R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Construction Materials	CEPC-311	3L-1T-2P	6

Course outcomes:

After completing this course, student will be able to:

- Identify relevant construction materials.
- Identify relevant natural construction materials.
- Select relevant artificial construction materials.
- Select relevant special type of construction materials.
- Identify and use of processed construction materials.

Unit – I

Overview of Construction Materials Scope of construction materials in Building Construction, Transportation Engineering, Environmental Engineering, Irrigation Engineering (applications only).Selection of materials for different civil engineering structures on the basis of strength, durability, Eco friendly and economy. Broad classification of materials –, Natural, Artificial, special, finishing and recycled.

Unit – II

Natural Construction Materials Requirements of good building stone; general characteristics of stone; quarrying and dressing methods and tools for stone. Structure of timber, general properties and uses of good timber, different methods of seasoning for preservation of timber, defects in timber, use of bamboo in construction. Asphalt, bitumen and tar used in construction, properties and uses. Properties of lime, its types and uses. Types of soil and its suitability in construction. Properties of sand and uses Classification of coarse aggregate according to size

Unit- III

Artificial Construction Materials Constituents of brick earth, Conventional / Traditional bricks, Modular and Standard bricks, Special bricks –fly ash bricks, Characteristics of good brick, Field tests on Bricks, Classification of burnt clay bricks and their suitability, Manufacturing process of burnt clay brick, fly ash bricks, Aerated concrete blocks. Flooring tiles – Types, uses Manufacturing process of Cement - dry and wet (only flow chart), types of cement and its uses. field tests on cement. Pre-cast concrete blocks- hollow, solid, pavement blocks, and their uses. Plywood, particle board, Veneers, laminated board and their uses. Types of glass: soda lime glass, lead glass and borosilicate glass and their uses. Ferrous and non-ferrous metals and their uses. 61 Civil Engineering Curriculum Structure

Unit– IV

Special Construction Materials Types of material and suitability in construction works of following materials: Water proofing, Termite proofing; Thermal and sound insulating materials.

Fibers – Types –Jute, Glass, Plastic Asbestos Fibers, (only uses).Geo polymer cement: Geo-cement: properties, uses

Unit– V

Processed Construction Materials Constituents and uses of POP (Plaster of Paris), POP finishing boards, sizes and uses. Paints- whitewash, cement paint, Distempers, Oil Paints and Varnishes with their uses. (Situations where used). Industrial waste materials- Fly ash, Blast furnace slag, Granite and marble polishing waste and their uses. Agro waste materials - Rice husk, Bagasse, coir fibres and their uses. Special processed construction materials; Geo synthetic, Ferro Crete, Artificial timber, Artificial sand and their uses.

Course Objectives:

Following are the objectives of this course:

- To learn about various construction materials, and understand their relevant characteristics.
- To be able to identify suitability of various materials for different construction purposes.
- To know about natural, artificial, and processed materials available for various purposes of construction activities.

Reference Book:

1. Ghose, D. N., Construction Materials, Tata McGraw Hill, New Delhi.
2. S.K. Sharma, Civil Engineering Construction Materials, Khanna Publishing House, Delhi
3. Varghese, P.C. , Building Materials, PHI learning, New Delhi.
4. Rangwala, S.C., Engineering Materials, Charator publisher, Ahmadabad.
5. Somayaji, Shan, Civil Engineering Materials, Pearson education, New Delhi.
6. Rajput, R.K, Engineering Materials, S. Chand and Co., New Delhi.

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Basic Surveying	CEPC-312	3L-1T-2P	6

Course outcomes:

After completing this course, student will be able to:

- Select the type of survey required for given situation.
- Compute area of open field using chain, tape and cross staff.
- Conduct traversing in the field using chain and compass.
- Use leveling instruments to determine reduced level for preparation of contour maps
- Use digital planimeter to calculate the areas.

Unit – I

Overview and Classification of Survey

Survey- Purpose and Use.Types of surveying- Primary and Secondary, Classification: Plane, Geodetic,Cadastral,Hydrographic,Photogrammetry and Aerial.Principles of Surveying. Scales: Engineer's scale, Representative Fraction (RF) and diagonal scale.

Unit– II

Chain Surveying

Instruments used in chain survey: Metric Chain, Tapes, Arrow, Ranging rod, Line ranger, Offset rod, Open cross staff, Optical square. Chain survey Station, Base line, Check line, Tie line, Offset. Tie station. Ranging: Direct and Indirect Ranging. Methods of Chaining, obstacles in chaining Errors in length: Instrumental error, personal error, error due to natural cause, random error. Principles of triangulation. Types of offsets: Perpendicular and Oblique. Conventional Signs, Recording of measurements in a field book.

Unit– III

Compass Traverse Survey

Compass Traversing- open, closed. Technical Terms: Geographic/ True Magnetic Meridians and Bearings, Whole Circle Bearing system and Reduced Bearing system and examples on conversion of given bearing to another bearing (from one form to another), Fore Bearing and Back Bearing, Calculation of internal and external angles from bearings at a station, Dip of Magnetic needle, Magnetic Declination. Components of Prismatic Compass and their Functions, Methods of using Prismatic Compass-Temporary adjustments and observing bearings. Local attraction, Methods of correction of observed bearings - Correction at station and correction to included angles. Methods of plotting a traverse and closing error, Graphical adjustment of closing error.

Unit– IV

Levelling and Contouring

Basic terminologies: Level surfaces, Horizontal and vertical surfaces, Datum, Bench Marks- GTS, Permanent, Arbitrary and Temporary, Reduced Level, Rise, Fall, Line of collimation, Station, Back sight, Fore sight, Intermediate sight, Change point, Height of instruments. Types of levels: Dumpy, Tilting, Auto level, Digital level, Components of Dumpy Level and its fundamental axes, Temporary adjustments of Level. Types of Leveling Staff: Self-reading staff and Target staff. Reduction of level by Line of collimation and Rise and Fall Method. Leveling Types: Simple, Differential, Fly, Profile and Reciprocal Leveling. Contour, contour intervals, horizontal equivalent. Uses of contour maps, Characteristics of contours, Methods of Contouring: Direct and indirect

Unit– V

Measurement of Area and Volume

Components and use of Digital planimeter. Measurement of area using digital planimeter. Measurement of volume of reservoir from contour map.

Course Objectives:

Following are the objectives of this course:

- To understand types of surveying works required.
- To know the types of method and equipments to be used for different surveys.
- To know the use and operational details of various surveying equipments.

Reference Book:

1. Punmia, B.C,; Jain, Ashok Kumar; Jain, Arun Kumar, Surveying I, Laxmi Publications, New Delhi.
2. Basak, N. N., Surveying and Levelling, McGraw Hill Education, New Delhi.
3. Kanetkar, T. P.; Kulkarni, S. V., Surveying and Levelling volume I, Pune VidyarthiGruhPrakashan.
4. Duggal, S. K., Survey I, McGraw Hill Education, New Delhi.
5. Saikia, M D.; Das. B.M.; Das. M.M., Surveying, PHI Learning, New Delhi.

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Mechanics of Material	CEPC-313	3L-1T-2P	6

Course outcomes:

After completing this course, student will be able to:

- Articulate practical applications of moment of inertia of symmetrical and unsymmetrical structural sections.
- Analyse structural behaviour of materials under various loading conditions.
- Interpret shear force and bending moment diagrams for various types of beams and loading
- Conditions.
- Determine the bending and shear stresses in beams under different loading conditions.
- Analyse the column for various loading and end conditions.

Unit – I

Moment of Inertia

Moment of inertia (M.I.): Definition, M.I. of plane lamina, Radius of gyration, section modulus,Parallel and Perpendicular axes theorems (without derivations),M.I. of rectangle,square, circle, semi-circle, quarter circle and triangle section (without derivations).M.I. of symmetrical and unsymmetrical I-section, Channel section, T-section,Anglesection,Hollow sections and built up sections about centroidal axes and any other referenceaxis.Polar Moment of Inertia of solid circular sections.

Unit– II

Simple Stresses and Strains

Definition of rigid, elastic and plastic bodies, deformation of elastic body under various forces, Definition of stress, strain, elasticity, Hook's law, Elastic limit, Modulus of elasticity. Type of Stresses-Normal, Direct, Bending and Shear and nature of stresses i.e. Tensile and Compressive stresses. Standard stress strain curve for tor steel bar under tension, Yield stress, Proof stress, Ultimate stress, Strain at various critical points, Percentage elongation and Factor of safety. Deformation of body due to axial force, forces applied at intermediate sections, Maximum and minimum stress induced, Composite section under axial loading. Concept of temperature stresses and strain, Stress and strain developed due to temperature variation in homogeneous simple bar (no composite section) Longitudinal and lateral strain, Modulus of Rigidity, Poisson's ratio, Biaxial and tri-axial stresses, volumetric strain, change in volume, Bulk modulus (Introduction only).Relation between modulus of elasticity, modulus of rigidity and bulk modulus (without derivation).

Unit– III

Shear Force and Bending Moment

Types of supports, beams and loads. Concept and definition of shear force and bending moment, Relation between load, shear force and bending moment (without derivation).Shear force and bending moment diagram for cantilever and simply supported beams subjected to point loads, uniformly distributed loads and couple (combination of any two types of loading), point of contra flexure.

Unit– IV

Bending and Shear Stresses in beams

Concept and theory of pure bending, assumptions, flexural equation (without derivation),bending stresses and their nature, bending stress distribution diagram. Concept of moment of resistance and simple numerical problems using flexural equation. Shear stress equation (without derivation), relation between maximum and average shear stress for rectangular and circular section, shear stress distribution diagram. Shear stress distribution for square, rectangular, circle, hollow, square, rectangular, circular, angle sections, channel section, I-section, T section. Simple numerical problems based on shear equation.

Unit– V

Columns

Concept of compression member, short and long column, Effective length, Radius of gyration, Slenderness ratio, Types of end condition for columns, Buckling of axially loaded columns. Euler's theory, assumptions made in Euler's theory and its limitations, Application of Euler's equation to calculate buckling load. Rankine' s formula and its application to calculate crippling load. Concept of working load/safe load, design load and factor of safety.

Course Objectives:

Following are the objectives of this course:

- To learn properties of area and structural material properties.
- To understand the concept of stress and strain.
- To calculate shear force, bending moment for different shapes of structural elements and Corresponding stresses.
- To understand the concept of buckling loads for short and long columns.

Reference Book:

1. Bedi D.S. , Strength of Materials, Khanna Publishing House, Delhi, Ed. 2018
2. Timoshenko, S., Strength of Materials, Vol. I, CBS, New Delhi.
3. Khurmi, R.S., Strength of Materials, S Chand and Co. Ltd. New Delhi.
4. Ramamurtham, S, Strength of Materials, DhanpatRai and sons, New Delhi.
5. Punmia B C, Strength of Materials, Laxmi Publications (p) Ltd. New Delhi.
6. Rattan S.S., Strength of Materials, McGraw Hill Education; New Delhi.

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Building Construction	CEPC-314	3L-1T-0P	4

Course outcomes:

After completing this course, student will be able to:

- Identify components of building structures.
- Propose suitable type of foundation for building structures.
- Select suitable type of masonry for building structures.
- Propose relevant means of communications for different types of buildings.
- Select relevant material for finishing works.

Unit – I

Overview of Building Components

Classification of Buildings as per National Building Code Group A to I, As per Types of Constructions-Load Bearing Structure, Framed Structure, Composite Structure. Building Components - Functions of Building Components, Substructure Foundation, Plinth. Superstructure – Walls, Partition wall, Cavity wall, Sill, Lintel, Doors and Windows, Floor, Mezzanine floor, Roof, Columns, Beams, Parapet.

Unit – II

Construction of Substructure

Job Layout: Site Clearance, Layout for Load Bearing Structure and Framed Structure by Center Line and Face Line Method, Precautions. Earth work: Excavation for Foundation, Timbering and Strutting, Earthwork for embankment, Material for plinth Filling, Tools and plants used for earthwork. Foundation: Functions of foundation, Types of foundation – Shallow Foundation, Stepped Footing, Wall Footing, Column Footing, Isolated and Combined Column Footing, Raft Foundation, Grillage Foundation. Deep Foundation - Pile Foundation, Well foundation and Caissons, Pumping Methods of Dewatering, Deep wells, Well points, Cofferdams (Introduction only).

Unit- III

Construction of Superstructure

Stone Masonry: Terms used in stone masonry- facing, backing, hearting, Through stone, corner stone, cornice. Types of stone masonry: Rubble masonry, Ashlar Masonry and their types. Joints in stone masonry and their purpose. Selection of Stone Masonry, Precautions to be taken in tone Masonry Construction.

Brick masonry: Terms used in brick masonry- header, stretcher, closer, quoins, course, face, back, hearting, bat bond, joints, lap, frog line, level and plumb. Bonds in brick masonry-header bond, stretcher bond, English bond and Flemish bond. Requirements of good brick masonry. Junctions in brick masonry and their purpose and procedure. Precautions to be observed in Brick Masonry Construction. Comparison between stone and Brick Masonry. Tools and plants required for construction of stone and brick masonry. Hollow concrete block masonry and composite masonry.

Scaffolding and Shoring: Purpose, Types of Scaffolding, Process of Erection and Dismantling. Purpose and Types of Shoring, Underpinning. Formwork: Definition of Formwork, Requirements of Formwork, Materials used in Formwork, Types of Formwork, Removal of formwork.

Unit– IV

Building Communication and Ventilation

Horizontal Communication: Doors –Components of Doors, Full Paneled Doors, Partly Paneled and Glazed Doors, Flush Doors, Collapsible Doors, Rolling Shutters, Revolving Doors, Glazed Doors. Sizes of Door recommended by BIS.

Windows: Component of windows, Types of Windows - Full Paneled, Partly Paneled and Glazed, wooden, Steel, Aluminum windows, Sliding Windows, Louvered Window, Bay window, Corner window, clear-storey window, Gable and Dormer window, Skylight. Sizes of Windows recommended by BIS. Ventilators. Fixtures and fastenings for doors and windows-Material used and functions of Window Silland Lintels, Shed / Chajja.

Vertical Communication: Means of Vertical Communication- Stair Case, Ramps, Lift, Elevator sand Escalators. Terms used in staircase-steps, tread, riser, nosing, soffit, waist slab, bal67Civil Engineering Curriculum Structureuster, balustrade, scotia, hand rails, newel post, landing, headroom, winder. Types of staircase(On the basis of shape): Straight, dog-legged, open well, Spiral, quarter turn, bifurcated, Three quarter turn and Half turn, (On the basis of Material): Stone, Brick, R.C.C., wooden and Metal.

Unit– V

Building Finishes

Floors and Roofs: Types of Floor Finishes and its suitability- Kota, Marble, Granite, Ceramic Tiles, Vitrified, Chequered Tiles, Paver Blocks, Concrete Floors, wooden Flooring, Skirting and Dado. Process of Laying and Construction, Finishing and Polishing of Floors, Roofing Materials-RCC, Mangalore Tiles, AC Sheets, G.I. sheets, Corrugated G.I. Sheets, Plastic and Fibre Sheets. Types of Roof: Flat roof, Pitched Roof-King Post truss, Queen Post Truss, terms used in roofs.

Wall Finishes: Plastering – Necessity of Plastering, Procedure of Plastering, Single Coat Plaster, Double Coat Plaster, Rough finish, Neeru Finishing and Plaster of Paris (POP). Special Plasters-Stucco plaster, sponge finish, pebble finish. Plaster Board and Wall Claddings. Precautions to be taken in plastering, defects in plastering. Pointing – Necessity, Types of point ingand procedure of Pointing. Painting –Necessity, Surface Preparation for painting, Methods of Application.

Course Objectives:

Following are the objectives of this course:

- To identify different components of building.
- To understand different types of foundation and their significance.
- To know different types of masonry and their construction.

- To highlight the importance of communications in building planning.

Reference Book:

1. S. P. Arora and Bindra., Building Construction, DhanpatRai Publication, Delhi.
2. Sushil Kumar., Building Construction, Standard Publication.
3. Rangawala, S. C., Building Construction, Charotar Publication, Anand.
4. Punmia B. C., and Jain A. K., Building Construction ,Firewall Media.
5. Sharma S. K., Building Construction, S. Chand and Co. Pvt. Ltd., New Delhi.
6. JanardanZha , Building Construction, Khanna Publication

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DIPLOMA (CIVIL ENGINEERING)

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Semester - III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Concrete Technology	CEPC-315	3L-1T-2P	6

Course outcomes:

After completing this course, student will be able to:

- Use different types of cement and aggregates in concrete
- Prepare concrete of desired compressive strength.
- Prepare concrete of required specification.
- Maintain quality of concrete under different conditions.
- Apply relevant admixtures for concreting.

Unit – I

Cement, Aggregates and Water

Physical properties of OPC and PPC: fineness, standard consistency, setting time, soundness, compressive strength. Different grades of OPC and relevant BIS codes Testing of cement: Laboratory tests-fineness, standard consistency, setting time, soundness, compressive strength. Storage of cement and effect of storage on properties of cement.BIS Specifications and field applications of different types of cements: Rapid hardening, Lowheat, Portland pozzolana, Sulphate resisting, Blast furnace slag, High Alumina and White cement.Aggregates: Requirements of good aggregate, Classification according to size and shape. Fine aggregates: Properties, size, specific gravity, bulk density, water absorption and bulking,fineness modulus and grading zone of sand, silt content and their specification as per IS 383.Concept of crushed Sand.Coarse aggregates: Properties, size, shape, surface texture, water absorption, soundness,specific gravity and bulk density, fineness modulus of coarse aggregate, grading of coarseaggregates, crushing value, impact value and abrasion value of coarse aggregates with specifications.Water: Quality of water, impurities in mixing water and permissible limits for solids as per IS: 456.

Unit– II

Concrete

Concrete: Different grades of concrete, provisions of IS 456.Duff Abraham water cement (w/c) ratio law, significance of w/c ratio, selection of w/c ratiofor different grades, maximum w/c ratio for different grades of concrete for different exposureconditions as per IS 456.Properties of fresh concrete: Workability: Factors affecting workability of concrete. Determinationof workability of concrete by slump cone, compaction factor, Vee-Bee Consistometer.Value of workability requirement for different types of concrete works.Segregation, bleeding and preventive measures. Properties of Hardened concrete: Strength, Durability, Impermeability.

Unit– III

Concrete Mix Design and Testing of Concrete

Concrete mix design: Objectives, methods of mix design, study of mix design as per IS 10262 (only procedural steps). Testing of concrete, determination of compressive strength of concrete cubes at differentages, interpretation and co-relation of test results. Non- destructive testing of concrete: Rebound hammer test, working principle of reboundhammer and factor affecting the rebound index, Ultrasonic pulse velocity test as per IS13311(part 1 and 2), Importance of NDT tests.69 Civil Engineering Curriculum Structure

Unit– IV

Quality Control of Concrete

Concreting Operations: Batching, Mixing, Transportation, Placing, Compaction, Curing and Finishing of concrete. Forms for concreting: Different types of form works for beams, slabs, columns, materials used for form work, requirement of good form work. Stripping time for removal of form works per IS 456. Waterproofing: Importance and need of waterproofing, methods of waterproofing and materials used for water proofing. Joints in concrete construction: Types of joints, methods for joining old and new concrete, materials used for filling joints.

Unit– V

Chemical Admixture, Special Concrete and Extreme Weather concreting

Admixtures in concrete: Purpose, properties and application for different types of admixture such as accelerating admixtures, retarding admixtures, water reducing admixtures, air entraining admixtures and super plasticizers. Special Concrete: Properties, advantages and limitation of following types of Special concrete: Ready mix Concrete, Fiber Reinforced Concrete, High performance Concrete Self-compacting concrete and light weight concrete. Cold weather concreting: effect of cold weather on concrete, precautions to be taken while concreting in cold weather condition. Hot weather concreting: effect of hot weather on concrete, precautions to be taken while concreting in hot weather condition.

Course Objectives:

Following are the objectives of this course:

- To know properties of cement, aggregate and water used in concrete.
- To understand different characteristics of concrete.
- To learn about role of admixtures in concrete.

Reference Book:

1. Gambhir, M.L., Concrete Technology, Tata McGraw Hill Publishing Co. Ltd., Delhi.
2. Shetty, M.S., Concrete Technology, S. Chand and Co. Pvt. Ltd., Ram Nagar, Delhi.
3. Santhakumar, A. R., Concrete Technology, Oxford University Press, New Delhi.
4. Neville, A. M. and Brooks, J.J., Concrete Technology, Pearson Education Pvt. Ltd.
5. Neville, A. M., Concrete Technology, Pearson Education Pvt. Ltd., New Delhi.
6. Sood, H., Kulkarni P. D., Mittal L. N., Laboratory Manual in Concrete Technology, CBS Publishers,
New Delhi.

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Semester - III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Geotechnical Engineering	CEPC-316	3L-1T-2P	6

Course outcomes:

After completing this course, student will be able to:

- Identify types of rocks and sub soil strata of earth.
- Interpret the physical properties of soil related to given construction activities.
- Use the results of permeability and shear strength test for foundation analysis.
- Interpret soil bearing capacity results.
- Compute optimum values for moisture content for maximum dry density of soil through various tests.

Unit – I

Overview of Geology and Geotechnical Engineering

Introduction of Geology, Branches of Geology, Importance of Geology for civil engineering structure and composition of earth, Definition of a rock: Classification based on their genesis(mode of origin), formation.Classification and engineering uses of igneous, sedimentary and metamorphic rocks.Importanceof soil as construction material in Civil engineering structures and as foundationbed for structures.Field application of geotechnical engineering for foundation design, pavement design, designof earth retaining structures, design of earthen dam

Unit– II

Physical and Index Properties of Soil

Soil as a three phase system, water content, determination of water content by oven ryingmethod as per BIS code, void ratio, porosity and degree of saturation, density index. Unitweight of soil mass – bulk unit weight, dry unit weight, unit weight of solids, saturated unitweight, submerged unit weight. Determination of bulk unit weight and dry unit weight bycore cutter and sand replacement method, Determination of specific gravity by pycnometer.Consistency of soil, Atterberg limits of consistency: Liquid limit, plastic limit and shrinkagelimit. Plasticity ndex.Particle size distribution test and plotting of curve, Determination of effective diameter ofsoil, well graded and uniformly graded soils, BIS classification of soil.

Unit– III

Permeability and Shear Strength of Soil

Definition of permeability, Darcy's law of permeability, coefficient of permeability, factors affecting permeability, determination of coefficient of permeability by constant head and falling head tests, simple problems to determine coefficient of permeability. Seepage throughearthen structures, seepage velocity, seepage pressure, phreatic line, flow lines, applicationof flow net,

(No numerical problems). Shear failure of soil, concept of shear strength of soil. Components of shearing resistance ofsoil – cohesion, internal friction.Mohr-Coulomb failure theory, Strength envelope, strengthequation for purely cohesive and cohesion less soils. Direct shear and vane shear test –laboratorymethods.

Unit– IV

Bearing Capacity of Soil

Bearing capacity and theory of earth pressure.Concept of bearing capacity, ultimate bearing capacity, safe bearing capacity and allowable bearing pressure.Introduction to Terzaghi's analysis and assumptions, effect of water table on bearing capacity.Field methods for determination of bearing capacity Plate load and Standard PenetrationTest.Test procedures as per IS:1888 & IS:2131. Definition of earth pressure,Active and Passive earth pressure for no surcharge condition,coefficient of earth pressure, Rankine's theory and assumptions made for non-cohesive Soils.

Unit– V

Compaction and stabilization of soil

Concept of compaction, Standard and Modified proctor test as per IS code, Plotting of Compac71Civil Engineering Curriculum Structuretion curve for determining: Optimum moisture content(OMC), maximum dry density(MDD),Zero air voids line. Factors affecting compaction, field methods of compaction – rolling, rammingand vibration. Suitability of various compaction equipments-smooth wheel roller, sheepfoot roller, pneumatic tyred roller, Rammer and Vibrator, Difference between compaction andconsolidation.Concept of soil stabilization, necessity of soil stabilization, different methods of soil stabilization.California bearing ratio (CBR) test - Meaning and Utilization in Pavement Construction Necessity of site investigation and soil exploration: Types of exploration, criteria for decidingthe location and number of test pits and bores. Field identification of soil – dry strength test,dilatancy test and toughness test.

Course Objectives:

Following are the objectives of this course:

- To understand and determine physical and index properties and classification of soil
- To estimate permeability and shear strength of soil
- To know the load bearing capacity of soil
- To learn various soil stabilization and compaction methods

Reference Book:

1. Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publication, Delhi.
2. Murthy, V.N.S., A text book of soil mechanics and foundation Engineering, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
3. Ramamurthy, T.N. &Sitharam,T.G., Geotechnical Engineering(Soil Mechanics), S Chand and Company LTD., New Delhi.
4. Raj, P. Purushothama, Soil Mechanics and Foundation Engineering, Pearson India, New Delhi.
5. Kasamalkar, B. J., Geotechnical Engineering, Pune VidyarthiGrihaPrakashan, Pune.
6. Arora K R, Soil Mechanics and Foundation Engineering, Standard Publisher.

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Semester- IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Hydraulics	CEPC-411	3L-1T-2P	6

Course outcomes:

After completing this course, student will be able to:

- Measure pressure and determine total hydrostatic pressure for different conditions.
- Understand various parameters associated with fluid flow
- Determine head loss of fluid flow through pipes.
- Find the fluid flow parameters in open channels.
- Select relevant hydraulic pumps for different applications.

Unit – I

Pressure measurement and Hydrostatic pressure

• Technical terms used in Hydraulics –fluid, fluid mechanics, hydraulics, hydrostatics and hydrodynamics - ideal and real fluid, application of hydraulics.

• Physical properties of fluid – density-specific volume, specific gravity, surface tension, capillarity, viscosity-Newton's law of viscosity.

• Various types of pressure – Atmospheric Pressure, Gauge Pressure, Absolute Pressure, Vacuum Pressure. Concept of Pressure head and its unit, Pascal's law of fluid pressure and its uses.

• Measurement of differential Pressure by different methods.

• Variation of pressure with depth, Pressure diagram, hydrostatic pressure and center of pressure on immersed surfaces and on tank walls.

• Determination of total pressure and center of pressure on sides and bottom of water tanks, sides and bottom of tanks containing two liquids, vertical surface in contact with liquid on either side

Unit– II

Fluid Flow Parameters

• Types of flow – Gravity and pressure flow, Laminar, Turbulent, Uniform, Non-uniform, Steady, Unsteady flow. Reynolds number.

• Discharge and its unit, continuity equation of flow.

• Energy of flowing liquid: potential, kinetic and pressure energy.

• Bernoulli's theorem : statement, assumptions, equation.

Unit– III

Flow through pipes

• Major head loss in pipe: Frictional loss and its computation by Darcy's Weisbach equation, Use of Moody's Diagram and Nomograms.

• Minor losses in pipe: loss at entrance, exit, sudden contraction, sudden enlargement and fittings.

• Flow through pipes in series, pipes in parallel and Dupuit's equation for equivalent pipe.

• Hydraulic gradient line and total energy line. Civil Engineering Curriculum Structure 80
• Water hammer in pipes: Causes and Remedial measures.
• Discharge measuring device for pipe flow: Venturi meter - construction and working.
• Discharge measurement using Orifice, Hydraulic Coefficients of Orifice.

Unit– IV

Flow through Open Channel

• Geometrical properties of channel section: Wetted area, wetted perimeter, hydraulic radius for rectangular and trapezoidal channel section.
• Determination of discharge by Chezy's equation and Manning's equation.
• Conditions for most economical rectangular and trapezoidal channel section.
• Discharge measuring devices: Triangular and rectangular Notches.
• Velocity measurement devices: current meter, floats and Pitot's tube.
• Specific energy diagram, Froudes' Number

Unit– V

Hydraulic Pumps

• Concept of pump, Types of pump - centrifugal, reciprocating, submersible.
• Centrifugal pump: components and working
• Reciprocating pump: single acting and double acting, components and working.
• Suction head, delivery head, static head, Manometric head
• Power of centrifugal pump.
• Selection and choice of pump.

Course Objectives:

Following are the objectives of this course:

- To understand parameters associated with fluid flow and hydrostatic pressure.
- To know head loss and water hammer in fluid flowing through pipes.
- To learn different types of pumps and their uses.

Reference Book:

1. Modi, P. N.and Seth, S.M., Hydraulics and Fluid Mechanics, Standard book house, Delhi.
2. S.S. Rattan, Fluid Mechanics & Hydraulic Machines, Khanna Book Publishing Co., New Delhi
3. Ramamrutham, and Narayan, R., Hydraulics, Fluid Mechanics and Fluid Machines, DhanpatRai Publishing Company, New Delhi.
4. Khurmi R S, Hydraulics, Fluid Mechanics, Hydraulic machines, S. Chand Publishers
5. Rajput, R K, Fluid Mechanics, S Chand, New Delhi.
6. Ojha, C S P, Berndtsson, R, and Chandramoulli P. N., Fluid Mechanics and Machinery, Oxford University Press, New Delhi.

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester- IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Advanced Surveying	C EPC-412	3L-1T-2P	6

Course outcomes:

- After completing this course, student will be able to:
- Prepare plans using Plane Table Surveys.
- Prepare plans using Theodolite surveys.
- Find distances and elevations using Tachometer.
- Prepare plans using Total Station instrument.
- Locate coordinates of stations using GPS.

Unit – I

Plane Table Surveying

• Principles of plane table survey.
• Accessories of plane table and their use, Telescopic alidade.
• Setting of plane table; Orientation of plane table - Back sighting and Magnetic meridian method, True Meridian Method.
• Methods of plane table surveys- Radiation, Intersection and Traversing.
• Merits and demerits of plane table survey.

