 4,5,6,7	FINAL	60%	

1.7 ENGINEERING GRAPHICS

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RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawing is their day to day responsibility. The subject is aimed at developing basic graphic skills in the students so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation. The emphasis, while imparting instructions, should be to develop conceptual skills in the students following BIS SP 46 – 1988.

Note:

i) First angle projection is to be followed
ii) Minimum of 30 sheets to be prepared
iii) Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students
iv) For better understanding, students should be encouraged to use engineering graph book, and computer based software like Auto CAD for free hand and orthographic projection practice.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Identify and use of different grades of pencils and other drafting instruments which are used in engineering field
- Draw free hand sketches of various kinds of objects.
- Utilize various types of lines used in engineering drawing.
- Read and apply different dimensioning methods on drawing of objects.
- Use different types of scales and their utilization in reading and reproducing drawings of objects and maps.
- Draw 2 - dimensional view of different objects viewed from different angles (orthographic views)
- Draw and interpret complete inner hidden details of an object which are otherwise not visible in normal view
- Generate isometric (3D) drawing from different 2D (orthographic) views/sketches
- Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances

- Use AutoCAD or other drafting software for making fast engineering drawings and even animating the assembly drawings.

DETAILED CONTENTS

1. Introduction to Engineering Drawing (4 sheets)

   1.1 Definition of Engineering Drawing, Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards, engineering graph book, different grades of pencils to be used.
   1.2 Different types of lines in engineering drawing as per BIS specifications
   1.3 Practice of vertical, horizontal and inclined lines
   1.4 Principles of dimensioning: Types, elements, placing, different methods of dimensioning
   1.5 Practice of geometrical figures such as –triangles, rectangles, circles, ellipses and parabola, hexagonal, pentagon with the help of drawing instruments.
   1.6 Definition and classification of lettering, single stroke vertical and inclined lettering at 75^0 (alphabet and numerals)
   1.7 Freehand letter writing and sketches of various kind of objects in graph Sketch book/graph paper.

2 Scales (2 sheets)

   2.1 Scales-their needs and importance(theoretical instructions), types of scales, definition of Representative Fraction(R.F.) and length of scale.
   2.2 Construction of Plain and diagonal scale.

3 Orthographic Projection (5 sheets)

   3.1 Theory of orthographic projections (Elaborate theoretical instructions)
   3.2 Projections of points in different quadrants
   3.3 Projection of line (1^{st} angle and 3^{rd} angle)
      3.3.1 Line parallel to both planes
      3.3.2 Line perpendicular to any one of the principal plane
      3.3.3 Line inclined to any one of the principal plane and parallel to other
   3.4 Projection of Solid-Cube, Cuboid, Cone, Prism, pyramid
   3.5 Three views of orthographic projections of different objects (At least one sheet in 3^{rd} angle)

4 Sectioning and Identification of surfaces (2 sheets)

   4. 1 Identifications of surfaces, Importance and salient features of sectioning of objects.
   4. 2 Description of full section, half section.

5 Isometric Views (2 sheets)

5.1 Fundamental of isometric projections and isometric scale

5.2 Isometric views of different objects

6 Graphics using CAD (5 sheets)

6.1 Meaning, requirement of computer graphics, CAD, screen structure and toolbars in AutoCAD, coordinate system, Drawing Limits, Units.

6.2 Practice of LINE command, coordinates-Absolute, incremental, polar. POLYLINE, CIRCLE(3P,2P, TTR), ARC, ELLIPSE

6.3 Using above geometrical commands for making figure e.g. triangle, rectangle, hexagon, pentagon, parabola.

6.4 Editing commands-Scale, erase, copy, stretch, lengthen and explode.

6.5 Use of SNAP, GRID and ORTHO mode for selection of points quickly. Use of these modes while picking points in LINE, CIRCLE, PLINE, ARC, ELLIPSE etc commands.

6.6 Drawing projections of lines and solids.

6.7 Drawing orthographic projections of different objects (at least 2 sheets)

6.8 AutoCAD for the isometric views sheets. Making single computer sheet showing all the three views and an isometric (in single split screen view) of any object showing understanding of use of AutoCAD in making isometric views – at least 1 sheet

7 Common Symbols and conventions used in Engineering (1 sheet)

7.1 Civil Engineering sanitary fitting symbols

7.2 Electrical fitting symbols for domestic interior installations

7.3 Safety symbols used in engineering works

8 Development of surfaces (cylinder, cuboid, cone) (1 sheet)

8.1 Parallel line, radial line method

(The teacher may explain both methods but will use one method in sheet in classroom and other method on sketchbook)

9 Detailed and assembly drawing (3 sheets)

9.1 Principle and utility of detailed and assembly drawings

9.2 Wooden joints i.e. corner mortise and tenon joint, Tee Halving joint, Mitre faced corner joint, Tee bridle joint , crossed wooden joint, cogged joint, dovetail joint, through Mortise and tenon joint, furniture drawing – freehand and with the help of drawing instruments

9.3 Making Wooden Joint sheets in AutoCAD, rendering & showing assembly animation at least 1 sheet

10 Screw threads and threaded fasteners (5 sheets)

10.1 Type of threads-external and internal threads, right and left hand threads (actual conventional representation), Single and multiple start thread.

10.2 Different forms of screw threads –V threads (B.S.W. threads, B.A thread, American National and Metric thread), Square threads (Square, Acme, buttress and Knuckle thread)

10.3 Different views of hexagonal and square nuts. Square and hexagonal headed bolt.

10. 4 Foundations bolts-Rag bolt, Lewis bolt, Curved bolt and eye bolt.

10. 5 Freehand sketches of various types of screws and studs.

11 Keys and Cotters (3 sheets)

11. 1 Various types of keys and cotters - their practical application, drawings of various keys and cotters showing keys and cotters in position.

11. 2 Various types of Joints

-Spigot and Socket Joints
-Gib and cotter joint
-Knuckle joint

12 Couplings (2 sheets)

12.1 Introduction to coupling, their use and types

12.2 Muff coupling

12.3 Flange coupling (protected)

12.4 Flexible Coupling

MEANS OF ASSESSMENT

- Drawing sheets
- Assignments and quiz/class tests

RECOMMENDED BOOKS

1. A Text Book of Engineering Drawing by Surjit Singh; Dhanpat Rai & Co., Delhi
2. Engineering Drawing by PS Gill; SK Kataria & Sons, New Delhi
3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt; Charotar Publishing House Pvt. Ltd., Anand
4. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar
5. Engineering Drawing I by DK Goel, GBD Publication.
6. CAD/CAM by J.S.Narang, Dhanpat Rai & Sons Publishers, New Delhi.
7. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.
8. Engineering Drawing with AutoCAD 2000 by T. Jeyapooran, Vikas Publishing House, Delhi

9. AutoCAD for Engineering Drawing Made Easy by P. Nageswara Rao; Tata McGraw Hill;, New Delhi.

Websites for Reference:

http://swayam.gov.in

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1 ,2	1st Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
B	20%	Unit 3,4,5	2nd Internal		
C	60%	Unit 6, 7, 8, 9, 10, 11, 12	FINAL	60%	

1.8 INFORMATION TECHNOLOGY

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RATIONALE

Information technology has great influence on all aspects of life. Primary purpose of using computer is to make the life easier. Almost all work places and living environment are being computerized. The subject introduces the fundamentals of computer system for using various hardware and software components. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concept of information technology and its scope; operating a computer; use of various tools using MS Office/Open Office/Libre Office using internet etc.,. This exposure will enable the students to enter their professions with confidence, live in a harmonious way and contribute to the productivity.

Note:
Explanation of Introductory part should be demonstrated with practical work. Following topics may be explained in the laboratory along with the practical exercises. There will not be any theory examination.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Identify Computer hardware components, network components and peripherals.
- Explain the role of an operating System.
- Install system and application software.
- Explain the function of the system components including processor, motherboard and input-output devices.
- Use Word Processing software to prepare document.
- Use spreadsheet software to create workbooks and automate calculation.
- Use presentation software to create interactive presentation.
- Perform fundamental tasks common to most application software including print, save, edit, cut, copy, paste, format, spell and grammar check.
- Find and evaluate information on the Web.
- Install antivirus.
- Safeguard against online frauds, threats and crimes.

TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION

1. Basic Concepts of IT and Its Application

   Information Technology concept and scope, applications of IT. in office, Air and Railway Ticket reservation, Banks financial transactions, E-Commerce and E-Governance applications etc., Ethics of IT, concept of online frauds, threats of IT crimes.

2. Computer Hardware:

   Block diagram of a computer, components of computer system, CPU, Memory, Input devices; keyboard, Scanner, mouse etc; Output devices; VDU, LCD, Printers etc. Primary and Secondary Memory: RAM, ROM, magnetic disks – tracks and sectors, optical disk (CD, DVD & Blue Ray Disk.), USB/Flash Drive.

3. Software Concepts:

   System software, Application software, Virtualization software and Utility software, Introduction of Operating System, Installation of Window / linux, Features of OPEN OFFICE/MS_OFFICE(MS word, Excel, PowerPoint) .

4. Internet Concepts:

   Basics of Networking – LAN, WAN, Wi-Fi technologies and sharing of printers and other resources, Concept of IP addresses, DNS, introduction of internet, applications of internet like: e-mail and browsing, concept of search engine and safe searching. Various browsers like Internet explorer/Microsoft Edge, Mozilla Firefox, use of cookies and history, WWW (World Wide Web), hyperlinks, introduction to Anti-virus.

LIST OF PRACTICAL EXERCISES

1. Given a PC, name its various components and peripherals. List their functions .
2. Installing various components of computer system and installing system software and application software
3 Installation of I/O devices, printers and installation of operating system viz. Windows/BOSS/ LINUX
4. Features of Windows as an operating system
   - Start
   - Shut down and restore
   - Creating and operating on the icons
   - Opening, closing and sizing the windows and working with windows interfacing elements (option buttons, checkbox, scroll etc.)

- Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file and folders
- Changing settings like, date, time, colour (back ground and fore ground etc.)
- Using short cuts
- Using on line help

5. Word Processing (MS Office/Open Office)

a) File Management:
   - Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file

b) Page set up:
   - Setting margins, tab setting, ruler, indenting

c) Editing a document:
   - Entering text, cut, copy, paste using tool- bars

d) Formatting a document:
   - Using different fonts, changing font size and colour, changing the appearance through bold/italic/underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
   - Aligning of text in a document, justification of document, inserting bullets and numbering
   - Formatting paragraph, inserting page breaks and column breaks, line spacing
   - Use of headers, footers: Inserting footnote, end note, use of comments, autotext
   - Inserting date, time, special symbols, importing graphic images, drawing tools

e) Tables and Borders:
   - Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
   - Print preview, zoom, page set up, printing options
   - Using find, replace options

f) Using Tools like:
   - Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelops and lables
   - Using shapes and drawing toolbar,
   - Working with more than one window .

6. Spread Sheet Processing (MS Office/Open Office)

a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, save worksheet, switching between different spread sheets

b) Menu commands:

Create, format charts, organise, manage data, solving problem by analyzing data. Programming with Excel Work Sheet, getting information while working

c) Work books:

Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations

Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet, conditional formatting

d) Creating a chart:

Working with chart types, changing data in chart, formatting a chart, use chart to analyze data

Using a list to organize data, sorting and filtering data in list

e) Retrieve data with query:

Create a pivot table, customizing a pivot table. Statistical analysis of data

f) Exchange data with other application:

Embedding objects, linking to other applications, import, export document.

7. PowerPoint Presentation (MS Office/Open Office)

a) Introduction to PowerPoint
- How to start PowerPoint
- Working environment: concept of toolbars, slide layout & templates.
- Opening a new/existing presentation
- Different views for viewing slides in a presentation: normal, slide sorter.

b) Addition, deletion and saving of slides

c) Insertion of multimedia elements
- Adding text boxes
- Adding/importing pictures
- Adding movies and sound
- Adding tables and charts etc.
- Adding organizational chart
- Editing objects
- Working with Clip Art

d) Formatting slides
- Using slide master
- Text formatting
- Changing slide layout

- Changing slide colour scheme
- Changing background
- Applying design template

e) How to view the slide show?
- Viewing the presentation using slide navigator
- Slide transition
- Animation effects, timing, order etc.

f) Use of Pack and Go Options.

8. Internet and its Applications

a) Establishing an internet connection.
b) Browsing and down loading of information from internet.
c) Sending and receiving e-mail
- Creating a message
- Creating an address book
- Attaching a file with e-mail message
- Receiving a message
- Deleting a message

d) Assigning IP Addresses to computers and use of domain names.

9. Functioning of Antivirus

a) Installation and updation of an antivirus.
b) How to scan and remove the virus.

INSTRUCTIONAL STRATEGY

Since this subject is practice oriented, the teacher should demonstrate the capabilities of computers to students while doing practical exercises. The students should be made familiar with computer parts, peripherals, connections and proficient in making use of MS Office/Open Office in addition to working on internet. The student should be made capable of working on computers independently.

RECOMMENDED BOOKS

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New Age International Publishers, New Delhi
3. Computers Today by SK Basandara, Galgotia publication Pvt Ltd. Daryaganj, New Delhi.

4. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
6. Fundamentals of Information Technology by Leon and Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
7. Fundamentals of Information Technology by Vipin Arora, Eagle Parkashan, Jalandhar

1.9 INTERNET OF THINGS AND ARTIFICIAL INTELLIGENCE

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LEARNING OUTCOMES

At the end of this course, the students will be able to:

- Understand the concepts of Internet of Things
- Build small IoT applications
- Understand and analysing sensor generated data using analytic techniques in Excel

DETAILED CONTENTS

1. Introduction to Internet of Things (IoT) (8 hrs)
   - Applications, architecture, protocols
   - Characteristics of IoT
   - Physical Design/Logical Design of IoT
   - Functional blocks of IoT, Communication Models.
2. Basics of C language using Arduino IDE (14 hrs)
   - Understating basics of Arduino IDE
   - Variables, datatype, loops, control statement, function
3. Practical using Arduino-interfacing sensors (28 hrs)
   i. Interfacing Light Emitting Diode(LED)- Blinking LED
   ii. Interfacing Button and LED – LED blinking when button is pressed
   iii. Interfacing Light Dependent Resistor (LDR) and LED, displaying automatic night lamp
   iv. Interfacing Temperature Sensor(LM35) and/or humidity sensor (e.g. DHT11)
   v. Interfacing Liquid Crystal Display(LCD) – display data generated by sensor on LCD
   vi. Interfacing Air Quality Sensor-pollution (e.g. MQ135) - display data on LCD , switch on LED when data sensed is higher than specified value.
   vii. Interfacing Bluetooth module (e.g. HC05)- receiving data from mobile phone on Arduino and display on LCD
   viii. Interfacing Relay module to demonstrate Bluetooth based home automation application. (using Bluetooth and relay).
4. Introduction to Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL). (20 hrs)
   - Role of AI in IoT and its applications
   - Managing and Analysing data generated by IoT devices – Big Data
   - Machine learning (ML) Techniques e.g. classification, linear regression, etc.
   - Numerical based on above techniques.
   - Understanding excel for analysing data

INSTRUCTIONAL STRATEGY:

Since this subject is practical oriented, the teacher should demonstrate functioning of various sensors and demonstrate building of IoT applications. Solution to various regression and classification problems should also be built.

LIST OF REFERENCE BOOKS:

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands On Approach, University Press
2. Yashavant Kanetkar, Shrirang Korde, "21 Internet Of Things (IOT) Experiments"
3. Neerparaj Rai , "Arduino Projects For Engineers"
4. Chandra S.S.V, "Artificial Intelligence and Machine Learning"

LIST OF COMPONENTS

1. One kit for 3-4 students : Arduino Uno, sensors(Bluetooth module(HC05), MQ135, DHT11, breadboard , LCD, 2-relay module etc)
2. Consumables : LED, button, connecting wires, LDR, LM35, battery, etc

1.10 GENERAL WORKSHOP PRACTICE

(Common for Mechatronics Engineering, Medical Electronics, Electrical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering, , Instrumentation & Control Engineering, Computer Engineering, Food Technology, Chemical Engineering, Chemical Engineering (Pulp & Paper), Ceramic Engineering)

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SCHEDULING

The students will visit the different workshops in two major rounds in a year. In 1st round, they will learn basic skills of each workshop and in 2nd round, they will refine their skills further**.**

RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. General workshop practices are included in the curriculum in order to provide hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of labour, safety at work place, team working and development of right attitude are the other objectives.

LEARNING OUTCOMES

After completing the course, the students will be able to:

- Identify tools and equipment used and their respective functions.
- Identify different types of materials and their basic properties.
- Use and take measurements with the help of basic measuring tools/equipment.
- Select materials, tools, and sequence of operations to make a job as per given specification/drawing.
- Prepare simple jobs independently and inspect the same.
- Inspect visually to identify various types of defects in different type of materials.
- Follow safety procedures and precautionary measures.
- Use safety equipment and Personal Protection Equipment(PPE).
- Maintain good housekeeping practices.

DETAILED CONTENTS (PRACTICAL EXERCISES)

1st ROUND

Workshop Safety Induction Session:

First turn of each shop shall be dedicated to safety practices and the contribution of safety to quality. The safety aspects should be categorised into 3 categories

- PSS (Process Safety System)
- SSS (Safety Shutdown System)
- ESD (Emergency Shutdown) or Emergency Depressurisation System.

