COURSE OF STUDY AND SCHEME OF EXAMINATION OF DIPLOMA VOCATIONAL IN ELECTRICAL EQUIPMENT MAINTENANCE
LEVEL IV

S No	Subject	Subject Code	Period per week			Scheme of Examination					Total Marks	Credit
						Theory			Practical			
			L	T	P	ELE	CT	TA	EPE	TA		
		(A) Academic Part General Education										
01	HINDI	900451(46)	4	-	-	100	10	10	-	-	120	08
02	ENGLISH	900452(46)	4	-	-	100	10	10	-	-	120	08
03	MATHEMATICS	991453(14)	4	1	-	100	10	10	-	-	120	10
04	PHYSICS	991454(15)	3	-	-	70	10	10	-	-	90	06
05	CHEMISTRY	991455(11)	**3**	**-**	**-**	**70**	10	10	**-**	**-**	90	06
06	PHYSICS LAB	991461(15)	-	-	2				30	10	40	04
07	CHEMISTRY LAB	991462(11)	**-**	**-**	**2**				**30**	**10**	40	04
	Vocational Part Vocational Education											
08	Electrical Equipments Maintenance	991463(24)	**-**	**-**	**12**	**-**	**-**	**-**	**350**	**30**	**380**	24
	TOTAL		**18**	**01**	**16**	**440**	**50**	**50**	**410**	**50**	**1000**	**70**

L-Lecture, T-Tutorial, P- Practical, ESE-End Level Exam, EPE-End Practical Exam, CT-Class Test, TA-Teachers Assessment

Assuming Total Duration 30 Weeks

Per Week 35 Periods One hour each

One Credit would mean equivalent of 15 period of 60 minutes each for Theory,Workshop/Labs and Tutorial.

SYLLABUS FOR LANGUAGE I: (HINDI)

DIPLOMA VOCATIONAL IN ELECTRICAL EQUIPMENT MAINTENANCE

LEVEL : IV

BRANCH DISCIPLINE : ELECTRICAL EQUIPMENT MAINTENANCE

TEACHING & EXAMINATION SCHEME:

S No	Subject	Subject Code	Period per week			Scheme of Examination					Total Marks	Credit
						Theory			Practical			
			L	T	P	ELE	CT	TA	EPE	TA		
1	**Theory**	**900451(46)**	4	-	-	100	10	10	-	-	120	08

DISTRIBUTION OF MARKS & HOURS:

CHAPTER NO.	CHAPTER NAME	HOURS	MARKS
क	अपठित बोध (गद्यांश और काब्यांश–बोध)	20	20
ख	रचनात्मक तथा व्यावहारिक लेखन	30	25
ग	अंतरा भाग – 2 : (काब्य भाग)	30	20
	: (गद्य –भाग)	25	20
घ	**अंतराल**, भाग –2	15	15
	TOTAL	**120**	**100**

COURSE CONTENT:

क अपठित बोध : (गद्यांश और काब्यांश–बोध) **20**

1. गद्यांश बोध : गद्याांश पर आधारित बोध, प्रयोग, रचानांतरण, शीर्षक आदि पर लघूत्तरात्मक प्रश्न – 10
2. काब्यांश बोध : काब्यांश पर आधारित पॉच लघूत्तरात्मक प्रश्न – 10

ख रचनात्मक तथा व्यवहारिक लेखन : **25**

3. निबंध (विकल्प) 10
4. कार्यालयीन पत्र – 05
5. ''अभिव्यक्ति और माध्यम'' के आधार पर व्यवहारिक लेखन पर पांच लघूत्तरात्मक प्रश्न : 05
6. रचनात्मक लेखन पर एक प्रश्न 05

ग अंतरा – भाग – 2 **(20+20)** **40**

काब्य – भाग : **20**

7. काब्यांश सप्रसंग व्याख्या (दो में से एक) – 08
8. कविताओं के कथ्य पर दो प्रश्न – (3+3) 06
9. कविताओं के काब्य – सौंदर्य पर दो प्रश्न – (3+3) 06