Unit– II

Theodolite Surveying

• Types and uses of Theodolite, Components of transit Theodolite and their functions, Reading theVernier of transit Theodolite.
• Technical terms- Swinging, Transiting, Face left, Face right.
• Fundamental axes of transit Theodolite and their relationship
• Temporary adjustment of transit Theodolite.
• Measurement of horizontal angle- Direct and Repetition method, Errors eliminated by method of repetition.
• Measurement of magnetic bearing of a line, Prolonging and ranging a line, deflection angle.
• Measurement of vertical Angle.
• Theodolite traversing by Included angle method and Deflection angle method.
• Checks for open and closed traverse, Calculations of bearing from angles.
• Traverse computation-Latitude, Departure, Consecutive coordinates, Independent coordinates, balancing the traverse by Bowditch's rule and Transit rule, Gale's Traverse table computation.

Unit– III

Tacheometric surveying and Curve setting

• Principles of Tacheometry, Tacheometer and its component parts, Anallatic lens.
• Tacheometric formula for horizontal distance with telescope horizontal and staff vertical.
• Field method for determining constants of tacheometer, Determining horizontal and vertical distances with tacheometer by fixed hair method and staff held vertical, Limitations of tacheometry.
Civil Engineering Curriculum Structure 82
• Types of curves used in roads and railway alignments. Designation of curves.
• Setting simple circular curve by offsets from long chord and Rankine's method of deflection angles.

Unit– IV

Advanced surveying equipments

• Principle of Electronic Distance Meter (EDM), its component parts and their Functions, use of EDM.
• Use of micro optic Theodolite and Electronic Digital Theodolite.
• Use of Total Station, Use of function keys.
• Measurements of Horizontal angles, vertical angles, distances and coordinates using Total Station, Traversing, Profile Survey and Contouring with Total Station.

Unit– V

Remote sensing, GPS and GIS

• Remote Sensing – Overview, Remote sensing system, Applications of remote sensing in Civil engineering, land use / Land cover, mapping, disaster management.
• Use of Global Positioning System (G.P.S.) instruments.
• Geographic Information System (GIS): Over view, Components, Applications, Software for GIS.
• Introduction to Drone Surveying.

Course Objectives:

Following are the objectives of this course:
• To know methods of plane surveying and Theodolite surveying and their uses
• To learn tacheometric surveying and curve setting
• To understand the principles of Electronic Distance Measurement equipment and Total station and their use.
• To know the concept of remote sensing, GPS and GIS

Reference Book:

1. Kanetkar, T. P.; Kulkarni, S. V., Surveying and Levelling Part I and II, Pune VidyarthiGruh Prakashan, Pune.
2. Basak, N. N.,Surveying and Levelling, McGraw Hill Education (India) Pvt. Ltd.,Noida.
3. Duggal, S. K., Survey I and Survey II, Tata McGraw Hill Education Pvt. Ltd., Noida.
4. Saikia, M D.; Das. B.M.; Das. M.M., Surveying PHI Learning Pvt. Ltd., New Delhi.
5. Subramanian, R., Surveying and Levelling, Oxford University Press. New Delhi.
6. Punmia, B.C,; Jain, Ashok Kumar; Jain, Arun Kumar, Surveying Vol. I and Surveying Vol. II,

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester- IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Theory of structures	CEPC-413	3L-1T-0P	4

Course outcomes:

After completing this course, student will be able to:

- Analyze stresses induced in vertical member subjected to direct and bending loads.
- Analyze slope and Deflection in fixed and continuous beams.
- Analyze continuous beam under different loading conditions using the principles of Three Moments.
- Analyze continuous beam using Moment Distribution Method under different loading conditions.
- Evaluate axial forces in the members of simple truss.

Unit – I

Direct and Bending Stresses in vertical members

• Introduction to axial and eccentric loads, eccentricity about one principal axis only, nature of stresses, Maximum and minimum stresses, resultant stresses and distribution diagram.
• Condition for no tension or zero stress at extreme fiber, Limit of eccentricity, core of section for rectangular and circular cross sections, Middle third rule.
• Chimneys of circular cross section subjected to wind pressure, Maximum and minimum stresses, resultant stresses and distribution diagram at base.
• Analysis of dams subjected to horizontal water pressure, conditions of stability, Maximum and minimum stresses, resultant stresses and distribution diagram at base.

Unit – II

Slope and Deflection

• Concept of slope and deflection, stiffness of beams, Relation among bending moment, slope, deflection and radius of curvature, (no derivation).
• Double integration method to find slope and deflection of cantilever and simply supported beams subjected to concentrated load and uniformly distributed load on entire span.
• Macaulay's method for slope and deflection, application to cantilever and simply supported beam subjected to concentrated and uniformly distributed load on entire span.

Unit- III

Fixed and Continuous Beam

• Concept of fixity, effect of fixity, advantages and disadvantages of fixed beam over simply supported beam.
• Principle of superposition, Fixed end moments from first principle for beam subjected to point load, UDL over entire span.
• Application of standard formulae in finding end moments, end reactions and drawing S.F. and

B.M. diagrams for a fixed beam.
• Definition, effect of continuity, nature of moments induced due to continuity, concept of deflected
shape, practical examples.
• Clapeyron's theorem of three moment (no derivation), Application of Clapeyron's theorem maximum up to three spans and two unknown support moment only, Support at same level spans having same and uniform moment of inertia subjected to concentrated loads and uniformly distributed loads over entire span.
• Drawing SF diagrams showing point of contraflexure, shear and BM diagrams showing net BM and point of contraflexure for continuous beams.
Civil Engineering Curriculum Structure 84

Unit– IV

Moment distribution method

• Introduction to moment distribution method, sign convention, Carry over factor, stiffness factor, distribution factor.
• Application of moment distribution method to various types of continuous beams subjected to concentrated loads and uniformly distributed load over entire span having same or different moment of inertia, supports at same level, up to three spans and two unknown support moments only.
• Introduction to portal frames – Symmetrical and unsymmetrical portal frames with the concept of Bays and stories.

Unit– V

Simple trusses

• Types of trusses (Simple, Fink, compound fink, French truss, pratt truss, Howe truss, North light truss, King post and Queen post truss)
• Calculate support reactions for trusses subjected to point loads at joints
• Calculate forces in members of truss using Method of joints and Method of sections.

Course Objectives:

Following are the objectives of this course:

- To learn concept of eccentric loading and stresses in vertical members like column, chimneys, dam
- To analyze beams using various methods like slope deflection, three moment, and moment
- distribution
- To understand different methods of finding axial forces in trusses.

Reference Book:

1. Ramamrutham.S, Theory of structures, Dhanpatrai& Sons.
2. Khurmi, R. S. , Theory of Structures S. Chand and Co., New Delhi.
3. Bhavikatti, S S , Structural Analysis Vol-1, ,Vikas Publishing House PvtLtd.New Delhi.
4. Junnarkar, S. B. , Mechanics of structures, Volume-I and II Charotar Publishing House, Anand.
5. Pandit, G.S. and Gupta, S.P., Theory of Structures, Tata McGraw Hill, New Delhi.
6. Agor R, Structural Analysis, Khanna Publishing House, Delhi.

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester- IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Building Planning and Drawing	CEPC-414	1L-0T-1P	2

Course outcomes:

After completing this course, student will be able to:

1. Interpret the symbols, signs and conventions from the given drawing.
2. Prepare line plans of residential and public buildings using principles of planning.
3. Prepare submission and working drawing for the given requirement of Load Bearing Structure.
4. Prepare submission and working drawing using CAD for the given requirement of Framed Structure.
5. Draw two-point perspective drawing for given small objects.

Unit-I

Conventions and Symbols

• Conventions as per IS 962, symbols for different materials such as earthwork, brickwork, stonework, concrete ,woodwork and glass.
• Graphical symbols for doors and windows, Abbreviations, symbols for sanitary and electrical installations.
• Types of lines-visible lines, centre line, hidden line, section line, dimension line, extension line, pointers, arrow head or dots. Appropriate size of lettering and numerals for titles, sub-titles, notes and dimensions.
• Types of scale- Monumental, Intimate, criteria for Proper Selection of scale for various types of drawing.
• Sizes of various standard papers/sheets.
• Reading and interpreting readymade Architectural building drawing (To be procured from Architect, Planning Consultants, Planning Engineer).

Unit– II

Planning of Building

• Principles of planning for Residential and Public building- Aspect, Prospect, Orientation, Grouping, Privacy, Elegance, Flexibility, Circulation, Furniture requirements, Sanitation, Economy.
• Space requirement and norms for minimum dimension of different units in the residential and public buildings as per IS 962.
• Rules and bye-laws of sanctioning authorities for construction work.
• Plot area, built up area, super built up area, plinth area, carpet area, floor area and FAR (Floor Area Ratio).
• Line plans for residential building of minimum three rooms including water closet (WC), bath and staircase as per principles of planning.
• Line plans for public building-school building, primary health centre, restaurant, bank, post office, hostel, Function Hall and Library.

Unit– III

Drawing of Load Bearing Structure

• Drawing of Single storey Load Bearing residential building (2 BHK) with staircase.
• Data drawing –plan, elevation, section, site plan, schedule of openings, construction notes with specifications, area statement, Planning and design of staircase- Rise and Tread for residential
and public building.
• Working drawing – developed plan, elevation, section passing through staircase or WC and bath.
• Foundation plan of Load bearing structure.

Unit– IV

Drawing of Framed Structure

• Drawing of Two storeyed Framed Structure (G+1), residential building (2 BHK) with staircase.
• Data drawing – developed plan, elevation, section, site plan, schedule of openings, construction notes with specifications, area statement. Planning and design of staircase- Rise and
Civil Engineering Curriculum Structure 86
Tread for residential and public building.
• Working drawing of Framed Structure – developed plan, elevation, section passing through staircase or WC and bath.
• Foundation plan of Framed Structure.
• Details of RCC footing, Column, Beam, Chajjas, Lintel, Staircase and slab.
• Drawing with CAD- Draw commands, modify commands, layer commands.

Unit– V

Perspective Drawing

• Definition, Types of perspective, terms used in perspective drawing, principles used in perspective
drawing
• Two Point Perspective of small objects only such as steps, monuments, pedestals.

Course Objectives:

Following are the objectives of this course:

- To learn basic principles of building planning and drawing.
- To know graphical representation of various components of buildings.
- To draw complete plan and elevation of a building.
- To learn basics of perspective drawings and Computer Aided Drawings.

Reference Book:

1. Shah. M.G. Kale, CM, Patki, S.Y., Building Drawing, Mcgraw Hill Publishing company Ltd. New Delhi.
2. Malik and Mayo, Civil Engineering Drawing, Computech Publication Ltd New Asian Publishers,
New Delhi.
3. M. G. Shah and C. M. Kale, Principles of Perspective Drawing, Mcgraw Hill Publishing company
Ltd. New Delhi.
4. Swamy, Kumara; Rao, N, Kameshwara, A ., Building Planning and Drawing, Charotar Publication,
Anand.
5. Bhavikatti, S. S., Building Construction, Vikas Publication House Pvt. Ltd., New Delhi.
6. Mantri, Sandip, A to Z Building Construction, SatyaPrakashan, New Delhi.

7. Singh, Ajit, Working with Auto CAD 2000, Mcgraw Hill Publishing company Ltd. New Delhi.
8. Sane, Y.S., Planning and design of Building, Allied Publishers, New Delhi.

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester- IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Water Resources Engineering	CEPC-415	3L-1T-2P	6

Course outcomes:

After completing this course, student will be able to:

- Estimate hydrological parameters.
- Estimate crop water requirements of a command area and capacity of canals.
- Execute Minor and Micro Irrigation Schemes.
- Select the relevant Cross Drainage works for the specific site conditions.
- Design, construct and maintain simple irrigation regulatory structures.

Unit – I

Introduction to Hydrology

• Hydrology: Definition and Hydrological cycle
• Rain Gauge: Symons rain gauge, automatic rain gauge,
• Methods of calculating average rainfall: Arithmetic mean, Isohyetal, and Theissen polygon method.
• Runoff, Factors affecting Run off, Computation of run–off.
• Maximum Flood Discharge measurement: Rational and empirical methods, Simple numerical problems.
• Yield and Dependable yield of a catchment, determination of dependable yield.

Unit– II

Crop water requirement and Reservoir Planning

• Irrigation and its classification.
• Crop Water requirement: Cropping seasons, Crop period, base period, Duty, Delta, CCA, GCA, intensity of irrigation, factors affecting duty, Problems on water requirement and capacity of canal.
• Methods of application of irrigation water and its assessment.
• Surveys for irrigation project, data collection for irrigation project.
• Area capacity curve.
• Silting of reservoir, Rate of silting, factors affecting silting and control measures.
• Control levels in reservoir, Simple numerical problems on Fixing Control levels.

Unit– III

Dams and Spillways

• Dams and its classification: Earthen dams and Gravity dams (masonry and concrete).
• Earthen Dams – Components with function, typical cross section, seepage through embankment
and foundation and its control.
• Methods of construction of earthen dam, types of failure of earthen dam and preventive

measures.
• Gravity Dams – Forces acting on dam, Theoretical and practical profile, typical cross section, drainage gallery, joints in gravity dam, concept of high dam and low dam.
• Spillways-Definition, function, location, types and components, Energy dissipaters.

Unit– IV

Minor and Micro Irrigation

• Bandhara irrigation: Layout, components, construction and working, solid and open bandhara.
• Percolation Tanks – Need, selection of site.
• Lift irrigation Scheme-Components and their functions, Lay out.
• Drip and Sprinkler Irrigation- Need, components and Layout.
• Well irrigation: types and yield of wells, advantages and disadvantages of well irrigation.

Unit– V

Diversion Head Works & Canals

• Weirs – components, parts, types, K.T. weir – components and construction
Civil Engineering Curriculum Structure 88
• Diversion head works – Layout, components and their function.
• Barrages – components and their functions. Difference between weir and Barrage.
• Canals – Classification according to alignment and position in the canal network, Cross section of canal in embankment and cutting, partial embankment and cutting, balancing depth, Design of most economical canal section.
• Canal lining - Purpose, material used and its properties, advantages.
• Cross Drainage works- Aqueduct, siphon aqueduct, super passage, level crossing.
• Canal regulators- Head regulator, Cross regulator, Escape, Falls and Outlets

Course Objectives:

Following are the objectives of this course:
 To learn estimation of hydrological parameters.
 To understand water demand of crops and provisions to meet the same.
 To know planning of reservoirs and dams.
 To design irrigation projects, canals and other diversion works.

Reference Book:

1. Punmia, B.C., Pande, B, Lal, Irrigation and Water Power Engineering, Laxmi Publications
2. Subramanayan, Engineering Hydrology, McGraw Hill.
3. Mutreja K N, Applied Hydrology, McGraw Hill
4. Sharma, R.K. and Sharma, T.K., Irrigation Engineering, S.Chand
5. Basak, N.N., Irrigation Engineering, McGraw Hill Education
6. Asawa, G.L., Irrigation and water resource Engineering, New Age
7. Dahigaonkar, J.G., Irrigation Engineering, Asian Book Pvt. Ltd., New Delhi.
8. Garg, S K, Irrigation and Hydraulic Structures, Khanna Publishers, Delhi.
9. Priyani V.B., Irrigation Engineering, Charotar Book Stall
, Anand.

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester- IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Transportation Engineering	CEPC-416	3L-1T-2P	6

Course outcomes:

After completing this course, student will be able to:

- Identify the types of roads as per IRC recommendations.
- Implement the geometrical design features of different highways.
- Perform different tests on road materials.
- Identify the components of railway tracks.
- Identify the defects in railway tracks.

Unit – I

Overview of Highway Engineering

• Role of transportation in the development of nation, Scope and Importance of roads in India and its' Characteristics.
• Different modes of transportation – land way, waterway, airway. Merits and demerits of roadway and railway;
• General classification of roads.
• Selection and factors affecting road alignment.

Unit– II

Geometric Design of Highway

• Camber: Definition, purpose, types as per IRC – recommendations.
• Kerbs: Road margin, road formation, right of way.
• Design speed and various factors affecting design speed as per IRC – recommendations.
• Gradient: Definition, types as per IRC – Recommendations.
• Sight distance (SSD): Definition, types IRC – recommendations, simple numerical.
• Curves: Necessity, types: Horizontal, vertical curves.
• Extra widening of roads: numerical examples.
• Super elevation: Definition, formula for calculating minimum and maximum Super elevation and method of providing super-elevation.
• Standards cross-sections of national highway in embankment and cutting.

Unit– III

Construction of Road Pavements

• Types of road materials and their Tests – Test on aggregates-Flakiness and Elongation Index tests, Angularity Number test, test on Bitumen- penetration, Ductility, Flash and Fire point test and Softening point test.
• Pavement – Definition, Types, Structural Components of pavement and their functions
• Construction of WBM road. Merits and demerits of WBM & WMM road.
• Construction of Flexible pavement / Bituminous Road, Types of Bitumen and its properties, Emulsion, Cutback, Tar, Terms used in BR-prime coat, tack coat, seal coat, Merits and Demerits of BR.

• Cement concrete road -methods of construction, Alternate and Continuous Bay Method, Construction joints, filler and sealers, merits and demerits of concrete roads. Types of joints.

Unit– IV

Basics of Railway Engineering

• Classification of Indian Railways, zones of Indian Railways
• Permanent way: Ideal requirement, Components; Rail Gauge, types, factors affecting selection of a gauge.
• Rail, Rail Joints - requirements, types.
• Creep of rail: causes and prevention.
• Sleepers - functions and Requirement, types - concrete sleepers and their density
• Ballast - function and types, suitability.
• Rail fixtures and fastenings – fish plate, spikes, bolts, keys, bearing plates, chairs-types of anchors and anti-creepers.
Civil Engineering Curriculum Structure 90

Unit– V

Track geometrics, Construction and Maintenance

• Alignment- Factors governing rail alignment.
• Track Cross sections – standard cross section of single and double line in cutting and embankment.
Important terms-permanent land, formation width, side drains,
• Railway Track Geometrics: Gradient, curves- types and factors affecting, grade compensation, super elevation, limits of Super elevation on curves, cant deficiency, negative cant, coning of wheel, tilting of rail.
• Branching of Tracks, Points and crossings, Turn out- types, components, functions and inspection.
Track junctions: crossovers, scissor cross over, diamond crossing, track triangle.
• Station -Purpose, requirement of railway station, important technical terms, types of railway station, factors affecting site selection for railway station.
• Station yard: Classification- Passenger, goods, locomotive and marshalling yards. Function & drawbacks of marshalling yards.
• Track Maintenance- Necessity, Classification, Tools required for track maintenance with their functions, Organisation of track maintenance, Duties of permanent way inspector, gang mate and key man.

Course Objectives::

Following are the objectives of this course:

- To identify the types of roads as per IRC recommendations.
- To understand the geometrical design features of different highways.
- To perform different tests on road materials.
- To identify the components of railway tracks.

Reference Book:

1. L.R. Kadiyali, Transportation Engineering, Khanna Book Publishing Co., Delhi (ISBN: 978-93-
82609-858) Edition 2018
2. Khanna S.K., Justo, C E G and Veeraragavan, A., Highway Engineering, Nem Chand and Brothers,
Roorkee.
3. Arora, N. L., Transportation Engineering, Khanna Publishers, Delhi.
4. Saxena S C and Arora S P, A Textbook of Railway Engineering, DhanpatRai Publication.

5. Birdi, Ahuja, Road, Railways, Bridge and Tunnel Engg , Standard Book House, New Delhi.
6. Sharma, S.K., Principles, Practice and Design of Highway Engineering,, S. Chand Publication, New Delhi.

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Precast and Pre stressed Concrete	CEPE-417	3L-1T-0P	4

Course outcomes:

After completing this course, student will be able to:

- Select the relevant precast concrete element for a given type of construction.
- Use relevant components for prefabricated structures.
- Justify the relevance of prestressed element in a given situation.
- Select relevant methods / systems for given construction work.
- Propose suitable cable profile for the given prestressed concrete members.

Unit – I

Precast concrete Elements

- Advantages and disadvantages of precast concrete members
- Non-structural Precast elements - Paver blocks, Fencing Poles, Transmission Poles, Manhole Covers, Hollow and Solid Blocks, kerb stones as per relevant BIS specifications
- Structural Precast elements – tunnel linings, Canal lining, Box culvert, bridge panels, foundation,
sheet piles
- Testing of Precast components as per BIS standards

Unit– II

Prefabricated building

- Precast Structural Building components such as slab panels, beams, columns, footings, walls, lintels and chajjas, staircase elements,
- Prefabricated building using precast load bearing and non load bearing wall panels, floor systems - Material characteristics, Plans & Standard specifications
- Modular co-ordination, modular grid, and finishes
- Prefab systems and structural schemes and their classification including design considerations
- Joints – requirements of structural joints and their design considerations
- Manufacturing, storage, curing, transportation and erection of above elements, equipment needed

Unit– III

Introduction to Prestressed Concrete

- Principles of pre-stressed concrete and basic terminology.
- Applications, advantages and disadvantages of prestressed concrete
- Materials used and their properties, Necessity of high-grade materials
- Types of Pre-stressing steel -Wire, Cable, tendon, Merits-demerits and applications

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Unit– IV

Methods and systems of prestressing

• Methods of prestressing – Internal and External pre-stressing, Pre and Post tensioning-applications

• Systems for pre tensioning – process, applications, merits and demerits - Hoyer system

• Systems for post-tensioning - process, applications, merits and demerits - Freyssinet system, MagnelBlaton system, Gifford Udall system.

• Prestressing force in Cable, Loss of prestress during the tensioning process - loss due to friction, length effect, wobbling effect and curvature effect, (Simple Numerical problems to determine loss of pre-stress), Loss of pre-stress at the anchoring stage.

• Loss of pre-stress occurring subsequently: losses due to shrinkage of concrete, creep of concrete, elastic shortening, and creep in steel, (Simple Numerical problems to determine loss of pre-stress).

• BIS recommendations for percentage loss in case of Pre and Post tensioning.

Unit– V

Analysis and design of Prestressed rectangular beam section

• Basic assumptions in analysis of pre-stressed concrete beams.

• Cable Profile in simply supported rectangular beam section – concentric, eccentric straight and parabolic

• Effect of cable profile on maximum stresses at mid span and at support.

• Numerical problems on determination of maximum stresses at mid spans with linear (concentric
and eccentric) cable profiles only.

• Simple steps involved in Design of simply supported rectangular beam section (No numerical problems)

Course Objectives:

Following are the objectives of this course:

- To introduce various types of precast and prefabricated concrete elements.
- To know advantages and disadvantages of precast and prefabricated concrete elements.
- To understand prestressing methods, systems for Reinforced Concrete members.
- To learn issues involved in design of prestressing system and loss of prestressing.

Reference Book:

1. Krishna Raju, N., Pre-stressed Concrete, Tata McGraw Hill, New Delhi.
2. Shrikant B. Vanakudre, Prestressed Concrete, Khanna Publishing House, New Delhi
3. Marzuki, Nor Ashikin, Pre Cast and Pre Stress Technology: Process, Method and Future Technology,
Createspace Independent Publication.
4. Indian Concrete Institute., Handbook on Precast Concrete buildings.
5. Elliott, Kim S., Precast Concrete Structures, CRC Press, New York.
6. Lin, T.Y., Design of Pre-Stressed Concrete Structures, John Wiley and Sons, New York Nagarajan,
Pravin., Pre-stressed Concrete Structures, Pearson Education India

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Design of Steel and RCC Structures	CEPC-511	3L-1T-2P	6

Course outcomes:

After competing this course, student will be able to perform:

- Design of steel tension and compression member.
- Design of steel I and Channel sections.
- Design of singly and doubly reinforced RCC beam.
- Design of RCC beam for shear and development length.
- Design of short and long RCC columns.

Unit – I

Design of Steel Tension and Compression Members (Limit State Method)

- Types of sections used for Tension members.
- Strength of tension member by- yielding of section, rupture of net cross-section and block shear.
- Design of axially loaded single angle and double angle tension members with bolted and welded connections.
- Types of sections used as compression member, Calculation of effective length, Radius of gyration and slenderness ratio, Permissible values of slenderness ratio as per IS 800, Design compressive stress.
- Introduction to built up sections, lacing and battening (Meaning and purpose), Diagrams of single and double lacing and battening system. (No numerical problems).
- Design of axially loaded single and double angle struts connected by bolted and welded connections with gusset plate.

Unit– II

Design of Steel beams (Limit State Method)

- Standard beam sections, Bending stress calculations.
- Design of simple I and channel section.
- Check for shear as per IS 800.

Unit– III

Design of Reinforced Concrete Beams by Limit State Method

- Concept of Limit state, Stress block diagram, Introduction to singly and doubly reinforced sections, IS 456
- Design of singly reinforced beam, concept of under reinforced, over reinforced and balanced section, Simple numerical problem on ultimate moment of resistance and design of beam section
- Design of doubly reinforced sections, stress and strain diagrams, depth of neutral axis, simple numerical problems on ultimate moment of resistance of reinforced beam, Calculation ofAst and Asc.

Unit– IV

Shear, Bond and Development length in Design of RCC member

• Nominal shear stress in RCC section, Design shear strength of concrete, Design of shear reinforcement,
Minimum Shear Reinforcement, Provisions of IS 456, forms of shear reinforcement
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• Types of bond, Bond stress, check for bond stress, Determination of Development length in tension and compression members and check as per codal provisions, Anchorage value of 900 hook, Lapping of bars.
• Simple numericals on: Shear reinforcement, Adequacy of section for shear.
• Introduction to serviceability limit state check

Unit– V

Design of axially loaded RCC Column

• Definition and classification of column, Limit state of compression members, Effective length of column.
• Provisions of IS 456 for minimum steel, cover, maximum steel, spacing of ties etc.
• Design of axially loaded short column - Square, Rectangular, and Circular only.

Course Objectives:

Following are the objectives of this course:

- To learn the concept of limit state design for tension and compression steel members.
- To learn the concept of limit state design of steel beams.
- To understand design of RCC elements.
- To know the design of short and long RCC columns.

Reference Book:

• Shah, V. L., and Gore, V., Limit State Design of Steel Structures, Structures Publications, Pune.
• Dayarathnam P., Design of Steel Structures, S. Chand and Company, Delhi.
• Subramanian N., Design of Steel Structures, Oxford University Press.
• Sairam, K.S., Design of Steel Structures, Pearson Publication, Chennai, Delhi.
• Shah, V. L., and Karve, S.R., Limit State Theory and Design of Reinforced Concrete Structures

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Estimating and Costing	CEPC-512	3L-1T-2P	6

Course outcomes:

After competing this course, student will be able to:

- Select modes of measurements for different items of works.
- Prepare approximate estimate of a civil engineering works.
- Prepare detailed estimate of a civil engineering works.
- Use relevant software for estimating the quantities and cost of items of works.
- Justify rate for given items of work using rate analysis techniques.

Unit – I

Fundamentals of Estimating and Costing

- Estimating and Costing – Meaning, purpose, Administrative approval, Technical Sanction and Budget provision.
- Types of estimates – Approximate and Detailed estimate.
- Types and Uses of Estimates: Revised estimate, Supplementary estimate, Repair and maintenance estimate, renovation estimate.
- Roles and responsibility of Estimator.
- Checklist of items in load bearing and framed structure.
- Standard formats of Measurement sheet, Abstract sheet, Face sheet.
- Modes of measurement and desired accuracy in measurements for different items of work as per IS:1200.
- Rules for deduction in different category of work as per IS:1200.
- Description / specification of items of building work as per PWD /DSR.

Unit– II

Approximate Estimates

- Approximate estimate- Definition, Purpose.
- Methods of approximate estimate - Service unit method, Plinth area rate method, Cubical content method, Typical bay method, Approximate quantity method (with simple numericals)
- Approximate estimate for roads, Railways, bridges/culvert, irrigation projects and water supply projects.

Unit– III

Detailed Estimate

- Detailed Estimate- Definition and Purpose, Data required for detailed estimate - Civil cost, GST, Contingencies, Supervision charges, Agency charges, Procedure for preparation of detailed estimate- Taking out quantities and Abstracting.
- Methods of Detailed Estimate- Unit quantity method and total quantity method (with simple numericals)

• Long wall and Short wall method, Centre line method.
• Bar bending schedule for footing, column, beam, Lintel, chajja and slab elements
• Provisions in detailed estimate: contingencies, work charged establishment, percentage charges, water supply and sanitary Charges and electrification charges etc.
• Prime cost, Provisional sum, Provisional quantities, Bill of quantities, Spot items or Site items.

Unit– IV

Estimate for Civil Engineering Works

• Earthwork - Quantities for roads, Embankment and canal by – Mid sectional area method, mean sectional area method, Prismoidal and trapezoidal formula method.
• Detailed estimate for septic tank, Community well.
• Use of computer /softwares / programmes for detailed estimate Preparation of Civil Engineering
Works.

Unit– V

Rate Analysis

• Rate Analysis: Definition, purpose and importance.
• Lead (Standard and Extra), lift, overhead charges, water charges and contractors' profit,
• Procedure for rate analysis.
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• Task work- Definition, types. Task work of different skilled labour for different items.
• Categories of labours, their daily wages, types and number of labours for different items of work.
• Transportation charges of materials - Lead and Lift, Hire charges of machineries and equipments.
• Preparing rate analysis of different items of work pertaining to buildings and roads.

Course Objectives:

Following are the objectives of this course:

- To learn the procedure for estimating and costing of Civil Engineering works.
- To perform rate analysis for different items associated with construction projects.
- To use software for detailed estimate related to civil infrastructural projects.

Reference Book:

1. Datta, B.N., Estimating and Costing in Civil engineering, UBS Publishers Distributors Pvt. Ltd.
New Delhi.
2. Peurifoy,Robert L. Oberlender,Garold, Estimating construction cost (fifth edition), McGraw Hill Education, ,New Delhi.
3. Rangwala,S.C., Estimating and Costing, Charotar Publishing House PVT. LTD., Anand.
4. Birdie,G.S., Estimating and Costing, DhanpatRai Publishing Company(P) Ltd. New Delhi.
5. Patil,B.S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai.