The following practices should be included:

- Use of PPE (Personal Protection Equipment)
- Use of Safety Equipment like fire extinguishers etc.)
- Paramedic teaching suite, First –Aid
- Reports to be prepared for the damages
- At the end of this session, the student must sign "Student Safety Declaration form".

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

1. Welding Shop – I
2. Fitting Shop – I
3. Sheet Metal Shop – I
4. Electric Shop – I
5. Electronic Shop – I

1. WELDING SHOP - I

1.1 Introduction and importance of welding process as compared to other material joining processes. Specifications and type of ARC welding machines, parts identification, classification, selection and coding of electrodes, welding parameters, welding joints and welding positions. Common weldable Materials, safety precautions, use of PPEs, welding screens, Hazards and remedies during welding, Elementary symbolic representations, demo of types of welding defects.

1.2 Jobs to be prepared

Job I Practice of striking arc (Minimum 4 continuous beads on 100 mm long M.S. flat).

Job II Practice of depositing beads on plate at different current levels. (Minimum 4 beads on M.S. plate at four setting of current level and differentiating their characteristics).

Types of joints and their edge preparations:

Job III Preparation of lap joint using arc welding process.

Job IV Preparation of butt joint using arc welding process. (100 mm long).

Job V Preparation of T Joint using arc or gas welding (100mm x 6 mm M.S. Flat).

2. FITTING SHOP – I

2.1 Introduction and Practical Importance of fitting jobs

2.2 Basic deburring processes.

2.3 Introduction to fitting shop tools, marking and measuring devices/equipment.

2.4 Identification of materials. (Iron, Copper, Stainless Steel, Aluminium etc.)

2.5 Identification of various steel sections (flat, angle, channel, bar etc.).

2.6 Introduction to various fitting shop operations/processes (Hacksawing, Drilling, Chipping and Filing). Demonstration of wrong fitting practices causing damage to filed surfaces (outsized, out angled etc.) and tool/blade breakages.

2.7 Jobs to be prepared:

Job I Marking of job, use of marking tools and various types of files, use of tri square, surface plate, filing and use of measuring instruments. (zero error and least count of Vernier calliper, Micrometer and Vernier height gauge).

Job II Filing a rectangular/square piece to maintain dimensions within an accuracy of ±0.5 mm.

Job III Making a cut-out from a square piece of MS flat using hand hacksaw and chipping..

3. SHEET METAL SHOP – I

3.1. Introduction and practical importance of sheet metal jobs, use of hand tools and accessories e.g. different types of hammers, hard and soft mallet, sheet and wire gauge, necessary allowance required during job fabrication, selection of material.

3.2 Introduction and demonstration of hand tools used in sheet metal shop.

3.3 Introduction and demonstration of various machines and equipment used in sheet metal shop e.g. Shearing Machine, Bar Folder, Burring Machine, Turning Machine, Wiring Machine, Setting Down Machine, Forming Machine, Brake etc.

3.4 Introduction and demonstration of various raw materials used in sheet metal shop e.g. black-plain sheet, galvanized-iron plain sheet, galvanised corrugated sheet, aluminium sheet etc.

3.5 Study of various types of nuts, bolts, rivets, screws etc.

Job I Shearing practice on a sheet using hand shears.

Job II Prepare a seam joint of G.I. Sheet

Job III Practice on making Single riveted lap joint/Double riveted lap
Joint.

Job IV Development of sheet for preparation of cubical container (300x150x25 mm)

4. ELECTRIC SHOP – I

4.1 Study, demonstration and identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, MCB & ELCB, fuses, cleats, clamps and allied items, tools and accessories.

4.2 Study of electrical safety measures and protective devices.

Job I Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs. Difference between series and parallel wiring.

Job II Carrying out house wiring circuits using fuse, switches, sockets, ceiling rose etc. in batten or P.V.C. casing-caping. Demo of conduit wiring through junctions

Job III To prepare a three level Godown wiring circuit with PVC conduit wiring system.

4.3 Introduction to the construction of lead acid battery, its working and its specification parameters(maH, sp gravity), precautions while handling battery, Introduction to battery charger and its functioning. Types of charging

Job IV Installation of battery and connecting two or three batteries in series and parallel and its effect. Charging a battery and testing with hydrometer and cell tester

4.4 Introduction to solar energised lighting or water heater system and their defects.

Job V Installation of Solar cells, costing according to capacity

5. ELECTRONIC SHOP – I

Safety precautions to be observed in the Electronics Shop:
Identification and familiarization with the following tools used in electronic shop such as Tweezers, Screw drivers (different sizes), Insulated Pliers, Cutter, Sniper, Screw Driver (Star Screw Driver), L- Keys, Soldering Iron, soldering wire, flux . Their demonstration and uses.
Identification, familiarization and uses of commonly used components; active and passive components; colour code and types of resistor and potentiometers, Diode, Transistor, LED, LDR, SCR, TRIAC,DIAC, Thermistor etc.
Identification, familiarization, demonstration and use of the following electronic instruments:

a) Analog multimeter
b) Digital multimeter

Identification, familiarization, demonstration and use of the following electronic instruments:

a) Simple CRO, function of every knob on the front panel

b) Power supply, fixed voltage and variable voltage, single output as well as dual output.

c) Function generator

Job I Practice in the use of above mentioned tools and instruments. For this a small experimental set up may be done

2ND ROUND

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Follow safety procedures and measures.
- Maintain good housekeeping practices.
- Select materials, sequence of operations, select tools to make a given job based on interpretation of drawing as per given specification with close tolerances using at least the resources of three shops.
- Prepare a job using resources of shops and compare the job with the specifications given.
- Specify and read/understand specifications of different types of tools, equipment and machines used in various shops.
- Inspect visually to identify various types of defects in different type of materials.
- Analyze a given job and identify various operations required to make it.

DETAILED CONTENTS (PRACTICAL EXERCISES)

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus.

1. Electric Shop – II
2. Electronic Shop – II
3. Computer Shop

1. ELECTRIC SHOP- II

1.1 Introduction to single phase and three phase supply and wiring system. Importance of three phase supply (RYB)& its sequence and wiring system.

Job I Connecting Generator and 3 phase wiring through Change over Switch.

1.2 Estimating and costing of power consumption

Job II Connecting single phase energy meter with supply and load. Reading and working out power consumption and cost of energy.

1.3 Study of internal wiring diagram of common electrical appliances such as auto electric iron, electric kettle, ceiling/table fan, desert cooler etc. Demonstration of dismantling, servicing and reassembling of table/ceiling fan, air-cooler, auto electric iron, heater etc.

Job III Dismantling, servicing and reassembling of any of the above electrical appliances, finding faults with series testing lamp and multimeter.

1.4 Testing and reversing direction of rotation of single phase and three phase motors.

Job IV Acceptance Testing of single phase/three phase motors by using voltmeter, ammeter and tachometer.

Job V Reversing direction of rotation of single phase and three phase motors.

1.5 Identification and familiarisation with the following tools:

Tweezers, Screw Drivers (Different sizes), Insulated pliers, Cutters, Sniper, Philips Screw driver (star screw driver), L-Keys, Soldering Iron and their demonstration and uses.

Job VI Practice on joining using soldering flux and removing components/wires by desoldering

2. ELECTRONIC SHOP - II

Various types of protective devices such as : wire fuse, cartridge fuse etc. ,
Demonstrate the joining (or connecting) methods/mounting and dismantling method, as well as uses of the items mentioned below:

a) Various types of plugs, sockets, connectors suitable for general purpose audio video use. Connectors, Banana plugs, sockets and similar male and female connectors and terminal strips.

b) Various types of switches such as: normal/miniature toggle, slide, push button piano key, rotary, SPST, SPDT, DPST, DPDT, band selector, multi-way Master Mains Switch.

Job-I Cut, bend, tin component, leads, inserts. Solder components e.g. resistor, capacitor, diodes, transistors on a PCB

Job-II Wiring of a small circuit on a PCB/tag strip involving laying, sleeving and use of identifier tags

Job-III De-soldering practice with de-soldering pump and with de-soldering wick.

Job-IV Cut, strip, join and insulate two lengths of wires/cables (repeat with different types of cables/ wires)

3. COMPUTER SHOP
EXERCISE– I

3.1 Keyboard

- Types of Keyboards
- Interfacing (PS2, USB port, DIN connector)
- Working
- Repairing

3.2 Mouse

- Types of Mouse
- Interfacing (serial, PS2, USB)

- Working

EXERCISE – II

3.3 Printers

- Types (Dot matrix, Inkjet, Laserjet)
- Interfacing (parallel port, USB port, Networking)
- Working
- Maintenance (cartridge change etc)
- Installation of printers
- Troubleshooting (Driver compatibility, Paper jam, printing problems due to uncleaned drum in laserjet printers, belt related problems in inkjet printer, jets choking problem in inkjet printer, color alignment problem).
- Tracing network printer and sharing it.

EXERCISE – III

3.4 Scanner

- Types
- Interfacing
- Scanning a document

3.5 Monitor

- Types and Interfacing
- Fault finding and repairing

EXERCISE – IV

3.6 CPU

- Motherboard connection (dimensions, processor, chipset, BIOS, EFI (Extended Firmware Interfacing), UFI (Unified Firmware Interfacing).
- SMPS-AT
  - Working
  - Voltage levels
  - Fault finding and repair

EXERCISE - V

3.7 Optical Devices

- CD-R, DVD, CD-W
- Working
- Copying
- CD/DVD drives
- Pen drive (copying data, formatting scanning)

3.8 Microphones and Speakers

- Types and Interfacing

EXERCISE – VI

3.9 Projectors

- Types
- Settings
- Interfacing

3.10 Hard disks

- Different makes of Hard disks
- Retrieval of Hard disk data

3.11 Graphic Card connection

3.12 Sound Card Connection

EXERCISE – VII

3.13 Different types of network interface cards, cables such as data cables, printer cables, network cables, power cables etc.

3.14 Networking tools such as cutter, connector (RJ45)

3.15 Network Cable

- Straight Cable
- Cross Cable
- Roll Cable

EXERCISE – VIII

3.16 Types of cables

- UTP Cables: CAT3, CAT5, CAT6, CAT7
- Fibre optic cable
- Structured cabling

MEANS OF ASSESSMENT

- Workshop jobs
- Report writing, presentation and viva voce

RECOMMENDED BOOKS

1. Workshop Technology I,II,III, by SK Hajra, Choudhary and AK Choudhary; Media Promoters and Publishers Pvt. Ltd. Mumbai.
2. Workshop Technology Vol. I, II, III by Manchanda; India Publishing House, Jalandhar.
3. Workshop Training Manual Vol. I, II by S.S. Ubhi; Katson Publishers, Ludhiana.
4. Manual on Workshop Practice by K Venkata Reddy; MacMillan India Ltd., New Delhi
5. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd., New Delhi
6. Workshop Technology by B.S. Raghuwanshi; Dhanpat Rai and Co., New Delhi
7. Workshop Technology by HS Bawa; Tata McGraw Hill Publishers, New Delhi

8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

THIRD SEMESTER

3.1 NON-CONVENTIONAL ENERGY SOURCES

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RATIONALE

Since the conventional energy resources are under fast depletion, it is high time to tap the non- conventional energy sources also. So, the solution primarily lies in tapping all possible energy generation sources but efficient use of available energy is also important. The electrical diploma holder must be made aware about saving and conserving Electrical Energy and tackle the problems of environmental pollution as they will have to face this challenge in future life. Hence the subject.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Explain the importance of non-conventional energy sources for the present energy scenario.
- Classify various non-conventional sources of energy
- Explain principle of solar photovoltaic energy conversion and the applications of solar energy in different fields.
- Explain basic conversion technologies of biomass, wind energy, geo-thermal, tidal energy, hydro energy and its applications.
- Explain direct energy conversion systems like magneto hydrodynamics and fuel cells and its applications.

DETAILED CONTENTS

1. Basic of Energy: (06 periods)
   Classification of Energy-primary and secondary energy, commercial and non-commercial energy, importance of non conventional energy sources, present scenario, future prospectus, energy scenario in India, sector-wise energy consumption (domestic, industrial, agriculture etc.)

2. Solar Energy: (12 periods)
   Principle of conversion of solar radiation into heat, photo-voltaic cell, electricity generation, application of solar energy like solar water heaters, solar furnaces, solar cookers, solar lighting, solar pumping.

3. Bio-energy: (10 periods)

Bio-mass conversion technologies- wet and dry processes. Methods for obtaining energy from biomass. Power generation by using gasifiers

4. Wind Energy: (10 periods)

Wind energy conversion, windmills, electricity generation from wind- types of wind mills, local control, energy storage

5. Geo-thermal and Tidal Energy: (10 periods)

Geo-thermal sources, Ocean thermal electric conversion, open and closed cycles, hybrid cycles. Prime movers for geo-thermal energy conversion. Steam Generation and electricity generation.

6. Magneto Hydro Dynamic (MHD) Power Generation (04 periods)

7. Fuel Cells (08 periods)

Design and operating principles of a fuel cell, conversion efficiency, work output and e.m.f of fuel cells, applications.

8. Hydro Energy – Mini & Micro hydro plants (04 periods)

INSTRUCTIONAL STRATEGY

The teacher should make the student s aware about the depletion of energy sources and the availability of alternate sources of energy their feasibility and limitations. The need for adopting non-conventional energy sources should be made clear to students. While explaining the need and energy management, the teacher should give students home assignments bases on energy conservation. The students should be made familiar with the energy efficient devices, various approaches to conserve energy, energy auditing procedure etc. Teacher must give practical application of these energy sources in nearby surrounding areas.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS :

1. Solar Energy – Principles of thermal collection and Storage SP Sukhatme, Tata McGraw Hill Publication, New Delhi.

2. Non-Conventional Energy Resources by RK Singal, SK Kataria and Sons, New Delhi

3. Solar Energy Utilization; GD Rai ; Khanna Publishers, New Delhi.

4. Reviews of Renewable Energy Sources, Vol. 3, Edited by MS Sodha, S.S. Mathur, MAS Malik, TC Kandpal ; Wiley Eastern Limited, New Delhi.

5. Renewable Energy Sources and Conversion Technology by NK Bansal, Manfred Kleemann, Michael Meliss, Tata McGraw Hill Publishing Co. Ltd New Delhi.

6. Energy Today and Tomorrow; Maheshwar Dayal; Publications Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi.

7. Energy Technology (non-conventional, renewable and conventional) by S Rao and BB Parulekar, Khanna Publishers, New Delhi

8. Manual on Energy Efficiency at Design Stage, CII Energy Management Cell.

9. Energy Conservation-case studies in ceramic industry, sugar industry, fertiliser industry, cement industry. CII, Energy Management Cell etc

10. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Sr. No	Topic	Time Allotted (periods)	Marks Allocation (%)
1.	Basic of Energy	06	10
2.	Solar Energy	12	15
3.	Bio-energy	10	10
4.	Wind Energy	10	15
5.	Geo-thermal and Tidal Energy	10	20
6.	Magneto Hydro Dynamic Power Generation	04	05
7.	Fuel Cells	08	15
8.	Hydro Energy	04	10
	Total	**64**	**100**

3.2 COMPUTER APPLICATIONS IN ELECTRICAL INSTALLATIONS

L	T	P
-	-	2

RATIONALE

Computer plays a very vital role in present day life, more so, in the professional life of Diploma engineers. In order to enable the students use the computers effectively, this course offers exposure to various engineering applications of computers in electrical engineering. The practical exercises and demonstration of application software in the field of electrical engineering during the course of study will help the students in getting the employment.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Use MATLAB and LABVIEW for solving problems and designing electrical systems
- Explain the utility of software – LABVIEW, EPLAN software

DETAILED CONTENTS

PRACTICAL EXERCISES:

1. MATLAB and SCILAB

   - Introduction to MATLAB, MATLAB Programming – input/output, types of graphs, functions, loops, structures, MATLAB Simulink.

2. LABVIEW

   Graphical Programming using LabVIEW including creation of VIs, subVIs, structures, arrays, clusters, charts and graphs, strings, File I/Os. Practice on NI ELVIS and other DAQ hardware

3. EPAN

   - Utility of EPLAN software

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce
- Software installation, operation, development and viva-voce

RECOMMENDED BOOKS

1. MATLAB and SIMULINK for Engineers, Agam Kumar Tyagi, Oxford, 2011.
2. MATLAB 7 by RudraPratap, Oxford University Press.
3. MATLAB Programming for Engineers by Stephen J. Chapman
4. MATLAB and Its Applications In Engineering by R.K. Bansal, A.K. Goel
5. Virtual Instrumentation Using LabVIEWKindle Edition by Jovitha Jerome, PHI, 2010
6. Introduction to Multisim for Electric Circuits, James W. Nilsson and Susan Riedel, 2014.
7. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in
http://nptel.ac.in
www.nittrchd.ac.in>hctel

3.3 ELECTRICAL AND ELECTRONICS ENGINEERING MATERIALS

L	T	P
4	-	-

RATIONALE

A diploma holder in Electrical Engineering will be involved in maintenance, repair and production of electrical equipment and systems. In addition, he may be required to procure, inspect and test electrical and electronic engineering materials. Knowledge of various types of materials will be needed in order to execute the above mentioned functions. He may also have to decide for an alternative when a particular material is either not readily available in the market or its cost becomes prohibitive.

LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Identify electrical and electronics engineering materials/component
- Select proper conducting material for a particular application
- Select a proper insulating material for a particular application
- Suggest an alternate material if proper material is not available
- Procure various electrical and electronics engineering material available in the market
- Select proper magnetic material for a particular application
- Make use of engineering material used for fabrication of particular electrical machine
- Select gaseous material for particular application

DETAILED CONTENTS

1. Classification (03 Periods)

   Classification of materials into conducting, semi conducting and insulating materials through a brief reference to their atomic structure and energy bands

2. Conducting Materials (12 Periods)

   2.1 Introduction
   2.2 Resistance and factors affecting it such as alloying and temperature etc
   2.3 Classification of conducting material as low resistivity and high resistivity materials, low resistance materials

   2.3.1 Copper:
   General properties as conductor: Resistivity, temperature coefficient, density, mechanical properties of hard-drawn and

annealed copper, corrosion, contact resistance. Application in the field of electrical engineering.

2.3.2 Aluminium:
General properties as conductor: resistivity, temperature coefficient, density, mechanical properties of hard and annealed aluminium, solderability, contact resistance. Applications in the field of electrical engineering.

2.3.3 Steel:
Mechanical properties of steel, applications in the field of electrical engineering.

2.3.4 Introduction to bundle conductors and its applications.

2.3.5 Low resistivity copper alloys: Brass, Bronze (cadmium and Beryllium), their practical applications with reasons for the same

2.3 Applications of special metals e.g. Silver, Gold, Platinum etc.

2.4 High resistivity materials and their applications e.g., manganin, constantan, Nichrome, mercury, platinum, carbon and tungsten

2.6 Superconductors and their applications

3. Review of Semi-conducting Materials (02 Periods)

Semi-conductors and their properties, Materials used for electronic components like resistors, capacitors, diodes, transistors and inductors etc.

4. Insulating materials; General Properties: (12 Periods)

4.1 Electrical Properties:
Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant

4.2 Physical Properties:
Hygroscopicity, tensile and compressive strength, abrasive resistance, brittleness

4.3 Thermal Properties:
Heat resistance, classification according to permissible temperature rise. Effect of overloading on the life of an electrical appliance, increase in rating with the use of insulating materials having higher thermal stability, Thermal conductivity, Electro-thermal breakdown in solid dielectrics

4.4 Chemical Properties:
Solubility, chemical resistance, weatherability

4.5 Mechanical properties, mechanical structure, tensile structure

5. Insulating Materials and their applications: (16 Periods)

5.1 Plastics

5.1.1 Definition and classification

5.1.2 Thermosetting materials:
Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and Melamine-formaldehyde), epoxy resins - their important properties and applications

5.1.3 Thermo-plastic materials:
Polyvinyl chloride (PVC), polyethelene, silicones, their important properties and applications

5.2 Natural insulating materials, properties and their applications

- Mica and Mica products
- Asbestos and asbestos products
- Ceramic materials (porcelain and steatite)
- Glass and glass products
- Cotton
- Silk
- Jute
- Paper (dry and impregnated)
- Rubber, Bitumen
- Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation
- Enamels for winding wires
- Glass fibre sleeves

5.3 Gaseous materials; Air, Hydrogen, Nitrogen, SF their properties and applications

6. Magnetic Materials: (11 Periods)

6.1 Introduction - ferromagnetic materials, permeability, B-H curve, magnetic saturation, hysteresis loop including coercive force and residual magnetism, concept of eddy current and hysteresis loss, Curie temperature, magnetostriction effect.

6.2 Soft Magnetic Materials:

6.2.1 Alloyed steels with silicon: High silicon, alloy steel for transformers, low silicon alloy steel for electric rotating machines

6.2.2 Cold rolled grain oriented steels for transformer, Non-oriented steels for rotating machine

6.2.3 Nickel-iron alloys

6.2.4 Soft Ferrites

6.3 Hard magnetic materials
Tungsten steel, chrome steel, hard ferrites and cobalt steel, their applications

7. Special Materials (04 Periods)

Thermocouple, bimetals, leads soldering and fuses material and their applications

8. Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers etc (04 Periods)

INSTRUCTIONAL STRATEGY

The teacher should bring different materials, electronic components and devices in the class while taking lectures and explain and make students familiar with them. Also he may give emphasis on practical applications of these devices and components in the field. In addition, the students should be given exercises on identification of materials used in various electronic gadgets etc .and be encouraged to do practical work independently and confidently.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi
2. Electronic Components and Materials by Grover and Jamwal, Dhanpat Rai and Co., New Delhi
3. Electrical Engineering Materials by Sahdev, Uneek International Publications, Jalandhar
4. Electronic Components and Materials by SM Dhir, Tata Mc Graw Hill, New Delhi
5. Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi
6. Electrical and Electronics Engineering Materials BR Sharma and Others, Satya Parkashan, New Delhi

7. Electrical and Electronics Engineering Materials DR Arora, Ishan Publications, Ambala City

8. Electrical Engineering Materials by Rakesh Dogra, SK Kataria and Sons, NEW Delhi

9. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1.	03	05
2.	12	20
3.	02	05
4.	12	20
5.	16	25
6.	11	15
7.	04	05
8.	04	05
Total	**64**	**100**

3.4 ELECTRONICS - II

L	P
3	2

RATIONALE

The purpose of the introduction of electronics in the electrical engineering diploma course has been already explained in the rationale of the subject Basic Electronics in this course topic like Amplifiers, Oscillators and Wave Shape Circuits have been dealt with.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Differentiate the voltage and power amplifier
- Analyze amplifier and enhance the gain of amplifier
- Design a wave shaping circuit
- Realize regulated power supply circuit using voltage regulator IC
- Use Op-Amp as amplifiers, adder, comparator, integrator and differentiator

DETAILED CONTENTS

1. Transistor Audio Power Amplifier (09 periods)

    1.1 Difference between voltage and power amplifier

    1.2 Important terms in Power Amplifier, collector efficiency, distortion and dissipation capability

    1.3 Classification of power amplifier class A, B and C

    1.4 Class A single-ended power amplifier, its working and collector efficiency

    1.5 Impedance matching in a power amplifier using transformer

    1.6 Heat sinks in power amplifiers

    1.7 Push-pull amplifier: circuit details, working and advantages (no mathematical derivations)

    1.8 Principles of the working of complementary symmetry push-pull amplifier

2. Tuned Voltage Amplifier (06 periods)

    2.1 Introduction

    2.2 Series and parallel resonance (No mathematical derivation)

    2.3 Single and double tuned voltage amplifiers

2.4 Frequency response of tuned voltage amplifiers

2.5 Applications of tuned voltage amplifiers

3. Feedback in Amplifiers (06 periods)

3.1 Feedback and its importance, positive and negative feedback and their need

3.2 Voltage gain of an amplifier with negative feedback $A = \frac{A}{1+\beta A}$

3.3 Effect of negative feedback on voltage gain, stability, distortion, band width, output and input impedance of an amplifier (No mathematical derivation)

3.4 Typical feedback circuits

3.5 Effect of removing the emitter by-pass capacitor on a CE transistor amplifier

3.6 Emitter follower and its applications

4. Sinusoidal Oscillators (06 periods)

4.1. Sinusoidal Oscillators – positive feedback in amplifiers

4.2. Difference between an oscillator and an alternator

4.3. Essentials of an oscillator

4.4. Circuit details and working of LC oscillators viz. Tuned Collector, Hartley and Colpitt's oscillators

4.5. R-C oscillator circuits, phase shift and Wein bridge oscillator circuits

4.6. Introduction to piezoelectric crystal and crystal oscillator circuit

5. Wave-Shaping and Switching Circuits (11 periods)

5.1 Concept of Wave-shaping

5.2 Wave-shaping circuits

a. R-C differentiating and integrating circuits

b. Diode clipping circuits

c. Diode clamping circuits

d. Applications of wave-shaping circuits

5.3 Transistor as a switch (explanation using CE transistor characteristics)

5.4 Collector coupled astable, monostable, bistable multivibrator circuits (explanation using wave shapes). Brief mention of uses of multivibrators

5.5 Working and applications of transistor inverter circuit using power transistors

6. Power supplies: (04 periods)

Working Principles of different types of power supplies viz. CVTs, IC voltage regulator (78 XX,79XX)

7. Operational Amplifier (06 periods)

7.1. The basic operational amplifier. The differential amplifier. The emitter coupled differential amplifier. Offset even voltages and currents

7.2. Basic operational amplifier applications, integrator and differentiator, summer, subtractor

7.3. Familiarization with specifications and pin configuration of IC 741

7.4. Block diagram and operation of 555 IC timer

LIST OF PRACTICALS

1. To study the effect of coupling capacitor on lower cut off frequency and upper cut off frequency by plotting frequency response curve of a two stage RC coupled amplifier
2. To measure (a) optimum load (b) output power (c) signal handling capacity of a push-pull amplifier
3. To measure (a) voltage gain (b) input and output impedance for an emitter follower circuit

   To measure frequency generation in (a) Hartley (b) R-C Phase Shift oscillator
4. To observe the differentiated and integrated square wave on a CRO for different values of R-C time constant
5. Clipping of both portion of sine-wave using:
   a) diode and dc source

b) /*zener diodes

Clamping a sine-wave to:

a) Negative dc voltage

b) Positive dc voltage

6. To generate square-wave using an astable multivibrator and to observe the wave form on a CRO and verify the result using p-spice software
7. To observe triggering and working of a bistable multivibrator circuit and observe its output wave form on a CRO
8. To use the op-Amp (IC 741) as inverting one and non-inverting amplifiers, adder, comparator, integrator and differentiator and verify the result using p-spice software
9. To study the pin configuration and working of IC 555 and its use as monostable and astable multivibrator

INSTRUCTIONAL STRATEGY

The teacher should bring electronic components and devices in the class while taking lectures and explain and make students familiar with them. Also he may give emphasis on practical applications of these devices and components in the field. In addition, the students should be encouraged to do practical work independently and confidently.
/

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

- Laboratory and practical work
- Model prototype making
- Viva—voce

RECOMMENDED BOOKS

1. A text book of Basic Electronics and Linear Circuits by NN Bhargava and others, Tata McGraw Hill, New Delhi

2. Electronics Principles by SK Sahdev, Dhanpat Rai and Co., New Delhi

3. Electronics Principles by Albert Paul Malina, Tata McGraw Hill, New Delhi

4. Operational Amplifiers and Linear Circuits by Rama Kant and A. Gayakwad, Prentice Hall of India, New Delhi

5. Electronic Devices Circuits by Rama Reddy, Narosa Publishing House Pvt. Ltd., New Delhi

6. Electronic Devices and Circuits by Millman and Halkias, McGraw Hill, New Delhi

7. Analog Electronics – II by DR Arora, Ishan Publication, Ambala

8. Electronic Devices and Circuits by JC Karhara, King India Publication, New Delh

9. Electronic Devices and Circuits-I, Eagle Prakashan, Jalandhar

10. Electronic Devices Circuits by JB Gupta, SK Kataria and Sons, New Delhi

11. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Sr. No	Topic	Time Allotted (hrs)	Marks Allocation (%)
1	Transistor Audio Power Amplifier	09	20
2	Tuned Voltage Amplifier	06	12
3	Feedback in Amplifiers	06	12
4	Sinusoidal Oscillators	06	12
5	Wave-Shaping and Switching Circuits	11	24
6	Power Supplies	04	08
7	Operational Amplifier	06	12
	Total	**48**	**100**

3.5 ELECTRICAL ENGINEERING DESIGN AND DRAWING I

L	T	P
-	-	6

RATIONALE

A student of electrical engineering is supposed to have ability to :

i) Read, understand and interpret engineering drawings
ii) Communicate and co-relate through sketches and drawings
iii) Prepare working drawings of panels, transmission and distribution

The contents of this subject has been designed to develop requisite knowledge and skills of electrical drawings in the students of diploma in electrical engineering.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Recognise various electrical devices and their symbols
- Recognise various electrical devices placed on the panels/distribution boards and to design the panels
- Recognise the internal details of various electrical machines and devices
- Read schematic and wiring diagrams of electrical devices
- Read and interpret electrical installation plan
- Communicate about circuits and devices through sketches and drawings

DETAILED CONTENTS (To make 16 Sheets)

1. Symbols and Signs Conventions (2 Sheets)

   Various Electrical Symbols used in Domestic and Industrial Installation and Power System (Generation, Transmission and Distribution including Sub-stations) as per BIS Code.

2. Wiring Diagram

   2.1. Wiring diagram of light, fan, bell and alarm circuits. (6 Sheets)
   2.2. Staircase and godown wiring

3. Panels/Distribution Boards (6 Sheets)

   Design and Drawing of panels/Distribution board using MCB, ELCB main switches and change over switches for domestic installation, industrial and commercial installation.

4. Orthographic projections of Simple Electrical Parts (8 Sheets)

- Bus bar post/ Kit Kat
- Pin type and shackle type insulator (Pin Type 11kV/66kV)
- Bobbins of a small transformer / choke
- Stay insulators/Suspension type insulators
- Rotor of a squirrel cage induction motor
- Motor body (induction motor) as per IS Specifications (using outside dimensions)
- Slip rings of 3-phase induction Motor.
- Stator of 3 phase Induction motor (Sectional View)

5.. Prepare wiring diagram and block diagrams for circuits/systems using any Engineering Graphic package (preferably CAD) (4 Sheets)

Note: At least 2 drawings are to be prepared using AutoCAD

INSTRUCTIONAL STRATEGY

Teacher should identify/prepare more exercises on the pattern shown above. The teacher should make the students confident in making drawing and layouts of electrical wiring installations and doing estimation and costing. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Sketching
- Design and Drawing
- Workshop Job
- Model prototype making

RECOMMENDED BOOKS

1. Electrical Engineering Design and Drawings by Surjeet Singh, Dhanpat Rai and Co, New Delhi

2. Electrical Engineering Design and Drawings by SK Bhattacharya, SK Kataria and Sons, New Delhi

3. Electrical Engineering Design and Drawings by Ubhi & Marwaha, IPH, New Delhi

4. Electrical Design and Drawing by SK Sahdev, Uneek Publications, Jalandhar

5. Electrical Engineering Drawing by Surjit Singh, SK Kataria and Sons, New Delhi

6. Electrical Design and Drawing by Surjit Singh, North Publication, Jalandhar.

7. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

3. 6 ELECTRICAL WORKSHOP PRACTICE - I

L	T	P
-	-	6

RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers working under him. In addition, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively in addition to conceptual understanding of the method or procedure he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, fault finding, wiring in electrical appliances and installations.

LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Illustrate types of tools/equipment
- Describe domestic and industrial applications of electric circuits
- Detect and rectify faults in circuits
- Identify electrical hazards and its safety measures
- Assemble distribution and extension boards
- Construct alarm and indicating circuits using relays, bells, push buttons
- Install electrical wiring and test it using meggar

DETAILED CONTENTS

1. Study of electrical safety measures as mentioned in the Indian Electricity Rules and shock treatment including first aid

2. Wire jointing

    2.1 Straight married joint
    2.2 Joint
    2.3 Western union joint
    2.4 Britania joint
    2.5 Twist sleeve joint
    2.6 Bolted type joint

3. Types of wiring and to make different light control circuits in the following types of wiring:

    3.1 Casing and capping (PVC) wiring.
    3.2 Conduit wiring (surface/concealed), Filling and crimping of thimbles

4. Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and fuses (only internal connection) Types of wiring and to make different light control circuits in the following types of wiring:

   4.1 Casing and Capping (PVC) wiring
   4.2 Conduit wiring (surface/concealed)

5. Construction/assembly of Distribution Board and Extension Board

   5.1 Construction of an extension board with two 5A sockets and one I5A Socket controlled by their respective switches, a fuse and indicator with series test lamp provision.

   5.2 Assembly of distribution board panel using MCB, main switch, change over switch and ELCB/RCCB.

   5.3 Wiring of main distribution board with four outgoing circuits for light and fan loads including main switch and fuses (only internal connection)

6. Simple light and Alarm Circuits (any four)

   6.1 One lamp controlled by two switches (staircase circuit)
   6.2 Two lamps controlled by three switches (double staircase circuit)
   6.3 Two ordinary bells (for day and night) used at a distant residence
   6.4 Bell response circuit using one bell and one relay
   6.5 Bell response circuit of an office (for three rooms)
   6.6 Traffic light control system for two roads crossing
   6.7 Wiring of a switch board containing at least two switches, one fan regulator and one 5/15A socket controlled by their respective switches using piano type switches and matching socket

7. Wiring of a series test lamp board and to use it for finding out simple faults

8. Testing of domestic wiring installation using meggar

10. Fault finding and repair of a tube light circuit

11. Wiring and testing of alarm and indicating circuits using relay, push buttons and bells (simple single phase circuits)

12. Assembly of distribution board/ panel using MCB, main switch, changeover switch and ELCB etc.

INSTRUCTIONAL STRATEGY

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

3.7 ESTIMATING AND COSTING IN ELECTRICAL ENGINEERING

L	T	P
4	-	2

RATIONALE

A diploma holder in electrical engineering should be familiar to Indian Standards and relevant Electricity Rules. Preparation of good estimates is a professional's job, which requires knowledge of materials and methods to deal with economics. The contents of this subject have been designed keeping in view developing requisite knowledge and skills of estimation and costing in students of diploma in electrical engineering.