गद्य – भाग : **20**

10. सप्रसंग व्याख्या (दो में से एक) 08
11. पाठों की विषय वस्तु पर आधारित तीन में से दो प्रश्न – (3+3) 06
12. किसी एक कवि/लेखक का साहित्यिक परिचय 06

घ पूरक पुस्तक : अंतराल : भाग 2 **15**

13. विषयवस्तु पर आधारित (चार में से तीन लघूतरात्मक प्रश्न) – 09

14. विषयवस्तु पर आधारित निबंधात्मक प्रश्न – 06

निर्धारित पुस्तकें :

1. **अंतरा भाग – 2** एन.सी.ई.आर.टी. द्वारा प्रकाशित
2. **अंतराल भाग – 2** (विविध विधाओं का संकलन) एन.सी.ई.आर.टी. द्वारा प्रकाशित
3. **अभिव्यक्ति और माध्यम** एन.सी.ई.आर.टी. द्वारा प्रकाशित

SYLLABUS FOR LANGUAGE II: (ENGLISH)

DIPLOMA VOCATIONAL IN ELECTRICAL EQUIPMENT MAINTENANCE

LEVEL : IV

BRANCH DISCIPLINE : ELECTRICAL EQUIPMENT MAINTENANCE

TEACHING & EXAMINATION SCHEME:

S No	Subject	Subject Code	Period per week			Scheme of Examination					Total Marks	Credit
						Theory			Practical			
			L	T	P	ELE	CT	TA	EPE	TA		
1	**Theory**	**900452(46)**	4	-	-	100	10	10	-	-	120	08

DISTRIBUTION OF MARKS & HOURS:

CHAPTER NO	CHAPTER NAME	HOURS	MARKS
01	COMMUNICATION	40	30
02	TECHNICAL WRITING	50	40
03	COMPOSITION	30	30
	TOTAL	**120**	**100**

COURSE CONTENT:

I. COMMUNICATION: 40 HOURS, 30MARKS

1. IMPORTANCE OF COMMUNICATION SKILLS
2. DIFFERENCE BETWEEN TECHNICAL WRITING & LITERARY WRITING
3. BASIC FACTS OF TECHNICAL WRITING
4. TYPES OF COMMUNICATION: VERBAL, NON-VERBAL, ELECTRONIC
5. MODES OF COMMUNICATION: READING, WRITING, SPEAKING & LISTENING
6. BARRIERS TO COMMUNICATION: HOW TO OVERCOME THEM
7. GENERAL SPEAKING SKILLS: SPEECH, DEBATE, GROUP DISCUSSION

II.TECHNICAL WRITING: 50 HOURS, 40MARKS

1. MAIN FEATURES OF TECHNICAL WRITING: ORGANISATION, STYLE, MECHANICS, TABLES& ILLUSTRATIONS
2. FORMS OF TECHNICAL WRITING
   - 2.1 WRITING DEFINITIONS
   - 2.2 WRITING TECHNICAL DESCRIPTIONS OF OBJECTS & PROCESSES
   - 2.3 WRITING INSTRUCTIONS
3. WRITING TECHNICAL REPORTS
   - 3.1 QUALITIES OF A GOOD REPORT
   - 3.2 FORMS OF REPORTS

3.3 TYPES OF REPORTS: PERIODIC REPORT, PROGRESS REPORT, LABORATORY REPORT, FEASIBILITY REPORT, TROUBLE REPORT

III. COMPOSITION: 30 HOURS, 30MARKS

1. PARAGRAPH WRITING
2. PRECIS WRITING
3. OFFICIAL & BUSINESS LETTERS

REREFENCE BOOKS:

1. A COURSE IN TECHNICAL WRITING, BOOK TWO, SOMAIYA PUBLICATIONS PVT LTD, BOMBAY

2. BASIC TECHNICAL COMMUNICATION: PHI LEARNING PRIVATE LIMITED, NEW DELHI

SYLLABUS FOR MATHEMATICS

DIPLOMA VOCATIONAL IN ELECTRICAL EQUIPMENT MAINTENANCE

LEVEL : IV

BRANCH DISCIPLINE : ELECTRICAL EQUIPMENT MAINTENANCE

TEACHING & EXAMINATION SCHEME:

S. No	Subject	Subject Code	Period per week			Scheme of Examination					Total Marks	Credit
						Theory			Practical			
			L	T	P	ELE	CT	TA	EPE	TA		
1	**Theory**	**991453(14)**	4	1	-	100	10	10	-	-	120	10

DISTRIBUTION OF MARKS & HOURS:

S. No.	Unit	Topic	No. of Hours/ Periods	Marks Allotted
1.	Unit I	RELATIONS AND FUNCTIONS	25	10
2.	Unit II	ALGEBRA	25	13
3.	Unit III	CALCULUS	65	44
4.	Unit IV	VECTORS AND THREE - DIMENSIONAL GEOMETRY	20	17
5.	Unit V	LINEAR PROGRAMMING	05	06
6.	Unit VI	PROBABILITY	10	10
TOTAL			**150**	**100**

COURSE CONTENT:

UNIT I. RELATIONS AND FUNCTIONS

1. Relations and Functions :

Types of relations: reflexive, symmetric, transitive and equivalence relations. One to one and onto functions, composite functions, inverse of a function. Binary operations.

2. Inverse Trigonometric Functions:

Definition, range, domain, principal value branches. Graphs of inverse trigonometric functions. Elementary properties of inverse trigonometric functions.

UNIT-II: ALGEBRA

1. Matrices:

Concept, notation, order, equality, types of matrices, zero matrix, transpose of a matrix, symmetric and skew symmetric matrices.Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication. Non-commutativity of multiplication of matrices and existence of non-zero matrices whose product is the zero matrix (restrict to square matrices of order 2). Concept of elementary row and column operations. Invertible matrices and proof of the uniqueness of inverse, if it exists; (Here all matrices will have real entries).

2. Determinants:

Determinant of a square matrix (up to 3 x 3 matrices), properties of determinants, minors,

cofactors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear

equations by examples, solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.

UNIT-III: CALCULUS

1. Continuity and Differentiability:

Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit functions.Concept of exponential and logarithmic functions. Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretation.

2. Applications of Derivatives:

Applications of derivatives: rate of change of bodies, increasing/decreasing functions, tangents and normals, use of derivatives in approximation, maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool). Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations).

3. Integrals:

Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, simple integrals of the following type to be evaluated.

$$\frac{dx}{\quad}, \quad \frac{dx}{\sqrt{\quad}}, \quad \frac{dx}{\sqrt{\quad}}, \quad \frac{px+q}{bx}\,dx, \quad \frac{px+q}{\sqrt{ax^2 \quad bx \quad c}}\,dx, \quad \sqrt{a^2 \quad x^2}\,dx,$$

$$x^2 \quad a^2 \qquad\qquad x^2 \quad a^2 \qquad a^2 \quad x^2 \qquad ax^2 \quad bx \quad c \qquad ax$$

$$\sqrt{ax^2 \quad bx \quad c}\,dx, \quad (px+q)\sqrt{ax^2 \quad bx \quad c}\,dx.$$

Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.

4. Applications of the Integrals:

Applications in finding the area under simple curves, especially lines, circles/parabolas/ ellipses (in standard form only), Area between the two above said curves (the region should be clearly identifiable).

5. Differential Equations:

Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables, homogeneous differential equations of first order and first degree. Solutions of linear differential equation of the type:

$\frac{dy}{dx} + py = q$, where p and q are functions of x or constant

$+ px = q$, where p and q are functions of y or constant

UNIT-IV: VECTORS AND THREE - DIMENSIONAL GEOMETRY

I.Vector:

Vector and Vector quantities, Vector as directed line Segment ,magnitude and direction of a vector., equal vector, unit vector, zero vector, position vector of a point, component of a vector vector in two and three dimensions, Addition of vectors, multiplication of a vector by a scalar

positions vector of a point diving a given straight line in a given ratio, Scalar product and vector of two vectors. Angle between two vectors.

II. Three – Dimensinal Geometry:

Three dimensional Cartesian coordinate system, projection of a point on a line and a plane ,projection of a line segment on a line ,direction cosines of a line and direction cosine of axes, direction ratio of a line joining two points, projection of a line segment joining two points on a given line.