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Traffic Engineering	CEPE-513	3L-1T-0P	4

Course outcomes:

After competing this course, student will be able to:

- Analyze road traffic characteristics.
- Undertake various types of road traffic studies.
- Use relevant road traffic signs, signal and markings.
- Identify the intersection depending on the traffic flow.
- Suggest preventive measures to avoid accidents by analyzing the traffic conditions at site.

Unit – I

Fundamentals of Traffic Engineering.

- Traffic engineering- Definition, objects, scope
- Relationship between speed, volume and density of traffic
- Road user's characteristics-physical, mental, emotional factors.
- Vehicular characteristics-width, length, height, weight, speed, efficiency of breaks.
- Road characteristics - gradient, curve of a road, design speed, friction between road and tyre surface.
- Reaction time - factors affecting reaction time. PIEV Theory.

Unit– II

Traffic Studies

- Traffic volume count data- representation and analysis of data.
- Necessity of Origin and Destination study and its methods.
- Speed studies - Spot speed studies, and its presentation.
- Need and method of parking study.

Unit– III

Road Signs and Traffic Markings

- Traffic control devices –definition, necessity, types.
- Road signs - definition, objects of road signs.

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- Classification as per IRC: 67-Mandatory or Regulatory, Cautionary or warning, informatory signs, Location of cautionary or warning sign in urban and non-urban areas, Points to be considered while designing and erecting road signs.
- Traffic markings- definition, classification, carriage way, kerb, object marking and reflectormarkers.

Unit– IV

Traffic Signals and Traffic Islands

- Traffic signals- Definition, Types, Traffic control signals, pedestrian signals.

• Types of traffic control signals - Fixed time, manually operated, traffic actuated signals and location of signals.
• Compute signal time by fix time cycle, Webster's and IRC method and sketch timing diagram for each phase.
• Traffic islands –Definition, advantages and disadvantages of providing islands.
• Types of traffic islands - rotary or central, channelizing or Refuge Island.
• Road intersections or junctions - Definition, Types of road intersection.
• Intersection at grade- Types, basic requirements of good intersection at grade.
• Grade separated intersection- advantages and disadvantages, types - flyovers-partial and full Cloverleaf pattern, Diamond intersection, Trumpet type, underpass
.

Unit– V

Road Accident Studies and Arboriculture

• Road Accidents-Definition, types and causes for collision and non-collision accidents.
• Measures to prevent road accidents.
• Collision and condition diagram.
• Street lighting –definition, necessity, types-luminaire, foot candle, lumen, factors affecting their utilization and maintenance.
• Arboriculture- definition, objectives, factors affecting selection of type of trees.
• Maintenance of trees-protection and care of road side trees.

Course Objectives:

Following are the objectives of this course:
• To understand the issues involved in traffic flow.
• To know and understand the tools for traffic studies.
• To delineate various traffic control measures.
• To understand measures for preventing accidents.

Reference Book:

1. Khanna S.K., Justo, C E G and Veeraragavan, A., Highway Engineering, Nem Chand and Brothers,
Roorkee.
2. Kadiyali L.R., Transportation Engineering, Khanna Book Publishing Co., Delhi
3. Vazirani, V N ,Chaondola, S P, Transportation Engineering Vol. I & II, Khanna Publishers. Delhi.
4. Saxena, S C, Traffic planning and design, DhanpatRai& Sons Delhi.
5. Kumar R S, Introduction to Traffic Engineering, University Press (India), Pvt. Ltd.

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Pavement Design and Maintenance	CEPE-514	3L-1T-0P	4

Course outcomes:

After competing this course, student will be able to:

- Identify the components of the given type of pavement.
- Suggest the type of pavement for the given situation.
- Design the flexible pavement using the provisions of IRC
- Design the concrete pavement using the provisions of IRC
- Decide type of maintenance required under different damaged conditions

Unit – I

Basics of pavement Design

- Types of pavement - Flexible, Rigid and Semi Rigid
- Comparison of Rigid and flexible pavement according to Design precision, life maintenance, initial cost, stages of construction, availability of materials, surface characteristic, penetration of water in the pavement, utility location, glare and night visibility.
- Functions and characteristics of pavement.
- Factors affecting selection of type of pavement.

Unit– II

Fundamentals of pavement design

- Factors affecting pavement design-design wheel load ,Traffic factors, Environmental factors, Road geometry and material, Characteristics of soil and Drainage situation.

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Unit– III

Design overview of Flexible and Concrete pavement

- Methods of flexible pavement design-Theoretical method, Empirical method with and without soil strength test.
- IRC37 guidelines for design of flexible pavement (overview only)
- Factors affecting design of concrete pavement.
- IRC58 guidelines for design of concrete pavement (overview only)
- Joints-Need, Types, requirements, spacing of joints
-

Unit– IV

Pavement evaluation

- Definition and purpose of pavement evaluation
- Methods of Pavement evaluation –Visual rating, Pavement serviceability index, Roughness measurements, Benkelman Beam deflection method

Unit -V

Pavement Maintenance

- Types of pavement maintenance - routine, periodic, and special. Need for inspection and

maintenance schedule. Causes of pavement failure and remedial measures. Typical flexible and rigid pavement failures

• Types and causes of damages in flexible pavement, surface defects, cracks. Deformations - Rutting, fatigue, settlement and upheaval. Disintegration- loss of aggregate, stripping, pothole. Remedial measures - slurry seal, liquid seal, fog seal, patching, ready mix patch.

• Types of damages to rigid pavement - cracking, spalling, slab rocking, settlement, joint sealant failure. Methods of repair - repair of spalled joints, full depth reconstruction, replacement of dowel bars.

Course Objectives:

Following are the objectives of this course:

• To know types of pavements and their uses.
• To learn issues in design of flexible and rigid pavements.
• To understand methods of pavement evaluation.
• To learn pavement maintenance methods.

Reference Book:

1. Kadiyali, L.R., Highway Engineering, Khanna Book Publishing House, New Delhi (ISBN: 978-93-86173-133)
2. Chakroborty, Partha Das, Animesh., Principles of Transportation engineering, Prentice-Hall of India Pvt.Ltd
3. Vazirani, V N, Chaondola, S P., Transportation Engineering Vol. I & II, Khanna Publishers. Delhi
4. Yoder, E J, Principles of Pavement Design, Wiley India Pvt Ltd.
5. Bindra, S P., Highway Engineering, DhanpatRai Publications (P) Ltd
6. Kumar R S, Pavement Evaluation and Maintenance Management system, University Press (India), Pvt. Ltd.
7. Sharma S K, Principles, Practice and Design of Highway Engineering, S Chand, New Delhi.

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester - V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Building Services and Maintenance	**CEPE-515**	**3L-1T-0P**	**4**

Course outcomes:

After completing this course, student will be able to:

- Classify various types of building services as per functional requirements.
- Propose the fire safety requirements for multi-storeyed building.
- Devise suitable water supply and sanitation system for given type of building.
- Evaluate the potential of rain water harvesting and solar water heater system for the given type of building.
- Justify the necessity of designing the system of lighting, ventilation and acoustics for the given type of building.

Unit-I

Overview of Building Services

Introduction to building services, Classification of buildings as per National Building code, Necessity of building services, Functional requirements of building, Different types of build- ing services i.e. HVAC (Heat, Ventilation and Air Conditioning), Escalators and lifts, fire safety, protection and control, plumbing services, rain water harvesting, solar water heating system, lighting, acoustics, sound insulation and electric installation etc.

Role and responsibility of Building Service Engineer, Introduction to BMS (Building Manage-ment Services), Role of BMS, concept of smart building.

Unit-II

Modes of vertical communication

Objectives and modes of vertical communication in building.

Lifts**:** Different types of lifts and its uses, Component parts of Lift- Lift Well, Travel, Pit, HoistWay, Machine, Buffer, Door Locks, Suspended Rope, Lift Car, Landing Door, Call Indicators, Call Push etc., Design provisions for basic size calculation of space enclosure to accommo- date lift services, Safety measures.

Escalators**:** Different Types of Escalators and its Uses, Components of escalators, Design provisions for basic size calculation of space enclosure to accommodate escalator services, Safety measures.

Ramp: Necessity, design consideration, gradient calculation, layout and Special features re-quired for physically handicapped and elderly.

Unit– III

Fire Safety

Fire protection requirements for multi-storeyed building, causes of fire in building, Fire detecting and various extinguishing systems, Working principles of various fire protection systems.

Safety against fire in residential and public buildings (multi-storeyed building), National Building Code provision for fire safety, Fire resisting materials and their properties, Fire resistant construction, procedures for carrying out fire safety inspections of existing build- ings, Provisions for evacuation.

Unit– IV

Plumbing Services

Importance of plumbing, AHJ (Authority Having Jurisdiction) approval, Plumbing Terminol- ogy and fixtures: Terms used in plumbing, Different types of plumbing fixtures, shapes/ sizes, capacities, situation and usage, Traps, Interceptors.

System of plumbing for building water supply: storage of water, hot and cold water supply system.

System of plumbing for building drainage: Types of drainage system such as two pipe sys- tem, one pipe system, types of Vents and purpose of venting, Concept of grey water and reclaimed water.

Different pipe materials, and jointing methods, fittings, hanger, supports and valves used in

plumbing and their suitability.

Unit– V

Lighting, Ventilation and Acoustics

Concept of SWH (Solar water heating), component parts of SWH, various system of SWH (heat transfer, propulsion, passive direct system, active direct system, Do-it-yourself), in- stallation and maintenance.

Concept of lighting, types of lighting (natural and artificial), factors influencing the bright- ness of room, factors affecting selection of artificial lighting, installation of light (direct, half-direct, indirect, half-indirect and direct-indirect), types of light control (manual switch,remote switch, timer switch and photo-electric cell switch), types of

lamps (incandescent, tungsten halogen and electric discharge), Lamp selection as per roomsizes.

Concept of ventilation, necessity and Types of ventilation.

Building Acoustic, Objectives, acoustic Control in a building, acoustic material (porous ab- sorber and cavity resonator)

Course Objectives:

Following are the objectives of this course:

- To know the procedure for classifying various types of building services.
- To know the fire safety requirements for multi-storeyed building.
- To devise suitable plumbing system for given type of building.
- To understand the procedure for rain water harvesting and solar water heater.
- To know the system for designing lighting, ventilation and acoustics for any building.

Reference Book:

1. Patil, S. M., Building Services, Seema Publication, Mumbai.
2. Mantri and Sandeep., The A to Z of Practical Building Construction and its Management, Satya Prakashan, New Delhi**.**
3. Bag S P, Fire Services in India: History, Detection, Protection, Management, Mittal Publica- tions, New Delhi.
4. Deolalikar,S. G., Plumbing Design and Practice, McGraw-Hill,
5. Akhil Kumar Das., Principles of Fire Safety Engineering: Understanding Fire and Fire Protec- tion, PHI Learning Pvt. Ltd, New Delhi.

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester -VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Public Health Engineering	CEPC-611	3L-1T-2P	6

Course outcomes:

After competing this course, student will be able to:

- Know the procedure to identify the sources of surface and subsurface water
- Estimate the quantity of drinking water required for a population
- Draw labelled layout for water supply scheme.
- Device suitable water treatment technique.
- Evaluate the characteristics and suggest treatment of sewage.

Unit – I

Sources, Demand and Quality of water

- Water supply schemes - Objectives, components,
- Sources of water: Surface and Subsurface sources of water, Intake Structures, Definition and types, Factors governing the location of an intake structure, Types of intakes.
- Demand of water: Factors affecting rate of demand, Variations of water demands, Forecasting of population, Methods of forecasting of population, (Simple problems on forecasting of population), Design period, Estimating of quantity of water supply required for city or town.
- Quality of water**:** Need for analysis of water, Characteristics of water- Physical, Chemical and Biological, Testing of water for Total solids, hardness, chlorides, dissolved Oxygen, pH, Fluoride,

Nitrogen and its compounds, Bacteriological tests, E coli, B coli index, MPN, Sampling of water, Water quality standards as per IS 10500.

Unit – II

Purification of water

- Purification of Water: Objectives of water treatment, Aeration- objects and methods of aeration,

Plain sedimentation, Sedimentation with coagulation, principles of coagulation, types of coagulants, Jar Test, process of coagulation, types of sedimentation tanks, Clariflocculator.

- Filtration - mechanisation of filtration, classification of filters: slow sand filter, rapid sand filter, pressure filter. Construction and working of slow sand filter and rapid sand filter, operational

problems in filtration. Disinfection: Objects, methods of disinfection, Chlorination- Application of chlorine, forms of chlorination, types of chlorination practices, residual chlorine and its importance, Flow diagram of water treatment plants.

- Miscellaneous water Treatments: Introduction to water softening, Defluoridation techniques.

Unit –III

Conveyance and Distribution of water

- Conveyance: Types of Pipes used for conveyance of water, choice of pipe material, Types of

joints& Types of valves- their use, location and function on a pipeline.
• Distribution of water: Methods of distribution of water- Gravity, pumping, and combined system, Service reservoirs - functions and types, Layouts of distribution of Water-Dead end system, grid iron system, circular system, radial system; their suitability, advantages and disadvantages.

Unit – IV

Domestic sewage and System of Sewerages

• Building Sanitation: **N**ecessity of sanitation, Necessity to treat domestic sewage, Definitions - Sewage, sullage, types of sewage. Definition of the terms related to Building SanitationCivil Engineering Curriculum Structure 122
Water pipe, Rain water pipe, Soil pipe, Sullage pipe, Vent pipe. Building Sanitary fittings-Water closet – Indian and European type, flushing cistern, wash basin, sinks, Urinals. Trapstypes, qualities of good trap. Systems of plumbing - one pipe, two pipe, single stack, choice of system. Principles regarding design of building drainage, inspection and junction chambers, their necessity, location, size and shape.
• Systems of Sewerage and Sewer Appurtenances: Types of Sewers, Systems of sewerage, self-cleansing velocity and non-scouring velocity, Laying, Testing and maintenance of sewers, Manholes and Drop Manhole-component parts, location, spacing, construction details, Sewer Inlets, Street Inlets.

Unit – V

Characteristics and treatment of Sewage

• Analysis of sewage: Characteristics of sewage, B.O.D., C.O.D. and its significance., Central Pollution
Control Board Norms for discharge of treated sewage, Objects of sewage treatment and flow diagram of conventional sewage treatment plant.
• Treatment of Sewage: Screening, Types of screens, Grit removal, Skimming, Sedimentation of sewage, Aerobic and anaerobic process, Sludge digestion, trickling filters, Activated sludge process, Disposal of sewage, Oxidation pond, Oxidation ditch. Septic tank, Recycling and Reuse of domestic waste.

Course Objectives:

Following are the objectives of this course:
- To learn the principles for identification of sources of surface and subsurface water
- To learn calculation of population and requirement of drinking water
- To understand the plotting of water supply scheme highlighting different features
- To know evaluation of characteristics and treatment of sewage.

Reference Book:

1. Sharma S.C, Environmental Engineering, Khanna Publishing House, New Delhi
2. Garg, S.K., Environmental Engineering Vol. I and Vol. II, Khanna Publishers
3. Birdie, G. S. and Birdie, J. S.Water Supply and Sanitary Engineering, DhanpatRai
4. Gupta, O.P., Elements of Environmental Pollution Control, Khanna Publishing House, Delhi
5. Rao, C.S., Environmental Pollution Control Engineering, New Age International
6. Punmia, B C, Environmental Engineering, vol. I and II, Laxmi Publishers
7. Peavy H S, Rowe D R, and Tchobanoglous G, Environmental Engineering, McGraw
8. Basak N N, Environmental Engineering, McGraw Hill Publishers.

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester -VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Repairs and Maintenance of Structures	CEPE-612	3L-1T-0P	6

Course outcomes:

After competing this course, student will be able to:

- Decide which type of maintenance is needed for a given damaged structure
- Assess causes of damages various types of structures.
- Select the relevant material for repair of the given structure.
- Apply relevant method of retrofitting for re-strengthening of structures.
- Suggest relevant technique to restore the damages of the given structural elements.

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Unit – I

Basics of maintenance

- Types of Maintenances - repair, retrofitting, re-strengthening, rehabilitation and restoration.
- Necessity, objectives and importance of maintenance.
- Approach of effective management for maintenance.
- Periodical maintenance: check list, maintenance manual containing building plan, reinforcement details, material sources, maintenance frequency, corrective maintenance procedures and sources. Pre- and post- monsoon maintenance.

Unit– II

Causes and detection of damages

- Causes of damages due to distress, earthquake, wind, flood, dampness, corrosion, fire, deterioration, termites, pollution and foundation settlement.
- Various aspects of visual observations for detection of damages.
- Load test and non-destructive tests (brief description). NDT tests on damaged structure such as rebound hammer, ultrasonic pulse velocity, rebar locator, crack detection microscope, digital crack measuring gauge.
- Chemical test - Chloride test, sulphate attack, carbonation test, pH measurement, resistivity method, Half-cell potential meter (Introduction and demonstration only).

Unit– III

Materials for maintenance and repairs

- Types of repair material, material selection.
- Essential parameters for maintenance and repair materials such - bond with substrate, durability.
- Waterproofing materials based on polymer modified cement slurry, UV resistant acrylic polymer, ferro-cement.
- Repairing materials for masonry: plastic/aluminum nipples, non-shrink cement, polyester

putty or 1:3 cement sand mortar, galvanized steel wire fabrics and clamping rods, wire nails, ferro-cement plates.
• Repairing materials for RCC: epoxy resins, epoxy mortar, cement mortar impregnated with polypropylene, silicon, polymer concrete composites, sealants, fiber reinforcement concrete, emulsions and paints.

Unit– IV

Maintenance and repair methods for masonry Construction

• Causes of cracks in walls - bulging of wall, shrinkage, bonding, shear, tensile, vegetation.
• Probable crack location: junction of main and cross wall, junction of slab and wall, cracks in masonry joints.
• Repair methods based on crack type - For minor & medium cracks (width 0.5 mm to 5mm): grouting and for major cracks (width more than 5mm): fixing mesh across cracks, RCC band, installingferro-cement plates at corners, dowel bars, propping of load bearing.
• Remedial measures for dampness & efflorescence in wall.

Unit– V

Maintenance and repair methods for RCC Construction

• Repair stages such as concrete removal and surface preparation, fixing suitable formwork, bonding/passive coat and repair application, various methods of surface preparation.
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• Repair options such as grouting, patch repairs, carbonated concrete, cleaning the corroded steel, concrete overlays, latex concrete, epoxy bonded mortar and concrete, polymer concrete, corrosion protection such as jacketing.
• Building cracks and its prevention, common methods for dormant crack repairs such as Epoxy injection, grooving and sealing, stitching, grouting and guniting/ shotcreting.
• Strengthening methods for live cracks such as addition of reinforcements, Jacketing, brackets, collars, supplementary members i.e. shoring, underpinning and propping of framed structure.

Course Objectives:

Following are the objectives of this course:
• To learn about types of maintenance techniques
• To understand causes of various types of damages.
• To know about relevant materials for repair.
• To learn methods of retrofitting for different structures

Reference Book:

1. Gahlot, P. S., Sharma, S., Building Repair and Maintenance Management, CBS Publishers & Distributors Pvt. Ltd., New Delhi
2. Guha, P. K., Maintenance and Repairs of Buildings, New Central Book Agencies
3. Hutchin Son, B. D., Maintenance and Repairs of Buildings, Newnes-Butterworth
4. Relevant BIS codes

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester -VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	ENTREPRENEURSHIP AND START-UPS	CEPC-613	3L-1T-0P	4

Learning Outcome:

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. Strategic Marketing Planning
6. New Product or Service Development
7. Business Plan Creation

Unit-I

Introduction to Entrepreneurship and Start – Ups. Definitions, Traits of an entrepreneur, Entrepreneurship, Motivation Types of Business Structures, Similarities/differences between entrepreneurs and managers.

Unit-II

Business Ideas and their implementation. Discovering ideas and visualizing the business Activity map Business Plan

Unit-III

Idea to Start-up. Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis

Unit-IV

Management Company's Organization Structure, Recruitment and management of talent. Financial organization and management.

Unit-V

Financing and Protection of Ideas. Financing methods available for start-ups in India Communication of Ideas to potential investors – Investor Pitch Patenting and Licenses.

Unit-VI

Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy

Course Learning Objectives:

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with various uses of human resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship - its contribution and role in the

growth and development of individual and the nation.
4. Acquiring entrepreneurial quality, competency, and motivation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

Reference Books:

1. The Startup Owner's Manual The Step-by-Step Guide for Building a Great Company Steve Blank and Bob Dorf
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses
3. Demand: Creating What People Love Before They Know They Want It Adrian J. Slywotzky with Karl Weber Headline Book Publishing
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way.

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester -VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Advance Design of Structures	CEOE-614	3L-1T-0P	6

Course outcomes:

After competing this course, student will be able to perform:

- Design of riveted and welded connections.
- Design of built up sections.
- Design of T and L shaped beam sections.
- Design of one way and two way slabs.
- Design of RCC column and isolated footings.

Unit-I

Design of connections in steel structures

Types of rivets, Riveted connections, Strength of riveted joints, Design of riveted joints for axially loaded members.Types of weld, welded connections, Permissible stresses in weld, Strength of weld. Advan-tages and disadvantages of weld, Design of fillet weld and butt weld for axial load. Design of column bases for axially loaded columns only.

Unit-II

Steel Beams

Different steel sections, Simple and built up sections, Permissible bending stresses,Design of built up sections (symmetrical I section with cover plates only), check for shear and deflection Introduction to plate girder: Components and functions (no numericals)

Unit-III

Design of RC flanged beam

General features of T and L beams, Advantages, Effective width as per BIS 456 Design of singly reinforcement T beam, Stress and Strain diagram, Depth of neutral axis, Mo-ment of resistance, T and L beams with neutral axis in flange only. Simple numerical on location of neutral axis, Effective width of flange.

Unit-IV

Design of slab

Design of simply supported one-way slab for flexure, shear and deflection and checks, as per the provisions of BIS 456 Design of one-way cantilever slab, Chajjas, Flexure including checks for Development length and Shear stress. Design of two-way simply supported slab, Introduction to design of dog-legged staircases.

Unit-V

Design of RCC Column and Footing design: Uni-axial bending

IS 456 provisions, Column with uni-axial moment, Effective length calculations, Minimum eccentricity Design of footing for axially loaded column only.

Course Objectives:

Following are the objectives of this course:

- To understand the concepts involved in the design of riveted and welded connections.
- To know the provisions of BIS code for design of built up sections.
- To analyze T and L shaped beam sections.
- To understand the concept for design of one way and two way slabs.
- To identify short and long columns and their design provisions.

Reference Book:

1. Shah, V. L., and Gore, V., Limit State Design of Steel Structures, Structures Publications, Pune.
2. Dayarathnam, P., Design of Steel Structures, S. Chand and Company, New Delhi.
3. Subramanian N., Design of Steel Structures, Oxford University Press.
4. Sairam, K.S., Design of Steel Structures, Pearson Publication, Chennai, Delhi.

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DIPLOMA (CIVIL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester -VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
CIVIL ENGINEERING	Tendering and Accounts	CEOE-615	3L-1T-0P	6

Course outcomes:

After completing this course, student will be able to:

- Understand various types of contract and when they are used
- Suggest the relevant type of contract for the given civil engineering work.
- Prepare the typical Tender document for the given civil engineering work.
- Decide type of payment for the executed work.
- Justify the rent fixation and valuation of given civil structure.

Unit – I

Procedure to execute the work

Administrative approval, Technical sanction, budget provision, expenditure sanction. Methods for carrying out works- contract method, departmental method -rate list method, piece work method, day's work method, employing labours on daily wages basis.

Unit– II

Contracts

Definition of contract, objects of contract, requirements of contract, overview of Indian Con-tract Act.

Types of engineering contract with advantages, disadvantages and their suitability - Lump sum contract, item rate contract, percentage rate contract, cost plus percentage, cost plus fixed fee, cost plus variable percentage and cost plus variable fee contract, labour contract, demolition contract, target contract, negotiated contract, Engineering Procurement Construction Contract (EPC), Annuity Contract. Introduction of FIDIC Conditions of contract. Classification of contractor on basis of financial limits, Requirement of documents for Regis tration of contractor. Build Operate Transfer (BOT) Project, BOT Toll contract, BOT (Annuity) contract, Design, Build, Finance, Operate and Transfer (DBFOT) contract, Hybrid Annuity contract, Operate Maintain and Transfer (OMT) contract, Operation & Maintenance contract (Introduction only).

Unit-III

Tender and Tender Documents

Definition of tender, necessity of tender, types of tender- Local, Global, Limited. E -Tendering System – Online procedure of submission and opening of bids (Technical and Financial). Notice to invite tender (NIT)- Points to be included while drafting tender notice, Drafting of tender notice. Procedure of submitting filled tender Documents (Two envelope system), procedure of opening tender, comparative statement, scrutiny of tenders, award of contract, letter of award. Meaning of terms - Earnest Money Deposit (EMD), Performance Security Deposit, Validity period, corrigendum to tender notice and its necessity, Unbalanced bid. Tender documents – Index, tender notice, general instructions, special instructions, Sched- ule A, Schedule B, Schedule C etc. Terms related to tender documents – contract conditions- time limit, time extension, pen- alty, defective material and workmanship, termination of contract, suspension of work, subletting of contract, extra items, price variation clause(escalation), defect

liability Period, liquidated Damages. Arbitration- Meaning, Qualification of an arbitrator, Appointment, Dispute and Settlement of disputes, Arbitration and Conciliation Act, Arbitration award.

Unit– IV

Accounts

Various account forms and their uses – Measurement Books, E- Measurement book (E-MB), Nominal Muster Roll(NMR), Imprest Cash, Indent, Invoice, Bill, Vouchers, Hand receipt Cash Book, Temporary Advance. Heads of Accounts. Mode of Payment to the contractor and its necessity -Interim Payment, Advance Payment Secured Advance, Petty advance, Mobilization advance, Running account bill, Final bill, Re-tention money, E - payment.

Unit– V

Introduction to Valuation

Definition and purpose of Valuation, role of valuer. Definition - Cost, Price and Value, Char-acteristics of Value, Factors Affecting Value. Types of Value - Book Value, Scrap Value, Salvage Value, Speculative Value, Distress Value, Market Value, monopoly Value, Sentimental Value. Factors affecting value. Depreciation, Obsolescence, Sinking Fund, Methods of Calculation of Depreciation – Straight Line Method, Sinking Fund Method, Constant Percentage Method. Fixation of rent, Lease – types of lease, lease hold property and free hold property. Mortgage – Mortgage deed, precautions to be taken while making mortgage.

Course Objectives:

Following are the objectives of this course:

- To understand terminologies in contract and tender document and their significance.
- To know different types of contracts and their uses.
- To learn preparation of typical Tender documents for civil engineering work.
- To get acquainted with rent fixation and valuation of civil structures.

Reference Book:

1. Datta, B. N., Estimating and Costing in Civil engineering, UBS Publishers Pvt. Ltd., New Delhi
2. Raina, V. K., Construction Management and Contract Practices, Shroff Publishers & Distributers Pvt. Ltd.
3. Rangawala, S. C., Estimating and Costing, Charotar Publishing House PVT. LTD., Gujrat
4. Birdie, G. S., Estimating and Costing, Dhanpat Rai Publishing Company(P) Ltd., New Delhi
5. Patil, B. S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai
6. Chakraborti, M., Estimating and Costing, Specification and Valuation in Civil Engineering, Monojit Chakraborti, Kolkata.

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Semester – III

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Data Structure**	**COPC-321**	**3L-1T-2P**	**6**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 Understand basic data structures such as arrays, linked lists, stacks and queues

CO2 Solve problem involving graphs, trees and heaps

CO3 Solve problem involving graphs, trees and heaps.

Course Contents:

UNIT 1:
Introduction to Data Structures: Basic Terminology, Classification of Data Structures, Operations on Data Structures.

UNIT 2:
Linear Data Structures- Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on a Stack, Applications of Stacks-Infix-to-Postfix Transformation, evaluating Postfix Expressions. Queues: Introduction to Queues, Array Representation of Queues, Operations on a Queue, Types of Queues-DeQueue, Circular Queue, Applications of Queues-Round Robin Algorithm.

UNIT 3:
Linked Lists: Singly Linked List, Representation in Memory, Operations on a Single Linked List, Circular Linked Lists, Doubly Linked Lists, Linked List Representation and Operations of Stack, Linked List Representation and Operations of Queue.

UNIT 4:
Non Linear Data Structures - Trees: Basic Terminologies, Definition and Concepts of Binary Trees, Representations of a Binary Tree using Arrays and Linked Lists, Operations on a Binary Tree-Insertion, Deletion, Traversals, Types of Binary Trees. GRAPHS: Graph Terminologies, Representation of Graphs- Set, Linked, Matrix, Graph Traversals

Reference Books:

1. Data Structures, R.S. Salaria, Khanna Book Publishing, New Delhi
2. Data Structures Using C, Reema Thareja, Oxford University Press India.
3. Classic Data Structures, Samanta Debasis, Prentice Hall of India.

4. Fundamentals of Data Structure in C, Horowitz, Ellis, Sahni, Sartaj, Anderson-Freed, Susan, University Press, India.
5. Data Structures: A Pseudo code approach with C, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India.
6. Data Structures and Algorithms: Concepts, Techniques and Applications, G. A. V. Pai, McGraw-Hill Education, India.

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Semester – III

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Computer System Organisation**	**COPC-322**	**3L-1T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Understand functioning of computer system as such and its various subcomponents.
CO2	Computing requirement for a specific purpose, analyse performance bottlenecks of the computing device and choose appropriate computing device for a given use case.