LEARNING OUTCOME

After undergoing the subject, student will be able to:

- Determine various types of wiring systems and how they are being used
- Practice and execute any type of wiring
- Estimate and determine the cost of wiring installation
- Estimate the material required for HT and LT lines
- Prepare a tender document for a particular job
- Estimate the material required for pole-mounted sub-stations

DETAILED CONTENTS

1. Introduction (06 Periods)

   Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule, costing, price list, preparation of tender document (with 2-3 exercises), net price list, market survey, overhead charges, labour charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements, orders for supply, payment of bills.

2. Types of Wiring (06 Periods)

   Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, selection and design of wiring schemes for particular situation (domestic and Industrial). Selection of wires and cables, wiring accessories and use of protective devices i.e. MCB, ELCB etc. Use of wire-gauge and tables (to be prepared/arranged)

3. Estimating and Costing: (24 Periods)

3.1 Domestic installations; standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate (single storey and multi-storey buildings having similar electrical load)

3.2 Industrial installations; relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with singe-phase, 3-phase motor load and the light load (3-phase supply system)

3.3 Service line connections estimate for domestic and industrial loads (over-head and under ground connections) from pole to energy meter.

4. Estimating Materials Required (16 Periods)

4.1 Transmission and distribution lines (overhead and underground) planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations

4.2 Substation: Types of substations, substation schemes and components, estimate of 11/0.4 kV pole mounted substation up to 200 kVA rating, earthing of substations, Key Diagram of 66 kV/11 kV Substation.

4.3 Single line diagram, layout sketching of outdoor, indoor 11kV sub-station or 33kV sub-station

5. Preparation of Tender Documents (12 Periods)

At least 2-3 exercises, tender – constituents finalization, specimen tender

PRACTICALS

1. Framing of Tender and reply to tender to get job/project
2. Identification of wiring for different applications
3 Prepare an estimate for a Two room residential building as per given plan
4 Prepare an estimate for service connection for residential building having connected load ---- kW.
5 Visit a nearby substation and list the components with diagram

INSTRUCTIONAL STRATEGY

Teacher should identify/prepare more exercises on the pattern shown above. The teacher should make the students confident in making drawing and layouts of electrical wiring installations and doing estimation and costing leading to preparation of small tender document.. This capability will lead the students to become a successful entrepreneur. Take the students to field/laboratory and show the material and equipment.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Laboratory and practical work
- Drawing
- Viva—voce

RECOMMENDED BOOKS

1. Electrical Installation, Estimating and Costing by JB Gupta, SK Kataria and Sons, New Delhi
2. Estimating and Costing by SK Bhattacharya, Tata McGraw Hill, New Delhi
3. Estimating and Costing by Surjeet Singh, Dhanpat Rai & Co., New Delhi
4. Estimating and Costing by Praveen Kumar; North Publication, Jalandhar
5. Estimating and Costing by SL Uppal, Khanna Publishers, New Delhi
6. Electrical Estimating and Costing by N Alagappan and B Ekambaram, TMH, New Delhi
7. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

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SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	06	10
2	06	10
3	24	45
4	16	20
5	12	15
Total	**64**	**100**

SOFT SKILLS – I

L	T	P
-	-	2

RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Identify components of effective verbal communication
- Prepare a report
- Learn the techniques of enhancing memory
- Set goals for overall personality development
- Understand the concept of quality and its implementation in an organisation.

DETAILED CONTENTS

- Soft Skills - Concept and Importance
- Communication Skills- Improving verbal communication
- Report Writing
- Method to enhance memory and concentration
- Component of overall personality- Dressing sense/etiquettes/body language etc.

In addition, the students must participate in the following activities to be organized in the institute.

- Sports
- NCC/NSS
- Camp – Blood donation
- Cultural Event

Note : Extension Lectures by experts may be organized. There will be no examination for this subject.

FOURTH SEMESTER

4.1 ELECTRICAL MACHINES - I

L	T	P
4	-	2

RATIONALE

Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Operate and maintain D.C. Generator
- Operate and maintain D.C. shunt, series and compound motors
- Execute speed control on D.C. Motors
- Select which type of D.C. motor suits a particular job
- Connect and use single phase transformer
- Operate auto transformers
- Conduct open CKT and short CKT tests on a single phase transformer
- Test polarity of windings of a three phase transformer and connect windings in various configurations
- Operate and maintain three phase transformers

DETAILED CONTENTS

1. Introduction to Electrical Machines (06 Periods)

    1.1 Definition of motor and generator
    1.2 Torque development due to alignment of two fields and the concept of torque angle
    1.3 Electro-magnetically induced emf
    1.4 Elementary concept of an electrical machine
    1.5 Comparison of generator and motor
    1.6 Generalised theory of electrical machines

2. DC Machines (22 Periods)

    2.1 Main constructional features, Types of armature winding
    2.2 Function of the commutator for motoring and generation action
    2.3 Factors determining induced emf
    2.4 Factors determining the electromagnetic torque
    2.5 Various types of DC generators

2.6 Significance of back e.m.f., the relation between back emf and Terminal voltage
2.7 Armature Reaction
2.8 Methods to improve commutation
2.9 Performance and characteristics of different types of DC motors
2.10 Speed control of dc shunt/series motors
2.11 Need of starter, three point dc shunt motor starter and 4 point starter
2.12 Electric Braking
2.13 Applications of DC motors
2.14 Faults in dc machines and their retrospective
2.15 Losses in a DC machine
2.16 Determination of losses by Swinburne's test
2.17 Rating and Specifications of DC machines

3. Single Phase Transformer (22 Periods)

3.1 Introduction
3.2 Constructional features of a transformer and parts of transformer
3.3 Working principle of a transformer
3.4 EMF equation
3.5 Transformer on no-load and its phasor diagram
3.6 Transformer – neglecting voltage drop in the windings – Ampere turn balance – its phasor diagram
3.7 Mutual and leakage fluxes, leakage reactance
3.8 Transformer on load, voltage drops and its phasor diagram
3.9 Equivalent circuit diagram
3.10 Relation between induced emf and terminal voltage, voltage regulation of a transformer- mathematical relation
3.11 Losses in a transformer
3.12 Open circuit and short circuit test. Calculation of efficiency, condition for maximum efficiency-maintenance of Transformer, scheduled Maintenance
3.13 Auto transformer construction, working and applications
3.14 Different types of transformers including dry type transformer.
3.15 Rating and Specifications of single phase transformer

4. Three Phase Transformer (14 Periods)

4.1 Construction of three phase transformers and accessories of transformers such as Conservator, breather, Buchholtz Relay, Tap Changer (off load and on load) (Brief idea)
4.2 Types of three phase transformer i.e. delta-delta, delta-star, star-delta and star-star
4.3 Star delta connections (relationship between phase and line voltage, phase and line current)
4.4 Conditions for parallel operation (only conditions are to be studied)
4.5 On load tap changer

4.6 Difference between power and distribution transformer
4.7 Cooling of transformer
4.8 Rating and Specifications of three phase transformers

LIST OF PRACTICALS

1. To measure the angular displacement of rotor of the three phase synchronous machine with respect to the stator on application of DC to the field winding and simultaneously to each phase-winding in sequence

   OR

   Measurement of the angular displacement of the rotor of a slip-ring induction motor on application of DC to stator of motor winding in sequence and simultaneously to each phase of rotor winding

2. Speed control of DC shunt motor (i) Armature control method (ii) Field control method

3. Study of DC series motor with starter (to operate the motor on no load for a moment)

4. Determine efficiency of DC motor by Swinburne's Test at (i) rated capacity (ii) half full load

5. To perform open circuit and short circuit test for determining: (i) equivalent circuit (ii) the regulation and (iii) efficiency of a transformer from the data obtained from open circuit and short circuit test at full load

6. To find the efficiency and regulation of single phase transformer by actually loading it.

7. Checking the polarity of the windings of a three phase transformer and connecting the windings in various configurations

8. Finding the voltage and current relationships of primary and secondary of a three phase transformer under balanced load in various configurations conditions such as
   (a) Star-star
   (b) Star-delta
   (c) Delta-star
   (d) Delta - Delta configuring conditions.

INSTRUCTIONAL STRATEGY

Electrical machines being a core subject of electrical diploma curriculum, where a student will deal with various types of electrical machines which are employed in industry, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Special care has to be taken on conceptual understanding of concepts and principles in the subject. For this purpose exposure to industry, work places, and utilization of various types of electrical machine for different applications may be emphasized. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, Education Pvt Ltd. New Delhi
2. Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar
3. Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi
4. Electrical Machines by JB Gupta, SK Kataria and Sons, New Delhi
5. Electrical Machines by Smarajit Ghosh-Pearson Publishers, Delhi.
6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1.	06	10
2.	22	35
3.	22	35
4.	14	20
Total	**64**	**100**

4.2 ELECTRICAL MEASURING INSTRUMENTS AND INSTRUMENTATION

L	T	P
4	-	2

RATIONALE

Diploma holders in Electrical Engineering have to work on various jobs in the field as well as in testing laboratories and on control panels, where be performs the duties of installation, operation, maintenance and testing by measuring instruments. Persons working on control panels in power plants, substations and in industries, will come across the use of various types of instruments and have to take measurements.

Instruments used to read and observe the general electrical quantities like current, voltage, power, energy, frequency, resistance etc and their wave shapes, have been incorporated in this subject. So the technician will know the construction and use of various types of electrical instruments.

LEARNING OUTCOMES

After undergoing the subject, student will be able to:

- Connect and repair different indicating and recording instruments in electric circuits
- Measure different electrical quantities like current, voltage, power, energy, power factor, frequency etc.
- Select the type and range of instruments to be used for the job
- Operate CT (Current Transformer) and PT (Potential Transformer) for measurement
- Select and use suitable sensors for measurements of different non-electrical quantities
- Use instruments for measuring different electrical quantities
- Use sensors for measuring non electrical quantities

DETAILED CONTENTS

1. Introduction to Electrical Measuring Instruments: (10 Periods)

    1.1 Concept of measurement and instruments
    1.2 Concept of measurement of electrical quantities and instruments for their measurements, sources of error.
    1.3 Types of electrical measuring instruments – indicating, integrating and recording type instruments

1.4 Essentials of indicating instruments – deflecting, controlling and damping torque

2. Ammeters and Voltmeters (Moving coil and moving iron type): (08 Periods)

2.1 Concept of ammeter and voltmeters and difference between them
2.2 Construction and working principles of moving Iron and moving coil instruments
2.3 Merits and demerits, sources of error and application of these instruments

3. Wattmeters (Dynamometer Type) (04 Periods)

Construction, working principle, merits and demerits of dynamometer type wattmeter, Digital wattmeters.

4. Energymeter (06 Periods)

a) Induction Type

Construction, working principle, merits and demerits of single-phase and three-phase energy meters

4.1 Errors and their compensation
4.2 Simple numerical problems
4.3 Construction and working principle of maximum demand indicators

b) Digital energy meter (diagram, construction and application)

5. Miscellaneous Measuring Instruments: (12 Periods)

5.1 Construction, working principle and application of Meggar, Earth tester(analog and digital) Multimeter, Frequency meter (dynamometer type) single phase power factor meter (Electrodynamometer type). Working principle of synchroscope and phase sequence indicator, tong tester (Clamp-on meter)
5.2 Instrument Transformers: Construction, working and applications
a) CT
b) PT

6. Electronic Instruments: (06 Periods)

6.1 Cathode Ray Oscilloscope: Block diagram, working principle of CRO and its various controls. Applications of CRO.
6.2 Digital multi-meter (only block diagram) and Applications

7. LCR meters. (04 Periods)
Study of LCR meters and their applications

8. Power Measurements in 3-phase circuits by (06 Periods)

   a) Two wattmeter method in balanced and unbalanced circuits and simple problems
   b) Three wattmeter method

9. Transducers :- (04 Periods)

   Introduction, Types of Transducers (1 phase,3 phase)

   Basic concept of pressure measurement, flow measurement, level measurement, displacement measurement using transducers

10. Measurement of Temperature (04 Periods)

    Different types of thermometers, thermocouple, resistance temperature detector and their construction, principle and working. Thermal Imager Camera (Concept)

LIST OF PRACTICALS

1. Use of analog and digital multimeter for measurement of voltage, current (A.C/D.C) and resistance
2. Measurement of pressure by using LVDT
3. To measure the value of earth resistance using earth tester.
4. To measure power, power factor in a single-phase circuit, using wattmeter and power factor meter and to verify results with calculations.
5. Measurement of power and power factor of a three-phase balanced load by two wattmeter method.
6. Measurement of voltage and frequency of a sinusoidal signal using CRO and draw wave shape of signal.
7. Measurement of power in a 3 phase circuit using CT, PT and 3-phase wattmeter.
8. Use of LCR meter for measuring inductance, capacitance and resistance.
9. To record all electrical quantities from the meters installed in the institution premises.
10. To measure Energy at different Loads using Single Phase Digital Energy meter
11. Measurement of temperature by using thermister/Thermal Imager
12. Calibration of single phase and three-phase energy meter

INSTRUCTIONAL STRATEGY

After making the students familiar with measuring instruments, they should be made conceptually clear about the constructional features and make them confident in making connection of various measuring instruments. Teacher should demonstrate the application

of each measuring instrument in laboratory and encourage students to use them independently.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Electrical Measurements and Measuring Instruments by Golding and Widdis; Wheeler Publishing House, New Delhi
2. Electrical Measurements and Measuring Instruments by SK Sahdev, Uneek International Publications, Jalandhar
3. A Course in Electrical Measurement and Measuring Instruments by AK Sawhney and PL Bhatia; Dhanpat Rai and Sons, New Delhi
4. Electric Instruments by D. Cooper
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International (P) Ltd., Publishers, New Delhi
6. Electronics Instrumentation by Umesh Sinha, Satya Publication, New Delhi
7. Basic Electrical Measurements by Melville B. Staut.
8. Electrical Measurement and Measuring Instruments by JB Gupta, SK Kataria and Sons, New Delhi
9. Electrical Measurement and Measuring Instruments by ML Anand, SK Kataria and Sons, New Delhi
10. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	10	15
2	08	15
3	04	05
4	06	10
5	12	20
6	06	10
7	04	05
8	06	10
9	04	05
10	04	05
Total	**64**	**100**

4.3 INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

L	T	P
4	-	-

RATIONALE

In his career as a supervisor, an electrical engineering technician will be called upon to inspect, test and modify the work done by skilled workers or artisans working under him. Many a times it will become necessary for him to demonstrate the correct method and procedure of doing certain operations. Normally manufacturers of heavy electrical equipment provide service manuals, instructions for installation, maintenance and fault location. Indian Electricity Rules and Indian Standard Specifications also provide enough guidelines. This syllabus has been designed to provide certain guidelines and broad principles regarding the above activities. Appropriate field trips will reinforce the learning.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Erect/install various electrical equipment as per IE Rules Act by adopting all safety measures.
- Prepare specifications for different items required for transmission lines.
- Design and excavation of cable trenches.
- Lay underground cables
- Test cables and their termination.
- Check HT/LT circuit breakers, transformers and related equipment in a substation
- Carry out earthing, make earth pits and measure earth resistance values.
- Find fault in a transmission/distribution system.
- Carry out preventive maintenance to minimize breakdowns.

DETAILED CONTENTS

1. Tools and Accessories (04 Periods)

   Tools, accessories and instruments required for installation, maintenance and repair work. Knowledge of Indian Electricity rules, safety codes, causes and prevention of accidents, artificial respiration of an electrocuted person, workmen's safety devices

2. Installation (18 Periods)

   2.1 Installation of transmission and Distribution Lines:

   Erection of steel structures, connecting jumpers, tee-off points, joints and dead ends; crossing of roads, streets, power/telecommunication lines and

railway line crossings, clearances; earthing of transmission lines and guarding, spacing and configuration of conductors: Arrangement for suspension and strain insulators, bird guards, anti-climbing devices and danger plates; sizes of conductor, earthwire and guy wires.

Laying of service lines, earthing, provision of service fuses, installation of energy meters

2.2 Laying of Underground Cables:

Inspection, storage, transportation and handling of cables, cable handling equipment, cable laying depths and clearances from other services such as: water, sewerage, gas, heating and other mains, and also a series of power and telecommunication cables and coordination with these services, excavation of trenches, direct cable laying, including laying of cable from the drum, laying cable in the trench, taking all measurements and making drawings, back filling of trenches with earth or sand, laying protective layer of bricks etc,) laying of cables into pipes and conduits and within buildings.

2.3 Elementary idea regarding, inspection and handling of transformers; pole mounted substations, plinth mounted substations, grid substation, busbars, isolators, voltage and current transformers, lightning arrestors, control and relay panels, HT/LT circuit breakers, LT switches, installation of power/distribution transformers, dehydration. Earthing system, fencing of yard, equipment foundations and trenches etc..

2.4 Testing of various electrical equipment such as electrical motor, transformers, cables, and generators, motor control centres, medium voltage distribution panels, power control centres, motor control centres, lighting arrangement, storage, pre-installation checks, connecting and starting, pre-commissioning checks, drying out

3. Maintenance (42 Periods)

3.1 Types of maintenance, maintenance schedules, procedures

3.2 Maintenance of Transmission and Distribution System

Authorized persons, danger notice, caution notice, permit to work, arranging of shutdowns personally, temporary earthing, cancellation of permit and restoration of supply.