UNIT-V: LINEAR PROGRAMMING

1. Linear Programming:

Introduction, related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

UNIT-VI: PROBABILITY

1. Probability:

Conditional probability, multiplication theorem on probability. independent events, total probability, Baye's theorem, Random variable and its probability distribution, mean and variance of random variable. Repeated independent (Bernoulli) trials and Binomial distribution.

Recommended Textbooks.

1) Mathematics Part I - Textbook for Class XI, NCERT Publication
2) Mathematics Part II - Textbook for Class XII, NCERT Publication

SYLLABUS FOR PHYSICS

DIPLOMA VOCATIONAL IN ELECTRICAL EQUIPMENT MAINTENANCE

LEVEL : IV

BRANCH DISCIPLINE : ELECTRICAL EQUIPMENT MAINTENANCE

TEACHING & EXAMINATION SCHEME:

S No	Subject	Subject Code	Period per week			Scheme of Examination					Total Marks	Credit
						Theory			Practical			
			L	T	P	ELE	CT	TA	EPE	TA		
1	**Theory**	**991454(15)**	3	-		70	10	10			90	06
2	**Practical**	**991461(15)**	-	-	2				30	10	40	04
	Total		3	-	2	70	10	10	30	10	130	10

DISTRIBUTION OF MARKS & HOURS:

S. No.	Unit	Topic	No. of Hours/ Periods	Marks Allotted
1.	Unit I	Electrostatics	10	08
2.	Unit II	Current Electricity	10	07
3.	Unit III	Magnetic effect of current & Magnetism	10	08
4.	Unit IV	Electromagnetic Induction and Alternating current	08	08
5.	Unit V	Electromagnetic Waves	08	03
6.	Unit VI	Optics	10	14
7.	UnitVII	Dual Nature of Matter	08	04
8.	UnitVIII	Atoms and Nuclei	08	06
9.	Unit IX	Electronic Devices	09	07
10.	Unit X	Communication Systems	09	05
TOTAL			**90**	**70**

Course Content:

THEORY HOURS 90

UNIT I: ELECTROSTATICS

Electric Charges; Conservation of charge, Coulomb's law-force between two point charges, forces between multiple charges; superposition principle and continuous charge distribution.
Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in uniform electric fleld. Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside).
Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor. Van de Graaff generator.

UNIT II: CURRENT ELECTRICITY

Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity. Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance. Internal resistance of a cell, potential difference and emf of a cell,combination of cells in series and in parallel. Kirchhoff's laws and simple applications. Wheatstone bridge, metre bridge.Potentiometer - principle and its applications to measure potential difference and for comparing emf of two cells; measurement of internal resistance of a cell.

UNIT III: MAGNETIC EFFECTS OF CURRENT AND MAGNETISM

Concept of magnetic field, Oersted's experiment. Biot - Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long straight wire. Straight and toroidal solenoids, Force on a moving charge in uniform magnetic and electric fields. Cyclotron. Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter. Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of a revolving electron. Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements. Para-, dia- and ferro - magnetic substances, with examples. Electromagnets and factors affecting their strengths. Permanent magnets.

UNIT IV: ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENTS

Electromagnetic induction; Faraday's laws, induced emf and current; Lenz's Law, Eddy currents. Self and mutual induction. Alternating currents, peak and rms value of alternating current/voltage; reactance and impedance; LC oscillations (qualitative treatment only), LCR series circuit, resonance; power in AC circuits, wattless current. AC generator and transformer.

UNIT V: ELECTROMAGNETIC WAVES

Need for displacement current, Electromagnetic waves and their characteristics (qualitative ideas only). Transverse nature of electromagnetic waves. Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

UNIT VI: OPTICS

Reflection of light, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applications, optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lensmaker's formula. Magnification, power of a lens, combination of thin lenses in contact combination of a lens and a mirror. Refraction and dispersion of light through a prism.
Scattering of light - blue colour of sky and reddish apprearance of the sun at sunrise and sunset.
Optical instruments : Human eye, image formation and accommodation correction of eye defects (myopia, hypermetropia) using lenses. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.
Wave optics: Wave front and Huygen's principle, relection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen's principle.Interference Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes. Polarisation, plane polarised light Brewster's law, uses of plane polarised light and Polaroids.