Course Contents:

UNIT 1:
Structure of Computers: Computer Functional units, Von-Neumann architecture, Bus structures, Basic Operational Concepts, Data representation (Fixed and Floating point), Error detecting codes. Register Transfer and Micro Operations: Register transfer, Bus and memory transfers, Arithmetic micro-operations, Logic micro-operations, Shift micro-operations, and Arithmetic logic shift unit.

UNIT 2:
Micro Programmed Control: Control memory, Address sequencing, and design of control unit. Computer Arithmetic: Addition and Subtraction, Multiplication and Division algorithms, Floating- point arithmetic operation, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors.

UNIT 3:
Introduction to Microproccessor Architecture: Instruction Set Architecture design principles from programmer's perspective. One example microprocessor (Intel, ARM, etc).

UNIT 4:
Assembly Language Programming: Simple programs, Assembly language programs involving logical, branch and call instructions, sorting, evaluation of arithmetic expressions, string manipulation, assembler directives, procedures and macros.

UNIT 5:
Memory and Digital Interfacing: addressing and address decoding, interfacing RAM, ROM, EPROM, programmable peripheral interface, various modes of operation and interfacing to processor, interfacing keyboard, displays, etc.

Reference Books:

1. Computer System Architecture, M. Moris Mano, Pearson/PHI, India.
2. Microprocessors Interface, Douglas V.Hall, Tata McGraw-Hill.
3. Computer Organization, Carl Hamacher, Zvonks Vranesic, SafeaZaky, McGraw-Hill
4. Advanced Microprocessors and Peripherals- Architecture, Programming and interfacing, A.K.Ray, K.M.Bhurchandi, Tata McGraw-Hill, New Delhi, India.
5. Computer Organization and Design: A Hardwar/Software Interface (MIPS Edition) by Patterson and Hennessy

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Semester – III

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Algorithms**	**COPC-323**	**3L-1T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	design basic algorithms for sorting and searching
CO2	understand the basic notions of time and space complexity of algorithms
CO3	implement sorting, searching, tree and graph algorithms in a modern computer programming language.

Course Contents:

UNIT 1:

Fundamentals

Programming Models. Data Abstraction. Sets, Multisets, Stacks, Queues. Asymptotic and worst-case analysis of algorithms.

UNIT 2:

Sorting

The sorting problem, Bubble sort, Selection sort, Insertion sort, Mergesort, Quicksort.

UNIT 3:

Searching

Symbol Tables, Binary Search Trees, Balanced Search Trees. Hash Tables.

UNIT 4:

Graphs

Definition of a directed and undirected graph. Paths, Cycles, spanning trees. Directed Acyclic Graphs. Topological Sorting. Minimum Spanning Tree algorithms. Shortest Path algorithms: Dijkstra's algorithm.

Flow-based algorithms.

UNIT 5:

Strings

String Sort. Tries. Substring Search. Regular Expressions. Elementary Data compression.

Reference Books:

1. Algorithms, Sedgewick and Wayne, Pearson
2. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein. MIT Press
3. Introduction to Theory of Computation, Sipser Michael, Cengage Learnng.
4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House

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Semester – III

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Computer Programming**	**COPC-324**	**4L-0T-2P**	**6**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Computationally formulate basic problems and write code snippets to execute them.
CO2	Formulating a solution for a given problem as a well-defined sequence of actions
CO3	Express solution in a machine readable form or a programming language.

Course Contents:

UNIT 1:
Introduction to Problem Solving (computational way of thinking); Variables and Representation

UNIT 2:
Arithmetic, Relational, Logical and Bitwise Operators; Input, Output, Formatting and File I/O

UNIT 3:

Conditional Statements, Repeat Statements, Loops and Nested Loops

UNIT 4:
Arrays and Memory Organization, Strings, Multidimensional Arrays, Functions and Parameter Passing

UNIT 5:
Recursion and Recursive solutions

Reference Books:

1. Let Us C, Yashavant Kanetkar
2. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House
3. C Programming Absolute Beginner's Guide, Dean Miller and Greg Perry
4. The C Programming Language, Kernighan and Ritchie, Prentice Hall of India
5. Programming in ANSI C, E. Balagurusamy, Tata McGraw-Hill
6. C Programming & Data Structures, B. A. Fouruzan and R. F. Gilberg, CENGAGE Learning.
7. Outline of Programming with C, Byron Gottfried, Schaum, McGraw-Hill

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Semester – III

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Scripting Language(Python)**	**COPC-325**	**4L-0T-2P**	**6**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Build program with a scripting language and will be able to learn any other scripting language on their own.
CO2	To learn how to work with a scripting language.

Course Contents:

UNIT 1: Introduction, Variables and Data Types

History, Features, Setting up path, Installation and Working with Perl/Python, Basic Syntax Understanding Perl/Python variables, Numeric data types, Using string data type and string operations, Basic Operators, Understanding coding blocks, Defining list andlist slicing, Other Data Types (Tuples, List, Dictionary -Python, Arrays, Associative Arrays/Hashes - Perl).

UNIT 2: Control Structures

Conditional blocks using if, else and elif, For loops and iterations, while loops, Loop manipulation using continue, break and else (and pass in Python), Programming using conditional and loops block

UNIT 3: Functions, Modules and Packages

Organizing Perl codes using functions, Organizing Perl projects into modules, Importing own module as well as external modules, Understanding Packages

UNIT 4: File I/O, Text Processing, Regular Expressions

Understanding read functions, Understanding write functions, Programming using file operations, Powerful pattern matching and searching, Power of pattern searching using regex

UNIT 5: Frameworks

Frameworks - Web2Py, Django, Ruby on Rails, Struts (any one of these or any other)

Reference Books:

1. Taming Python by Programming, Jeeva Jose, Khanna Publishing House
2. Starting Out with Python, Tony Gaddis, Pearson
3. Core Python Programming, Wesley J. Chun, Prentice Hall
4. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University
5. Introduction to Computation and Programming Using Python. John V. Guttag, MIT Press.
6. Beginning Python using Python 2.6 and Python 3, James Payne, Wrox publishing
7. Practical Programming: An Introduction to Computer Science using Python 3, Paul Gries, The Pragmatic Bookshelf

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Semester – IV

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Operating System**	**COPC-421**	**3L-1T-2P**	**6**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1 demonstrate basic knowledge about Operating System

CO2 apply OS concepts such as processes, memory and file systems to system design

CO3 configure OS in an efficient and secure manner

Course Contents:

UNIT 1:

Overview of Operating System, basic concepts, UNIX/LINUX Architecture, Kernel, services and systems calls, system programs.

UNIT 2:

Process Management: Process concepts, operations on processes, IPC, Process Scheduling, Multithreaded Programming Memory management: Memory allocation, Swapping, Paging, Segmentation, Virtual Memory, various faults.

UNIT 3:

File management: Concept of a file, access methods, directory structure, file system mounting, file sharing and protection, file system structure and implementation, directory implementation, freespace management, efficiency and performance. Different types of file systems

UNIT 4:

I/O System: Mass storage structure - overview, disk structure, disk attachment, disk scheduling algorithms, swap space management, RAID types.

UNIT 5:

OS Security: Authentication, Access Control, Access Rights, System Logs

Reference Books:

1. Operating System Concepts, Silberschatz and Galvin, Wiley India Limited

2. UNIX Concepts and Applications, Sumitabha Das, McGraw-Hill Education
3. Operating Systems, Internals and Design Principles, Stallings, Pearson Education, India
4. Operating System Concepts, Ekta Walia, Khanna Publishing House
5. Modern Operating Systems, Andrew S. Tanenbaum, Prentice Hall of India
6. Operating systems, Deitel & Deitel, Pearson Education, India

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Semester – IV

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Introduction to DBMS**	**COPC-422**	**3L-1T-2P**	**6**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	understand how to design a database, database-based applications
CO2	How to use a DBMS

Course Contents:

UNIT 1:
Introduction; Database System Concepts and Architecture

UNIT 2 :
Data Modeling using the Entity-Relationship Model; The Enhanced Entity-Relationship (EER) model

UNIT 3:
The Relational Data Model and Relational Database Constraints; ER/EER to Relational Model mapping; Relational Algebra and Relational Calculus

UNIT 4:
SQL-99: Schema definition, Constraints, Queries, and Views; Security; Introduction to SQL programming Techniques

UNIT 5:
Functional dependencies and normalization for relational databases; Relational database design algorithms and further dependencies.

Reference Books:

1. Fundamentals of Database Systems, Elmasri & Navathe, Pearson Education
2. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata McGraw-Hill.
3. Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill, New Delhi, India.
4. Introduction to Database Systems, C.J.Date, Pearson Education
5. Introduction to SQL, Rick F.Vander Lans, Pearson Education

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Semester – IV

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Computer Network**	**COPC-423**	**3L-1T-2P**	**6**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Understand computer networks, issues, limitations, options available
CO2	Understand the care that needs to be taken while developing applications designed to work over computer networks
CO3	configure basic LAN and connect computers to it.

Course Contents:

UNIT 1:

Introduction to computer networks; Network Models- OSI Reference Model, TCP/IP Model;

UNIT 2:

Transmission Media – principles, issues and examples; Wired Media – Coaxial, UTP, STP, Fiber Optic Cables; Wireless Media – HF, VHF, UHF, Microwave, Ku Band; Network topologies; Data Link Layer – design issues, example protocols (Ethernet, WLAN, Bluetooth); Switching Techniques;

UNIT 3:

Network Layer - design issues, example protocols (IPv4); Routing - principles/issues, algorithms (Distance-vector, Link-state) and protocols (RIP, OSPF);

UNIT 4:

Transport Layer - design issues, example protocols (TCP); Application Layer Protocols (SMTP, DNS).

UNIT 5:

Functioning of Network Devices – NIC, Hub, Switch, Router, WiFi Devices; Network Management System and example protocol (SNMP).

Reference Books:

1. Computer Networks, 4th Edition (or later), Andrew S. Tanenbaum, PHI
2. TCP/IP Illustrated, Volume-1, W. Richard Stevens, Addision Wesley
3. Data and Computer Communications, William Stallings, PHI
4. An Engineering Approach to Computer Networking, S. Keshav, Addision Wesley/Pearson
5. An Integrated Approach to Computer Networks, Bhavneet Sidhu, Khanna Publishing House

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Semester – IV

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Software Engineering**	**COPC-424**	**3L-1T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Computationally formulate basic problems and write code snippets to execute them.
CO2	Formulating a solution for a given problem as a well-defined sequence of actions
CO3	Express solution in a machine readable form or a programming language.

UNIT 1:
Introduction to Software Engineering, Lifecycle, Process Models - Traditional v/s Agile processes.

UNIT 2:
Development Activities - Requirements Gathering and Analysis, Design Concepts, Software architecture and Architectural styles, Basic UI design, Effective Coding and Debugging techniques.

UNIT 3:
Software Testing Basics, Unit, Integration, System and Acceptance Testing, Introduction to various testing techniques (e.g. Stress testing), Writing and executing test cases, Quality Assurance.

UNIT 4:
Project Management - Project management concepts, Configuration and Release Management, Version Control and its tools (Git), Release Planning, Change Management, Software Maintenance, Project Metrics.

UNIT 5:
Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards.

Reference Books:

1. Software Engineering – A Practitioner's Approach, 7th Edition, Roger Pressman.
2. Software engineering, Ian Sommerville, Pearson Education
3. An Integrated Approach to Software Engineering, Pankaj Jalote, Springer Verlag
4. Software Engineering, Nasib Singh Gill, Khanna Book Publishing Co. India.
5. Software Engineering, K. K. Agarval, Yogesh Singh, New Age International Publishers

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Semester – IV

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Web Technology**	**COPC-425**	**4L-0T-2P**	**6**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Build program with a scripting language and will be able to learn any other scripting language on their own.
CO2	To learn how to work with a scripting language.

Course Contents:

UNIT 1: Introduction to www

Protocols and programs, secure connections, application and development tools, the web browser, What is server, setting up UNIX and LINUX web servers, Logging users, dynamic IP Web Design: Web site design principles, planning the site and navigation

UNIT 2: Web Systems Architecture

Architecture of Web based systems- client/server (2-tier) architecture, 3-Tier architecture, Building blocks of fast and scalable data access Concepts - Caches-Proxies- Indexes-Load Balancers- Queues, Web Application architecture (WAA)

UNIT 3: Javascript

Client side scripting, What is Javascript, simple Javascript, variables, functions,conditions, loops and repetition

UNIT 4: Advance scripting

Understanding read functions, Understanding write functions, Programming using file operations, Powerful pattern matching and searching, Power of pattern searching using regex

UNIT 5: Frameworks

Frameworks - Web2Py, Django, Ruby on Rails, Struts (any one of these or any other)

Reference Books:

1. “Web Technologies--A Computer Science Perspective”, Jeffrey C.Jackson,

2. “Internet & World Wide Web How To Program”, Deitel, Deitel, Goldberg, Pearson Education
3. “Web programming- Building Internet Application”, Chris Bales
4. Web Applications: Concepts and Real World Design, Knuckles5.

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Semester – V

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma(CSE)	**Introduction to E-Governance**	**COPC-521**	**3L-1T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	The course will help students to understand and appreciate the essence of e-Governance.
CO2	Through exposure to introductory ideas
CO3	Practices followed in a selected number of e-Governance initiatives in India.

Course Contents:

UNIT 1: Exposure to emerging trends in ICT for development; Understanding of design and implementation of e-Government projects, e-governance lifecycle.

UNIT 2: Need for Government Process Re-engineering (GPR); National e-Governance Plan(NeGP) for India; SMART Governments & Thumb Rules

UNIT 3: Architecture and models of e-Governance, including Public Private Partnership (PPP); Need for Innovation and Change Management in eGovernance; Critical Success Factors; Major issue including corruption, resistance for change, e-Security and Cyber laws

UNIT 4: Focusing on Indian initiatives and their impact on citizens; Sharing of case studies to highlight best practices in managing e-Governance projects in Indian context. Visits to local e-governance sites (CSC, eSeva, Post Office, Passport Seva Kendra, etc) as part of Tutorials.

UNIT 5: Mini Projects by students in groups – primarily evaluation of various e-governance projects.

Reference Books:

1. Managing Transformation –Objectives to Outcomes. J Satyanarayana, Prentice Hall India
2. The State, IT and Development. Kenneth Kenniston, RK Bagga and Rohit Raj Mathur, Sage Publications India Pvt Ltd.
3. e-Government -The Science of the Possible. J Satyanarayana, Prentice Hall, India
4. http://www.csi-sigegov.org/publications.php
5. https://negd.gov.in 6. https://www.nisg.org/case-studies-on-e-governance-in-india

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Semester – V

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Internet of Things**	**COPC-522**	**3L-1T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Students will have good understanding of various aspect of IoT
CO2	know some tools and have basic implementation skills

Course Contents:

UNIT 1:
Introduction to IoT; Sensing; Actuation

UNIT 2 :
Basics of IoT Networking, Communication Protocols, Sensor networks

UNIT 3:
Introduction to Arduino programming, Integration of Sensors/Actuators to Arduino

UNIT 4:
Implementation of IoT with Raspberry Pi; Data Handling Analytics

UNIT 5:
Case Studies: Agriculture, Healthcare, Activity Monitoring

Reference Books:

1. https://nptel.ac.in/noc/individual_course.php?id=noc17-cs22
2. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
3. Internet of Things by Dr. Jeeva Jose, Khanna Publishing House (Edition 2017) 4. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)
4. Internet of Things: Architecture and Design Principles, Raj Kamal, McGraw Hill

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Semester – V

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Mobile Computing**	**COPC-5231**	**4L-0T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Will be able to develop and deploy basic mobile applications
CO2	skills to understand the mobile computing system

Course Contents:

UNIT 1:

A brief history of Mobile, Types of mobile phone generations, The Mobile Ecosystem, Types of Mobile Applications, Mobile Information Architecture Android Versions, Features of Android, Android Architecture, Installing Android SDK Tools, Configuring Android in Eclipse IDE, Android Development Tools (ADT), Creating Android Virtual Devices (AVD)

UNIT 2:

Creating first android application, Anatomy of android application, Deploying Android app on USB connected Android device, Android application components, Activity life cycle, Understanding activities, Exploring Intent objects, Intent Types, Linking activities using intents

UNIT 3:

Fragments life cycle, Interaction between fragments, Understanding the components of a screen (Layouts), Adapting to display orientation, Action Bar, Views(UI Widgets)-Button, Toast, ToggleButton, CheckBox, RadioButton, Spinner, WebView, EditText, DatePicker, TimePicker, ListView, ProgressBar, Analog and Digital clock, Handling UI events, List fragment, Dialog fragment

UNIT 4:

Menus-Option, Context, Popup, Images-ImageView, ImageSwitcher, AlertDialog, Alarm manager, SMS, E-mail, Media Player, Using camera, recording video, Handling Telephony Manager

UNIT 5:

Storing the data persistently-Data Storage Options: preferences, Internal Storage, External Storage, Content Provider , The SQLite database, Connecting with SQLite database and operations-Insert, Delete, Update,

Fetch, Publishing android applications, Deploying APK files

References:

1. Wei-Meng Lee, Beginning Android 4 Application Development, Wiley Publishing, Inc
2. Pradeep Kothari, “Android Application Development Black Book”, DreamTech Press
3. James C.Sheusi, “Android Application Development for Java Programmers”, Cengage Learning
4. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd
5. Sayed Y Hashimi and SatyaKomatineni(2009), “Pro Android”, Wiley India Pvt Ltd
6. Reto Meier, Professional Android 4 Application Development, Wiley India Pvt Ltd

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Semester – V

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Multimedia Technology**	**COPC-5232**	**4L-0T-0P**	**4**

Course Outcomes:
After completing this course satisfactorily, a student will be able to:

CO1	Student will understand various aspects of Multimedia and related standards
CO2	Student will be able to build multimedia content and applications
CO3	Understand to multimedia enable Web applications and mobile applications.

Course Contents:

UNIT 1: Introduction to Multimedia Multimedia Foundation and Concepts: Multimedia Hardware, Multimedia Software , Multimedia operating systems , Multimedia communication system

UNIT 2: Basic Compression Techniques Video and Audio Data Compression Techniques – Lossy and Lossless. Example algorithms/standards: Huffman, RLE, JPEG, MPEG, MP3, MP4, LZMA, FLAC, ALAC, ITU G.722, H.261, H.265

UNIT 3: Content Development and Distribution Desktop publishing (Coral Draw, Photoshop, Page maker) Multimedia Animation & Special effects (2D/3D animation, Flash)

UNIT 4: Introduction to Digital Imaging Basics of Graphic Design and use of Digital technology, Definition of Digital images, Digital imaging in multimedia

UNIT 5: Introduction to Multimedia Programming and Applications

Reference Books:

1. An Introduction to Multimedia Authoring, A. Eliens
2. Fundamentals of Multimedia, Prentice Hall/Pearson, Ze-Nian Li & Mark S. Drew.
3. Multimedia and Animation, V.K. Jain, Khanna Publishing House, Edition 2018
4. Fundamentals of Multimedia, Ramesh Bangia, Khanna Book Publishing Co., N. Delhi (2007)

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Semester – V

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Advance Computer Network**	**COPC-5241**	**4L-0T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Understanding core concepts/theories/algorithms of computer networks
CO2	Some hands-on capability on various network devices and tools
CO3	Capability to design and implement a computer network

Course Contents:

UNIT 1: Review of Networking Basics; Advance Topics in IPv4 – Subnetting, Multicasting, Multicast Routing Protocols (IGMP, PIM, DVMRP); Advance Topics in TCP – flow management, congestion avoidance, protocol spoofing; IPv6

UNIT 2: Telecom Networks, Switching Techniques; Introduction to Frame Relay, ATM, MPLS; VSAT Communication – Star and Mesh architectures, bandwidth reservation; Wireless Networks – WiFi, WiMax, Cellular Phone Technologies – GSM, CDMA, 3G, 4G

UNIT 3: Network Redundancy, Load Balancers, Caching, Storage Networks; QoS; Network Monitoring – SNMP, RMON;

UNIT 4: Introduction to Network Security – VLAN, VPN, Firewall, IPS, Proxy Servers

UNIT 5: Network Simulation, Network design case studies and exercises, IP Addressing schema, Protocol Analyzers (Wireshark, etc)

References:

1. RFCs and Standards Documents (www.ietf.org and other standard body websites)
2. Communication Networking – An Analytical Approach, Anurag-Manjunath-Joy
3. TCP/IP Illustrated (Vol.1,2), Stevens
4. Data Networks, Bertsekas-Gallager
5. An Engineering Approach to Computer Networking, S. Keshav

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Semester – V

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Information Security**	**COPC-5242**	**4L-0T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Understanding of security needs and issues of IT infrastructure
CO2	Have basic skills on security audit of networks, operating systems and application software.

Course Contents:

UNIT 1:

Introduction to Information Security, Various aspects of information security (PAIN), Security Features of Operating Systems – Authentication, Logs, Audit Features, File System Protection, User Privileges, RAID options, Anti-Virus Software, etc.

UNIT 2:

Understanding security weaknesses in popular networking protocols – IP, TCP, UDP, RIP, OSPF, HTTP, SMTP, etc.; security weaknesses in common networking devices – Hub, switch, router, WiFi; Security solutions to mitigate security risk of networking protocols (IPSec, HTTPS, etc) and devices (VLAN, VPN, Ingress Filtering, etc)

UNIT 3:

Basics of Cryptography, PKI, Security considerations while developing softwares

UNIT 4:

Network Security Products – Firewall, IDS/IPS, VPN Concentrator, Content Screening Gateways, etc.

UNIT 5:

Introduction to Security Standards – ISO 27001, Indian IT Act, IPR Laws; Security Audit procedures; Developing Security Policies; Disaster Recovery, Business Continuity Planning

References:

1. Information Security and Cyber Laws, Sarika Gupta, Khanna Publishing House
2. RFCs of protocols listed in content (https://www.ietf.org)
3. Various Acts, Laws and Standards (IT Act, ISO27001 Standard, IPR and Copyright Laws, etc.)
4. Security Guideline documents of Operating Systems (OS Manual, Man Pages, etc)
5. https://www.cert-in.org.in/ 6. https://www.sans.org/

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Semester – VI

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Soft Computing Techniques**	**COPC-5251**	**4L-0T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Classify and differentiate problem solving methods and tools.
CO2	Apply A*, AO*, Branch and Bound search techniques for problem solving.
CO3	Formulate an optimization problem to solve using evolutionary computing methods.
CO4	Design and implement GA, PSO and ACO algorithms for optimization problems in Mechanical Engineering.

Course Contents:

UNIT-I:

Problem Solving Methods and Tools: Problem Space, Problem solving, State space, Algorithm's performance and complexity, Search Algorithms, Depth first search method, Breadth first search methods their comparison, A*, AO*, Branch and Bound search techniques, p type, Np complete and Np Hard problems.

UNIT-II:

Evolutionary Computing Methods: Principles of Evolutionary Processes and genetics, A history of Evolutionary computation and introduction to evolutionary algorithms, Genetic algorithms, Evolutionary strategy, Evolutionary programming, Genetic programming. Genetic Algorithm and Genetic Programming: Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

UNIT-III:

Swarm Optimization: Introduction to Swarm intelligence, Ant colony optimization (ACO), Particle swarm optimization (PSO), Artificial Bee colony algorithm (ABC), Other variants of swarm intelligence algorithms.

UNIT-IV:

Advances in Soft Computing Tools: Fuzzy Logic, Theory and applications, Fuzzy Neural networks, Pattern Recognition, Differential Evolution, Data Mining Concepts, Applications of above algorithms in

manufacturing engineering problems. Artificial Neural Networks: Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward 443 Open Elective Courses networks, recurrent networks. Back propagation algorithm, factors affecting back propagation training, applications

UNIT-V:

Application of Soft Computing to Mechanical Engineering/Production Engineering Problems: Application to Inventory control, Scheduling problems, Production, Distribution, Routing, Transportation, Assignment problems

Reference Books:

1. Tettamanzi Andrea, Tomassini and Marco, Soft Computing Integrating Evolutionary, Neural and Fuzzy Systems, Springer, 2001.
2. Elaine Rich, Artificial Intelligence, McGraw Hill, 2/e, 1990.
3. Kalyanmoy Deb, Multi-objective Optimization using Evolutionary Algorithms, John Wiley and Sons, 2001.

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Semester – VI

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**AI & Machine Learning**	**COPC-5252**	**4L-0T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Identify problems that are amenable to solution by AI methods
CO2	Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.
CO3	Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
CO4	able to design and implement various machine learning algorithms in a range of real-world applications.

Course Contents:

UNIT-I: Introduction: History and foundations of AI, Problem solving: Uninformed and informed Search; Constraint Satisfaction Problems and Constrained Optimization problems (complete and incomplete techniques).

UNIT-II: Adversarial Search: Two players games, games with uncertainty; Decision support systems and technologies; Knowledge representation, Reasoning, Expert systems Contents (2/2), Planning (basics).

UNIT-III: Machine learning Basics: Decision trees, Ensemble learning, Reinforcement learning, Evolutionary computation, Neural networks, Problems, data, and tools; Visualization;

UNIT-IV: Linear regression; SSE; gradient descent; closed form; normal equations; features, Over fitting and complexity; training, validation, test data, and introduction to Matlab.

UNIT-V: Classification problems; Decision boundaries; Probability and classification, Bayes optimal decisions, Naive Bayes and Gaussian class-conditional distribution.

Reference Books:

1. Russell, Norvig, Artificial intelligence: A modern approach, 2nd edition. Pearson/Prentice Hall.
2. EthemAlpaydin, Introduction to Machine Learning, Second Edition, http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012.

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Semester –VI

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Network Forensic**	**COPC-6211**	**3L-0T-0P**	**3**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	understand basic concepts of network forensics
CO2	learn tools
CO3	do basic forensic investigations and handle security incidents.

Course Contents:

UNIT 1:

Review of Networking concepts and Protocols, Introduction to Network Forensics, various aspects of Network Forensics

UNIT 2:

Introduction to Network Forensic Tools and techniques: Wireshark, TCP Dump, Syslog, NMS, Promiscuous Mode, Network Port Mirroring, snooping, scanning tools, etc.

UNIT 3:

Understanding and Examining Data Link Layer, Physical Layer, Ethernet Switch Logs, MAC Table, ARP Table, etc. Understanding and Examining Network Layer, Router Logs, WiFi Device logs, Firewall logs.

UNIT 4:

Understanding audit features of OS and applications; Enabling and Examining Server logs, User activity logs, Browser history analysis, Proxy server logs, Antivirus logs, Email logs.

UNIT 5:

Limitations and challenges of network forensics due to encryption, spoofing, mobility, storage limitations, privacy laws, etc

Reference Books:

1. Manuals of OS, application software, network devices
2. RFCs of various networking protocols (https://www.ietf.org/)
3. https://www.sans.org/
4. https://www.cert-in.org.in/
5. Handbook of Digital Forensics and Investigation, Eoghan Casey, Elsevier Academic Press
6. Cyber Forensics, Albert Marcella and Doug Menendez, CRC Press
7. Computer Forensics (5 volume Set) mapping to CHFI (Certified Hacking Forensics Investigator), by EC-Council

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Semester – VI

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Data Science: Data Warehousing and Data Mining**	**COPC-6212**	**3L-0T-0P**	**3**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	have general idea about Data Warehousing and Data Mining techniques
CO2	explore further and effectively use related tools

Course Contents:

UNIT 1:

Introduction Motivation, Importance, Definitions, Kind of Data, Data Mining Functionalities, Kinds of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of A Data Mining System with A Database or Data Warehouse System, Major Issues in Data Mining, Types of Data Sets and Attribute Values, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity. PREPROCESSING: Data Quality, Major Tasks in Data Preprocessing, Data Reduction, Data Transformation and Data Discretization, Data Cleaning and Data Integration.

UNIT 2:

Data Warehousing and on-line Analytical Processing Data Warehouse basic concepts, Data Warehouse Modeling - Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction, Data Cube Computation.

UNIT 3:

Patterns, Associations and Correlations Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Pattern Evaluation Methods, Applications of frequent pattern and associations. Frequent Patterns and Association Mining: A Road Map, Mining Various Kinds of Association Rules, Constraint-Based Frequent Pattern Mining, Extended Applications of Frequent Patterns.

UNIT 4:

Classification Basic Concepts, Decision Tree Induction, Bayesian Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy: Ensemble Methods, Handling Different Kinds of Cases in Classification, Classification by Neural Networks, Support Vector Machines, Pattern-Based Classification, Lazy Learners (or Learning from Your Neighbors).

UNIT 5:

Cluster Analysis Basic Concepts of Cluster Analysis, Clustering Structures, Major Clustering Approaches, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Model-Based Clustering, Why outlieranalysis, Identifying and handling of outliers, Outlier Detection Techniques. WEB MINING: Basic concepts of web mining, different types of web mining, PAGE RANK Algorithm, HITS Algorithm

Reference Books:

1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier
2. Margaret H Dunham, Data Mining Introductory and Advanced Topics, Pearson Education
3. Amitesh Sinha, Data Warehousing, Thomson Learning, India.
4. Xingdong Wu, Vipin Kumar, the Top Ten Algorithms in Data Mining, CRC Press, UK..

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Semester – VI

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**FOSS(Free and Open Source Software)**	**COPC-6221**	**3L-0T-0P**	**3**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	work with FOSS tools
CO2	find and evaluate FOSS alternatives for any software requirement

Course Contents:

UNIT 1:

Understanding the FOSS Community and FOSS Philosophy, Benefits of Community based SoftwareDevelopment, Guidelines for working with FOSS community, Requirements for being open, free software, open source software, FOSS Licensing Models, FOSS examples.