Patrolling and visual inspection of lines - points to be noted during patrolling from ground; special inspections and night inspections;

Location of faults using Meggar, effect of open or loose neutral connections, provision of proper fuses on service lines and their effect on system, causes of dim and flickering lights.

3.3 Maintenance of Distribution Transformers

Transformer maintenance and points to be attended to in respect of various items of equipment

Checking of insulation resistance, transformer oil level and BDV test of oil, measurement of earth resistance

3.4 Maintenance of Grid Substations

Checking and maintenance of busbars, isolating switches, HT/LT circuit breakers, LT switches. Power transformers

3.5 Maintenance of Motors

Over hauling of motors, preventive maintenance, trouble shooting of electric motors

3.6 Domestic Installation

Introduction, testing of electrical installation of a building, testing of insulation resistance to earth, testing of insulation and resistance between conductors, continuity or open circuit test

INSTRUCTIONAL STRATEGY

This subject needs theoretical and practical inputs. Demonstration at actual site may be arranged for conceptual understanding. The subject teacher should plan in advance about the visits to the actual sites and establish liaison with the appropriate authorities/ persons with the help of HOD and Principal of the institution. The students be taken to actual workplace and explain various test procedures.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Testing, Commissioning , Operation and Maintenance of Electrical Equipment by S Rao, Khanna Technical Publication, New Delhi

2.. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana

3 Installation and Maintenance of Electrical Equipment by Praveen Kumar, North Publication, Jalandhar

3 e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1	4	5
2	18	30
3	42	65
Total	**64**	**100**

4.4 DIGITAL ELECTRONICS

L	T	P
4	-	2

RATIONALE

Digital electronics has made extremely rapid advances in the last five decades. It has important applications in communication entertainment, instrumentation, control, automation etc. Thus it appears that there is no end to its usefulness. In fact, the light and the new world belongs to it. So it is necessary to give the knowledge of digital electronics to the electrical students. Microprocessor is one of the most exciting technological advancement among the semiconductor devices in recent times. It has a tremendous impact on the Industrial processes due to its high reliability, flexibility and control capacity both at the design and the Implementation stages. The decreasing cost with increasing facilities act as catalysts in widening their scope of applications.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Add, multiply, subtract binary to hexadecimal number system
- Use 1's and 2's compliment method for addition and substraction
- Draw the symbols of various gates and write the truth tables for those gates
- Use boolean laws for the simplification of logical expressions
- Use the de-morgan's theorem for simplification
- Apply K-map technique for simplifications
- Apply half adder, full adder, encoder, decoder, multiplexer and demultiplexer
- Use various flip-flops in digital circuits
- Use converted from A/D and D/A conversions
- Use various types of numbers in digital circuits

DETAILED CONTENTS

(Part-A)

1. Number Systems (10 Periods)

    1.1 Decimal, binary, octal and hexa-decimal number systems and their inter-conversion
    1.2 Binary and Hexadecimal addition, subtraction and multiplication
    1.3 1's and 2's complement methods of addition/subtraction

2. Gates (07 Periods)

Definition, symbol and truth tables for inverter, OR, AND, NAND, NOR and X-OR and equivalence circuit (Ex.NOR)

3. Boolean Algebra (10 Periods)

   3.1 Boolean Relations and their applications
   3.2 DeMorgan's Theorems
   3.3 K-Map upto four variables

4. Combinational Circuits (10 Periods)

   4.1 Half adder, Full adder
   4.2 Encoder, Decoder
   4.3 Multiplexer/Demultiplexer
   4.4 Display Devices (LED, LCD and 7-segment display)

5. Flip-Flops (08 Periods)

   5.1 J-K Flip-Flop
   5.2 R-S Flip-Flop
   5.3 D-Type Flip-Flop
   5.4 T-Type Flip-Flop
   5.5 Applications of Flip-Flops

6. Introduction of Shift Registers and Counters (08Periods)

7. A/D and D/A Converters (06 Periods)

   7.1 A/D converter (Counter ramp, successive approximation method of A/D Conversion)
   7.2 D/A converters (Binary weighted, R-2R D/A Converter)

8. Semi-conductor Memories (05 Periods)

   Types, merits, demerits, and applications

LIST OF PRACTICALS

1. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, X-OR gates
2. Construction of Half Adder using gates
3. Construction of Full Adder using gates
4. To verify the truth table for JK flipflop
5. Construction and testing of any counter
6. Verification of operation of a 8-bit D/A Converter

INSTRUCTIONAL STRATEGY

The digital systems in microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing), A/D, D/A converters and other Topics. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. More emphasis while teaching this subject should be given on practical aspects along with the theory input. Lots of programming exercises may be given to the students. Mini projects based on microprocessor operations may be identified and given to students as assignments.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Modern Digital Electronics by RP Jain, Tata McGraw Hill, Education Pvt. Ltd. New Delhi
2. Digital Principles and Electronics by Malvino and Leach, Tata McGraw Hill, New Delhi
3. Digital Electronics by Rajiv Sapra, Eshan Publications, Ambala City
4. Digital Fundamentals by Floyd and Jain , Pearsons Education (Singapore) Pte Ltd Patparganj, Delhi 110092
5. Digital Electronics by Jamwal, Dhanpat Rai and Co. New Delhi
6. Microprocessors Architecture, Programming and Application with 8085/8080A, Ramesh S Gaonkar, Wiley Eastern Ltd. New Delhi
7. Introduction to Microporcessors by Aditya Mathur, TMH Publishing Co., New Delhi
8. Microprocessors and Microcontrollers by BP Singh, Galgotia Publications, New Delhi
9. Digital Systems by Sanjay K Bose, Wiley Eatern(P) Ltd. New Delhi
10. Digital Systems : principles and Applications by RJ Tocci, Prentice Hall of India, New Delhi
11. Digital Integrated Circuits by AK Gautam, SK Kataria and Sons, New Delhi
12. Microprocessors(The 8086 and 8088) by AK Gautam and A Jaiswal; SK Kataria and Sons, New Delhi
13. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in
http://nptel.ac.in
www.nitttrchd.ac.in.> nctel

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	10	16
2.	07	10
3.	10	16
4.	10	16
5.	08	12
6.	08	12
7.	06	10
8.	05	08
Total	**64**	**100**

4.5 ELECTRICAL ENGINEERING DESIGN AND DRAWING - II

L	T	P
-	-	6

RATIONALE

A diploma holer in Electrical Engineering is supposed to have ability to :

i) Read, understand and interpret electrical engineering drawings
ii) Communicate and correlate through sketches and drawings
iii) Prepare working drawings of electrical circuits, motor control, earthing and motor parts

The contents of this subject has been designed to develop requisite knowledge and skills of electrical drawings in the students of diploma in electrical engineering.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- recognize contactor and its use in various applications of 3 phase induction motor
- recognize different types of earthing
- tell about relevant IS specification for earthing
- read and interpret key diagrams
- read and interpret schematic and wiring diagrams

DETAILED CONTENTS

1 Contractor Control Circuits (48 periods)

Design of circuit drawing of schematic diagram and power wiring diagram of following circuits, specification of contactors

1.1 DOL starting of 3-phase induction motor

1.2 3-phase induction motor getting supply from selected feeder

1.3 Forwarding/reversing of a 3-phase induction motor

1.4 Two speed control of 3-phase induction motor

1.5 Limit switch control of a 3-phase induction motor

1.6 Sequential operating of two motors using time delay relay

1.7 Manually generated star delta starter for 3-phase induction motor

1.8 Automatic star delta starter for 3-phase Induction Motor

2. Earthing (30 periods)

2.1 Concept and purpose of earthing

2.2 Different types of earthing, drawings of plate and pipe earthing

2.3 Procedure of earthing, test of materials required and costing

2.4 Method of reducing earth resistance

2.5 Relevant IS specifications of earth electrode for earthing a transformer, a high building

2.6 Earthing layout of distribution transformer

2.7 Substation earthing layout and earthing materials

2.8 Key diagram of 11kV, 33kV, 66kV, 132 kV sub-stations

3. Schematic Diagram of lighting system of conference room/Theatre/sports stadium (indoor and outdoor) and Circuits using timers using CAD and , Drawing sheets. (18 periods)

Note: Draw various schematic and wiring diagrams using graphic package(preferably CAD)

MEANS OF ASSESSMENT

- Design and drawing
- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

RECOMMENDED BOOKS

1. Electrical Design and Drawings by Raina & Bhattacharya
2. Electrical Design & Drawings by Sarabjeet Singh
3. IEEE Guide 80 for Earthing, IEEE Publication, New York
4. Electrical Design and Drawing by Surjit Singh, North Publication, Jalandhar
5. BIS for Electrical Earthing
6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

4.6 ELECTRICAL WORKSHOP PRACTICE – II

L	T	P
-	-	6

RATIONALE

An electrical diploma holder will be required to inspect, test and modify the work done by skilled workers or artisans working under him. In addition to these persons, many a times, it will become necessary for him to demonstrate the correct method and procedure of doing a job. In order to carry out this function effectively in addition to conceptual understanding of the method or procedure he must possess appropriate manual skills. The subject aims at developing special skills required for repairing, faultfinding, wiring in electrical appliances and installations.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Carryout pipe and plate earthing and
- Provide connection to 3-ϕ motors through various starters
- Detect and rectify various types of faults in contactor control circuits
- Rewind a single phase motor or choke coil
- Make cable joints and lay underground cables at the work site
- Make connections of star-delta transformers and D.O.L. starters
- Repair and maintain electrical wiring and appliances
- Design a small PCB for small electrical circuit

DETAILED CONTENTS

PRACTICAL EXERCISES:

1. To carry out pipe/plate earthing for a small house and 3-phase induction motor. Testing the earthing using earth tester

2. Connections of single phase and 3-phase motors, through an appropriate starter and to change their direction of rotation

3. Wiring, testing and fault finding of the following contactor control circuits operating on 3-phase supply:

    a) Remote control circuits
    b) Time delay circuits
    c) Inter locking circuits
    d) Sequential operation control circuits

    Note: Students may be asked to study control circuit of a passenger lift, automatic milling machine, etc. using relays

4. Winding/re-winding of a fan (ceiling and table)/ motor
5. Power cable jointing using epoxy based jointing kits

6. Demonstration of laying of underground cables at worksite

7. Dismantling/assembly of star-delta and DOL starter

8. Dismantling and assembly of voltage stabilizers

9. Repair and maintenance of domestic electric appliances, i.e. electric iron, geyser, fan, heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnace etc.

10. Dismantling/assembly/maintenance of motor operated appliances such as mixer, blender, drill machine etc.

11. Design a printed circuit Board (PCB) for voltage regulator using zener diode.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

SOFT SKILLS – II

L	T	P
-	-	1

RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Develop Communication Skills
- Work in a team
- Learn to resolve conflict by appropriate method
- Identify leadership traits and learn self motivation
- Follow ethics

DETAILED CONTENTS

- Concept of team building, behavior in a team
- Developing Interpersonal Relations- empathy, sympathy
- Communication skills-improving non-verbal communication
- Conflict Management
- Motivation
- Leadership
- Professional Ethics and Values
- Health, Hygiene, Cleanliness and Safety

In addition, the students must participate in the following activities to be organized in the institute

- Sports
- NCC/NSS
- Camp – Environment awareness
- Cultural Event

Note : Extension Lectures by experts may be organized. There will be no examination for this subject.

INDUSTRIAL TRAINING

Industrial training provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 6 weeks upto 8 weeks duration to be organized during the semester break starting after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A teacher may guide a group of 4-5 students. A minimum of one visit per week by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An internal assessment of 100 and external assessment of 100 marks have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behavior, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry. The components of evaluation will include the following.

a) Punctuality and regularity 15%
b) Initiative in learning new things 15%
c) Relationship with workers 15%
d) Industrial training report 55%

FIFTH SEMESTER

5.1 ELECTRICAL MACHINES - II

L	T	P
4	-	2

RATIONALE

Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Demonstrate the constructional features of a synchronous machine and its working as a synchronous motor
- Operate the synchronous motor as synchronous condenser
- Use 3-ϕ induction motor in the industry for various operations
- Operate and maintain three phase squirrel cage and three phase slip ring induction motors.
- Start and reverse the direction of rotation of three phase induction motors using different types of starters.
- Conduct speed control of three phase induction motor.
- Operate and maintain double cage induction motors.
- Recognize the condition of cogging and crawling in three phase induction motors.
- Operate different types of single phase induction motors.
- Operate different types of special purpose motors

DETAILED CONTENTS

1. 3 Phase Induction Motors (25 Periods)

    1.1 Salient constructional features of squirrel cage and slip ring 3-phase induction motors
    1.2 Principle of operation, slip and its significance
    1.3 Locking of rotor and stator fields
    1.4 Rotor resistance, inductance, emf and current
    1.5 Relationship between rotor copper losses, slip and rotor input power.
    1.6 Power flow diagram of an induction motor
    1.7 Factors determining the torque
    1.8 Torque-slip curve, stable and unstable zones

1.9 Effect of rotor resistance upon the torque slip curve
1.10 Double cage rotor motor and its applications
1.11 Starting of 3-phase induction motors, DOL, star-delta, auto transformer starter.
1.12 Causes of low power factor of induction motors
1.13 Testing of 3-phase motor on no load and blocked rotor test and to find efficiency
1.14 Method of Speed control of induction motor
1.15 Harmonics and its effects, cogging and crawling in Induction Motors.
1.16 Specifications and ratings of induction motors.

2. Single Phase Motors (10 Periods)

2.1 Single phase induction motors; Construction characteristics, specifications and applications

2.2 Nature of field produced in single phase induction motor-double revolving field theory.

2.3 Split phase induction motor

2.3.1 Capacitor start, capacitor run, capacitor start and run motor
2.3.2 Shaded pole motor

2.4 Alternating current series motor and universal motors, construction, working principle and operation, application.

2.5 Single phase synchronous motor

2.5.1 Reluctance motor
2.5.2 Hysteresis motor

3 Synchronous Machines (25 periods)

3.1 Main constructional features of synchronous machine including commutator and brushless excitation system

3.2 Production of rotating magnetic field in a three phase winding

3.3 Generation of three phase emf

3.4 Concept of distribution factor and coil span factor and emf equation
Armature reaction at unity, lag and lead power factor

3.5 Equivalent circuit diagram of synchronous machine

3.6 Concept of voltage regulation. Determination of voltage regulation by synchronous impedance method.

3.7. Operation of single synchronous machine independently supplying a load.

3.8. Concept of infinite bus bar. Need and necessary conditions of parallel operation of alternators, Synchronizing an alternator (Synchroscope method) with the bus bars

3.9 Operation of synchronous machine as a motor –its starting methods

3.10 Effect of change in excitation of a synchronous motor, V curve, Concept of synchronous condenser.

3.11 Concept and cause of hunting and its prevention

3.12 Specification, rating and cooling of synchronous machines

3.13 Applications of synchronous machines

4. Special Purpose Machines (04 periods)

Construction, working principle and application of linear induction motor, stepper motor, AC Servomotor, Submersible Motor,

LIST OF PRACTICALS

1. Determination of efficiency by (a) no load test and blocked rotor test on an induction motor (b) direct loading of an induction motor (refer BIS code)
2. Determination of effect of rotor resistance on torque speed curve of an induction motor
3. Observe the performance of a ceiling fan (I-ϕ) induction motor) without capacitor Determine the effect of change in capacitor on the performance of 1-phase induction motor and reverse the direction of motor.
4. To plot relationship between no load terminal voltage and excitation current in a synchronous generator at constant speed
5. Determination of the relationship between the voltage and load current of an alternator, keeping excitation and speed constant
6. Determination of the regulation and efficiency of alternator from the open circuit and short circuit test
7 Determination of the effect of variation of excitation on performance of a synchronous motor

INSTRUCTIONAL STRATEGY

Teacher should lay-emphasis on development of understanding amongst students about basic principles of operation and control of electrical machines. This may be achieved by conducting quiz tests and by giving home assignments. The teachers should also conduct laboratories classes themselves encouraging each should to perform with his/her own hands and draw conclusions.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

Electrical Machines by SK Bhattacharya, Tata Mc Graw Hill, New Delhi

Electrical Machines by SK Sahdev, Uneek Publications, Jalandhar

Electrical Machines by Nagrath and Kothari, Tata Mc Graw Hill, New Delhi

Electrical Engineering by JB Gupta, SK Kataria and sons, New Delhi

Electrical Machines by Samarjit Ghosh, Pearson Education (Singapore) Pte, Ltd. 482, FIE Patparganj, Delhi 110092

Electrical Machines by DR Arora, Ishan Publications, Ambala City.