UNIT VII: DUAL NATURE OF MATTER AND RADIATION
Dual nature of radiation. Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light. Matter waves-wave nature of particles, de Broglie relation. Davisson-Germer experiment (experimental details should be omitted; only conclusion should be explained).

UNIT VIII: ATOMS & NUCLEI
Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars; isotones. Radioactivityalpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission, nuclear fusion.

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

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

Practicals
Every student will perform atleast 15 experiments (7 from section A and 8 from Section B) The activities mentioned here should only be for the purpose of demonstration. One Project of three marks is to be carried out by the students.

SECTION A
Total 30 Marks **30 HOURS**

Experiments

(Any 7 experiments out of the following to be performed by the students)

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

Activities

1. To measure the resistance and impedance of an inductor with or without iron core.

2. To measure resistance, voltage (AC/DC), current (AC) and check continuity of a given circuit using multimeter.
3. To assemble a household circuit comprising three bulbs, three (on/off) switches, a fuse and a power source.
4. To assemble the components of a given electrical circuit.
5. To study the variation in potential drop with length of a wire for a steady current.
6. To draw the diagram of a given open circuit comprising at least a battery, resistor/rheostat, key, ammeter and voltmeter. Mark the components that are not connected in proper order and correct the circuit and also the circuit diagram.

SECTION B **30 HOURS**

(Any 8 experiments out of the following to be performed by the students)

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

Activities (For the purpose of demonstration only)

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

Recommended Textbooks.

1. Physics, Class XI, Part -I & II, Published by NCERT.
2. Physics, Class XII, Part -I & II, Published by NCERT

SYLLABUS FOR CHEMISTRY

DIPLOMA VOCATIONAL IN ELECTRICAL EQUIPMENT MAINTENANCE
LEVEL : IV
BRANCH DISCIPLINE : ELECTRICAL EQUIPMENT MAINTENANCE

TEACHING & EXAMINATION SCHEME:

S No	Subject	Subject Code	Period per week			Scheme of Examination					Total Marks	Credit
						Theory			Practical			
			L	T	P	ELE	CT	TA	EPE	TA		
1	**Theory**	**991455(11)**	3	-		70	10	10	-	-	90	06
2	**Practical**	**991462(11)**	-	-	2	-	-	-	30	10	40	04
	Total		3	-	2	70	10	10	30	10	130	10

DISTRIBUTION OF MARKS & HOURS:

S. No	Unit	Topic	No. of Hours/ Periods	Marks Allotted
1.	Unit I	Solid State	06	04
2.	Unit II	Solutions	05	05
3.	Unit III	Electrochemistry	06	05
4.	Unit IV	Chemical Kinetics	06	05
5.	Unit V	Surface Chemistry	07	04
6.	Unit VI	General Principles and Processes of Isolation of Elements	05	03
7.	UnitVII	p -Block Elements	08	08
8.	UnitVIII	d -and f -Block Elements	04	05
9.	Unit IX	Coordination Compounds	06	03
10.	Unit X	Haloalkanes and Haloarenes	06	04
11.	Unit XI	Alcohols, Phenols and Ethers	06	04
12.	Unit XII	Aldehydes, Ketons and Carboxylic Acids	06	06
13.	Unit XIII	Organic Compounds containing Nitrogen	05	04
14.	Unit IV	Biomolecules	06	04
15.	Unit V	Polymers	06	03
16.	Unit VI	Chemistry in Everyday Life	02	03
TOTAL			**90**	**70**

COURSE CONTENT:

UNIT I: SOLID STATE

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea). Unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties. Band theory of metals, conductors, semiconductors and insulators and n & p type semiconductors.

UNIT II: SOLUTIONS

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties - relative lowering of vapour pressure, Raoult's law, elevation of boiling point, depression of freezing point, osmotic pressure,

determination of molecular masses using colligative properties, abnormal molecular mass,

UNIT III: ELECTROCHEMISTRY

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementary idea), dry cell -electrolytic cells and Galvanic cells, lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and emf of a cell, fuel cells, corrosion.