UNIT 2:

Linux Installation and Hardware Configuration, Boot Process, Dual-Booting Linux and other Operating Systems, Kernel Options during Boot, X Windows System Configuration, System Administration (Server Administration, Backup and Restore Procedures, Strategies for keeping a Secure Server)

UNIT 3:

Libreoffice Tools; Samba: Cross platform; Introduction about LAMP; Brief Introduction to Programming using languages like Java /Python / Perl; Database Systems Mysql, PostgreSQL or equivalent; Open Source UML Tools.

UNIT 4:

Introduction to Mobile Programming; Version Control Systems like SVN, Git or equivalent; Project Management Tools; Bug Tracking Systems; Package Management Systems.

UNIT 5:

Some example case studies of FOSS implementation

References:

1. Linux in a Nutshell, by Ellen Siever

2. Philosophy of GNU URL: http://www.gnu.org/philosophy/.
3. Linux Administration URL: http://www.tldp.org/LDP/lame/LAME/linux-admin-madeeasy/.
4. Version control system URL: http://git-scm.com/.
5. Samba: URL : http://www.samba.org/.
6. Libre office: http://www.libreoffice.org/.

Curricula

Semester – VI

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Software Testing**	**COPC-6222**	**3L-0T-0P**	**3**

Course Outcomes:
After completing this course satisfactorily, a student will be able to:

CO1	skills to understand the system
CO2	choose suitable testing methods, strategies, tools and technology, execute and report the test
CO3	understand need and usage of test automation and gain expertise in at least 1 test automation tool

Course Contents:

UNIT 1: Basics
Introduction to Software Quality basics: Verification and validation, quality perspectives, Testing terminology, Software Testing Life Cycle (STLC), "V" model of Testing, QA process, cost of testing, types of tests.

UNIT 2: Writing Test Cases
Writing test cases, Functional Testing, non-functional testing, (Performance testing), UI testing. Preparing test data, Writing Unit test, Integration test and User Acceptance Tests, preparing test scenarios from Software requirements.

UNIT 3: Test Execution and Management
test execution, Test Oracles, test planning, test strategy including when to stop testing, test-coverage - Traceability matrix, JIRA, Bugzilla and other bug tracking tools. Test data mining, test reporting.

UNIT 4: Test Automation
Why automation, when not to automate, writing simple automated test cases, learn and practice any one automated testing framework like Selenium.

UNIT 5: Other quality Assurance
Quality and Defect management - Code reviews, Quality tools, Change management, version control

Reference Books:
1. Software Engineering – A Practitioner's Approach, 7th Edition, Roger Pressman.
2. Bugzilla (https://www.bugzilla.org/)
3. JIRA (https://www.atlassian.com/software/jira)

Curricula

Semester – VI

Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Entrepreneurship and Start - ups**	**COPC-623**	**3L-1T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Understanding the dynamic role of entrepreneurship and small businesses
CO2	Organizing and Managing a Small Business
CO3	Financial Planning and Control
CO4	Strategic Marketing Planning
CO5	New Product or Service Development

Course Contents:

Unit 1

- Introduction to Entrepreneurship and Start – Ups
- Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation
- Types of Business Structures, Similarities/differences between entrepreneurs and managers.

Unit 2 –

- Business Ideas and their implementation
- Discovering ideas and visualizing the business
- Activity map
- Business Plan

Unit 3 –

- Idea to Start-up
- Market Analysis – Identifying the target market,
- Competition evaluation and Strategy Development,
- Marketing and accounting,
- Risk analysis

Unit 4 –

- Management
- Company's Organization Structure,
- Recruitment and management of talent.
- Financial organization and management

Unit 5 –

- Financing and Protection of Ideas
- Financing methods available for start-ups in India
- Communication of Ideas to potential investors – Investor Pitch
- Patenting and Licenses

References:

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company Steve Blank and Bob Dorf K & S Ranch ISBN – 978-0984999392
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses Eric Ries Penguin UK ISBN – 978-0670921607
3. Demand: Creating What People Love Before They Know They Want It Adrian J. Slywotzky with Karl Weber Headline Book Publishing ISBN – 978-0755388974
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business Clayton M. Christensen Harvard business ISBN: 978-142219602

Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	Cyber Security Laws, Standards and IPR	COPC-6241	3L-1T-0P	4

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Learn the conceptual and theoretical perspective of cyber laws
CO2	Understand the international development of cyber laws
CO3	Understand the legalities through analysis of IT Act, 2000
CO4	Understand the relation between IPR laws
CO5	Understand the importance of E-commerce

Course Contents:

UNIT-I: Introduction:

Conceptual and theoretical perspective of Cyber Law - Computer and Web Technology - Development of Cyber Law – National and International Perspective Cyber Law - Legal Issues and Challenges in India, USA and EU Data Protection - Cyber Security.

UNIT-II: International Perspectives:

International Perspectives - Budapest Convention on Cybercrime - ICANN's core principles and the domain names disputes - Net neutrality – EU electronic communications regulatory framework - Web Content Accessibility Guidelines (WCAG).

UNIT-III: Information Technology Act, 2000:

Information Technology Act, 2000 - Aims and Objects - Overview of the Act – Jurisdiction -Electronic Governance – Electronic Evidence - Digital Signature Certificates - Digital signatures - Duties of Subscribers - Role of Certifying Authorities - The Cyber Regulations Appellate Tribunal - Internet Service Providers and their Liability – Powers of Police - Impact of the Act on other Laws - Social Networking Sites Vis-àvis Human Rights.

UNIT-IV: Cyber Law and IPR: Cyber Law and IPRs :

Understanding Copy Right in Information Technology - Software - Copyrights Vs Patents debate- Authorship and Assignment Issues - Copyright in Internet - Multimedia and Copyright issues - Software Piracy –Patents - Understanding Patents - European Position on Computer related Patents - Legal position of U.S. on Computer

related Patents - Indian Position on Computer related Patents –Trademarks - Trademarks in Internet - Domain name registration - Domain Name Disputes & WIPO - Databases in Information Technology - Protection of databases - Position in USA, EU and India.

UNIT-V: E-Commerce: E-Commerce - UNCITRAL Model - Legal aspects of E-Commerce - Digital Signatures - Technical and Legal issues - E-Commerce, Trends and Prospects - Etaxation, E-banking, online publishing and online credit card payment - Employment Contracts – Non-Disclosure Agreements - Shrink Wrap Contract -Source Code - Escrow Agreements, etc.

References:

1. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing, UP, 2016.

2. Farouq Ahmed, Cyber Law in India, Allahabad Law Agency, 2015

3. Karnika Seth, Computers, Internet and New Technology Laws-A Comprehensive Reference

Work With Special Focus On Developments In India, LexisNexis, Nagpur, 2016.

4. Kamath Nandan: Law relating to Computer, Internet and E-Commerce, Universal Law Publishing, UP, 2007.

Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Robotics**	**COPC-6242**	**3L-1T-0P**	**4**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Explain the robot anatomy, classification, characteristics of robot, advantages and disadvantages.
CO2	Explain the various robotic actuators on hydraulic, pneumatic and electrical drives
CO3	Explain about various types of sensors and concepts on robot vision system.
CO4	Explain the concepts of robot programming languages and various methods of robot programming.
CO5	Explain the various applications of robots.

Course Contents:

UNIT-I: Fundamentals of Robotics:

Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Classification of robots; Cartesian, Cylindrical, Spherical, Scara, Vertical articulated; Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume; Robot work Volumes, comparison; Advantages and disadvantages of robots.

Unit-II: Robotic Drive System and Controller:

Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives; AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion; Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Level of Controller; Open loop and Closed loop controller; Microprocessor based control system; Robot path control: Point to point, Continuous path control and Sensor based path control; Controller programming.

Unit-III: Sensors:

Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo Electric); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing. Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Videocon camera (Working principle & construction); Applications of Robot vision system: Inspection, Identification, Navigation & serving.

Unit-IV: Robot kinematics and Robot Programming:

Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems. Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effecter commands; and Simple programs.

Unit-V: Automation:

Basic elements of automated system, advanced automation functions, levels of automation. Industrial Applications: Application of robots in machining; welding; assembly and material handling.

Reference Books:

1. Introduction to Robotics: Analysis, Systems, Applications – Saeed B. Niku, Pearson Education Inc. New Delhi 2006.
2. Industrial Robotics: Technology, Programming and Applications – M.P. Groover, Tata McGraw Hill Co, 2001.
3. Robotics Control, Sensing, Vision and Intelligence – Fu.K.S. Gonzalz.R.C and Lee C.S.G, Mc-Graw Hill Book Co, 1987.
4. Robotics for Engineers – Yoram Koren, McGraw Hill Book Co, 1992.
5. A Text book on Industrial Robotics – Ganesh S. Hedge, Laxmi Publications Pvt. Ltd., New Delhi, 2008.
6. Robotics Technology and Flexible Automation – S.R. Deb & Sankha Deb, Tata McGraw-Hill, 2010.
7. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018

Semester – VI
Course Content

Branch	Subject Title	Subject Code	Contact Hours per Week	Total Credits
Diploma (CSE)	**Indian Constitution**	**COPC-625**	**2L-0T-0P**	**2**

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

CO1	Understand the meaning and importance of Constitution
CO2	Explain about making of Indian Constitution - contribution of Constituent assembly on it.
CO3	Describe the Salient (Outstanding) features of Indian Constitution.
CO4	Describe the importance of Preamble of the Indian Constitution and its significance.

Course Contents:

Unit 1 – The Constitution - Introduction

- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

Unit 2 – Union Government

- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

Unit 3 – State Government

- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

Unit 4 – Local Administration

- District Administration
- Municipal Corporation
- Zila Panchayat

Unit 5 – Election Commission

- Role and Functioning
- Chief Election Commissioner

- State Election Commission

Reference Books:

1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2. The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition

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DIPLOMA ENGINEERING (ELECTRICAL ENGINEERING)
New Scheme Based On AICTE Flexible Curriculum

Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	INTRODUCTION TO ELECTRIC GENERATION SYSTEMS	EEPC-321	3L-1T-2P	6

Course Outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Maintain the optimised working of the thermal power plant.
b) Maintain the optimised working of large and micro hydro power plants.
c) Maintain the optimised working of solar and biomass-based power plants.
d) Maintain the optimised working of wind power plants.
e) Select the adequate mix of power generation based on economic operation.

Course Contents:

Unit – I

Thermal Power Plants: Coal, Gas/ Diesel and Nuclear-based. Layout and working of a typical thermal power plant with steam turbines and electric generators. Properties of conventional fuels used in the energy conversion equipment used in thermal power plants: Coal, Gas/ diesel, Nuclear fuels –fusion and fission action Safe Practices and working of various thermal power plants: coal-based, gas-based, diesel-based, nuclear-based. Functions of the following types of thermal power plants and their major auxiliaries: Coal fired boilers: fire tube and water tube. Gas/diesel based combustion engines Types of nuclear reactors: Disposal of nuclear waste and nuclear shielding. Thermal power plants in Maharashtra.

Unit – II

Large and Micro-Hydro Power Plants. Energy conversion process of hydro power plant Classification of hydro power plant: High, medium and low head. Construction and working of hydro turbines used in different types of hydro power plant:
a. High head – Pelton turbine b. Medium head – Francis turbine c. Low head – Kaplan turbine.
Safe Practices for hydro power plants. Different types of micro- hydro turbines for different heads: Pelton, Francis and Kaplan turbines Locations of these different types of large and micro-hydro power plants in Maharashtra Potential locations of micro-hydro power plants in Maharashtra.

Unit– III

Solar and Biomass based Power Plants. Solar Map of India: Global solar power radiation Solar Power Technology.

a. Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors
b. Solar Photovoltaic (PV) power plant: layout, construction, working .Biomass-based Power Plants
a. Layout of a Bio-chemical based (e.g. biogas) power plant:
b. Layout of a Thermo-chemical based (e.g. Municipal waste) power plant
c. Layout of an Agro-chemical based (e.g. bio-diesel) power plant
Features of the solid, liquid and gas biomasses as fuel for biomass power plant.

Unit– IV

Wind Power Plants. Wind Map of India**:** Wind power density in watts per square meter Layout of Horizontal axis large wind power plant: Geared wind power plant. Direct-drive wind power plant. Salient Features of electric generators used in large wind power plants: Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG) Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG)

Unit– V

Economics of Power Generation and Interconnected Power System. Related terms: connected load, firm power, cold reserve, hot reserve, spinning reserve. Base load and peak load plants; Load curve, load duration curve, integrated duration curve Cost of generation: Average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor. Choice of size and number of generator units, combined operation of power station. Causes and Impact and reasons of Grid system fault: State grid, national grid, brownout and black out; sample blackouts at national and international level

Books:

1. Nag. P. K.Power Plant Engineering, McGraw Hill, New Delhi, ISBN: 978-9339204044
2. Tanmoy Deb, Electrical Power Generation, Khanna Publishing House, Delhi (Ed. 2018)
3. Gupta, B.R., Generation of Electrical Energy, S. Chand& Co. New Delhi,
4. Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi,
5. Solanki, Chetan Singh, – Solar Photovoltaics: Fundamentals, Technologies and Applications,

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	ELECTRIC CIRCUITS	EEPC-322	3L-1T-2P	6

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Troubleshoot problems related to single phase A.C series circuits.
b) Troubleshoot problems related to single phase A.C parallel circuits.
c) Troubleshoot problems related to three phase circuits.
d) Use principles of circuit analysis to troubleshoot electric circuits.
e) Apply network theorems to troubleshoot electric circuits.

Course Contents:

Unit – I

Single Phase A.C Series Circuits. Generation of alternating voltage, Phasor representation of sinusoidal quantities R, L, C circuit elements its voltage and current response R-L, R-C, R-L-C combination of A.C series circuit, impedance, reactance triangle, Power factor, active power, reactive power, apparent power, power triangle and vector diagram Resonance, Bandwidth, Quality factor and voltage magnification in series R-L, R-C, RL-C circuit.

Unit – II

Single Phase A.C Parallel Circuits. R-L, R-C and R-L-C parallel combination of A.C. circuits. Impedance, reactance, phasor diagram, impedance triangle R-L, R-C, R-L-C parallel A.C. circuits power factor, active power, apparent power, reactive power ,power triangle Resonance in parallel R-L, R-C, R-L-C circuit, Bandwidth, Quality factor and voltage magnification.

Unit– III

Three Phase Circuits. Phasor and complex representation of three phase supply Phase sequence and polarity Types of three-phase connections, Phase and line quantities in three phase star and delta system Balanced and unbalanced load, neutral shift in unbalanced load Three phase power, active, reactive and apparent power in star and delta system.

Unit– IV

Network Reduction and Principles of Circuit Analysis. Source transformation Star/delta and delta/star transformation Mesh Analysis Node Analysis.

Unit– V

Network Theorems. Superposition theorem. Thevenin's theorem. Norton's theorem Maximum power transfer theorem Reciprocity theorem Duality in electric circuits.

Books:

1 Ashfaq Husain, Networks & Systems, Khanna Book Publishing, New Delhi.
2. Gupta, B.R; Singhal, Vandana;, Fundamentals of Electrical Network, S.Chand and Co.
3. Saxena, S.B Lal; Dasgupta, K; Fundamentals of Electrical Engineering, Cambridge University
4. Theraja, B. L. : Theraja, A. K;, A Text Book of Electrical Technology Vol-I, S. Chand & Co.

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	ELECTRICAL AND ELECTRONIC MEASUREMENTS	EEPC-323	3L-1T-2P	6

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Check the working of the electrical measuring instrument.
b) Use different types of measuring instruments for measuring voltage and current.
c) Use different types of measuring instruments for measuring electric power
d) Use different types of measuring instruments for measuring electric energy.
e) Use different types of electrical instruments for measuring various ranges of electrical parameters.

Course Contents:

Unit – I

Fundamentals of Measurements. Measurement: Significance, units, fundamental quantities and standards Classification of Instrument Systems: Null and deflection type instruments Absolute and secondary instruments Analog and digital instruments Static and dynamic characteristics, types of errors Calibration: need and procedure Classification of measuring instruments indicating, recording and integrating instruments. Essential requirements of an indicating instruments

Unit – II

Measurement of voltage and current.DC Ammeter: Basic, Multi range, Universal shunt, DC Voltmeter: Basic, Multi-range, concept of loading effect and sensitivity AC voltmeter: Rectifier type (half wave and full wave) CT and PT: construction, working and applications. Clamp-on meter

Unit– III

Measurement of Electric Power. Analog meters: Permanent magnet moving coil (PMMC) and Permanent magnet moving iron(PMMI) meter, their construction, working, salient features, merits and demerits Dynamometer type wattmeter: Construction and working Range Multiplying factor and extension of range using CT and PT Errors and compensations. Active and reactive power measurement: One, two and three wattmeter method. Effect of Power factor on wattmeter reading in two wattmeter method. Maximum Demand indicator

Unit– IV

Measurement of Electric Energy. Single and three phase electronic energy meter: Constructional features and working principle.Errors and their compensations. Calibration of single phase electronic energy meter using direct loading.

Unit– V

Circuit Parameter Measurement, CRO and Other Meters. Measurement of resistance: Low resistance: Kelvin's double bridge, Medium Resistance: Voltmeter and ammeter method High resistance: Megger and Ohm meter: Series and shunt Measurement of inductance using Anderson bridge (no derivation and phasor diagram) Measurement of capacitance using Schering bridge (no derivation and phasor diagram) Single beam/single trace CRO, Digital storage Oscilloscope**:** Basic block diagram, working, Cathode ray tube, electrostatic deflection, vertical amplifier, time base generator, horizontal amplifier, measurement of voltage/ amplitude/ time period/ frequency/ phase angle delayline, specifications. Other meters: Earth tester, Digital Multimeter; L-C-R meter, Frequency meter (ferromagnetic and Weston type), Phase sequence indicator, power factor meter (single phase and three phase dynamometer type), Synchro scope, Tri-vector meter Signal generator: need, working and basic block diagram. Function generator: need, working and basic block diagram, function of symmetry.

Books:

1.Theraja B. L., Theraja A. K., A Text Book of Electrical Technology Vol-I
2 Mittle V. N., Basic Electrical Engineering, McGraw-Hill New Delhi,
3. Edward Hughes, Electrical Technology, Pearson Education, New Delhi,
4. Rajput R.K., Electrical and Electronic Measurement and Instrumentation, S.Chand and
5. Sawhney A.K., Electrical and Electronics Measurements and Instrumentation., Dhanpai Rai.

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	ELECTRIC MOTORS AND TRANSFORMERS	EEPC-324	3L-1T-2P	6

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Maintain different types of DC generators.
b) Maintain different types of DC motors.
c) Maintain single phase transformer.
d) Maintain three phase transformers.
e) Maintain different types of special purpose transformers used in different applications.

Course Contents:

Unit – I

DC Generators. DC generator: construction, parts, materials and their functions. Principle of operation of DC generator: Fleming's right hand rule, schematic diagrams, e.m.f. equation of generator, armature reaction, commutation and. Applications of DC generators. Classification of measuring instruments: indicating, recording and integrating instruments.

Unit – II

D.C. Motors. DC motor: Types of DC motors. Fleming's left hand rule, Principle of operation of, Back e.m.f. and its significance, Voltage equation of DC motor. Torque and Speed; Armature torque, Shaft torque, BHP, Brake test, losses, efficiency. DC motor starters: Necessity, two point and three point starters. Speed control of DC shunt and series motor: Flux and Armature control. Brushless DC Motor: Construction and working.

Unit– III

Single Phase Transformers. Types of transformers: Shell type and core type; Construction: Parts and functions, materials used for different parts: CRGO, CRNGO, HRGO, amorphous cores, Transformer: Principle of operation, EMF equation of transformer: Derivation, Voltage transformation ratio, Significance of transformer ratings Transformer No-load and on-load phasor diagram, Leakage reactance, Equivalent circuit of transformer: Equivalent resistance and reactance. Voltage regulation and Efficiency: Direct loading, OC/SC method, All day efficiency.

Unit– IV

Three Phase Transformers. Bank of three single phase transformers, Single unit of three phase transformer Distribution and Power transformers. Construction, cooling, Three phase transformers connections as per IS:2026 (part IV)-1977, Three phase to two phase conversion (Scott Connection), Selection of transformer as per IS: 10028 (Part I)-1985, Criteria for selection of distribution transformer, and power transformer, Amorphous Core type Distribution Transformer, Specifications of three-phase distribution transformers as per IS:1180 (part I)-1989 Need of parallel operation of three phase transformer, Conditions for parallel operation. Polarity tests on mutually inductive coils and single phase transformers; Polarity test, Phasing out test on Three-phase transformer.

Unit– V

Special Purpose Transformers. Single phase and three phase auto transformers: Construction, working and applications. Instrument Transformers: Construction, working and applications of Current transformer and Potential transformer. Isolation transformer: Constructional Features and applications. Single phase welding transformer: constructional features and applications. Pulse transformer: constructional features and applications. 'K' factor of transformers: overheating due to non-linear loads and harmonics.

References:

1 . G.C. Garg & P.S. Bimbhra, Electrical Machines, Vol-I, II, Khanna Book Publishing House (ISBN:978-9386173-447, 978-93-86173-607), New Delhi
2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, McGraw Hill Education, New Delhi ISBN: 9780070593572
3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi,ISBN: 9780070699670
4. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi, ISBN: 9789332902855
5. Mehta, V. K. and Mehta, Rohit, Principles of Electrical Machines, S. Chand and Co. Ltd., New Delhi ISBN: 9788121930888

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	Renewable Energy Power Plants	EEPC-325	3L-1T-2P	6

Course outcomes:

the theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Maintain the optimised working of solar PV and CS power plants.
b) Maintain the optimised working of large wind power plants
c) Maintain the optimised working of small wind turbines.
d) Maintain the optimised working of micro hydro power plants.
e) Maintain the optimised working of biomass-based power plants.

Course Contents:

Unit – I

Solar PV and Concentrated Solar Power Plants
Solar Map of India: Global solar power radiation, Solar PV Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors Solar Photovoltaic (PV) power plant: components layout, construction, working. Rooftop solar PV power system.

Unit – II

Large Wind Power Plants
Wind Map of India: Wind power density in watts per square meter Lift and drag principle; long path theory. Geared type wind power plants: components, layout and working. Direct drive type wind power plants: components, layout and working. Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG), Wound Rotor Induction Generator (WRIG); Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG)

Unit– III

Small Wind Turbines
Horizontal axis small wind turbine: direct drive type, components and working Horizontal axis small wind turbine: geared type, components and working Vertical axis small wind turbine: direct drive and geared, components and working Types of towers and installation of small wind turbines on roof tops and open fields. Electric generators used in small wind power plants

Unit– IV

Micro-hydro Power Plants

Energy conversion process of hydro power plant. Classification of hydro power plant: High, medium and low head. Layouts of micro-hydro power plants Construction and working of hydro turbines used in different types of hydro power plant:

o High head – Pelton turbine
o Medium head – Francis turbine
o Low head – Kaplan turbine.

Safe Practices for micro hydro power plants.

Unit– V

Biomass-based Power Plants

Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste

Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-dieselgobar gas

Layout of a Bio-chemical based (e.g. biogas) power plant: Layout of a Thermo-chemical based (e.g. Municipal waste) power plant Layout of a Agro-chemical based (e.g. bio-diesel) power plant

References:

1. Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736
2. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd - Renewable Energy Systems, Pearson EducationNew Delhi , ISBN: 9789332586826,
3. Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN:
   978-93-88028-49- 3; E-book 978-93-88028-50-9
4. Khoiyangbam, R S Navindu; Gupta and Sushil Kumar; Biogas Technology: Towards Sustainable
   Development; TERI, New Delhi; ISBN: 9788179934043
5. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304

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Semester-III

INTRODUCTION TO ELECTRIC GENERATION SYSTEMS LAB

1. Identify the routine maintenance parts of the coal fired thermal power plant after watching a video programme.
2. Identify the routine maintenance parts of the gas fired thermal power plant after watching a video programme.
3. Assemble and dismantle a small diesel generator power plant.
4. Identify the routine maintenance parts of the nuclear fired thermal power plant after watching a video programme.
5. Identify the routine maintenance parts of the large hydro power plant after watching a video programme.
6. Identify the routine maintenance parts of the micro hydro power plant after watching a video programme.
7. Assemble a micro hydro power plant and then dismantle it
8. Assemble the parabolic trough or parabolic dish Concentrated Solar Power (CSP) plant.
9. Dismantle the parabolic trough or parabolic dish CSP plant.
10. Assemble the solar PV plant to produce electric power and then dismantle it.
11. Assemble a small biogas plant to generate electric power
12. Dismantle the biogas plant.
13. Identify the routine maintenance parts of the large wind power plant after watching a video programme.
14. Assemble a horizontal axis small wind turbine to produce electric power
15. Dismantle a horizontal axis small wind turbine.
16. Assemble a vertical axis small wind turbine to produce electric power and then dismantle it.
17. Identify the routine maintenance parts of the horizontal axis small wind turbine after watching a video programme.
18. Identify the routine maintenance parts of the vertical axis small wind turbine after watching a video programme.

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Semester-III

ELECTRIC CIRCUITS LAB

1. Use dual trace oscilloscope to determine A.C voltage and current response in given R, L, C circuit.
2. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L series circuit. Draw phasor diagram.
3. Use voltmeter, ammeter to determine active, reactive and apparent power consumed in given R-C series circuit. Draw phasor diagram.
4. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C series circuit. Draw phasor diagram.
5. Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor. Engineering Curriculum Structure 142
6. Use voltmeter, ammeter, wattmeter to determine current, p.f. , active, reactive and apparent power in R-C parallel A.C. circuit.
7. Use voltmeter, ammeter, wattmeter, p.f meter to determine current, p.f., active, reactive and apparent power for given R-L-C parallel circuit with series connection of resistor and inductor in parallel with capacitor.
8. Use variable frequency supply create resonance in given parallel R-L-C circuit or by using variable inductor or capacitor.
9. Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for balanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
10. Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for unbalanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
11. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying mesh analysis.
12. Use voltmeter, ammeter to determine current through the given branch of a electric network by applying node analysis.
13. Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.
14. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Thevenin's theorem
15. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Norton's theorem
16. Use voltmeter, ammeter to determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem.

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Semester-III

ELECTRICAL AND ELECTRONIC MEASUREMENTS LAB

1. Identify measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale.
2. Identify the components of PMMC and MI instruments.
3. Troubleshoot PMMC and MI instruments.
4. Measure AC and DC quantities in a working circuit.
5. Extend range of ammeter and voltmeter by using (i) shunt and multiplier (ii) CT and PT.
6. Use Clamp-on meter for measurement of AC/DC current, AC/DC voltage.
7. Use electro-dynamic watt-meter for measurement of power in a single phase circuit
8. Troubleshoot electrodynamic watt-meter for measurement of power in a single phase circuit
9. Use single wattmeter for measurement of active and reactive power of three phase balanced load.
10. Use two watt-meters for measuring active power of three-phase balanced load.
11. Calibrate single phase electronic energy meter by direct loading.
12. Troubleshoot single phase electronic energy meter.
13. Use digital multi-meter for measurement of AC/DC current, AC/DC voltage.
14. Use Kelvin's double bridge for measurement of low resistance.
15. Use voltmeter and ammeter method for measurement of medium resistance.
16. Use Megger for insulation resistance measurements.
17. Use earth tester for measurement of earth resistance.
18. Use CRO for the Measurement of supply frequency in single-phase circuit.
19. Use Tri-vector meter for measuring kW, kVAr and kVA of a power line.

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Semester-III

ELECTRIC MOTORS AND TRANSFORMERS LABORATORY

Practicals:

1. Dismantle a DC machine.
2. Reverse the direction of rotation of the DC shunt motor.
3. Perform brake test on DC shunt motor.
4. Control the speed of DC shunt motor by different methods.
5. Control the speed of DC series motor by different methods.
6. Perform the brake test on DC series motor.
7. Check the functioning of single phase transformer.
8. Determine regulation and efficiency of single phase transformer by direct loading.
9. Perform open circuit and short circuit test on single phase transformer to determine equivalent circuit constants, voltage regulation and efficiency.
10. Perform parallel operation of two single phase transformers to determine the load current sharing.
11. Perform parallel operation of two single phase transformers and determine the apparent and real power load sharing.
12. Perform polarity test on a single phase transformer whose polarity markings are masked.
13. Perform phasing out test on a three phase transformer whose phase markings are masked.
14. Connect the auto-transformer in step-up and step-down modes noting the input/output readings.
15. Check the functioning of the CT, PT and isolation transformer.
16. Test the pulse transformer.

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Semester-IV

Renewable Energy Power Plants Laboratory

Practicals:

1. Dismantle the parabolic trough CSP plant.
2. Assemble the parabolic trough Concentrated Solar Power (CSP) plant.
3. Assemble the parabolic dish CSP plant.
4. Dismantle the parabolic dish CSP plant.
5. Assemble the solar PV plant to produce electric power.
6. Dismantle the solar PV plant.
7. Identify the routine maintenance parts of the large wind power plant after watching a video programme.
8. Assemble a horizontal axis small wind turbine to produce electric power
9. Dismantle a horizontal axis small wind turbine.
10. Assemble a vertical axis small wind turbine to produce electric power
11. Dismantle a vertical axis small wind turbine.
12. Identify the routine maintenance parts of the micro hydro power plant after watching a video programme.
13. Assemble a micro hydro power plant.
14. Dismantle a micro hydro power plant.
15. Assemble a small biogas plant to generate electric power
16. Dismantle the biogas plant.

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	**Fundamentals of Power Electronics**	EEPC- 421	3L-1T-2P	6

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Select power electronic devices for specific applications.
b) Maintain the performance of Thyristors.
c) Troubleshoot turn-on and turn-off circuits of Thyristors.
d) Maintain phase controlled rectifiers.
e) Maintain industrial control circuits

Course Contents:

Unit – I

Power Electronic Devices
Power electronic devices Power transistor: construction, working principle, V-I characteristics and uses. IGBT: Construction, working principle, V-I characteristics and uses. Concept of single electron transistor (SET) - aspects of Nano- technology.