6 e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Periods)	Marks Allocation (%)
1	25	35
2	10	20
3	25	35
4	04	10
Total	**64**	**100**

5.2 ELECTRICAL POWER – 1

L	T	P
4	-	-

RATIONALE

The majority of the diploma passouts who get employment in State Electricity Boards have to perform various activities in the field of generation, transmission and distribution of electrical power. The range of these activities vary from simple operation and maintenance of equipment, lines, fault location, planning and designing of simple distribution schemes, executive and supervisory control in power stations, transmission and distribution networks in addition to administrative jobs including public relations. They should also be made aware of recent developments, current practices in the electricity departments, corporations and boards to keep them abreast with modern techniques in transmission and distribution of electrical power.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Distinguish and select suitable resource of energy required for a particular area and environment
- Calculate effective cost generation
- Select suitable supporting structure, insulators, conductors and other accessories for transmission lines and distribution lines
- Prepare layout plan for HT and LT lines/distribution system
- Prepare estimate for HT and LT (OH and underground cables) lines
- Operate and maintain indoor and outdoor substations
- Use various methods for improvement of power factor

DETAILED CONTENTS

1. Power Generation (12 Periods)

    1.1 Main resources of energy, conventional and non-conventional
    1.2 Different types of power stations, thermal, hydro, gas, diesel and nuclear power stations. Flow diagrams and details of their operation, comparison of the generating stations on the basis of running cost, site, starting, maintenance etc.
    1.3 Importance of non-conventional sources of energy in the present scenario. Brief details of solar energy, bio-energy, wind energy

2. Economics of Generation (06 Periods)

2.1 Fixed and running cost, load estimation, load curves, demand factor, load factor, diversity factor, power factor and their effect on cost of generation, simple problems there on.

2.2 Base load and peak load power stations, inter-connection of power stations and its advantages, concept of regional and national grid.

3. Transmission Systems (20 Periods)

3.1 Layout of transmission system, selection of voltage for H.T and L.T lines, advantages of high voltage for Transmission both AC and DC

3.2 Comparison of different system: AC versus DC for power transmission, conductor material and sizes from standard tables

3.3 Constructional features of transmission lines: Types of supports, types of insulators, Types of conductors, Selection of insulators, conductors, earth wire and their accessories, Transposition of conductors and string efficiency of suspension type insulators, Bundle Conductors.

3.4 Mechanical features of line: Importance of sag, calculation of sag, effects of wind and ice related problems; Indian electricity rules pertaining to clearance

3.5 Electrical features of line: Calculation of resistance, inductance and capacitance without derivation in a.c. transmission line, voltage regulation, and concept of corona. Effects of corona and remedial measures

3.6 Transmission Losses

4. Distribution System (16 Periods)

4.1 Lay out of HT and LT distribution system, constructional feature of distribution lines and their erection. LT feeders and service mains; Simple problems on AC radial distribution system, determination of size of conductor

4.2 Preparation of estimates of HT and LT lines (OH and Cables).

4.3 Constructional features of LT (400 V), HT (II kV) underground cables, advantages and disadvantages of underground system with respect to overhead system.

4.4 Losses in distribution system

4.5 Faults in underground cables-determine fault location by Blavier Test, Murray Loop Test, Varley Loop Test

5. Substations: (06 Periods)

5.1 Brief idea about substations; out door grid sub-station 220/132 KV, 66/33 KV outdoor substations, pole mounted substations and indoor substation

5.2 Layout of 33/11 kV/400V distribution substation and various auxiliaries and equipment associated with it.

6. Power Factor: (04 Periods)

6.1 Concept of power factor
6.2 Reasons and disadvantages of low power factor
6.3 Methods for improvement of power factor using capacitor banks, VAR ` Static Compensator (SVC)

Note: students should visit power generation plants, sub-stations etc.

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment, accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition, viva-voce be conducted to evaluate the knowledge gained during the field visit.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Electrical Power System and Analysis by CL Wadhwa, 3rd edition, New Age International Publishers, New Delhi
2. Substation Design and Equipment by Satnam and PV Gupta, Dhanpat Rai & Sons, New Delhi

3. Electrical Power –I by SK Sahdev, Uneek Publications, Jalandhar
4. Electrical Power System by VK Mehta, S Chand and Co., New Delhi
5. Electrical Power System by JB Gupta, SK Kataria and Sons, New Delhi
6. Sub-Station Design by Satnam, Dhanpat Rai and Co., New Delhi
7. Electrical Power Distribution System by AS Pabla, Tata McGraw Hill, New Delhi
8. Electrical Power System by S Channi Singh, Tata McGraw Publishing Co. New Delhi
9 e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	12	20
2	06	10
3	20	30
4	16	24
5	06	10
6	04	06
Total	**64**	**100**

5.3 PROGRAMMABLE LOGIC CONTROLLERS AND MICRO CONTROLLERS

L	T	P
5	-	2

RATIONALE

A diploma holder when employed in automated industrial process controls or in automated power station will be required to know the basics of Programmable Logic Controllers, their working and their programming. In industry, many manufacturing processes demand a sequence of operation, which are to be performed repetitively. Early automation systems were mechanical in design, timing and sequencing being effected by gears and cams. Slowly these design concepts were replaced by electrical drives which were controlled by relays and now by programmable logic controllers (PLCs). A PLC is a solid state device, designed to operate in noisy industrial environments and can perform all logic functions. PLCs are widely used in all industries for efficient control operations. A diploma holder in industry is called upon to design , modify and troubleshoot such control circuits. Looking at the industrial applications of PLCs in the modern industry, this subject finds its usefulness in the present curriculum.

Microcontrollers have also assumed great significance in the field of electronics and comma goods industry, and thus considered to be an important field of engineering. This subject aims to expose the students to both of these and give them adequate knowledge of these topics.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Explain functioning of PLC
- Identify inputs and outputs modules and configure with PLC module.
- Write a simple ladder logic program to realize logic functions.
- Use PLCs for simple applications
- Explain working of SCADA system for simple applications
- Explain the architecture and pin diagram of 8051 microcontroller
- Write a simple program to demonstrate Input and Output operations
- Interface Keypad, 7-segment display and stepper motor with micro controller.

DETAILED CONTENTS

1. Introduction to PLC (06 Periods)

   What is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc.

2. Working of PLC (08 Periods)

   - Basic operation and principles of PLC
   - Architectural details processor
   - Memory structures, I/O structure
   - Programming terminal, power supply

3. Instruction Set (12 Periods)

   - Basic instructions like latch, master control self holding relays.
   - Timer instruction like retentive timers, resetting of timers.
   - Counter instructions like up counter, down counter, resetting of counters.
   - Arithmetic Instructions (ADD,SUB,DIV,MUL etc.)
   - MOV instruction
   - RTC(Real Time Clock Function)
   - Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal

4. Ladder Diagram Programming (10 Periods)

   Programming based on basic instructions, timer, counter, sequencer, and comparison instructions using ladder program.

5 Applications of PLCs (10 Periods)

   - Assembly line
   - Packaging
   - Process controls
   - Car parking
   - Traffic light control
   - Washing machine
   - Motor in forward and reverse direction
   - Star-Delta, DOL Starters
   - Filling of Bottles
   - Room Automation

6. Introduction to SCADA (02 periods)

7. Micro Controller Series (MCS)-51 Over View (08 Periods)

- Difference between micro processor and micro controller
- Pin details
- I/o Port structure
- Memory Organisation
- Special function registers

8 Instruction Set and Addressing Modes (08 Periods)

- Timer operation
- Serial Port operation
- Interrupts

9 Assembly language programming (08 Periods)

- Data Transfer operations
- Input/Output operations

10 Design and Interface (06 Periods)

Examples like: keypad interface, 7- segment interface, LCD, stepper motor.

11. Application of Micro controllers (02 Periods)
Listing different types of Micro controllers and their typical applications (one each)

LIST OF PRACTICALS

PLCs

1. Demonstration of various components/sub-components of a PLC, Learning functions of different modules of a PLC system
2. Practical steps in programming a PLC (a) using a Hand held programmer (b) using computer interface
3. Demonstration to step 5 programming language, ladder diagram concepts, instruction list syntax
4. Basic logic operations, AND, OR, NOT functions
5. Logic control systems with time response as applied to clamping operation
6. Sequence control system e.g. in lifting a device for packaging and counting
7. Use of PLC for an application(teacher may decide)

Micro Controllers

8. Demonstration and study of Micro Controllers (8051) kit
9. Testing of general input/output on Micro controller board
10. Controlling of LEDs using microcontroller program

INSTRUCTIONAL STRATEGY

Introduce the subject and make the students familiar with applications of PLCs and Microcontrollers. The inputs shall start with theoretical inputs to architecture, instruction set, assembly language programming, Small projects may be identified, be designed and implemented. PLC ladder diagram and programming should be supplemented with visits to industry. More emphasis may be given to practical work.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests.
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1) Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA
2) Introduction to PLCs by Gary Dunning. McGraw Hill
3) Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh
4) Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar
5) Module on "Allen Bradlag PlC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
6) Module on "PLC Applications based on SLC 5/03" By Rajesh Kumar, NITTTR Chandigarh
7) The 8051 Micro controllers Architecture, programming and Applications by Ayala; Penram International
8) Microcontrollers by Mazidi
9) e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1.	06	05
2.	08	13
3.	12	12
4.	10	10
5.	10	10
6.	02	05
7.	08	12
8.	08	10
9.	08	11
10.	06	07
11.	02	05
Total	**80**	**100**

5.4.1 INSTRUMENTATION

L	T	P
4	-	2

RATIONALE

This subject deals with the various instruments, their construction and working which control the various parameters and operations in any industry. Electrical supervisor employed for maintenance of electrical equipment/ machinery is required to diagnose faults, rectify them and test the total system for good performance. Thus there is a need of introducing diploma holders to the basics of Instrumentation. Basics of instrumentation has been dealt with in this subject

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Describe basic measuring systems.
- Use various measuring devices.
- Use instrument for measurement of a particular electrical quantity.
- Use instruments for measurement of a particular non-electrical quantity.
- Explain controlling system of a particular instrument.

DETAILED CONTENTS

1. Measurements: (04 Periods)

   Importance of measurement, Basic measuring systems, advantages and limitations of each measuring systems, generalized measurement system, signal conditioning and display devices

2. Transducers: (08 Periods)

   Theory, construction and use of various transducers (resistance, inductance, capacitance, electromagnetic, piezo electric type)

3. Measurement of Displacement and Strain: (10 Periods)

   Displacement Measuring Devices: wire wound potentiometer, LVDT, strain gauges and their different types such as inductance type, resistive type, wire and foil type etc. Gauge factor, gauge materials, and their selections, sources of errors and its compensations. Use of electrical strain gauges, strain gauge bridges and amplifiers.

4. Force and Torque Measurement: (10 Periods)

Different types of force measuring devices and their principles, load measurements by using elastic Transducers and electrical strain gauges. Load cells, proving rings. Measurements of torque by brake, dynamometer, electrical strain gauges, speed measurements; different methods, devices.

5. Pressure Measurement: (08 Periods)

Bourdon pressure gauges, electrical pressure pick ups and their principle, construction and applications. Use of pressure cells.

6. Flow Measurement: (06 Periods)

Basic principles of magnetic and ultrasonic flow meters

7. Measurement of Temperature: (10 Periods)

Bimetallic thermometer, pressure thermometers, thermoelectric thermometers, resistance thermometers, thermocouple, thermisters and pyrometer, errors in temperature measurements in rapidly moving fluids. Temperature recorders

8. Measurement of other non electrical quantities such as humidity, pH level and vibrations (08 Periods)

PRACTICAL EXERCISES

1. To measure the level of a liquid using a transducer
2. To measure temperature using a thermo-couple
3. Study and use of digital temperature controller
4. Use of themistor in ON/OFF transducer
5. Study of variable capacitive transducer
6. Draw the characteristics of a potentiometer
7. To measure linear displacement using LVDT
8. To study the use of electrical strain gauge
9. To study weighing machine using load cell
10. To study pH meter.

INSTRUCTIONAL STRATEGY

The teacher should explain the scope of various measuring devices and their practical applications in the field. The transducers and measuring devices must be shown to the students and they should be trained in the reaction, operation, maintenance and calibrations. Frequent visits to nearby process industries will be of immense help to the students.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- *Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce*

RECOMMENDED BOOKS

1. Electronic Measurement and Instrumentation by Dr Rajendra Prasad
2. Electronic Measurement and Instrumentation by JB Gupta, SK Kataria and Sons, New Delhi
3. Electrical and Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Co., New Delhi
4. Electronic Instrumentation and Measurement Techniques by WD Cooper, AD Helfrick Prentice Hall of India Pvt. Ltd. New Delhi
5. Industrial Instrumentation by Umesh Rathore, SK Kataria and Sons, New Delhi
6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	04	05
2	08	15
3	10	15
4	10	15
5	08	10
6	06	10
7	10	15
8	08	15
Total	**64**	**100**

5.4.2 AUTO ELECTRICAL

L	T	P
4	-	2

RATIONALE

Diploma holders in Electrical Engineering have to deal with different types of batteries, their charging and testing, regulators, lighting system and various other electrical accessories used in automobiles. Hence the subject of automotive electric equipment is very essential for diploma holders.

LEARNING OUTCOMES

After undergoing this subject, the students will be able to:

- Identify various auto-electrical faults/troubles and their causes.
- Analyse and rectify various auto-electrical troubles with the help of troubleshooting charts
- Use suitable instruments and tools for diagnosis and testing of automotive electrical system
- Describe different type of accessories used in automobiles
- Explain charging and starting system

DETAILED CONTENTS

1. Introduction (04 Periods)

   Various Electrical and Electronics equipment components/systems in Automobile. Their functions and demands, earth return system, types of earthing, 6V, 12V system.

2. Batteries (12 Periods)

   2.1. Lead Acid Batteries: Construction, working, elements, types, materials used, electrolyte and its strength, effect of added plate area and temperature, rating, capacity, efficiency, temperature characteristics, terminal voltages, charging and discharging.

   2.2. Battery Testing: Electrolyte testing by hydrometer, voltage test, high discharge and cadmium test. (voltage)

2.3. Battery Charging: Constant potential and constant current, initial charging, normal charging, trickle charging, intermittent charging, boost charging.

2.4. Battery Defects: Stipulation, plates decay, working, erosion, cracking, sedimentation, separator defects, short circuits, overcharging

2.5. Basic description of Alkaline Batteries:

2.6 Lithium ion battery: Construction and working

3. Charging System (10 Periods)

3.1. Circuits, function and various components, dynamo and alternator, types, construction, working, advantages and disadvantages of dynamo and alternators, drives, cut out relay.

3.2. Regulation: Functions of various components of two unit, three unit and heavy duty Regulators, Regulators for alternators.

4. Starting System (10 Periods)

Function of various components, torque terms, principle and constructional details of starter motor, switches, types, starter to engine drive and their types, integrated started motor.

5. Lighting System (08 Periods)

5.1. Various lighting circuits, head lamp, type and constructional details, sealed beam, double filaments, asymmetric and dual units, vertical and side control of lamps, fog light, side light, brake light, instrument light, indicator lights, reversing light, lamp mounting.

5.2. Wiring: HT and LT, their specifications, cable colour codes, wiring Harness, Cable connections, Wiring diagrams of cars and two wheeler, Fuses, faults and rectification.

6. Electrical Accessories (08 Periods)

Fuel gauges - bimetallic and balancing coil type, Air pressure gauges, temperature gauges, Ammeter, warning light, speedometer, wind screen wipers, horns, horn relay, electric fuel pump, Faults and rectification.

7. Control Area Network (07 periods)

7.1. Block diagram

7.2. Control of different sub systems in modern automobiles using micro controller

8. Miscellaneous Electrical Equipments (05 Periods)

Impulse Speedometer, tachometer, heater, defroster, Air conditioner, and Electric door locks, window actuation, Seat adjusters.

LIST OF PRACTICALS

1. Testing of battery - specific gravity test using hydrometer, voltage test, high rate discharge test; Charging of battery using battery charger.
2. Testing of field winding of alternator and armature of starter motor for open circuit, short circuit and earthing.
3. Study and sketching of various lighting circuits on a working model circuit board.
4. Basic electrical checks:- Battery connections, electrical bulbs and units, circuit protection devices, wiring harness connections, colour coding.
5. Replacement of head lamps, tail lamps, indicator lamps, fog lamps and lamp holders.
6. Head light beam alignment and setting
7. Testing and setting of horn and relay.
8. Servicing of windscreen wiping system; replacement of wiper blade assembly.

INSTRUCTIONAL STATREGY

Teachers should lay emphasis on concepts and principles while imparting instructions. As far possible, subject teaching should be supplemented by demonstrations in the laboratory. During practical work, individual students should be given opportunities to perform practicals independently.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Automobile Engineering by Dr. Kirpal Singh, Standard Publishers, Delhi
2. Automotive Electrical Equipment by P.L. Kohli, Tata McGraw Hill, Delhi
3. Automotive Electrical Equipment by William H. Crouse, Tata McGraw Hill, Delhi
4. Automobile Engineering by Dr. R.B. Gupta, Satya Prakashan, New Delhi
5 e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	06
2	12	20
3	10	16
4	10	16
5	08	12
6	08	12
7	07	10
8	05	08
Total	**64**	**100**

5.4.3 SOLAR PANEL INSTALLATION AND MAINTENANCE

L	T	P
4	-	2

RATIONALE

To train the person, who checks the installation site, understands the layout requirement as per design, assesses precautionary measures to be taken, installs the solar panel as per customer's requirement and ensures effective functioning of the system post installation.