UNIT IV: CHEMICAL KINETICS

Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half life (only for zero and first order reactions), concept of collision theory (elementary idea, no mathematical treatment). Activation energy, Arrhenious equation.

UNIT V: SURFACE CHEMISTRY

Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids, catalysis, homogenous and heterogenous activity and selectivity; enzyme catalysis colloidal state distinction between true solutions, colloids and suspension; lyophilic , lyophobic multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsion - types of emulsions.

UNIT VI : GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF ELEMENT

Principles and methods of extraction - concentration, oxidation, reduction - electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and iron.

UNIT VII: P -BLOCK ELEMENTS

Group -15 Elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; nitrogen preparation properties & uses ; compounds of nitrogen, preparation and properties of ammonia and nitric acid, oxides of nitrogen (Structure only) ; Phosphorus - allotropic forms, compounds of phosphorus: preparation and properties of phosphine, halides PCl_3, PCl_5 and oxoacids (elementary idea only).

Group 16 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties,dioxygen: Preparation, Properties and uses, classification of oxides, Ozone, Sulphure -allotropic forms; compounds of sulphure: Preparation properties and uses of sulphur-dioxide, sulphuric acid: industrial process of manufacture, properties and uses; oxoacids of sulphur (Structures only).

Group 17 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, Preparation properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens (structures only).

Group 18 Elements: General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

UNIT VIII: *D* AND *F* BLOCK ELEMENTS

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals - metallic character, ionization enthalpy,oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds,alloy formation, preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$.

Lanthanoids - Electronic configuration, oxidation states, chemical reactvity and lanthanoid contraction and its consequences.
Actinoids - Electronic configuration, oxidation states and comparison with lanthanoids.

UNIT IX: COORDINATION COMPOUNDS
Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT; structure and stereo isomerism, importance of coordination compounds (in qualitative inclusion, extraction of metals and biological system).

UNIT X : HALOALKANES AND HALOARENES.
Haloalkanes: Nomenclature, nature of C -X bond, physical and chemical properties, mechanism of substitution reactions, optical rotation.
Haloarenes: Nature of C -X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only.Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform freons, DDT.

UNIT XI: ALCOHOLS, PHENOLS AND ETHERS
Alcohols: Nomenclature, methods of preparation, physical and chemical properties(of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration,
uses with special reference to methanol and ethanol.
Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophillic substitution reactions, uses of phenols.
Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

UNIT XII: ALDEHYDES, KETONES AND CARBOXYLIC ACIDS
Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of nucleophillic addition, reactivity of alpha hydrogen in aldehydes: uses.
Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

UNITXIII: ORGANIC COMPOUNDS CONTAINING NITROGEN
Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.
Cyanides and Isocyanides - will be mentioned at relevant places in context.
Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

UNIT XIV: BIOMOLECULES
Carbohydrates - Classification (aldoses and ketoses), monosaccahrides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen) importance.
Proteins -Elementary idea of α - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes. Hormones - Elementary idea excluding structure.
Vitamins - Classification and functions.
Nucleic Acids: DNA and RNA.

UNIT XV: POLYMERS
Classification - natural and synthetic, methods of polymerization (addition and condensation),

copolymerization, some important polymers: natural and synthetic like polythene, nylon polyesters, bakelite, rubber. Biodegradable and non-biodegradable polymers.

UNIT XVI: CHEMISTRY IN EVERYDAY LIFE

Chemicals in medicines - analgesics, tranquilizers antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines.

Chemicals in food - preservations, artificial sweetening agents, elementary idea of antioxidants.

Cleansing agents- soaps and detergents, cleansing action.

PRACTICAL SYLLABUS 60 Hours

Micro-chemical methods are available for several of the practical experiments. Wherever possible, such techniques should be used.

A. Surface Chemistry

(a) Preparation of one lyophilic and one lyophobic sol

Lyophilic sol - starch, egg albumin and gum

Lyophobic sol - aluminium hydroxide, ferric hydroxide, arsenous sulphide.

(b) Dialysis of sol-prepared in (a) above.