Unit – II

Thyristor Family Devices
SCR: construction, two transistor analogy, types, working and characteristics. SCR mounting and cooling. Types of Thyristors: SCR, LASCR, SCS, GTO, UJT, PUT, DIAC and TRIAC Thyristor family devices: symbol, construction, operating principle and V-I characteristics. Protection circuits: over-voltage, over-current, Snubber, Crowbar.

Unit– III

Turn-on and Turn-off Methods of Thyristors
SCR Turn-On methods: High Voltage thermal triggering, Illumination triggering, dv/dt triggering, Gate triggering. Gate trigger circuits – Resistance and Resistance-Capacitance circuits. SCR triggering using UJT, PUT: Relaxation Oscillator and Synchronized UJT circuit. Pulse transformer and opto-coupler based triggering. SCR Turn-Off methods: Class A- Series resonant commutation circuit, Class B-Shunt Resonant commutation circuit, Class C-Complimentary Symmetry commutation circuit, Class D –Auxiliary commutation, Class E-External pulse commutation, Class F- Line or natural commutation.

Unit– IV

Phase Controlled Rectifiers
Phase control: firing angle, conduction angle.
Single phase half controlled, full controlled and midpoint controlled rectifier with R, RL

load: Circuit diagram, working, input- output waveforms, equations for DC output and effect of freewheeling diode. Different configurations of bridge controlled rectifiers: Full bridge, half bridge with common
anode, common cathode, SCRs in one arm and diodes in another arm.

Unit– V

Industrial Control Circuits

Applications: Burglar's alarm system, Battery charger using SCR, Emergency light system, Temperature controller using SCR and; Illumination control / fan speed control TRIAC. SMPS.UPS: Offline and Online SCR based AC and DC circuit breakers.

References:

1. Ramamoorty M., An Introduction to Thyristors and their applications, East-West Press Pvt. Ltd., New Delhi, ISBN: 8185336679.
2. Sugandhi, Rajendra Kumar and Sugandhi, Krishna Kumar, Thyristors: Theory and Applications, New Age International (P) ltd. Publishers, New Delhi, ISBN: 978-0-85226-852-0
3. Bhattacharya, S.K., Fundamentals of Power Electronics, Vikas Publishing House Pvt. Ltd. Noida. ISBN: 978-8125918530.
4. Jain & Alok , Power Electronics and its Applications, Penram International Publishing (India) Pvt. Ltd, Mumbai, ISBN: 978-8187972228.
5. Rashid , Muhammad, Power Electronics Circuits Devices and Applications, Pearson Education India, Noida, ISBN: 978-0133125900.

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	ELECTRIC POWER TRANSMISSION AND DISTRIBUTION	EEPC- 422	3L-1T-2P	6

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the normal operation of the electric transmission and distribution systems.
b) Maintain the functioning of the medium and high voltage transmission system.
c) Interpret the parameters of the extra high voltage transmission system.
d) Maintain the functioning of the low voltage AC distribution system.
e) Maintain the components of the transmission and distribution lines.

Course Contents:

Unit – I

Basics of Transmission and Distribution

Single line diagrams with components of the electric supply transmission and distribution systems. Classification of transmission lines: Primary and secondary transmission; standard voltage level used in India. Classification of transmission lines: based on type of voltage, voltage level, length and others Characteristics of high voltage for power transmission. Method of construction of electric supply transmission system – 110 kV, 220 kV, 400 kV. Method of construction of electric supply distribution systems – 220 V, 400V, 11 kV, 33 kV

Unit – II

Transmission Line Parameters and Performance

Line Parameters: Concepts of R, L and C of line parameters and types of lines. Performance of short line: Efficiency, regulation and its derivation, effect of power factor, vector diagram for different power factor. Performance of medium line: representation, nominal 'T', nominal 'π' and end condenser methods.Transposition of conductors and its necessity. Skin effect and proximity effect.

Unit– III

Extra High Voltage Transmission

Extra High Voltage AC (EHVAC) transmission line**:** Necessity, high voltage substation components such as transformers and other switchgears, advantages, limitations and applications and lines in India. Ferranti and Corona effect. High Voltage DC (HVDC) Transmission Line**:** Necessity, components, advantages, limitations and applications. Layout of monopolar, bi-Polar and homo-polar transmission lines. Lines in India. Features of EHVAC and HVDC transmission line. Flexible AC Transmission line: Features, d types of FACTS controller. New trends in wireless transmission of electrical power.

Unit– IV

A.C Distribution System

AC distribution: Components classification, requirements of an ideal distribution system, primary and secondary distribution system. Feeder and distributor, factors to be considered in design of feeder and distributor Types of different distribution schemes: radial, ring, and grid, layout, advantages, disadvantages and applications. Voltage drop, sending end and receiving end voltage. Distribution Sub-Station: Classification, site selection, advantages, disadvantages and applications. Single Line diagram (layout) of 33/11KV Sub-Station, 11KV/400V sub-station, Symbols and functions of their components.

Unit– V

Components of Transmission and Distribution Line

Overhead Conductors**:** Properties of material, types of conductor with trade names, significance of sag. Line supports: Requirements, types of line structures and their specifications, methods of erection. Line Insulators**:** Properties of insulating material, selection of material, types of insulators and their applications, causes of insulator failure, derivation of equation of string efficiency for string of three suspension insulator, methods of improving string efficiency. Underground Cables**:** Requirements, classification, construction, comparison with overhead lines, cable laying and cable jointing

References:

1. G.C. Garg, Utilization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355)
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3. Soni;Gupta; Bhatnagar, A Course in Electrical Power, Dhanpat Rai and Sons New Delhi, ISBN: 9788177000207
4. Gupta,J.B., A Course in Power Systems, S.K. Kataria and sons, New Delhi, ISBN: 9788188458523
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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	INDUCTION, SYNCHRONOUS AND SPECIA ELECTRIC MACHINES	EEPC- 423	3L-1T-2P	6

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taughtand implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Maintain three phase induction motor used in different applications.
b) Maintain single phase induction motor used in different applications.
c) Maintain three phase alternators used in different applications.
d) Maintain synchronous motors used in different applications.
e) Maintain FHP motors used in different applications.

Course Contents:

Unit – I

Three Phase Induction Motor
Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip. Constructional details of 3 phase induction motors: Squirrel cage induction motor and Slip ring induction motor. Rotor quantities: frequency, induced emf, power factor at starting and running condition. Characteristics of torque versus slip (speed), Torques: starting, full load and maximum with relations among them. Induction motor as a generalized transformer with phasor diagram. Four quadrant operation, Power flow diagram Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters. Speed control methods: stator voltage, pole changing, rotor resistance and VVVF. Motor selection for different applications as per the load torque-speed requirements. Maintenance of three phase induction motors

Unit – II

Single phase induction motors
Double field revolving theory, principle of making these motors self-start. Construction and working: Resistance start induction run, capacitor start induction run, capacitor start capacitor run, shaded pole, repulsion type, series motor, universal motor, hysteresis motor. Torque-speed characteristics for all of the above motors. Motor selection for different applications as per the load torque-speed requirements. Maintenance of single phase induction motors

Unit– III

Three phase Alternators
Principle of working, moving and stationary armatures. Constructional details: parts and their functions, rotor constructions. Windings: Single and Double layer. E.M.F. equation of an Alternator with numerical by considering short pitch factor and distribution factor. Alternator

loading: Factors affecting the terminal voltage of alternator; Armature resistance and leakage reactance drops. Armature reaction at various power factors and synchronous impedance. Voltage regulation: direct loading and synchronous impedance methods. Maintenance of alternators

Unit– IV

Synchronous motors

Principle of working /operation, significance of load angle.Torques: starting torque, running torque, pull in torque, pull out torque. Synchronous motor on load with constant excitation (numerical), effect of excitation at constant load (numerical). V-Curves and Inverted V-Curves. Hunting and Phase swinging. Methods of Starting of Synchronous Motor. Losses in synchronous motors and efficiency (no numerical). Applications areas

Unit– V

Fractional horse power (FHP) Motors

Construction and working: Synchronous Reluctance Motor, Switched Reluctance Motor, BLDC, Permanent Magnet Synchronous Motors, stepper motors, AC and DC servomotors. Torque speed characteristics of above motors. Applications of above motors.

References:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-294)
2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, McGraw Hill Education New Delhi, ISBN :9780070593572
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4. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi, ISBN:9789332902855
5. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S.Chand and Co. Ltd., New Delhi, ISBN : 9788121924375

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	INDUSTRIAL INSTRUMENTATION AND CONDITION MONITORING	EEPE- 424	3L-1T-2P	6

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Select relevant instruments used for measuring electrical and non-electrical quantities.
b) Select relevant transducers/sensors for various applications.
c) Use relevant instruments for measuring non-electrical quantities.
d) Check the signal conditioning and telemetry system for their proper functioning.
e) Use data acquisition systems in various applications.
f) Undertake condition monitoring for diagnostic analysis of electrical equipment

Course Contents:

Unit – I

Fundamentals of instrumentation
Basic purpose of instrumentation. Basic block diagram (transduction, signal conditioning, signal presentation) and their function. Construction, working and application of switching devices- Push button, limit switch, float switch, pressure switch, thermostat, electromagnetic relay.

Unit – II

Transducers
Distinguish between Primary and Secondary, Electrical and Mechanical, Analog and Digital, Active and Passive. Mechanical devices pry. And sec. transducers Advantages of electric transducers Required characteristics of transducers. Factors affecting the choice of transducers Construction and principle of resistive transducer-Potentiometer –variac and strain gauges -No derivation. Only definition and formula for gauge factor Types of strain gauges like unbonded, bonded and semiconductor. Construction and principle of Inductive transducers-L.V.D.T. and R.V.D.T, their applications. Construction, principle and applications of transducers – Piezo-Electric transducer, photoconductive cells, photo voltaic cells.

Unit– III

Measurement of Non-Electrical Quantities
Temperature measurement - Construction and Working of RTD, Thermistor and Thermocouple, radiation pyrometer, technical specifications and ranges. Pressure measurement – Construction and working of bourdon tube, bellow diaphragm and strain gauge, Combination of diaphragm and inductive transducer, Bourdon tube and LVDT, bellow and LVDT, diaphragm capacitance

and bridge Circuit. Construction and Working of Speed Measurement by contacting and non-Contact Type- DC tachometer, photo- electric tachometer, toothed rotor tachometer Generator - magnetic pickup and Stroboscope. Construction and Working of Vibration measurement by accelerometer-LVDT accelerometer, 175 Electrical Engineering Curriculum Structure Piezo electric type. Construction and Working of Flow measurement by electromagnetic and Turbine Flow meter. Construction and Working of Liquid level measurement by resistive, inductive, Capacitive gamma rays and Ultrasonic methods. Construction and Working of Thickness measurement by resistive, inductive, capacitive, ultrasonic and Nuclear methods.

Unit– IV

Signal Conditioning

Basic Concept of signal conditioning System. Draw pin configuration of IC 741. Define Ideal OP-AMPand Electrical Characteristics of OP-AMP. Different Parameters of op-amp:-Input offset voltage, Input offset current, Input bias current, Differential input resistance, CMMR, SVRR, voltage gain, output voltage, slew rate, gain bandwidth. Output, short circuit current. Use of op-amp as inverting, non- inverting mode, adder, subtractor, and Working of Differential amplifier and instrumentation amplifier. Filters: Types of RC filters and frequency response -no derivation. Sample and hold circuits - operation and its application.

Unit– V

Data Acquisition System

Generalized DAS- Block diagram and description of Transducer, signal conditioner, multiplexer, converter and recorder Draw Single Channel and Multi-channel DAS- Block diagram only. Difference between Signal Channel and Multi-Channel DAS. Data conversion- Construction and Working of Analog to digital conversion- successive approximation method, ramp type method. Digital to Analog conversion- Construction and Working of binary weighted resistance method. Concept and methods of data transmission of electrical and electronic transmission. Construction and principle of telemetry system and its type - Electrical telemetering system- Digital display device- operation and its application of seven segment display, dot matrix display and concept of 3½, 4½ digits, LED and LCD applications

Unit– VI

Condition Monitoring and Diagnostic Analysis

Definition of condition monitoring Insulation deterioration Mechanism- factors affecting occurrence and rate of deterioration, types of stresses responsible for deterioration Different tests on transformer, their purpose, and the necessary condition of machine. Tests on Circuit breaker, purpose and required condition of machine Tests on CT, purpose, item to be tested and required condition of machine. Power factor, capacitance /tan delta test Insulation and Polarization index, DC winding resistance test, Turns Ratio test Tools and equipment used in Condition monitoring

References:

1. Sawhney, A.K. Electric and Electronic Measurement and instrumentation, Dhanpat Rai and Co. Author, Nineteenth revised edition 2011 reprint, 2014**,** ISBN:10: 8177001000
2. Rangan, C.S. G.R.Sharma. andV.S.V.Mani, Instrumentation devices and system, Pen ram

International *Publishing* India Pvt. Ltd. Fifth edition, ISBN:10: 0074633503
3. Mehta, V.K. Electronics and instrumentation, Third edition-S.Chand and company Pvt Ltd Reprint, 2010, ISBN:81-219-2729-3
4. Singh, S.K. Industrial instrumentation and control, Tata McGraw-Hill, 1987. ISBN: 007451914X, 9780074519141.
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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	INDUSTRIAL AUTOMATION AND CONTROL	EEPE- 425	3L-1T-2P	6

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Identify different types of automation systems.
b) Interface I/O devices with the PLC modules.
c) Develop PLC ladder programs for various applications.
d) Select the suitable motor drives for different applications
e) Prepare simple SCADA applications.

Course Contents:

Unit – I

Introduction to Industrial Automation
Automation: Need and benefits. Types of automation system: Fixed, Programmable, Flexible Different systems used for Industrial automation: PLC, HMI, SCADA, DCS, Drives. Evolution of PLC.

Unit – II

PLC Fundamentals
Building blocks of PLC**:** CPU, Memory organization, Input- output modules (discrete and analog), Specialty I/O Modules, Power supply Fixed and Modular PLC and their types, Redundancy in PLC module I/O module selection criteria Interfacing different I/O devices with appropriate I/O modules

Unit– III

PLC Programming and Applications
PLC I/O addressing PLC programming Instructions**:** Relay type instructions, Timer instructions: On delay, off delay, retentive, Counter instructions: Up, Down, High speed, Logical instructions, Comparison Instructions, Data handling Instructions, Arithmetic instructions. PLC programming language**:** Functional Block Diagram (FBD), Instruction List. Structured text, Sequential Function Chart (SFC), Ladder Programming. Simple Programming examples using ladder logic**:** Language based on relay, timer counter, logical, comparison, arithmetic and data handling instructions. PLC Based Applications: Motor sequence control, Traffic light control, Elevator control, Tank Level control, Conveyor system, Stepper motor control, Reactor Control Gate trigger circuits – Resistance and Resistance-Capacitance circuits.

Unit– IV

Electric Drives and special machines

Electric drives: Types, functions, characteristics, four quadrant operation. DC and AC drive controls: V/F control, Parameters, direct torque control. Drives: Specifications, Applications- Speed control of AC motor /DC Motor.

Unit– V

Supervisory Control and Data Acquisition System (SCADA)

Introduction to SCADA: Typical SCADA architecture/block diagram, Benefits of SCADA Various editors of SCADA Interfacing SCADA system with PLC: Typical connection diagram, Object Linking & embedding for Process Control(OPC) architecture, Steps in Creating SCADA Screen for simple object, Steps for Linking SCADA object (defining Tags and Items) with PLC ladder program using OPC. Applications of SCADA: Traffic light control, water distribution, pipeline control.

References:

1. Dunning, G., Introduction to Programmable Logic Controllers, Thomson /Delmar learning, New Delhi, 2005,ISBN 13 : 9781401884260
2. Jadhav, V. R., Programmable Logic Controller, Khanna publishers, New Delhi, 2017, ISBN : 9788174092281
3. Petruzella, F.D., Programmable Logic Controllers, McGraw Hill India, New Delhi, 2010, ISBN: 9780071067386
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Semester-IV

FUNDAMENTALS OF POWER ELECTRONICS LABORATORY

Practicals:

1. Test the proper functioning of power transistor.
2. Test the proper functioning of IGBT.
3. Test the proper functioning of DIAC to determine the break over voltage.
4. Determine the latching current andholding current using V-I characteristics of SCR.
5. Test the variation of R, C in R and RC triggering circuits onfiring angle of SCR.
6. Test the effect of variation of R, C in UJT triggering technique.
7. Perform the operation of Class – A, B, C, turn off circuits.
8. Perform the operation of Class –D, E, F turn off circuits.
9. Use CRO to observe the output waveform of half wave controlled rectifier with resistive load and determine the load voltage.
10. Draw the output waveform of Full wave controlled rectifier with R load, RL load, free Wheeling diode and determine the load voltage.
11. Determine the firing angle using DIAC and TRIAC phase controlled circuit on output power under different loads such as lamp, motor or heater
12. Simulate above firing angle control on SCILAB software
13. Test the performance of given SMPS, UPS.
14. Troubleshoot the Burglar's alarm, Emergency light system, Speed control system, Temperature control system.

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Semester-IV

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION LABORATORY

Laboratory work is not applicable for this course.

Following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare a report based on transmission line network in Maharashtra.
b. Collect the information on components of transmission line.
c. Evaluate transmission line performance parameters of a given line.
d. Library/ Internet survey of electrical high voltage line and HVDC lines.
e. Visit to 33/11 KV and 11KV/400V Distribution Substation and write a report

Also one micro-project can be assigned to the student. A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare a model showing:
i. Single line diagram of electric supply system.
ii. Single line diagram of a given distribution system.
iii. Short line and medium transmission line.
iv. Write a report on the same by giving the details of lines in Maharashtra State.
b. Collect different samples of Overhead Conductors, Underground Cables, Line supports and Line Insulators.
c. Prepare a power point presentation:
i. Extra High Voltage AC Transmission line.
ii. High Voltage DC Transmission line.
iii. Flexible AC Transmission line.
iv. New trends in wireless transmission of electrical power.
d. Collect information on:
i. A.C Distribution System adjacent to your institute.
ii. Draw a layout diagram of 11KV/400 V substation in your campus/ adjacent substation.

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Semester-IV

INDUCTION, SYNCHRONOUS AND SPECIAL ELECTRIC MACHINES LABORATORY

Practicals:

1. Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
2. Connect and run the three phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two)
3. Perform the direct load test on the three phase squirrel cage induction motor and plot the i) efficiency versus output, ii) power factor versus output, iii) power factor versus motor current and iv) torque – slip/speed characteristics.
4. Conduct the No-load and Blocked-rotor tests on given 3-f squirrel cage induction motor and determine the equivalent circuit parameters.
5. Conduct the No-load and Blocked-rotor tests on given 3-f squirrel cage induction motor and plot the Circle diagram.
6. Control the speed of the given three phase squirrel cage/slip ring induction motor using the applicable methods: i) auto-transformer, ii) VVVF.
7. Measure the open circuit voltage ratio of the three phase slip ring induction motor.
8. Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.
9. Perform the direct loading test on the given three phase alternator and determine the regulation and efficiency.
10. Determine the regulation and efficiency of the given three phase alternator from OC and SC tests (Synchronous impedance method)
11. Conduct the test on load or no load to plot the ‘V’ curves and inverted ‘V’ curves (at no-load) of 3-f synchronous motor.
12. Dismantling and reassembling of single phase motors used for ceiling fans, universal motor for mixer.
13. Control the speed and reverse the direction of stepper motor
14. Control the speed and reverse the direction of the AC servo motor
15. Control the speed and reverse the direction of the DC servo motor

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Semester-IV

INDUSTRIAL INSTRUMENTATION AND CONDITION MONITORING LABORATORY

Practicals:

1. Identify different switches used in instrumentation system.
2. Measure linear displacement by L.V.D.T.
3. Measure the strain with the help of strain gauge
4. Measure temperature by PT-100, thermistor, thermocouple along with simple resistance bridge.
5. Use Thermocouple to control the temperature of a furnace/machine.
6. Measure pressure using pressure sensor kit.
7. Measure angular speed using stroboscope and tachometer.
8. Measure the flow using flow meter.
9. Use op-amp as inverter, non-inverting mode, adder, differentiator and integrator.
10. Convert digital data into analog data by using analog to digital converters and analog datainto digital data by digital to analog converter.
11. Visit to testing center of electrical testing lab for tan delta and diagnostic tests and Determine polarization index
12. Prepare a Report on various tools and equipment used for condition monitoring of electrical machines]I9KYI

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Semester-IV

INDUSTRIAL AUTOMATION AND CONTROL LABORATORY

Practicals:

1. Identify various automation systems available in different appliances/ devices/ machines in day to day use.
2. Identify various parts of the given PLC and front panel status indicators.
3. Use PLC to test the START STOP logic using two inputs and one output.
4. Develop/Execute a ladder program for the given application using following: - timer, counter, comparison, logical, arithmetic instructions.
5. Use PLC to control the following devices like lamp, motor, push button switches, proximity sensor
6. Measure the temperature of the given liquid using RTD or Thermocouple and PLC.
7. Develop/test ladder program to blink the LED/lamp.
8. Develop / test the Ladder program for sequential control application of lamps/ DC motors.
9. Develop ladder program for Traffic light control system.
10. Develop and test ladder program for pulse counting using limit switch /Proximity sensor.
11. Develop /test ladder program for Automated car parking system.
12. Develop / test ladder program for Automated elevator control.
13. Develop / test ladder program for rotating stepper motor in forward and reverse direction at constant speed.
14. Develop /test ladder program for tank water level control.
15. Develop / test ladder program for control of speed of stepper motor with suitable drivers.
16. Identify various front panel controls of VFD (smart drive).
17. Control speed of AC/DC motor using VFD. (VFD-Variable Frequency Drive)
18. Use various functions of SCADA simulation editors to develop simple project.
19. Develop a SCADA mimic diagram for Tank level control.
20. Develop SCADA mimic diagram for Flow control in a given system.
21. Simulate Tank level control using available SCADA system.

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	MICROCONTROLLER APPLICATIONS	EEPC- 521	3L-1T-2P	6

Course outcomes:
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Interpret the salient features of various types of microcontrollers.
b) Interpret the salient features of architype of types microcontrollers IC 8051
c) Maintain the program features of the Microcontroller based application
d) Develop assembly language program
e) Develop programs to interface 8051 microcontrollers with LED/SWITCH

Course Contents:

Unit – I

Introduction to Microcontrollers
Evolution of Microcontrollers 163 Electrical Engineering Curriculum Structure Block diagram of Microcomputer, elements of Microcomputer, types of buses Von Neuman and Harward Architecture Compare Microprocessor and Microcontrollers Need of Microcontroller Family of Microcontrollers and their specifications Versions of Microcontroller 8951, 89C1051, 89C2051, 89C4051 with their specifications and comparison

Unit – II

Architecture of Microcontroller8051
Block diagram of 8051, function of each block Pin diagram, function of each pin Concept of Internal memory and External memory (RAM and ROM) Internal RAM structure Reset and clock circuit Various registers and SFRs of 8051

Unit– III

8051 Instruction Set and Programs
Overview of 8051 instruction set Various addressing modes Classification of instructions Data transfer instructions Arithmetic instructions Logical instructions Branching instructions Bit manipulation instructions Stack, subroutine and interrupt related instructions Programs based on above instructions.

Unit– IV

Assembly Language Programming
Software development steps Software development tools like Editor, Assembler, Linker, Loader and Hex converters. Role of various files created at various levels in running a Assembly

program using simulators like RIDE or KEIL. Various directives of Assembly language programming Programs using directives.

Unit– V

8051 Internal Peripherals and Related Programs

I/O ports- List, diagram, read write operation, instructions and related SFRs Timers/counters – list, related SFRs, programming modes, operations with diagram. Serial communication- Basics of serial communication, baud rate, related SFRs, programming modes, operations with diagram. Interrupts- related SFRs, types, operations with diagram. Power saving operation- modes, related SFR.

References:

1. Kenneth, Ayala, 8051 Microcontroller Architecture Programming and Application, PHI Learning, New Delhi,ISBN: 978-1401861582
2. Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D., The 8051 Microcontroller and Embedded system, Pearson Education, Delhi, ISBN 978-8177589030
3. Pal, Ajit, Microcontroller Principle and Application, PHI Learning, New Delhi, ISBN13: 978-81-203-4392-4
4. Deshmukh, Ajay, Microcontroller Theory and Application, McGraw Hill., New Delhi, ISBN- 9780070585959
5. Kamal, Raj, Microcontroller Architecture Programming, Interfacing and System Design, Pearson Education India, Delhi, ISBN: 9788131759905

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	ENERGY CONSERVATION AND AUDIT	EEPC- 522	3L-1T-2P	6

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Interpret energy conservation policies in India.
b) Implement energy conservation techniques in electrical machines.
c) Apply energy conservation techniques in electrical installations.
d) Use Co-generation and relevant tariff for reducing losses in facilities.
e) Undertake energy audit for electrical system.

Course Contents:

Unit – I

Energy Conservation Basics
Energy Scenario: Primary and Secondary Energy, Energy demand and supply, National scenario.
Energy conservation and Energy audit; concepts and difference Indian Electricity Act 2001; relevant clauses of energy conservation BEE and its Roles MEDA and its Roles Star Labelling: Need and its benefits.

Unit – II

Energy Conservation in Electrical Machines
Need for energy conservation in induction motor and transformer. Energy conservation techniques in induction motor by: Improving Power quality. Motor survey Matching motor with loading. Minimizing the idle and redundant running of motor. Operating in star mode. Rewinding of motor. Replacement by energy efficient motor Periodic maintenance Energy conservation techniques in Transformer. Loading sharing Parallel operation Isolating technique Replacement by energy efficient transformers. Periodic maintenance. Energy Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p. f. controller (APFC), Intelligent p. f. controller (IPFC) Energy efficient motor; significant features, advantages, applications and limitations.s. Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer / Dry type of transformer.

Unit– III

Energy conservation in Electrical Installation systems
Aggregated Technical and commercial losses (ATC); Power system at state, regional, national

and global level. Technical losses; causes and measures to reduce by.
a) Controlling I2R losses. b) Optimizing distribution voltage c) Balancing phase currents
d) Compensating reactive power flow
Commercial losses: pilferage, causes and remedies
Energy conservation equipment: Maximum Demand Controller , kVAR Controller, Automatic Power Factor controller(APFC) Energy Conservation in Lighting System
a) Replacing Lamp sources.
b) Using energy efficient luminaries.
c) Using light controlled gears.
d) Installation of separate transformer / servo stabilizer for lighting.
e) Periodic survey and adequate maintenance programs.
Energy Conservation techniques in fans, Electronic regulators.

Unit– IV

Energy conservation through Cogeneration and Tariff

Co-generation and Tariff; concept, significance for energy conservation Co-generation Types of cogeneration on basis of sequence of energy use (Topping cycle, Bottoming cycle) Types of cogeneration basis of technology (Steam turbine cogeneration, Gas turbine cogeneration, Reciprocating engine cogeneration). Factors governing the selection of cogeneration system. Advantages of cogeneration. Tariff: Types of tariff structure: Special tariffs; Time-off-day tariff, Peak-off-day tariff, Power factor tariff, Maximum Demand tariff, Load factor tariff. Application of tariff system to reduce energy bill.

Unit– V

Energy Audit of Electrical System

Energy audit (definition as per Energy Conservation Act) Energy audit instruments and their use. Questionnaire for energy audit projects. Energy flow diagram (Sankey diagram) Simple payback period, Energy Audit procedure (walk through audit and detailed audit). Energy Audit report format.

References:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi
3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN*: 978-* 0195606539
4. Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708
5. Sharma, K. V., Venkataseshaiah; P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	ELECTRICAL TESTING AND COMMISIONING	EEPE- 523	3L-1T-2P	6

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taughtand implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Identify the different types of data communication equipment and techniques.
b) Use relevant digital modulation techniques.
c) Interpret data communication media.
d) Use fibre optics in data communication.
e) Use OSI model and relevant data communication protocols.
f) Maintain wireless network environment.

Course Contents:

Unit – I

Electrical Safety and Insulation
Do's and don'ts regarding safety in domestic electrical appliances as well for substation/ power station operators Electrical safety in industry/power stations/ substations at the time of operation/ control/ maintenance. Fire detection alarm, fire-fighting equipments Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958 Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectric absorption, iii) Megger and to predict the condition of insulation Reconditioning of insulation, Insulating oil - properties of insulating oil, causes of deterioration of oil, testing of transformer oil as per IS 1866-1961

Unit – II

Installation and Erection
Concept of foundation for installation of machinery. Requirements of foundation for static and rotating electrical machinery. Concept of leveling and aligning Procedure for leveling and aligning alignment of direct coupled drive, effects of mis-alignment Installation of transformer as per I.S.-1886-1967 and procedure of installation of transformer, Requirements of installation of pole mounted transformer Requirements of installation of rotating electrical machines as per I.S. 900 – 1965 Devices and tools required for loading, unloading, lifting, and carrying heavy equipment and precautions to be taken while handling them

Unit– III

Testing and Commissioning

Concept of testing, Objectives of testing. Roles of I.S.S. in testing of electrical equipment, Types of tests and concepts, Routine tests, type tests, supplementary test, special tests, Methods of testing - Direct/Indirect/Regenerative testing. Tolerances for the various items for equipment – transformer, induction motor, dc motor, synchronous machines Commissioning, Tests before Commissioning for transformer, induction motor, alternator Testing of transformer as per I.S.1886- 1967 and I.S.2026- 1962 Testing of three-phase Induction motor as per I.S.325 - 1970. Testing of single-phase induction motor as per I.S.990-1965. Testing of synchronous machines as per ISS Testing of D.C. machines

Unit– IV

Troubleshooting Plans

Internal and external causes for failure / abnormal operation of equipment. List of mechanical faults, electrical faults and magnetic faults in the electrical equipment remedies, applications Use of tools like bearing puller filler gauges, dial indicator, spirit level, megger, earth tester, and growler. Common troubles in electrical equipments and machines. Preparation of trouble shooting charts for D.C. Machines, AC Machines and transformers.