LEARNING OUTCOMES:

At the end of the course, the students will be able to:

- Check site conditions, collect tools and raw materials
- Install solar panel
- Coordinate colleagues at workplace.
- Ensure safety at workplace

DETAIL CONTENTS

1. Check site conditions, collect tools and raw materials (20 periods)

    1.1. Basics on solar energy and power generation systems
    1.2. Use and handling procedure of solar panels
    1.3. Energy storage, control and conversion
    1.4. Basic electrical system and functioning
    1.5. Mechanical equipment and its functioning
    1.6. Maintenance procedure of equipment
    1.7. Site survey, design and evaluation of various parameters
    1.8. Tools involved in installation of system
    1.9. Quality and process standards
    1.10. Occupational health and safety standards

2. Installation of Solar Panel (20 periods)

    2.1 Solar energy system components such as panels, batteries, charge controllers, inverters
    2.2 Significance of volts, amps and watts: series and parallel connection
    2.3 Voltage requirement of various equipment
    2.4 Panel mounting and inclination and angle of tilt
    2.5 Placement of solar panel mounting
    2.6 Sunlight and direction assessment
    2.7 Site surveying methods and evaluation parameters
    2.8 Tools involved in installation of system

3. Coordinate colleagues at work (12 periods)
   - 3.1 Company's policies on incentives, delivery standards, and personnel management
   - 3.2 Importance of the individual's role in the workflow
   - 3.3 Reporting structure
   - 3.4 Communicating effectively
   - 3.5 Building team coordination

4. Safety at workplace (10 periods)
   - 4.1 Maintaining the work area safe and secure
   - 4.2 Handling hazardous material
   - 4.3 Operating hazardous tools and equipment
   - 4.4 Emergency procedures to be followed such as fire accidents, etc.

5. Concept of Solar Tracking System (02 periods)

LIST OF PRACTICALS

1. Panel Installation
2. Using Tools and Machines
3. Handling Safety Equipment

INSTRUCTIONAL STATREGY

Teachers should lay emphasis on concepts and principles while imparting instructions. As far possible, subject teaching should be supplemented by demonstrations in the laboratory. During practical work, individual students should be given opportunities to perform practicals independently.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

RECOMMENDED BOOKS

1. Solar Panel Installation Guide & User Manual (Indian Edition) (E book) Solar Electrical Energy By N L Sharman

2. D. Yogi Goswami, Frank Kreith, Jan. F. Kreider, "Principles of Solar Engineering", Taylor & Francis, 2000, Indian reprint, 20032.

3. “Fundamentals for solar energy conversion” by Edward E. Anderson; Addison Wesley Publ. Co., 1983

4 e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	20	30
2	20	30
3	12	20
4	10	16
5	02	04
Total	**64**	**100**

5.5 UTILIZATION OF ELECTRICAL ENERGY

L	T	P
4	-	-

RATIONALE

This subject assumes importance in view of the fact that an electrical technician has to work in a wide spectrum of activities wherein he has to make selection from alternative schemes making technical and economical considerations; e.g. to plan and design an electrical layout using basic principles and handbooks, to select equipment, processes and components in different situations. The contents have been designed keeping the above objectives in view. Besides giving him basic knowledge in the topics concerned, attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction, visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas

LEARNING OUTCOMES

After undergoing the subject, the student will be able to:

- Design lighting scheme for domestic, industrial and commercial installation
- Design and select a suitable heating arrangement for a particular job
- Handle and maintain electric welding equipment
- Handle and maintain electrolytic plant
- Find faults in electric circuits of refrigerators
- Suggest electric drives as per need
- Maintain electric traction lines and track

DETAILED CONTENTS

1. Electric Heating (12 Periods)

    1.1 Advantages of electrical heating
    1.2 Heating methods:
        1.2.1 Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit
        1.2.2 Induction heating; principle of core type and coreless induction furnace, their construction and applications

1.2.3 Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace
1.2.4 Dielectric heating, applications in various industrial fields
1.2.5. Infra-red heating and its applications (construction and working of two appliances)
1.2.6. Microwave heating and its applications (construction and working of two appliances)
1.2.7 Solar Heating

1.3 Calculation of resistance heating elements (simple problems)

2. Electric Welding: (06 Periods)

2.1 Advantages of electric welding
2.2 Welding methods
2.2.1. Principles of resistance welding, types – spot, projection, seam and butt welding, welding equipment
2.2.2 Principle of arc production, electric arc welding, characteristics of arc; carbon arc, metal arc, hydrogen arc welding method and their applications. Power supply requirement. Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper

3. Electrolytic Processes: (12 Periods)

3.1 Need of electro-deposition
3.2 Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing and buffing
3.3. Equipment and accessories for electroplating
3.4. Factors affecting electro-deposition
3.5. Principle of galvanizing and its applications
3.6 Principles of anodizing and its applications
3.7 Electroplating of non-conducting materials
3.8 Manufacture of chemicals by electrolytic process

4. Electrical Circuits used in Refrigeration, Air Conditioning and Water Coolers: (08 Periods)

4.1 Principle of air conditioning
4.2 Description of Electrical circuit used in
a) Refrigerator,
b) Air-conditioner, and
c) Water cooler

5. Electric Drives: (12 Periods)
5.1 Advantages of electric drives

5.2. Characteristics of different mechanical loads
5.3. Types of motors used as electric drive
5.4. General idea about the methods of power transfer by direct coupling by using devices like belt drive, gears, chain drives etc.
5.5 Examples of selection of motors for different types of domestic loads
5.6 Selection of drive for applications such as general workshop, textile mill, paper mill, steel mill, printing press, crane and lift etc. Application of flywheel.
5.7 Selection of motors for Domestic Appliances

6. Electric Traction: (14 Periods)

6.1 Advantages of electric traction
6.2 Different systems of electric traction, DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main line and their speed-time curves
6.3 Different accessories for track electrification; such as overhead catenary wire, conductor rail system, current collector-pentagraph
6.4 Factors affecting scheduled speed
6.5. Electrical block diagram of an electric locomotive with description of various equipment and accessories used.
6.6 Types of motors used for electric traction
6.7 Power supply arrangements
6.8 Starting and braking of electric locomotives
6.9 Introduction to EMU and metro railways
6.10 Train Lighting Scheme

Note: Students should be taken for visits to nearest electrified railway track and railway station to study the electric traction system.

INSTRUCTIONAL STRATEGY

It is desired to give ample practical examples in the class while teaching this subject. Teacher must supplement his/her classroom teaching with aids such as models, charts, and video films from time to time. This subject requires demonstrations and exposure to actual workplace/industry/field. For this purpose, the subject teacher should do advance planning for visits/studies related to each topic in consultation with HOD and Principal of the polytechnic/institution.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce
- Software installation, operation, development

RECOMMENDED BOOKS

1. Art and Science of Utilization of Electrical Energy by H Partap, Dhanpat Rai & Sons, Delhi
2. Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana
3. Utilization of Electrical Energy by Sahdev, Uneek Publication, Jalandhar
4. A Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
5. Modern Electric Traction by H Partap, Dhanpat Rai & Sons, Delhi
6. Utilization of Electrical Energy by D.R. Arora, North Publication, Jalandhar
7. Generation, Distribution and Utilization if Electrical Power by CL Wadhwa, Wiley Eastern Ltd., New Delhi
8. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	12	19
2	06	09
3	12	19
4	08	12
5	12	19
6	14	22
Total	**64**	**100**

5.6 MINOR PROJECT WORK

L	T	P
-	-	6

RATIONALE

Minor project work aims at exposing the students to industrial/field practices so as to have an appreciation of size, scale and type of operations; and work culture in the industries.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Apply concepts, principles and practices taught in the classroom in solving field/industrial problems.

GENERAL GUIDELINES

Depending upon the interests of the students and location of the organization, the students may be asked to do Market study in the following cases:

1. Working model based on generation of electrical energy using non-conventional energy sources.

2 Various types of cables available in the market, their current rating/specifications, different makes/manufacturing companies (minimum three), comparison of cost between different makes.

3. Various types of domestic/wiring components such as switches, sockets, holders etc., their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes.

4. Various types of protective devises used in domestic and industrial wiring such as MCBs, ELCB/RCCB, fuses etc. their specifications, make (minimum three), and comparison of cost between different makes.

5 Various types of electric lamps (lumeneries) available in the market, their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes.

6. Various types of Electrical Appliances (domestic and commercial) available in the market, their specifications, different makes or manufacturing companies (minimum three), comparison of cost between different makes. (compare any one type)

7. Survey and study industrial/government buildings and house wiring accessories, manufacturers, rates, specifications, their literature collection for their design

8. Study of LT/HT components, detailed specifications from catalogues of manufacturers, drawings, rates, availability in local market

NOTE:

This is only a suggestive list. The students may take any other problem as per their interest. The students of the class may be divided into five groups and work may be assigned to each group as per their interest.

The components of evaluation will include the following :

	Component	**Weightage**
a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with others/workers	15%
d)	Project Report/ Technical report	55%

SOFT SKILLS – III

L	T	P
-	-	2

RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Develop communication skills.
- Learn how to speak without fear and get rid of hesitation
- Use effective presentation techniques
- Understand entrepreneurial traits
- Exhibit attitudinal changes

DETAILED CONTENTS

- Communication Skills – Handling fear and phobia
- Resume Writing
- Applying for job through email/job portal
- Interview preparation : Mock Interview, Group Discussions and Extempore
- Presentation Techniques
- Developing attitude towards safety. Disaster management.

In addition, the students must participate in the following activities to be organized in the institute

- Sports
- NCC/NSS
- Camp – Entrepreneurial awareness
- Cultural Event

Note : Extension Lectures by experts may be organized. There will be no examination for this subject.

SIXTH SEMESTER

6.1 ELECTRICAL ENERGY CONSERVATION AND MANAGEMENT

L	T	P
5	-	-

RATIONALE

The requirement of energy has increased manifolds in last two decades due to rapid urbanization and growth in industrial/service sector. It has become challenging task to meet ever increasing energy demands with limited conventional fuels and natural resources. Due to fast depletion of fossil fuels and a tremendous gap between supply and demand of energy, it is essential to adopt energy conservation techniques in almost every field like industries, commercial and residential sectors etc. Energy conservation has attained priority as it is regarded as additional energy resource. Energy saved is energy produced. This course covers the concepts of energy management and its conservation. It gives the insight to energy conservation opportunities in general industry and details out energy audit methodology and energy audit instruments.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Define principles and objectives of energy management and energy audit.
- Understand Energy Conservation Act 2001 and its features.
- Understand various forms & elements of energy.
- Identify electrical and thermal utilities. Understand their basic principle of operation and assess performance of various equipment.
- Identify areas of energy conservation and adopt conservation methods in various systems.
- Evaluate the techno economic feasibility of the energy conservation technique adopted.

DETAILED CONTENTS

1. **Lighting System** (10 periods)

   1.1. Basic definitions- Lux, lumen and illumination space to height ratio

   1.2 Types of different lamps and their features
   1.3 Energy efficient practices in lighting
   1.4. Tips for energy saving in building - New Building, Existing Building
   1.5 Laws of Illumination
   1.6 Calculation of illumination at different points, Main requirements for proper lighting
   1.7 Macro level approach at design stage

2. **Energy Conservation and EC Act 2001 (05 periods)**

   2.1 Introduction to energy management, energy conservation, energy efficiency and its need

2.2 Salient features of Energy Conservation Act 2001 & The Energy Conservation (Amendment) Act, 2010 and its importance

2.3 Standards and Labeling - Concept of star rating and its importance, Types of product available for star rating

3. **Energy Audit** **(08 periods)**

3.1 Types and methodology

3.2 Energy auditing reporting format

3.3 Energy audit instruments

4. **Electrical Supply System and Motors** **(20 periods)**

4.1 Types of electrical supply system

4.2 Single line diagram

4.3 Transformer loading

4.4 Tips for energy savings in transformers

4.5 Motor Loading

4.6 Variation in efficiency and power factor with loading

4.7 Tips for energy savings in motors

4.8 Need for energy efficient motors

4.9 Initial cost versus like cycle cost

4.10 Cost analysis on life cycle basis

4.11 Various constructional features of EEMs

4.12 EEM as compared to standard motors

5. **Energy Efficiency in Electrical Utilities.** **(17 periods)**

5.1. Understanding Electricity Bill

- 5.1.1. Tariff structure
- 5.1.2. Components of power (kW, kVA and kVAR) and power factor
- 5.1.3 Concept of sanctioned load, maximum demand, contract demand and monthly minimum charges (MMC)

5.2. Pumps

- 5.2.1. Introduction to pump and its application
- 5.2.2. Efficient pumping system operation
- 5.2.3 Energy efficiency in agriculture pumps
- 5.2.4. Tips for energy saving in pumps

5.3. Compressed Air System

- 5.3.1. Types of air compressor and its applications
- 5.3.2. Leakage test
- 5.3.3. Energy saving opportunities in compressors

5.4. Energy Conservation in HVAC and Refrigeration System

- 5.4.1. Introduction
- 5.4.2. Concept of Energy Efficiency Ratio (EER)
- 5.4.3. Energy saving opportunities in Heating, Ventilation and Air-conditioning (HVAC) and Refrigeration Systems.

5.5. Thermal Basics:

5.5.1 Types of fuels

5.5.2 Thermal energy

5.5.3 Energy contents in fuel

5.5.4 Energy Units and its conversion in terms of metric tonne of oil equivalent (MTOE).

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6. **General Energy Saving Tips (10 periods)**

6.1 Lighting System
6.2 Room Air Conditioners
6.3 Refrigerators
6.4 Water Heater
6.5 Computers
6.6 Fans, Heaters, Blowers and Washing Machines
6.7 Water Pumps
6.8 Kitchens
6.9 Transport

7. **Energy Conservation Building Code (10 periods)**

7.1 Haryana ECBC and its salient features including thermal behavior of buildings
7.2 ECBC Guidelines on Building Envelope
7.3 ECBC Prescriptive Requirements for Building Envelope
7.4 ECBC Guidelines on Heating, Ventilation and Air Conditioning
7.5 ECBC Guidelines on Service Hot Water and Pumping
7.6 ECBC Guidelines on Lighting
7.7 ECBC Guidelines on Electrical Power
7.8 ECBC Guidelines on Star Labelling and Minimum Star rating

STUDENT ACTIVITIES ON ENERGY CONSERVATION/ENERGY

EFFICIENCY

1. Presentations of Case Studies
2. Debate competitions
3. Poster competitions
4. Industrial visits
5. Visual Aids

INSTRUCTIONAL STRATEGY

Teachers are expected to lay considerable stress on understanding the basic concepts in energy conservation, principles and their applications. For this purpose, teachers are expected to give simple problems in the class room so as to develop necessary knowledge for comprehending the basic concepts and principles. As far as possible, the teaching of the subject must be supplemented by demonstrations and practical work in the laboratory. Visits to industries must be carried out.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

REFERENCE BOOKS

1. Electric Energy Generation, Utilisation and Conservation by Sivaganaraju, S; Pearson, New Delhi
2. Electrical Power by V.K. Mehta; Khanna and Khanna Publishers, New Delhi
3. Handbook on Energy Audit & Environmental Management by Y P Abbi & Shashank Jain published by TERI. Latest Edition
4. Guide book on General Aspects of Energy Management and Energy Audit by Bureau of Energy Efficiency, Government of India. Edition 2015
5. Guide book on Energy Efficiency in Electrical Utilities, by Bureau of Energy Efficiency, Government of India.
6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	10	12
2.	05	06
3.	08	08
4.	20	26
5.	17	24
6.	10	12
7.	10	12
Total	**80**	**100**

6.2 ELECTRICAL POWER-II

L	T	P
4	-	3

RATIONALE

In view of the complexities associated with the modern interconnected power stations, the responsibilities and the job requirements of a diploma pass out have become more complex than what they used to be earlier. He is required to work with modern electrical equipment and maintain reliability of supply. The course is designed to understand the concepts, principles involved in the construction and working of generating stations and protective switch gear system so that one can handle, install, maintain them and also take decisions at his/her level in different situations. The teaching of this subject requires reinforcement in the form of visits to substations, power stations and well designed laboratory experiences. A practice-oriented approach to the teaching of this subject is suggested.

LEARNING OUTCOMES

After undergoing the subject, the student will be able to:

- Identify the faults in overheads and underground power system
- Operate and maintain protective switchgears
- Handle, operate and maintain protective devices
- Use and select protective relays and protective scheme
- Maintain over-voltage protection scheme
- Calculate the power bill using different tariff schemes

DETAILED CONTENTS

1. Faults: (06 Periods)

   Common type of faults in both overhead and underground systems, symmetrical/ unsymmetrical faults. Single line to ground fault, double line to ground fault, 3-phase to ground fault open circuit , simple problems relating to fault finding.

2. Switch Gears (16 Periods)

   2.1 Purpose of protective gear. Difference between switch, isolator and circuit breakers. Function of isolator and circuit breaker. Making capacity and breaking capacity of circuit breaker (only definition)

   2.2 Principles of Arc extinction in OCB and ACB, Constructional features of OCB, VCB, ACB, and their working,

   2.3 Types of circuit breakers, bulk and minimum oil circuit breakers, air blast circuit breakers, SF_6 circuit breakers

2.4 Miniature circuit breakers ACB, ELCB, MCB, for distribution and transmission system (Descriptive)

3. Protection Devices (16 Periods)

3.1 Fuses; function of fuse. Types of fuses, HV and LV fuses, rewire-able, cartridge, HRC

3.2 Earthing: purpose of earthing, method of earthing, Equipment earthing, Substation earthing, system earthing as per Indian Electricity rules. Methods of reducing earth resistance.