(c) Study of the role of emulsifying agents in stabilizing the emulsion of different oils.

B. Chemical Kinetics

(a) Effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.

(b) Study of reaction rates of any one of the following:

(i) Reaction of iodide ion with hydrogen peroxide at room temperature using different concentration of iodide ions.

(ii) Reaction between potassium iodate, (KIO_3) and sodium sulphite: (Na_2SO_3) using starch solution as indicator (clock reaction).

C. Thermochemistry

Any one of the following experiments

i) Enthalpy of dissolution of copper sulphate or potassium nitrate.

ii) Enthalpy of neutralization of strong acid (HCI) and strong base (NaOH).

iii) Determination of enthaply change during interaction (Hydrogen bond formation) between acetone and chloroform.

D. Electrochemistry

Variation of cell potential in $Zn/Zn^{2+}||\ Cu^{2+}/Cu$ with change in concentration of electrolytes ($CuSO_4$ or $ZnSO_4$) at room temperature.

E. Chromatography

i) Separation of pigments from extracts of leaves and flowers by paper chromatography and determination of Rf values.

ii) Separation of constituents present in an inorganic mixture containing two cations only (constituents having large difference in Rf values to be provided).

F. Preparation of Inorganic Compounds

i) Preparation of double salt of ferrous ammonium sulphate or potash alum.

ii) Preparation of potassium ferric oxalate.

G. Preparation of Organic Compounds

Preparation of any one of the following compounds
i) Acetanilide
ii) Di -benzal acetone
iii) p-Nitroacetanilide
iv) Aniline yellow or 2 - Naphthol aniline dye[3].

H. Tests for the functional groups present in organic compounds:
Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (Primary) groups.

I. Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given food stuffs.

J. Determination of concentration/ molarity of KMnO solution by titrating it against a standard solution of:
i) Oxalic acid,
ii) Ferrous ammonium sulphate
(Students will be required to prepare standard solutions by weighing themselves).

K. Qualitative analysis
Determination of one cation and one anion in a given salt.
Cation - Pb^{2+}, Cu^{2+}, As^{3+}, , Fe^{3+},Mn^{2+}, Zn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, NH_4^+
Anions - CO_3^{2-}, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_3^-, NO_2^-, Cl^-, Br^-, I^-, PO_4^{3-}, $C_2O_4^{2-}$, CH_3COO^-
(Note: Insoluble salts excluded)

PROJECT
Scientific investigations involving laboratory testing and collecting information from other sources.

A few suggested Projects.
• Study of the presence of oxalate ions in guava fruit at different stages of ripening.
• Study of quantity of casein present in different samples of milk.
• Preparation of soybean milk and its comparison with the natural milk with respect to curd formation, effect of temperature, etc.
• Study of the effect of potassium bisulphate as food preservative under various conditions (temperature, concentration, time etc.)
• Study of digestion of starch by salivary amylase and effect of pH and temperature on it.
• Comparative study of the rate of fermentation of following materials: wheat flour, gram flour, potato juice, carrot juice etc.
• Extraction of essential oils present in Saunf (aniseed),Ajwain (carum), Illaichi (cardamom).
• Study of common food adulterants in fat, oil, butter, sugar, turmeric power, chilli powder and pepper.

Note: Any investigatory project, which involves about 10 periods of work, can be chosen with the approval of the teacher.

Recommended Textbooks.
1. Chemistry Part -I, Published by NCERT.
2. Chemistry Part -II, Published by NCERT.

SYLLABUS FOR VOCATIONAL TRAINING

DIPLOMA VOCATIONAL IN ELECTRICAL EQUIPMENT MAINTENANCE

LEVEL : IV

BRANCH DISCIPLINE : ELECTRICAL EQUIPMENT MAINTENANCE

TEACHING & EXAMINATION SCHEME:

SNo	Subject	Subject Code	Period per week			Scheme of Examination					Total Marks	Credit
						Theory			Practical			
			L	T	P	ELE	CT	TA	EPE	TA		
1	**Practical**	**991463(24)**	-	-	12	-	-	-	350	30	380	24
	Total		-	-	12	-	-	-	350	30	380	24

DISTRIBUTION OF MARKS & HOURS:

CHAPTER NO.	CHAPTER NAME	HOURS
01	Safety precautions	20
02	Earthing & House Wiring	60
03	Repair of Home Appliance	90
04	Transformer Winding	95
05	DC Machine Winding	95
	TOTAL	360

COURSE CONTENT

Chapter 1 Electrical Safety & Safety Measures

Safety Precautions
General safety tools & equipment
Safety equipment available with electrician while working on live electrical Installation

Chapter 2 Earthing & House Wiring

ISI rules related to wiring
Diagram & system used in domestic wiring installation
Earthing – types
Earthing domestic installation
IE rule for Energy meter Installation

Chapter 3 Repair of Home Appliance

Install service & repair all kinds or electrical home appliances
Repair & rectification of an automatic electric iron
Servicing & repairing of mixer, ceiling & table fan
Assemble & install fluorescent 6 lamps
Assemble, connect & install a twin fluorescent lamp with accessories
Maintenance of decorative serial lamp for a required supply voltage
Thermostat heat controls of Automatic electric iron, steam iron, spray irons
Understands home appliances like heater, iron, kettle, ceiling fan, table fan, washing machines etc.
Repair & service technique of cooking range, storage water heater, washing machines, wet grinders

Replace the heating element in a soldering

Chapter 4 Transformer Winding

Identification of phase & neutral in single-phase A/C. supply
Test a single phase transformer for its continuity & insulation
Measuring an enamelled winding wire with standard wire gauge
Wind/ rewind a small transformer
Use & Operation of hand operated & motorized coil winding machine.
Impregnation varnish after testing the transformer – its advantages.

Chapter 5 Armature Winding

Type of winding
Introduction to armature winding
Method of dismantling the burnt winding wire
Pole pitch, coil pitch back & front pitch progressive & retrogressive winding etc.
A/C & D/C armature winding
Preparation of winding data for given armature
Preparation of winding table, connection diagram, winding diagram for given Armature
Impregnation methods of armature after rewinding & testing.

PRACTICAL EXPERIENCES

1. Study about safety precautions
2. Common hand tools, their uses, care & maintenance.
3. Identifying the wiring accessories aa per symbols
4. Carryout the wiring in PVC casing & capping as per layout
5. Carryout pipe earthing& plate earthing
6. Carryout domestic installation testing
7. General repair of heating iron, kettle, ceiling fan, table fan, washing machine etc.
8. Test the fan capacitors
9. Clean and lubricate the bearing of ceiling & table fan, & check the speed
10. Regulator of both fan
11. Measure the insulation resistance between the terminal & body of the appliance
12. Check the oscillator mechanisms of table fan
13. Select the fuse size according to the load of circuit
14. Check the internal connections of cooking range selector switch & circuits connections in different temperature arrangements.
15. Determine the number of lamps to be connected in series for particulars supply voltage for making decorative serial lamp
16. Dismantle & reassemble automatic iron, ceiling fan, table fan, cooking range, storage heater, washing machines & wet grinders etc

17. Check the simple mechanical timer, small water pump of washing machines & regular service & faults
18. Repair of house wiring
19. Testing the supply using test lamp with different wattage lamps.
20. Take the dimensions of a bobbin & prepare the bobbin from suitable materials
21. Measure & determine the size of winding wire for primary & secondary
22. Dismantle/ reassemble the transformer cores
23. Wind the primary & secondary windings layer by layer
24. Familiarization & operation with the motorized coil winding machine – General maintenance to be done
25. Test the transformer for insulation, transformation ratio & performance
26. Study the parts of armature & check & test the armature, strip the old winding from the armature
27. Record the winding data & prepare the armature for rewinding
28. Wind the coils by hand insulate them & connection of armature leads on raiser
29. Understand end connections, electrical & distinguishing start & finish of each
30. Varnish the armature winding

SUGGESTED REFERENCES

1. Electrical Appliances Anwani, J.M. R.B. Publications, New Delhi
2. Basic Electrical Engineering Mittal, V.N. Tata McGraw-HillNew Delhi
3. Electrical Installation Maintenance & testing Qureshi M.F, Deepak pbs.