Unit– V

Maintenance

Concept of maintenance, types of maintenance, Routine, preventive and breakdown maintenance. Causes of failure of electrical machines Preventive maintenance-procedure or developing maintenance schedules for electrical machines. Factors affecting preventive maintenance schedules, Concept of TPM, Pillars of TPM Identification of different types of faults developed such as mechanical/ electrical/ magnetic faults Maintenance schedules of the following as per I.S.S.

a) Distribution transformer as per I.S.1886-1967
b) Single phase and three phase Induction motors as per I.S.900-1965.
c) Batteries

References:

1. Deshpande.M. V. PHI Learning Pvt. Ltd., 2010, Design and Testing of Electrical Machines ISBN No 8120336453, 9788120336452.
2. Rao, B V S Asia Club House, First Reprint, 2011, Operation and Maintenance of Electrical Equipment Vol-I, ISBN No 8185099022
3. Rosenberg. Mc GRAW-HILL, 1st Edition, May 2003, Maintenance and Repairs, ISBN No 9780071396035
4. Sharotri, S.K. Glencoe/ Mcgraw- Hill; 2ndEdition , June 1969; Preventive Maintenance of Electrical Apparatus, ISBN No 10: 007030839X 13: 978-0070308398

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	SWITCHGEAR AND PROTECTION	EEPE- 524	3L-1T-2P	6

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
199 Electrical Engineering Curriculum Structure
a) Identify various types of faults in power system.
b) Select suitable switchgears for different applications.
c) Test the performance of different protective relays.
d) Maintain protection systems of alternators and transformers.
e) Maintain protection schemes for motors and transmission lines.
f) Maintain protection schemes for power system against overvoltages.

Course Contents:

Unit – I

Basics of Protection
Necessity, functions of protective system. Normal and abnormal conditions. Types of faults and their causes. Protection zones and backup protection . Short circuit fault calculations in lines fed by generators through transformers Need of current limiting reactors and their arrangements.

Unit – II

Circuit Interruption Devices
Isolators- Vertical break, Horizontal break and Pantograph type. HRC fuses – Construction, working, characteristics and applications. Arc formation process, methods of arc extinction (High resistance and Low resistance), Arc voltage, Recovery voltage, Re-striking voltage, RRRV. HT circuit breakers (Sulphur-hexa Fluoride (SF6), Vacuum circuit breaker) - Working, construction, specifications and applications. L.T. circuit breaker (Air circuit breakers (ACB), Miniature circuit breakers (MCB), Moulded case circuit breakers (MCCB) and Earth leakage circuit breaker (ELCB)) - Working and applications. of LT and HT circuit breakers (ratings), Selection of MCCB for motors. Gas insulated switchgear.

Unit– III

Protective Relays
Fundamental quality requirements: Selectivity, Speed, Sensitivity, Reliability, Simplicity, Economy. Basic relay terminology- Protective relay, Relay time, Pick up, Reset current, current setting, Plug setting multiplier, Time setting multiplier. Protective relays: Classification,

principle of working, construction and operation of – Electromagnetic (Attracted armature type, Solenoid type, Watt-hour meter type) relay, Thermal relay. Block diagram and working of Static relay. relay-Time current characteristics. Microprocessor based over current relays: Block diagram, working. Distance relaying- Principle, operation of Definite distance relays. Directional relay: Need and operation. Operation of current and voltage differential relay.

Unit– IV

Protection of Alternator and Transformer

Alternator Protection

Faults, Differential protection Over current, earth fault, overheating and field failure, protection. Reverse power protection.

Transformer Protection

Faults, Differential, over current, earth fault, over heating protection, Limitations of differential protection. Buchholz relay: Construction, operation, merits and demerits.

Unit– V

Protection of Motors, Bus-bar and Transmission Line Motor

Faults. Short circuit protection, Overload protection, Single phase preventer**.**

Bus bar and Transmission line

Faults on Bus bar and Transmission Lines. Bus bar protection: Differential and Fault bus protection.

Transmission line: Over current, Distance and Pilot wire protection.

References:

1. Mehta V. K ;Rohit Mehta, Principles of Power System, S .Chand and Co., New Delhi., ISBN: 978-81-2192-496-2.
1. Rao.Sunil S., Switchgear and Protection, Khanna Publishers, New Delhi, ISBN: 978-81-7409-232-3.
2. Singh, R. P., Switchgear and Power System Protection, PHI Learning, New Delhi, ISBN: 978-81-203-3660-5.
3. Gupta. J. B.. Switchgear and Protection, S. K. Kataria and Sons, New Delhi, ISBN: 978-93-5014-372-8.
4. Veerapan, N.,Krishnamurty, S. R., Switchgear and Protection, S .Chand and Co., New Delhi. ISBN: 978-81-2193-212-7.
5. Ram, Badri; Vishwakarma D. N., Power System Protection and Switchgear, McGraw-Hill, New Delhi. ISBN : 978-07-107774-X

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	SOLAR POWER TECHNOLOGIES	EEOE- 525	3L-1T-0P	4

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Maintain the solar non-electric equipment.
b) Maintain CSP plants
c) Maintain solar PV systems.
d) Maintain solar PV electronics and MPPT systems
e) Maintain off-grid and on-grid solar power plants

Course Contents:

Unit – I

Solar Energy
Solar Map of India: Global solar power radiation. Different types of Solar water heaters: Construction, working, specifications and installation. Solar Heating systems Solar drying and different types of Solar cookers Solar lighting. Preventive maintenance of all of the above.

Unit – II

Concentrated Solar Power (CSP)
Concentrated Solar Power (CSP) plants or solar thermal electric systems. Parabolic Trough: Construction, working and specifications Parabolic Dish: Construction, working and specifications. Power Tower, Fresnel Reflectors: Construction, working and specifications Solar Stirling engines, Preventive maintenance of all of the above

Unit– III

Solar PV Systems
Solar PV cell: Types construction, working, Typical specifications of solar cells. Solar PV working principle: Series and parallel connections of solar modules. Solar Photovoltaic (PV) system: components layout and working.. Solar modules, arrays and their standard specifications. Roof top and streetlight solar PV systems and typical specifications. Maintenance of these systems

Unit– IV

Solar PV Electronics

Solar Charge controllers: working and specifications, switchgear and cables. Batteries: Different types for solar PV systems, maintenance and specifications. Solar Inverters: working and specifications. Signal conditioning systems: working and specifications. Solar Power tracking: construction, working, tilt angle, solar radiation, I-V, P-V characteristics, maximum power point tracking (MPPT) Maintenance of these systems.

Unit– V

Solar PV Off-grid and Grid Tied Systems

Solar off grid systems: layout and specifications. Solar Grid tied (on grid) systems: Working principle of grid-tied dc-ac inverter, grid synchronization and active power export. Net metering: main features and working. Solar-wind Hybrid systems: Layout and specifications.

References:

1. Solanki, Chetan Singh, - Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning, New Delhi, ISBN: 9788120351110
1. Solanki, Chetan Singh, - Solar Photovoltaic Technology and Systems - A Manual For Technicians, Trainers and Engineers, PHI Learning, New Delhi, ISBN: 9788120347113
2. Kothari, D.P. et aL:Renewable Energy Sources and Emerging Technologies, PHI
3. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, - Renewable Energy Systems, Pearson Education New Delhi ,ISBN: 9789332586826
4. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning
5. O.P. Gupta, Energy Technology, Khanna Publishing House, ISBN: 978-93-86173-683

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Semester- V

MICROCONTROLLER APPLICATIONS LABORATORY

Practicals:

1. Interpret details of Hardware kit for Microcontroller and practice to write and execute programs.
2. Identify different menus available in a simulator software RIDE/KEIL and demonstrate their use.
3. Develop and execute Assembly language programs using Arithmetic Instructions and demonstrate outcome for a given input data
4. Develop and execute Assembly language programs using Logical Instructions and demonstrate outcome for a given input
5. Develop and execute an Assembly language program for Addition of series of 8 bit nos, 16 bit result and demonstrate outcome for a given input data
6. Develop and execute Assembly language program for addition/subtraction of 16 bit no/multibyte nos. and demonstrate outcome for a given input data
7. Develop and execute Assembly language program for Block transfer from and to Internal/External memory using directives and demonstrate outcome for a given input data.
8. Develop and execute Assembly language program Largest/smallest of given series of no. from Internal/External memory and demonstrate outcome for a given input data.
9. Develop and execute Assembly language program arrange no in ascending/descending order from Internal/External memory and demonstrate outcome for a given input data.
10. Develop and execute Assembly language program for LED blinking/LED sequences using delay/ timer mode.
11. Develop and execute Assembly language program to interface LED with microcontroller.

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Semester-V

ENERGY CONSERVATION AND AUDIT LABORATORY

Practicals:

1. Identify star labelled electrical apparatus and compare the data for various star ratings.
2. Determine the '% loading' of the given loaded Induction motor.
3. Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.
4. Use APFC unit for improvement of p. f. of electrical load.
5. Compare power consumption of different types of TL with choke, electronic ballast and LED lamps by direct measurements.
6. Determine the reduction in power consumption by replacement of lamps in a class room / laboratory.
7. Determine the reduction in power consumption by replacement of Fans and regulators in a class room / laboratory.
8. Collect electricity bill of an industrial consumer and suggest suitable tariff for energy Conservation and its impact on energy bill.
9. Collect electricity bill of a commercial consumer and suggest suitable tariff for conservation and reduction of its energy bill.
10. Collect electricity bill of a residential consumer and suggest suitable means for conservation and reduction of the energy bill.
11. Estimate energy saving by improving power factor and load factor for given cases.
12. Prepare a sample energy audit questionnaire for the given industrial facility.
13. Prepare an energy audit report (Phase-I)
14. Prepare an energy audit report (Phase-II)
15. Prepare an energy audit report (Phase-III)

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Semester-V

SWITCHGEAR AND PROTECTION LABORATORY

Practicals:

1. Identify various switchgears in the laboratory and write their specifications.
2. Test HRC fuse by performing the load test.
3. Test MCB by performing the load test
4. Dismantle MCCB/ELCB and identify various parts.
5. Dismantle ACB/VCB and identify different parts.
6. Set the plug and time (with PSM, TSM) of induction type electromagnetic relay.
7. Test electromagnetic over-current relay by performing load test.
8. Simulate differential protection scheme for transformer with power system simulation kit.
9. Test the working of the single phasing preventer using a three phase induction motor.
10. Simulate transmission line protection by using the impedance relay/over current relay for various faults. (On transmission line protection simulation Kit).
11. Dismantle Thyrite type arrester and identify different parts.
12. Perform neutral earthing at different substations / locations.

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Semester-V

SOLAR POWER TECHNOLOGIES LABORATORY

Practicals:

1. Dismantle solar power heaters
2. Assemble solar power heaters
3. Assemble the parabolic dish CSP plant.
4. Dismantle the parabolic dish CSP plant.
5. Troubleshoot a CSP plant
6. Assemble the solar PV system.
7. Dismantle the solar PV system
8. Troubleshoot a solar PV system
9. Troubleshoot a solar PV panels and arrays
10. Troubleshoot solar inverters
11. Troubleshoot solar signal conditioners
12. Troubleshoot solar PV MPPT systems
13. Troubleshoot solar off-grid systems
14. Troubleshoot solar net metering systems
15. Troubleshoot solar-wind hybrid systems.

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	BUILDING ELECTRIFICATION	EEPC- 621	3L-1T-2P	6

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taughtand implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:
a) Select accessories, wires, cables and wiring systems for electrification.
b) Design electrical wiring installation system for residential unit.
c) Design proper illumination scheme for residential unit.
d) Prepare wiring layouts on wiring board.
e) Locate and diagnose faults in electrical wiring installation.
f) Do proper earthing for building electrification.

Course Contents:

Unit – I

Wiring Tools and Accessories
Various tools required for wiring- screwdrivers, pliers, Try square, saws, hacksaw, chisel, hammers, mallet, rawl punch, hand drill machine, portable drilling machine, files, plumb bob, line thread, electricians knife, test lamp, tester and their BIS specifications, application, care & maintenance of tools. Classification of electrical accessories- controlling, holding, safety, outlet BIS symbols of following electrical accessories.
Switch – Their types according to construction such as surface switch, flush switch, and pull switch, rotary switch, knife switch, pendent switch, Main-switch (ICDP, ICTP). Their types according to working such as single pole, double pole, two-way, two-way centre off, intermediate, series parallel switch
Holders- Their types such as bayonet cap lamp holder, pendent holder, batten lamp holder, angle holder, bracket holder, tube light holder, screw type Edison and goliath Edison lamp holder, swivel lamp holder.
Socket outlets and plugs- two pin, three-pin, multi pin sockets, two-pin and three-pin plug.
Others- Iron connector, adaptor, and ceiling rose, distribution box, neutral link, bus-bar chamber. Wooden/ mica boards, Moulded/ MS Concealed boxes of different sizes. Modular accessories.

Unit – II

Electrical Wires and Underground Cables
Conductors: - wire, cable, bus bar, stranded conductor, cable, armoured cable, flexible cable, solid conductor, PVC wires, CTS wire, LC wire, FR (Fire retardant) wire, Size of wire according

to BIS. Tools used for measurement of wire size, Wire jointing methods. Classification of cables, low tension, high tension, and extra high tension cables, solid, oil filled and gas filled type Cable insulation materials –vulcanized rubber (VIR), polyvinyl chloride (PVC), cross linked polythene (XLPE), impregnated paper, Selection of suitable cable size and type from standard data Cable jointing methods Cable laying methods. Factors determining selection of electric cables

Unit– III

Wiring Methods and wiring layout

Factors determining the selection of wiring methods. Classification of wiring methods. PVC casing-capping wiring- wiring rules according to IS: 732-1983 Conduit wiring- Types of conduit, comparison between Metal and PVC conduit, types of conduit wiring (Surface/Concealed). Conduit wiring accessories, BIS rules for Metal and PVC conduit wiring. Comparison of various wiring systems. General BIS rules for domestic installations. Design, working and drawing of following electrical circuits: Simple light and fan circuits, Stair case wiring, Go-down wiring circuit, Bedroom lighting circuit, Corridor lighting circuit, Series parallel circuit, Master switch control circuit, Different lighting circuit using – Intermediate switch, Call bell circuit using bell indicator, Design of wiring circuits according to user's requirement

Unit– IV

Residential Building Electrification

Domestic Dwellings/Residential Buildings: reading of Civil Engineering building drawing, Interpretation of electrical installation plan and electrical diagrams, electrical symbols as per IS: 732. Electrical installation for residential building as per part I section 9 of NEC-2011 Difference between residential and industrial load, rules/requirements related to lighting load followed in electrical installations, Positioning of equipment. Lighting and power circuits: Light and fan circuit, Power circuit Wiring and circuit Schematic diagram according to IS: 2042(Part-I)-1962: multiline and single line representation Load assessment: Selection of size of conducto, Selection of rating of main switch and protective switch gear. Design and drawing, estimation and costing of a residential installation having maximum 5 KW load; Sequence to be followed for preparing estimate; Calculation of length of wire and other materials, labour cost Testing of wiring installation as per IS: 732-1982: Insulation resistance - between earth and conductors, between conductors, polarity test of single pole switches. Testing of earth continuity path. Residential building Service Connection- types Underground and overhead. Calculation of Material required for service connection

Unit– V

Protection of Electrical Installation

Fuse in electric circuit: fuse element, fuse current rating, minimum fusing current, cut-off current, fusing factor, Fuse material Types of fuses –Re-wirable, cartridge fuses (HRC and LRC), Fuse material Selection of fuse. Miniature circuit Breaker (MCB)-Construction, Principle rating and uses, Earth Leakage Circuit Breaker (ELCB)-Construction, Principle rating and uses. System and equipment earthing and its requirements, Earth, earth electrode, earth current, earth terminal, earthing wire, earthing lead, fault current, leakage current, Measurement of earth resistance using earth tester, Methods of reducing earth resistance, Methods of earthing as per IS 3043: 1987 and their procedure- Driven pipe, pipe and plate earthing, modern methods of earthing,

Unit– VI

Illumination in Residential Installation

Concept of Luminous flux, Luminous intensity, Lumen, Illumination or illuminance, Lux, Space-height ratio, utilization factor, depreciation factor, luminous efficiency- values for different luminaries. Laws of Illumination-Inverse Square Law, Cosine Law, illumination received directly underneath, horizontal screen and screen moved horizontally at certain distance Factors affecting the illumination. Different types of lighting arrangements, Luminous flux of different types of light sources, Lux level required for different places as per SP 72: 2010.

References:

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2. Allagappan,N. S.Ekambarram, Electrical Estimating and Costing, New Delhi, ISBN-13: 9780074624784
3. Singh, Surjit, Electrical Estimating and Costing, Dhanpat Rai and Co. New Delhi, ISBN: 1234567150995
4. Gupta, J B: A Course in Electrical Installation Estimating and Costing, S K Kataria and Sons,New Delhi, ISBN:978-93-5014-279-0
5. Bureau of Indian Standard, IS: 732-1989, Code of practice for electrical wiring installation

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	ENTREPRENEURSHIP AND START-UPS	EEPC- 622	3L-1T-0P	4

Course Contents:

UNIT -I

Introduction to Entrepreneurship and Start – Ups. Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation Types of Business Structures, Similarities/differences between entrepreneurs and managers.

UNIT -II

Business Ideas and their implementation. Discovering ideas and visualizing the business Activity map Business Plan

UNIT -III

Idea to Start-up. Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis

UNIT -IV

Management Company's Organization Structure, Recruitment and management of talent. Financial organization and management.

UNIT -V

Financing and Protection of Ideas. Financing methods available for start-ups in India Communication of Ideas to potential investors – Investor Pitch Patenting and Licenses.

UNIT -VI

Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy
Learning Outcome: Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:
1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. Strategic Marketing Planning
6. New Product or Service Development

7. Business Plan Creation

Books.

1. The Startup Owner's Manual The Step-by-Step Guide for Building a Great Company
Steve Blank and Bob Dorf
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses
3. Demand: Creating What People Love Before They Know They Want It Adrian J. Slywotzky with Karl Weber Headline Book Publishing
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way.

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	ELECTRIC VEHICLES	EEOE- 623	3L-1T-2P	6

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the salient features of Hybrid electric vehicles.
b) Interpret the Dynamics of hybrid and Electric vehicles
c) Maintain the DC-DC converters in EV applications.
d) Maintain the DC-AC converters in EV applications
211 Electrical Engineering Curriculum Structure
e) Select the batteries for EV applications.

Course Contents:

Unit – I

Introduction to Hybrid Electric Vehicles

Evolution of Electric vehicles. Advanced Electric drive vehicle technology Vehicles-Electric vehicles (EV), Hybrid Electric drive (HEV), Plug in Electric vehicle (PIEV), Components used Hybrid Electric Vehicle. Economic and environmental impacts of Electric hybrid vehicle. Parameters affecting Environmental and economic analysis. Comparative study of vehicles for economic, environmental aspects

Unit – II

Dynamics of hybrid and Electric vehicles

General description of vehicle movement . Factors affecting vehicle motion- Vehicle resistance, tyre ground adhesion, rolling resistance, aerodynamic drag, equation of grading resistance, dynamic equation. Drive train configuration, Automobile power train, classification of vehicle power plant Performance characteristics of IC engine, electric motor, need of gear box. Classification of motors used in Electric vehicles. Basic architecture of hybrid drive trains, types of HEVs. Energy saving potential of hybrid drive trains. HEV Configurations-Series, parallel, Series-parallel, complex.

Unit– III

DC-DC Converters for EV and HEV Applications

EV and HEV configuration based on power converters. Classification of converters – unidirectional and bidirectional. Principle of step down operation.and Buck- Boost converters. Principle of Step-Up operation. Two quadrant converters; multi quadrant converters

Unit– IV

DC-AC Inverter & Motors for EV and HEVs

DC-AC Converters, Principle of operation of half bridge DC-AC inverter (R load, R-L load) Single phase Bridge DC-AC inverter with R load, R-L load Electric Machines used in EVs and HEVs, principle of operation, working & control. Permanent magnet motors, their drives, switched reluctance motor. Characteristics and applications of above motors

Unit– V

Batteries

Overview of batteries, Battery Parameters, types of batteries, Battery Charging, alternative novel energy sources-solar photovoltaic cells, fuel cells, super capacitors, flywheels. Control system for EVs and HEVs, overview, Electronic control unit ECU, Schematics of hybrid drive train, control architecture Regenerative braking in EVs

References:

1. A.K. Babu, Electric & Hybrid Vehicles, Khanna Publishing House, New Delhi (Ed. 2018)
2. Fuhs, A. E. Hybrid Vehicles and the Future of Personal Transportation, CRC Press,
3. Gianfranco, *Electric and Hybrid Vehicles:* Power Sources, Models, Sustainability, Infrastructure And The Market, Pistoia Consultant, Rome, Italy,
4. Ehsani, M. *Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*, CRC Press
5. Husain, I. *Electric and Hybrid Electric Vehicles*, CRC Press

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRICAL ENGINEERING	ELECTRIC TRACTION	EEOE- 624	3L-1T-2P	6

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the traction layout and its systems
b) Maintain the power supply arrangements.
c) Maintain the function of the overhead equipment for electric traction
d) Maintain the different components of the electric locomotive.
e) Maintain the traction motor and train lighting system
f) Maintain the signalling and supervisory control systems.

Course Contents:

Unit – I

Basics of Traction

General description of Electrical Traction system in India. Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive. Problems associated with AC traction System and remedies for it. Voltage balance, current balance, production of harmonics, induction effects. Metro rail system, features

Unit – II

Power Supply Arrangements

Constituents of supply system:-

- Substation: layout, list of equipment and their functions
- Feeding post: list of equipment and their functions
- Feeding and sectioning Arrangements
- Sectioning and paralleling post
- Sub sectioning and Paralleling post
- Sub sectioning post
- Elementary section

Major equipment at substation, Miscellaneous equipment at control post or Switching station Protection system for traction transformer and 25 kV centenary construction

Unit– III

Overhead Equipment

Different types of overhead equipments, Pentagonal OHE Centenary Construction Different Types of Centenary according to speed Limit. OHE Supporting Structure, Cantilever assembly diagram Overhead system- Trolley collector, Bow collector, Pantograph Collector. Types and construction of pantograph

Unit– IV

Electric Locomotive

Classification and Nomenclature of Electric Locomotive, Block diagram of AC locomotive. Power Circuit of AC Locomotive, Equipment (List and Function only) used in auxiliary circuit of AC Locomotive, Loco bogie classification according to wheel arrangements, Maintenance of AC systems

Unit– V

Traction Motors and Train Lighting

Desirable characteristics of traction motor. Types of motors used for traction with their characteristics and features. Control of motors used for traction and methods to control
Requirements of braking, types of braking. Electric braking, Regenerative braking. Systems of train lighting, Single battery, double battery parallel block system SG, HOG, End on generation

Unit VI.

Signalling and Supervisory Control

Requirements of signaling systems, Types of signals, track circuits, Advantages of remote control Systems of remote control, equipment and network, Metro rail-supply systems, advantages, schemes in India

References:

1. G.C. Garg, Utlization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355) Revised Ed. 2018
2. Gupta J.B., S.K.Kataria and Son, Utilization of Electric power and traction
3. Partab H., Dhanpat Rai and Co,' Art and Science of Utilization of Electrical Energy
4. Partab H., Dhanpat Rai and Co, Modern Electric Traction
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Semester-VI

BUILDING ELECTRIFICATION LABORATORY

Practicals:

1. Prepare series testing board.
2. Select the electric wire using measuring and testing instruments for particular applications.
3. Identify cables of different current ratings.
4. Prepare wiring installation on a board showing control of one lamp, one fan and one Socket from one switch board in PVC surface conduit wiring system.
5. Prepare wiring installation on a board.
6. Control one lamp from two different places using PVC surface conduit wiring system.
7. Prepare wiring installation on a board. Control one lamp from three different places usingPVC surface conduit wiring system.
8. Prepare wiring installation on a board.
9. Perform go-down wiring for three blocks using PVC casing capping.
10. Design 2 BHK residential installation scheme and estimate the material required. And draw the details required for installation on A4 size sheet.
11. Test wiring installation using megger

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Semester-VI

ELECTRIC VEHICLES LABORATORY

Practicals:

1. Develop block diagram of Electric vehicle and identify parts
2. Case study- Compare minimum four vehicles for economic and environmental analysis
3. Develop schematic diagram of hybrid electric vehicle and identify the components fluorescent lamp.
4. Prepare report on Plug in Electric vehicle by visiting a charging station
5. Inspect and install inverter of given lead acid battery
6. Prepare a report on batteries used from market survey
7. Collect specifications of converters and inverters used for Electric vehicles a single lamp control by two switches
8. Diagnose, repair and maintain battery used in electric vehicle
9. Prepare test procedure for equipment used in Electric vehicle
10. List safety procedures and schedule for handling HEVs and EVs.

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Semester-VI

ELECTRIC TRACTION LABORATORY

Practicals:

1. Dismantle a traction motor
2. Assemble a traction motor
3. Troubleshoot a traction motor
4. Visit electric-traction train lighting system installation, identify components of system and prepare report
5. Visit electric-traction loco shed, investigate working of each section & prepare report
6. Visit to Traction Substation or feeding post (for layout and OHE) and write a report
7. Visit to Railway Station (for signalling and train lighting) and writing a report on visit
8. Draw traction substation Layout on drawing sheet and prepare report
9. Draw Pentagonal OHE Catenary, different Catenaries according to speed limit, OHE supporting structure on drawing sheet and prepare report
10. Draw Power Circuit of AC Locomotive on drawing sheet and prepare report.

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	PRINCIPLES OF ELECTRONIC COMMUNICATION	ECPC-301	3L-1T-2P	6

Course Outcomes:

1. Use of different modulation and demodulation techniques used in analog communication.
2. Identify and solve basic communication problems.
3. Analyse transmitter and receiver circuits.
4. Compare and contrast design issues, advantages, disadvantages and limitations of analog communication systems

Course Contents:

UNIT – I

ANALOG MODULATION: Concept of frequency translation. Amplitude Modulation: Description of full AM, DSBSC, SSB and VSB in time and frequency domains, methods of generation & emodulation, descriptions of FM signal in time and frequency domains

UNIT – II

PULSE ANALOG MODULATION: Ideal sampling, Sampling theorem, aliasing, interpolation, natural and flat top sampling in time and frequency domains.

UNIT – III

PCM & DELTA MODULATION SYSTEMS: Uniform and Non-uniform quantization. PCM and delta modulation, Signal to quantization noise ratio in PCM and delta modulation.

UNIT – IV

DIGITAL MODULATION: Baseband transmission: Line coding (RZ, NRZ), inter symbol interference (ISI), pulse shaping, Nyquist criterion for distortion free base band transmission, raised cosine spectrum. Pass band transmission: Geometric interpretation of signals, orthogonalization.

UNIT – V

SPREAD-SPECTRUM MODULATION: Introduction, Pseudo-Noise sequences, direct sequence spread spectrum (DSSS) with coherent BPSK, processing gain, probability of error, frequency-hop spread spectrum (FHSS). Application of spread spectrum: CDMA.

Books:

1. Principles of communication systems By Taub Schilling, T.M.H.
2. Fundamentals of communication systems By Proakis & Salehi, Pearson education
3. Communication Systems by Simon Haykin, John Wiley
4. Communication Systems (Analog and Digital) By R.P. Singh, S.D. Sapre, T.M.H.
5. Modern Digital & Analog Communication By B.P. Lathi, Oxford Publications.

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	ELECTRONICS DEVICES AND CIRCUITS.	ECPC-302	3L-1T-2P	6

Course Contents:

UNIT –I

Semiconductor and Diodes Definition, Extrinsic/Intrinsic, N-type & p-type PN Junction Diode Forward and Reverse Bias Characteristics Zener Diode – Principle, characteristics, construction, working Diode Rectifiers – Half Wave and Full Wave. Filters – C, LC and PI Filters

UNIT -II

Bipolar Junction Transistor (BJT) NPN and PNP Transistor – Operation and characteristics Common Base Configuration – characteristics and working Common Emitter Configuration characteristics and working Common Base Configuration – characteristics and working High frequency model of BJT Classification of amplifiers, negative feedback.

UNIT –III

Field Effect Transistors FET – Working Principle, Classification MOSFET Small Signal modelN-Channel/ P-Channel MOSFETs – characteristics, enhancement and depletion mode, MOSFET as a Switch Common Source Amplifiers Uni-Junction Transistor equivalent circuit and peration

UNIT –IV

SCR DIAC & TRIAC SCR – Construction, operation, working, characteristics DIAC - Construction, operation, working, characteristics TRIAC - Construction, operation, working, characteristics SCR and MOSFET as a Switch, DIAC as bidirectional switch Comparison of SCR, DIAC, TRIAC,MOSFET

UNIT –V

Amplifiers and Oscillators Feedback Amplifiers – Properties of negative Feedback, impact of feedback on different parameters Basic Feedback Amplifier Topologies: Voltage Series, Voltage Shunt Current Series, Current Shunt Oscillator – Basic Principles, Crystal Oscillator, Non-linear/ Pulse Oscillator

Books:

1. Analog Circuits A.K. Maini Khanna Publishing House Ed. 2018
2. Electronic Devices and Circuits S. Salivahanan and N. Suresh Kumar McGraw Hill Education;
3. Electronics Devices and circuit theory Boyestad & Nashelsky Pearson Education India;
4. Electronic Principles Albert Malvino & David Bates Tata McGraw Hill Publication 2010
5. Electronics Devices & Circuits Jacob Millman McGraw Hill Education; 4 edition (2015)

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	DIGITAL ELECTRONICS	ECPC-303	3L-1T-2P	6

Course Contents:

UNIT –I

Number Systems & Boolean Algebra . Introduction to different number systems – Binary, Octal, Decimal, Hexadecimal Conversion from one number system to another. Boolean variables Rules and laws of Boolean Algebra De-Morgan's Theorem Karnaugh Maps and their use for simplification of Boolean expressions.