3.3 Relays:

a) Introduction- types of relays. Electromagnetic, numercial and thermal relays, their construction and working

b) Induction type over-current, earth fault relays, instantaneous over current relay

c) Directional over-current, differential relays, their functions

d) Distance relays, their functions

e) Static numeric and digital relays and their applications

4. Protection Scheme (10 Periods)

4.1 Relays for generator protection

4.2 Relays for transformer, protection including Buchholtz relay protection

4.3 Protection of feeders and bus bars, Over current and earth fault protection.

4.4 Distance protection for transmission system

4.5 Relays for motor protection

5. Over-voltage Protection (10 Periods)

5.1 Protection of system against over voltages, causes of over voltages, utility of ground wire

5.2 Lightning arrestors, rod gap, horn gap, metal oxide type.

5.3 Transmission Line and substation protection against over-voltages and lightning

6. Various Types of Tariffs: (06 Periods)

6.1 Concept of Tariffs

6.2 Block rate, flat rate, maximum demand and two part tariffs

6.3 Simple problems

Note: Students may be taken to various Sub-stations/ Grid Stations. Students must be familiarized with present tariff system employed by State Electricity Boards.

LIST OF PRACTICALS

1. Testing of the dielectric strength of transformer oil and air
2. Study of different types of circuit breakers and isolators by visiting power station
3. Plot the time current characteristics of over current relay
4. Power measurement by using CTs and PTs
5. Earthing of different equipment/Main Distribution Board and Energy Meter Box
6. Perform the overload and short circuit test of MCB as per IS specifications
7. Plot the time-current characteristics of Kit-Kat fuse wire
8. Measurement of current on any LT line with clip meter

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of generating stations and substations be arranged and various equipment, accessories and components explained to the students. The protection schemes should be shown at the site and engineers from field may be invited for delivering expert lectures on these topics. Help of Video Films may be taken to explain the layout; construction and working of different power equipment.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

- **Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce**

RECOMMENDED BOOKS

1. Testing, Commissioning , Operation and Maintenance of Electrical Equipment by S Rao, Khanna Technical Publication, New Delhi
2. Electrical Power – II by SK Sahdev, Uneek Publications, Jalandhar (Pb)
3. Electrical Power Systems by CL Wadhwa, Wiley Eastern Ltd., New Delhi
4. Textbook of Electrical Technology by BL Theraja, S Chand and Co., New Delhi
5. Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
6. A Course in Electrical Power by ML Soni, PV Gupta and Bhatnagar, Dhanpat Rai & Sons, New Delhi
7. Principles of Power Systems by VK Mehta, S Chand and Co., New Delhi
8. Preventive Maintenance of Electrical Apparatus by SK Sharotri, Katson Publishing House, Ludhiana

9 e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1	06	10
2	16	25
3	16	25
4	10	15
5	10	15
6	06	10
Total	**64**	**100**

6.3 INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES

L	T	P
4	-	3

RATIONALE

Industrial electronics plays a very vital role in the field of control engineering specifically in the modern industries as they mostly use electronic controls, which are more efficient, effective and precise as compare to the conventional methods. The old magnetic and electrical control schemes have all become obsolete. Electrical diploma holder many times has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control panels is must for them in order to supervise the work efficiently and effectively. Looking in to usefulness and importance of the subject this has been incorporated in the curriculum.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Use SCR, TRIAC and Diac as per requirement of circuit
- Control fan speed using Triac and Quadriac
- Control speed of D.C. shunt motor or universal motor
- Demonstrate the output wave shape on CRO
- Repair UPS and Inverter
- Maintain storage batteries
- Maintain panels used in the modern control process

DETAILED CONTENTS

1. Introduction to SCR (16 Periods**)**

   1.1. Construction and working principles of an SCR, two transistor analogy and characteristics of SCR
   1.2. SCR specifications and rating
   1.3. Construction, working principles and V-I characteristics of DIAC, TRIAC and Quadriac
   1.4. Basic idea about the selection of heat sinks for SCR and TRIACS
   1.5. Methods of triggering a Thyristor. Study of triggering circuits
   1.6. UJT, its Construction, working principles and V-I characteristics, UJT relaxation oscillator
   1.7. Commutation of Thyristors
   1.8. Series and parallel operation of Thyristors
   1.9. Applications of SCR, TRIACS and Quadriac such as light intensity control, speed control of DC and universal motor, fan regulator, battery charger etc.
   1.10. dv/dt and di/dt protection of SCR.

2. Controlled Rectifiers (10 Periods)

2.1 Single phase half wave controlled rectifier with resistive load and inductive load, concept of free wheeling diode.
2.2 Single phase half controlled full wave rectifier
2.3 Single phase fully controlled full wave rectifier
2.4 Single phase full wave centre tapped rectifier
2.5 Three phase full wave half controlled bridge rectifier
2.6 Three phase full wave fully controlled bridge rectifier

3. Inverters, Choppers, Dual Converters and Cyclo Convertors (18 Periods)

3.1 Inverter-introduction, working principles, voltage and current driven series and parallel inverters and applications
3.2 Choppers-introduction, types of choppers and their working principles and applications
3.3 Dual converters-introduction, working principles and applications
3.4 Cyclo-converters- introduction, types, working principles and applications

4. Thyristor Control of Electric Drives (15 Periods)

4.1 DC drives control (Basic Concept)
4.2 Half wave drives
4.3 Full wave drives
4.4 Chopper drives
4.5 AC drives control
4.6 Phase control
4.7 Variable frequency a.c. drives
4.8 Constant V/F application
4.9 Voltage controlled inverter drives
4.10 Constant current inverter drives
4.11 Cyclo convertors controlled AC drives
4.12 Slip control AC drives

5 Uninterrupted power supplies (05 Periods)

5.1 UPS online, off line
5.2 Storage devices (batteries)
5.3 SMPS, CVT

LIST OF PRACTICALS

1. To draw V-I characteristics of an SCR
2. To draw V-I characteristics of a TRIAC
3. To draw V-I characteristics of a DIAC
4. To draw uni-junction transistor characteristics
5. Observe the output wave of an UJT relaxation oscillator
6. Observe the wave shape across SCR and load of an illumination control circuit
7. Fan speed regulator using TRIAC Quadriac (fabrication of this circuit)
8. Speed-control of a DC shunt motor or universal motor
9. To observe the output wave shape on CRO of (a) Single phase half controlled full wave rectifier(b)Single phase controlled rectifier

INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. The available video films on the subject must be shown to the students.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests.
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

BOOKS RECOMMENDED

1. Industrial Control Electronics. John Webb, Kevin Greshock, Maxwell, Macmillan International editions.
2. Fundamentals of Power Electronics by S Rama Reddi, Narosa Publishing House Pvt. Ltd, New Delhi
3. Power Electronics, Circuits Devices and Applications by Mohammad H. Rashid
4. Power Electronics by PC Sen
5. Power Electronics by Dr. PS Bhimbra, Khanna Publishers, New Delhi
6. Industrial Electronics & Control by SK Bhattacharya & S Chatterji, New Age international Publications(P) Ltd, New Delhi
7. Power Electronics by SK Sahdev, Uneek Publication, Jalandhar
8. Industrial Power Electronics by JC Karhava, King India Publication,
9. Power Electronics and Controls by Samir K Datta, Prentice Hall of India, New Delhi
10. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allocation (%)
1.	16	25
2.	10	15
3.	18	30
4.	15	20
5.	05	10
Total	**64**	**100**

6.4 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

L	T	P
3	-	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. It may be further added that an entrepreneurial mindset with managerial skills helps the student in the job market. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

LEARNING OUTCOMES

After undergoing this course, the students will be able to :

- Know about various schemes of assistance by entrepreneurial support agencies
- Conduct market survey
- Prepare project report
- Explain the principles of management including its functions in an organisation.
- Have insight into different types of organizations and their structures.
- Inculcate leadership qualities to motivate self and others.
- Manage human resources at the shop-floor
- Maintain and be a part of healthy work culture in an organisation.
- Use marketing skills for the benefit of the organization .
- Maintain books of accounts and take financial decisions.
- Undertake store management.
- Use modern concepts like TQM, JIT and CRM.

DETAILED CONTENTS

SECTION – A ENTREPRENEURSHIP

1. Introduction (10 Periods)

- Concept /Meaning and its need
- Qualities and functions of entrepreneur and barriers in entrepreneurship
- Sole proprietorship and partnership forms and other forms of business organisations
- Schemes of assistance by entrepreneurial support agencies at National, State, District –level, organisation: NSIC, NRDC, DC, MSME, SIDBI, NABARD, NIESBUD, HARDICON Ltd., Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubators (TBI) and Science and Technology Entrepreneur Parks

2. Market Survey and Opportunity Identification/Ideation (08 Periods)

- Scanning of the business environment
- Salient features of National and Haryana State industrial policies and resultant business opportunities
- Types and conduct of market survey
- Assessment of demand and supply in potential areas of growth
- Identifying business opportunity
- Considerations in product selection
- Converting an idea into a business opportunity

3. Project report Preparation (06 Periods)

- Preliminary project report
- Detailed project report including technical, economic and market feasibility
- Common errors in project report preparations
- Exercises on preparation of project report
- Sample project report

SECTION –B MANAGEMENT

4. Introduction to Management (04 Periods)

- Definitions and importance of management
- Functions of management: Importance and process of planning, organising, staffing, directing and controlling
- Principles of management (Henri Fayol, F.W. Taylor)
- Concept and structure of an organisation
- Types of industrial organisations and their advantages

- Line organisation, staff organisation
- Line and staff organisation
- Functional Organisation

5. Leadership and Motivation (03 Periods)

a) Leadership

- Definition and Need
- Qualities and functions of a leader
- Manager Vs leader
- Types of leadership
- Case studies of great leaders

b) Motivation

- Definition and characteristics
- Importance of self motivation
- Factors affecting motivation
- Theories of motivation (Maslow, Herzberg, Douglas, McGregor)

6. Management Scope in Different Areas (06 Periods)

a) Human Resource Management

- Introduction and objective
- Introduction to Man power planning, recruitment and selection
- Introduction to performance appraisal methods

b) Material and Store Management

- Introduction functions, and objectives
- ABC Analysis and EOQ

c) Marketing and sales

- Introduction, importance, and its functions
- Physical distribution
- Introduction to promotion mix
- Sales promotion

d) Financial Management

- Introductions, importance and its functions
- knowledge of income tax, sales tax, excise duty, custom duty, VAT, GST

7. Work Culture (04 Periods)

7.1. Introduction and importance of Healthy Work Culture in organization
7.2. Components of Culture
7.3. Importance of attitude, values and behaviour
Behavioural Science – Individual and group behavior.
7.4. Professional ethics – Concept and need of Professional Ethics and human values.

8. Basic of Accounting and Finance (04 Periods)

a) Basic of Accounting:

- Meaning and definition of accounting
- Double entry system of book keeping
- Trading account, PLA account and balance sheet of a company

b) Objectives of Financial Management

- Profit Maximization v/s Wealth Maximization

9. Miscellaneous Topics (03 Periods)

a) Total Quality Management (TQM)

- Statistical process control
- Total employees Involvement
- Just in time (JIT)

b) Intellectual Property Right (IPR)

- Introduction, definition and its importance
- Infringement related to patents, copy right, trade mark

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided.

MEANS OF ASSESSMENT

Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development and Management by J.S.Narang; Dhanpat Rai & Sons, Delhi.
3. Entrepreneurship Development by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi
4. Handbook of Small Scale Industry by PM Bhandari
5. Entrepreneurship Development and Management by MK Garg
6. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	20
2	08	16
3	06	14
4	04	10
5	03	06
6	06	14
7	04	08
8	04	08
9	03	06
Total	48	100

6.5 MAJOR PROJECT WORK

L	T	P
-	-	12

RATIONALE

Major Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period.

LEARNING OUTCOMES

After undergoing the project work, students will be able to:

Apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place the learner for project oriented practical training in actual work situation for the stipulated period with a view to:

- Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study

- Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.

- Develop first hand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.

- Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.

General Guidelines

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

This practical training cum project work **should not be considered** as merely conventional industrial training in which students are sent at work places with either minimal or no supervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.

Some of the project activities are given below:

- Projects related to designing small electrical equipment / instruments.
- Projects related to increasing productivity in electrical manufacturing areas.
- Projects related to quality assurance.
- Projects connected with repair and maintenance of plant and equipment.
- Projects related to design of PCBs.
- Projects related to design of small oscillators and amplifier circuits.
- Projects related to design, fabrication, testing and application of simple digital circuits and components.
- Projects related to microprocessor/microcontroller based circuits/ instruments.

A suggestive list of project is given below:-

1. Design and fabrication of control panel for various applications in the field of electrical engineering.
2. Rewinding of a single phase/three phase induction motor
3. Fabrication of working model of a solar thermal power plant.
4. Design and fabrication of automated car parking system.
5. Design and fabrication of automated gate control of railway crossing.
6. Design and fabrication of electrical resistive/inductive/capacitive loads.
7. Design and fabrication of remote control of various domestic electrical appliances.
8. Design and fabrication of microcontroller based DC drive system.
9. Design and fabrication of automatic water level control system.
10. Design and fabrication of automatic solar battery charger.
11. Fabrication of automatic star-delta starter.

12. Fabrication of working model of hydro electric power plant.
13. Fabrication of sine wave inverter up to 500VA.
14. Fabrication of water level indicator.
15. Fabrication of rain/fire/ smoke/burglar detector.
16. Fabrication of automatic solar panel based street lights.
17. Fabrication of automatic solar panel based traffic lights
18. Fabrication of automatic voltage stabilizer up to 1 KVA.
19. Fabrication of working model of wind power plant.
20. Fabrication of heat convector blower with humidifier.
21. Fabrication of oil based radiation type room heater.
22. Fabrication of small 1- phase transformer up to 1KVA.
23. Fabrication of UPS up to 500VA.
24. Fabrication of a distribution board as per requirement.
25. Fabrication of Direct-On-Line (DOL) starter.
26. Fabrication of solar tracking system.
27. Fabrication of automatic power factor corrector.
28. Fabrication of desert cooler/ room cooler.
29. Fabrication of electric/solar water heater.
30. Erection, installation & commissioning of electrical equipments.
31. Fault detection & repair of electrical/ electronic instruments.
32. Drawing, estimating and costing of electrical installation of the institution from supplier's pole to the institution distribution board.
33. Drawing, estimating and costing of electrical installation of a workshop having a given number of electrically operated appliances/machines.
34. To study the laying out of underground distribution cable for a small colony starting from main distribution pole.
35. To study the erection of a 5 pole span over head line for a small distance for distribution of electrical energy and to prepare list of material required.
36. Energy audit for the workshop of your institution & to suggest remedies to reduce electricity bills.

37. Estimate the material required to provide a service connection to a consumer's premises for domestic purposes.
38. To survey the load of a given area in a village, small colony, calculate the effective load and find out the sizes of cables/conductors for the proposed distribution system.
39. Designing of light and fan scheme for an institutional or commercial building.
40. To study and estimate the material required during augmentation of a nearby pole mounted sub-station.
41. To study and estimate the material required during augmentation of a nearby in door sub-station.
42. To study and estimate the material required for a solar power station up to 100KW after visiting the actual site
43. To prepare a proposal for substation of your institution , calculating the total load (estimating and costing)
44. Installation of home security system
45. Detection of electricity theft control system with wireless indication system
46. Fabrication of cyclo-converter (frequency changer)
47. Design and fabrication of panel for automatic switching of DG set with supply system
48. Design and fabrication of wireless AC Power transmission.
49. Design and fabrication of solar energy bored projects like solar cooker, solar dryer, solar street light, solar inverter, solar pump, solar emergency light etc.

NOTE: The project should be preferably undertaken by a group of students depending upon cost and time involved.

There is no binding to take up the above projects as it is only a suggestive list of projects.

A suggestive criterion for assessing student performance by the external (person from industry) and internal (teacher) examiner is given in table below:

Sr.	Performance Criteria	Max.**	Rating Scale

No.		Marks	Excel lent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9	Viva voce	10%	10	8	6	4	2
Total marks		**100**	**100**	**80**	**60**	**40**	**20**

The overall grading of the practical training shall be made as per following table.

In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance to improve and re-evaluate before being disqualified and declared "not eligible to receive diploma ". It is also important to note that the students must get more than six "goods" or above "good" grade in different performance criteria items in order to get "Overall Good" grade.

	Range of maximum marks	**Overall grade**
i)	More than 80	*Excellent*
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 40	Fair
v)	Less than 40	Poor

Important Notes

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve other criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work

SOFT SKILLS – IV

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RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. The diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Communicate effectively.
- Apply techniques of effective time management
- Develop habits to overcome stress
- Face problems with confidence
- Exhibit attributes required to appear for an interview
- Learn about current and future career opportunities
- Exhibit entrepreneurial skills
- Use QC/QT tools

DETAILED CONTENTS

- Communication Skills - Presentation
- Time management
- Stress Management
- Problem solving
- Career opportunities-Current and future
- Entrepreneurial Skills
- Quality and Quality tools used in industry

In addition, the students must participate in the following activities to be organized in the institute

- Sports
- NCC/NSS
- Cultural Event

Note : Extension Lectures by experts may be organized. There will be no examination for this subject.