UNIT –II

Logic Gates. Logic Gates – AND, OR, NOT, NAND, NOR , XOR, XNOR: Symbolic representation and truth table Implementation of Boolean expressions and Logic Functions using gates Simplification of expressions.

UNIT –III

Combinational Logic Circuits. Arithmetic Circuits – Addition, Subtraction, 1's 2's Complement, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel and Series Adders Encoder, Decoder Multiplexer – 2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX. Applications Demultiplexer – 1 to 2 DEMUX, 1- 4 DEMUX, 1- 8 DEMUX.

UNIT –IV

Sequential Logic Circuits. Flip Flops – SR,JK, T, D, FF, JK-MS, Triggering Counters – 4 bit Up Down Counters, Asynchronous/ Ripple Counter, Decade Counter- Mod 3, Mod 7 Counter, Johnson Counter, Ring Counter Registers – 4bit Shift Register: Serial In Serial Out, Serial in Parallel Out, Parallel In Serial Out, Parallel In Parallel Out.

UNIT –V

Memory Devices. Classification of Memories – RAM Organization, Address Lines and Memory Sixe, Static RAM, Bipolar RAM, cell Dynamic RAM, D RAM, DDR RAM Read Only memory ROM organization, Expanding memory, PROM, EPROM, EEPROM, Flash Memory Data Converters – Digital to Analog converters, Analog to Digital Converters.

Books:

1. Digital principles & Applications Albert Paul Malvino & Donald P. Leach McGraw Hill Education;
2. Digital Electronics Roger L. Tokheim Macmillian McGraw-Hill Education (ISE Editions);
3. Digital Electronics – anintroduction to theory and practice William H. Gothmann Prentice Hall

4. Fundamentals of Logic Design Charles H. Roth Jr. Jaico Publishing House; First edition.
5. Digital Electronics R. Anand Khanna Publications, New Delhi.

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	ELECTRONIC MEASUREMENT AND INSTRUMENTATION	ECPC-304	3L-1T-2P	6

Course Contents:

UNIT –I

Basics of Measurements and Bridges. Accuracy & precision, Resolution Types of Errors DC Bridges – Wheatstone and Kelvin Double Bridge AC Bridges - Maxwell's Bridge, Hay's Bridge, Anderson Bridge, De-Sauty's Bridge.

UNIT –II

Potentiometer. Basic DC slide wire Potentiometer Crompton's DC Potentiometer Applications of DC Potentiometer AC Potentiometers Applications of AC Potentiometers

UNIT – III

Measuring Instruments. Permanent Magnet Moving Coil Instruments (PMMC) Moving Iron type Instruments (MI) Electro Dynamo Type Instruments Single Phase Energy Meter.

UNIT – IV

Electronic Instruments. Electronic Voltmeter and Digital Voltmeter Electronic Multimeters Q – Meter Vector Impedance Meter

UNIT – V

Oscilloscopes. Cathode ray tube: construction, operation, screens, graticules Vertical deflection system, Horizontal deflection system, Delay line, Measurement of frequency, time delay, phase angle and modulation index (trapezoidal method) Oscilloscope probe: Structure of 1:1 and 10:1 probe Multiple Trace CRO

UNIT - VI

Transducers. Classification, Selection Criteria, Characteristics, Construction, Working Principles and Application of following Transducers: RTD, Thermocouple, Thermistor LVDT, Strain Gauge
Load Cell Piezoelectric Transducers.

Books:

1. Electrical & Electronic Measurement & Instruments A.K. Sawhney Dhanpat Rai & Sons,
2. Electronic Instrument and Measurement Technique W.D. Cooper Prentice Hall International,
3. Electronic Measurement & Instrumentation J.G. Joshi Khanna Publishing House, Delhi
4. Measurement systems application and design E.O. Doebelin and D N.Manik The Mcgraw-Hill
5. Electronic Measurements and Instrumentation Oliver and Cage The Mcgraw-Hill.

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	ELECTRIC CIRCUITS & NETWORK	ECPC-305	3L-1T-0P	4

Course Contents:

UNIT – I

Basics of Network and Network Theorem. Node and Mesh Analysis Superposition Theorem Thevenin Theorem Norton Theorem Maximum Power transfer theorem Reciprocity Theorem.

UNIT – II

Graph Theory Graph of network, tree, incidence matrix F- Tie Set Analysis F-Cut Set Analysis Analysis of resistive network using cut-set and tie-set Duality.

UNIT – III

Time Domain and Frequency Domain Analysis. Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits Initial and Final conditions in network elements Forced and Free response, time constants Steady State and Transient State Response Analysis of electrical circuits using Laplace Transform for standard inputs (UNIT , Ramp, Step)

UNIT –IV

Trigonometric and exponential Fourier series. Discrete spectra and symmetry of waveform Steady state response of a network to non-sinusoidal periodic inputs, power factor, effective Values Fourier transform and continuous spectra.

UNIT - V

Two Port Network. Two Port Network Open Circuit Impedance Parameters Short Circuit Admittance Parameters.Transmission Parameters Hybrid Parameters Interrelationship of Two Port Network Inter Connection of Two Port Network.

Books:

1. Networks and Systems Ashfaq Husain Khanna Publishing House.
2. Network Analysis M. E. Van Valkenburg Prentice Hall of India.
3. Engineering Circuit Analysis W. H. Hayt, J. E. Kemmerlyand S. M. Durbin McGraw Hill.
4. Electrical Circuits Joseph Edminister Schaum's Outline, Tata McGraw Hill.
5. Basic Circuit Theory Lawrence P. Huelsma Prentice Hall of India.

1. Harmonic analysis of a square wave of modulated waveform: measures modulation index.

2. To modulate a high frequency carrier with sinusoidal signal to obtain FM signal.

3. To study and observe the operation of a super heterodyne receiver.

4. To modulate a pulse carrier with sinusoidal signal to obtain PWM signal and demodulate it.

5. To modulate a pulse carrier with sinusoidal signal to obtain PPM signal and demodulate it.

6. To observe pulse amplitude modulated waveform and its demodulation.

7. To observe the operation of a PCM encoder and decoder. To consider reason for using digital signal x-missions of analog signals.

8. To study & observe the amplitude response of automatic gain controller (AGC).

1. Construct the circuit and plot the VI characteristics of the PN Junction Diode find the cut in voltage

2. Construct the circuit and plot the characteristics of a Zener Diode. Find the breakdown voltage

3. Construct a Half Wave Rectifier and obtain regulation characteristics Without Filters and with Filters Compare the results

4. Construct a Full Wave Rectifier and obtain regulation characteristics Without Filters and with Filters Compare the results.

5. Construct a Bridge Rectifier and obtain regulation characteristics Without Filters and with Filters.

6. Obtain the characteristics of DIAC and TRIAC 3

7. Simulate half wave, full wave and bridge rectifier using simulation tool like PSpice/ Orcad/ Multisim.

8. Develop a simulation model for Voltage Series and Voltage Shunt Feedback Amplifiers

9. Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.

10. Develop a simulation model for Current Series and Current Shunt Feedback Amplifiers

11. Develop circuits for Current Series and Current Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model

1. To verify the truth tables for all logic fates – NOT OR AND NAND NOR XOR XNOR using CMOS Logic gates and TTL Logic Gates.

2. Implement and realize Boolean Expressions with Logic Gates.

3. Implement Half Adder, Full Adder, Half Subtractor, Full subtractor using Ics.

4. Implement parallel and serial full-adder using Ics.

5. Design and development of Multiplexer and De-multiplexer using multiplexer Ics.

6. Verification of the function of SR,D, JK and T Flip Flops.

7. Design controlled shift registers.

8. Construct a Single digit Decade Counter (0-9) with 7 segment display.

9. To design a programmable Up-Down Counter with a 7 segment display.

10. Study of different memory Ics.

1.Measure unknown inductance using following bridges (a)Anderson Bridge.(b)Maxwell Bridge.

2. Measure Low resistance by Kelvin's Double Bridge.

3. Calibrate an ammeter using DC slide wire potentiometer.

4. Calibrate a voltmeter using Crompton potentiometer.

5. Measure low resistance by Crompton potentiometer.

6. Calibrate a single-phase energy meter by phantom loading.

7. Study the working of Q-meter and measure Q of coils

8. Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O.(ii) C.R.O. Probes

9. Measurement of displacement with the help of LVDT VI 2

10.Draw the characteristics of the following temperature transducers.(a)RTD(Pt-100)(b) Thermistor

11. Measurement of strain/force with the help of strain gauge load cell

Semester : IV

Electronics & Telecommunication

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	MICROCONTROLLER AND APPLICATIONS	ECPC-401	3L-1T-2P	6

Course Contents:

UNIT I

Introduction. Introduction to Microprocessors and Microcontrollers, Architectures [8085,8086] Intel MCS- 51 family features – 8051 -organization and architecture

UNIT II

Programming with 805110 8051 instruction set, addressing modes, conditional instructions, I/O Programming, Arithmetic logic instructions, single bit instructions, interrupt handling, Programming counters, timers and Stack

UNIT III

MCS51 and external Interfaces 8 User interface – keyboard, LCD, LED, Real world interface ADC, DAC, SENSORS Communication interface.

UNIT IV

C programming with 8051 8 I/O Programming, Timers/counters, Serial Communication, Interrupt, User Interfaces- LCD, Keypad, LED and communication interfaces [RS232].

UNIT V

ARM processor core based microcontrollers 14 Need for RISC Processor-ARM processor fundamentals, ARM core based controller [LPC214X], IO ports, ADC/DAC, Timers.

Books:

1. The 8051 Micro Controller and Embedded Systems Muhammad Ali Mazidi & Janice Gilli Mazidi,
2. Microprocessor and Microcontrollers Krishna Kant Eastern Company Edition, Prentice Hall of
3. Microprocessor & Microcontroller Architecture: Programming & Interfacing using 8085,8086,8051
4. Microcontrollers: Architecture implementation and Programming Tabak Daniel,
5. ARM Developer's Guide.UM10139 LPC214X User manual – Rev.4
6. Microprocessors and interfacing: programming and hardware Douglas V. Hall Tata McGraw Hill,

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	CONSUMER ELECTRONICS	ECPC-402	3L-1T-0P	4

Course Contents:

UNIT -I

Audio Fundamentals and Devices. Basic characteristics of sound signal, Audio level metering, decibel level in acoustic measurement, Microphone & Types, speaker types & working principle, Sound recording principle & types

UNIT -II

Audio Systems CD player, home theatre sound system, surround sound, Digital console block diagram, working principle, applications, FM tuner , ICs used in FM tuner TDA 7021T , PA address system.

UNIT -III

Television Systems Monochrome TV standards, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution, Composite video signal, Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance, Different types of TV camera, Transmission standards

UNIT -IV

Television Receivers and Video Systems-PAL-D colour TV receiver, Digital TVs:- LCD, LED PLASMA, HDTV, 3-D TV, projection TV, DTH receiver, Video interface, Digital Video, SDI, HDMI Multimedia Interface , Digital Video Interface, CD and DVD player.

UNIT -V

Home / Office Appliances Diagrams, operating principles and controller for FAX and Photocopier, Microwave Oven, Washing Machine, Air conditioner and Refrigerators, Digital camera and cam coder.

Books.

1. Consumer Electronics Bali S.P. Pearson Education India,2010 , latest edition
2. Audio video systems : principle practices & troubleshooting Bali R and Bali S.P Khanna Book
3. Modern Television practices Gulati R.R. New Age International Publication (P)
4. Audio video systems Gupta R.G. Tata Mc graw Hill, New Delhi, India 2010, latest edition
5. Mastering Digital Television Whitaker Jerry & Benson Blair McGraw-Hill Professional, 2010,
6. Standard handbook of Audio engineering Whitaker Jerry & Benson Blair McGraw-Hill.

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	DIGITAL COMMUNICATION SYSTEMS	ECPC-403	3L-1T-2P	6

Course Contents:

UNIT -I

Block diagram and sub-system description of a digital communication system. Sampling of low-pass and band-pass signals, PAM , PCM, signal to quantization noise ratio analysis of linear and nonlinear quantizers, Line codes and bandwidth considerations; PCM TDM hierarchies, frame structures, frame synchronization and bit stuffing.

UNIT -II

Quantization noise analysis of DM and ADM; DPCM and ADPCM; Low bit rate coding of speech and video signals. Baseband transmission, matched filter, performance in additive Gaussian noise; Intersymbol interference (ISI), Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers and adaptive equalizers; Digital subscriber lines.

UNIT -III

Geometric representation of signals, maximum likelihood decoding; Correlation receiver, equivalence with matched filter. Generation, detection and probability of error analysis of OOK, BPSK, coherent and non-coherent FSK, QPSK and DPSK; QAM, MSK and multicarrier modulation; Comparison of bandwidth and bit rate of digital modulation schemes.

UNIT -IV

Introduction to Information and Coding Theories: Information Theory: information measures, Shannon entropy, differential entropy, mutual information, capacity theorem for point-to-point channels with discrete and continuous alphabets. Coding Theory: linear block codes – definitions, properties, bounds on minimum distance (singleton, Hamming, GV, MRRW), soft versus hard decision decoding, some specific codes (Hamming, RS, Concatenated); Convolutional codes – structure, decoding (the Viterbi and BCJR algorithms); Turbo codes, LDPC codes.

Books.

1. Communication Systems Haykin, S 4th Ed., John Wiley & Sons
2. Modern Digital and Analog Communication Systems Lathi, B.P. and Ding, Z Intl.
3. Digital Communications Proakis, J.G. and Saheli, M 5th Ed., McGraw-Hill
4. Digital Communication: Fundamentals and Applications Sklar, B., and Ray, P.K 2nd Ed.,
5. Elements of Information TheoryT. Cover and J. Thomas 2/e, Wiley.

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	ELECTRONIC EQUIPMENT MAINTENANCE	ECPC-404	3L-1T-0P	4

Course Contents:

UNIT -I

Fundamental Troubleshooting Procedures Inside An Electronic Equipment: Reading Drawings And Diagrams – Block Diagram, Circuit Diagram, Wiring Diagram; Dis-assembly and re-assembly of equipment, Equipment Failures and causes such as poor design, production deficiencies, careless storage and transport, inappropriate operating conditions, Nature of faults, Fault location procedure, Fault finding aids – Service and maintenance manuals and instruction manuals, Test and Measuring instruments, special tools Troubleshooting techniques, Approaching components for tests, Ground ing systems in Electronic Equipment, Temperature sensitive Intermittent problems Corrective actions, Situations where repairs should not be attempted.

UNIT -II

Passive Components and Their Testing Passive Components- Resistors, Capacitors, Inductors Failures in fixed resistors, testing of resistors, variable resistors, variable resistors as potentiometers, failures in potentiometers, testing of potentiometers, servicing potentiometers, LDRs and Thermistors Types of capacitors and their performance, Failures in capacitors, testing of capacitors and precautions therein, variable capacitor types, Testing of inductors and inductance measurement

UNIT -III

Testing of Semiconductor Devices Types of semiconductor devices, Causes of failure in Semiconductor Devices, Types of failure Test procedures for Diodes, special types of Diodes, Bipolar Junction Transistors, Field Effect Transistors, Thyristors Operational Amplifiers, Fault diagnosis in op-amp circuits

UNIT -IV

Logic IC families, Packages in Digital ICs, IC identification, IC pin-outs, Handling ICs, Digital troubleshooting methods – typical faults, testing digital ICs with pulse generators Logic clip, Logic Probe, Logic Pulser, Logic Current Tracer, Logic Comparator Special consideration for fault diagnosis in digital circuits Handling precautions for ICs sensitive to static electricity Testing flip-flops, counters, registers, multiplexers and de-multiplexers, encoders and decoders; Tri-state logic

UNIT -V

Rework and Repair of Surface Mount Assemblies Surface Mount Technology and surface mount devices Surface Mount Semiconductor packages – SOIC, SOT, LCCC, LGA, BGA, COB, Flatpacks and Quad Packs, Cylindrical Diode Packages, Packaging of Passive Components as SMDs Repairing Surface Mount PCBs, Rework Stations.

Books.

1. Modern Electronic Equipment: Troubleshooting, Repair and Maintenance Khandpur TMH
2. Electronic Instruments and Systems: Principles, Maintenance and Troubleshooting
3. Student Reference Manual for Electronic Instrumentation Laboratories David L Terrell
4. Electronic Testing and Fault Diagnosis G. C. Loveday, A. H Wheeler Publishing

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	LINEAR INTEGRATED CIRCUITS	ECPC-405	3L-1T-2P	6

Course Contents:

UNIT - I

IC Fabrication and Circuit Configuration for Linear IC Advantages of ICs over discrete components – Manufacturing process of monolithic Ics Construction of monolithic bipolar transistor – Monolithic diodes – Integrated Resistors Monolithic Capacitors– Inductors. Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, General operational amplifier stages-and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT - II

Applications Of Operational Amplifiers. Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT - III

Analog Multiplier and PLL. Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

UNIT - IV

Analog to digital and digital to analog converters Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R2R Ladder types switches for D/A converters, high speed sample-and-hold circuits, A/D Converters specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion Over-sampling A/D Converters.

UNIT - V

Waveform generators and special function ICs Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

Books.

1. Design with operational amplifiers and analog integrated circuits, 3rd Edition
2. Linear Integrated Circuits, . D.Roy Choudhry, Shail Jain New Age International Pvt. Ltd
3. System design using Integrated Circuits . B.S.Sonde New Age Pub, 2nd Edition, 2001
4. Analysis and Design of Analog Integrated Circuits Gray and Meyer Wiley International, 2005.
5. OP-AMP and Linear ICs Ramakant A.Gayakwad Prentice Hall / Pearson.

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Semester-IV

1. Programming 8051 Micro controller using ASM and C, and implementation in flash 8051 microcontroller.

2. Programming with Arithmetic logic instructions [Assembly]

3. Program using constructs (Sorting an array) [Assembly]

4. Programming using Ports [Assembly and C]

5. Delay generation using Timer [Assembly and C]

6. Programming Interrupts [Assembly and C]

7. Implementation of standard UART communication (using hyper terminal) [Assembly and C].

8. Interfacing LCD Display. [Assembly and C]

9. Interfacing with Keypad [Assembly and C]

10. Programming ADC/DAC [Assembly and C]

11. Interfacing with stepper motor. [Assembly and C]

12.Pulse Width Modulation. [Assembly and C] Programming ARM Micro controller using ASM and C using simulator. 11.Programming with Arithmetic logic instructions[Assembly]

13. GPIO programming in ARM microcontroller. [C Programming].

14. Timers programing in ARM Microcontroller. [C Programming].

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Semester-IV

1. Pulse Code Modulation and Differential Pulse Code Modulation.

2. Delta Modulation and Adaptive Delta modulation.

3. Simulation of Band Pass Signal Transmission and Reception Amplitude Shift Keying Frequency Shift Keying • Phase Shift Keying.

4. Performance Analysis of Band Pass Signal Transmission and Reception Amplitude Shift Keying Frequency Shift Keying Phase Shift Keying.

5. Implementation of Amplitude Shift Keying

6. Implementation of Frequency Shift Keying

7. Implementation of Phase Shift Keying.

8. Time Division Multiplexing: PLL (CD 4046) based synch, clock and data extraction.

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Semester-IV

1. Operational Amplifiers (IC741)-Characteristics and Application.

2. Waveform Generation using Op-Amp (IC741).

3. Applications of Timer IC555.

4. Design of Active filters.

5. Study and application of PLL IC's

6. Design of binary adder and subtractor.

7. Design of counters.

8. Study of multiplexer and demultiplexer /decoders.

9. Implementation of combinational logic circuits.

10. Study of DAC and ADC 11. Op-Amp voltage Regulator- IC 723

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	EMBEDDED SYSTEMS	ECPC-501	3L-1T-2P	6

Course Contents:

UNIT -I

Embedded C basics operators for ArduinoFamiliarizing with the Arduino IDE. Sketch designing for Arduino Communication interface using serial port Basic understanding of the code with boolean operations, pointer access operations, bitwise operations, compounded operations.

UNIT II

Embedded C control structure blocks Looping mechanism – for, do and while. The branching operations based on conditions expression

UNIT - III

Introduction to Arduino Mega Arduino Mega specifications including power ratings, digital and analog peripherals. Difference between the C language and Embedded C language Arduino Mega Ports, Pins, Digital and Analog Peripherals

UNIT IV

Communication with Arduino Different communication modules available with their real-life application Communication interface

Books.

1. Arduino Projects For Dummies Kennedy George; Davis Bernard; Prasanna SRM
2. Maketing Started With Arduino The Open Source Electronics Prototyping Platform Massimo Banzi and Michael Shiloh.

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Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	MOBILE AND WIRELESS COMMUNICATION	ECPC-502	3L-1T-2P	6

Course Contents:

UNIT - I

Overview of Cellular Systems Evolution 2g/3G/4G/5G Cellular Concepts – Frequency reuse, Cochannel and Adjacent channel Interference

UNIT - II

Wireless propagation Link budget, Free-space path loss, Noise figure of receiver Multipath fading, Shadowing, Fading margin, Shadowing margin

UNIT III

Antenna diversity, wireless channel capacity and MIMO

UNIT IV

Overview of CDMA , OFDM and LTE

Books.

1 Wireless Communications – Principles and Practice T. S. Rappaport, (2nd edition) Pearson
2 Modern Wireless Communications Haykin & Moher Pearson 2011 (Indian Edition).

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	INDUSTRIAL AUTOMATION	ECPE-503	3L-1T-2P	6

Course Contents:

UNIT - I

Industrial automation overview and data acquisition Architecture of Industrial Automation Systems. Measurement Systems Characteristics Data Acquisition Systems

UNIT -II

Control Generation Introduction to Automatic Control P-I-D Control Feed forward Control Ratio Control The branching operations based on conditions expression.

UNIT III

Sequential control and PLC Introduction to Sequence Control, PLC , RLL PLC Hardware Environment

UNIT IV

Industrial control application Hydraulic Control Systems Pneumatic Control Systems Energy Savings with Variable Speed Drives Introduction To CNC Machines.

Books.

1. Industrial Instrumentation ,Control and Automation S. Mukhopadhyay, S. Sen and A. K. Deb Jaico
2. Electric Motor Drives, Modelling, Analysis and Control R. Krishnan Prentice Hall India, 2002

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Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	MICROWAVE AND RADAR	ECPE-504	3L-1T-2P	6

Course Contents:

UNIT - I

Introduction to Microwaves History and applications of Microwaves Mathematical Model of Microwave Transmission-Microwave transmission modes, waveguides and transmission lines, Impedance Matching Microwave Network Analysis

UNIT - II

Passive and Active Microwave Devices Directional Coupler, Power Divider, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Microwave Tubes.

UNIT - III

Microwave Design Principles- Microwave Filter Design, Microwave Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas.

UNIT - IV

Microwave Measurements, Microwave Systems, Effect of Microwaves on human body.

Books.

1 Microwave Engineering D.M. Pozar Wiley; Fourth edition (2013)
2 Foundation for Microwave Engineering R.E. Collins Wiley; Second edition (2007)

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	RENEWABLE ENERGY TECHNOLOGIES	ECOE-505	3L-1T-0P	4

Course outcomes:

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

CO1 Understand present and future energy scenario of the world.

CO2 Understand various methods of solar energy harvesting.

CO3 Identify various wind energy systems.

CO4 Evaluate appropriate methods for Bio energy generations from various Bio wastes.

CO5 Identify suitable energy sources for a location.

Course Contents:

UNIT -I

Introduction: World Energy Use; Reserves of Energy Resources; Environmental Aspects of Energy Utilisation Renewable Energy Scenario in India and around the World Potentials Achievements/ Applications; Economics of renewable energy systems.

UNIT -II

Solar energy: Solar Radiation; Measurements of Solar Radiation; Flat Plate and Concentrating Collectors; Solar direct Thermal Applications; Solar thermal Power Generation Fundamentals of Solar Photo Voltaic Conversion; Solar Cells; Solar PV Power Generation; Solar PV Applications.

UNIT -III

Wind Energy: Wind Data and Energy Estimation; Types of Wind Energy Systems; Performance Site Selection; Details of Wind Turbine Generator; Safety and Environmental Aspects.

UNIT -IV

Bio-Energy: Biomass direct combustion; Biomass gasifiers; Biogas plants; Digesters; Ethanol production; Bio diesel; Cogeneration; Biomass Applications.

UNIT -V

Other Renewable Energy Sources: Tidal energy; Wave Energy; Open and Closed OTEC CyclesSmall Hydro-Geothermal Energy; Hydrogen and Storage; Fuel Cell Systems; Hybrid Systems.

Books:

• Non-Conventional Energy Sources, Rai. G.D., Khanna Publishers, New Delhi, 2011.
• Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN Spon Ltd., UK, 2006.
• Solar Energy, Sukhatme. S.P., Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press,
• Fundamental of Renewable Energy Sources, GN Tiwari and MK Ghoshal, Narosa, New Delhi,
• Renewable Energy and Environment-A Policy Analysis for India, NH Ravindranath, UK Rao,

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Semester-V

1. Built-in LED state control by push button sketch implementation.
2. Built-in LED blinking sketch implementation.
3. Built-in LED blinking by toggling states based on binary operation.
4. Built-in LED state control by user interface through serial port.
5. User interface for boolean operation and bit wise operation through serial port.
6. User interface for compounded operation through serial port.
7. Looping mechanism to check the state of pin and if change print its status on serial port.
8. Controlling multiple LEDs with a loop and an array.
9. Use a potentiometer to control the blinking of an LED.
10. Uses an analog output (PWM pin) to fade an LED.
11. Servo Motor Control using PWM.
12. Temperature sensor interfacing and sending its reading over serial port.
13. I2C light sensor interfacing and sending its reading over serial port.

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Semester-V

1. To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell.

2. To understand the path loss.

3. Understand the path loss with shadowing.

4. Understanding the Flat fading

5. Understanding the Frequency selective fading

6. Understanding the Multipath channel for the following objectives.
1. No Fading 2. Flat Fading. 3. Dispersive Fading

7. To simulate a dipole antenna (λ, λ/4, λ/2, 3λ/2) for a particular frequency using 4NEC2

8. Perform following experiments using CDMA trainer kit.
1. PSK modulation and demodulation experiment 2. Bit synchronization extraction experiment
3. Error correction encoding experiment

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Semester-V

1. Develop a data acquisition system using arduino.
2. Temperature control system using PID.
3. Level control system based on error feedback.
4. PLC programming using Relay ladder Logic for AND , OR XOR and NOR gate.
5. PLC, RLL programming using CASCADE method.
6. PLC timer, counter, registers and analog input/output functions.
7. Variable Speed drive of an induction motor.
8. PLC/ microcontroller based computer numerical control machine job completion

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	COMPUTER NETWORKING AND DATA COMMUNICATION	ECPC-601	3L-1T-2P	6

Course Contents:

UNIT -I

Introduction to data communication. Concept of analog and digital signals. Bandwidth. Network architecture. Basics of OSI and TCP/IP reference models. Types of Computer Networks Personal Area Network, Local Area Network, Metropolitan Area Network, Wide Area Network, Internetwork. Computer Network Topologies – Point to Point, Bus topology, Star topology, ring topology, mesh topology, tree topology, Daisy Chain, Hybrid Topology, Computer Network Model. Transmission media. Wired and wireless connectivity.

UNIT -II

Digital & Analog Transmission. Digital Transmission – Digital to Digital Conversion, Line Coding, Unipolar Encoding, Polar Encoding, Bipolar Encoding, block Coding Analog Transmission - Analog-to-Digital Conversion, Digital to analog Conversion, Analog to Analog Conversion. Sampling, Quantization, Encoding, Transmission Modes.

UNIT -III

Wireless Communication. Radio, Microwave, Infra-red, Light Transmission. Wireless Communication Standards, Characterization of the Wireless Channel, Receiver Techniques for Fading Dispersive Channels, Mobility Management in Wireless Networks, Mobile IP, Mobile Ad hoc Networks, Ad hoc Routing Protocols, Performance Analysis of DSR and CBRP, Cluster Techniques, Incremental Cluster Maintenance Scheme, Space time Coding for Wireless Communication.

UNIT -IV

Data Link Layer Technologies. Types of Network Routing, Network Layer Protocols. FDM, TDM and CDMA. Circuit and packet switching. Frame relay and ATM switching. ISDN. Local area network protocols. Fiber optic networks. Satellite networks. Data link layer design issues: its functions and protocols. Internet protocol. Routing algorithms. Congestion control algorithms. IP addressing schemes. Internetworking and sub-netting. Error Detection and Correction - Types of Errors, Detection, Correction Switching and Data link layer, data link control and protocols.

UNIT -V

Transmission Media & Transmission Control protocol. Magnetic Media, Twisted Pair Cable, Coaxial Cable, Power Lines, Fiber Optics. Protocol– Features, Header, Addressing, Connection Management, Error Control and Flow Control, Multiplexing, Congestion Control, Timer Management, Crash Recover.

Books.

1. Computer Networking A top down Approach: J.F.Kurose Pearson
2. Computer Networks and Internet D.E. Comer Pearson
3. Wireless Communications: Principles and Practice, 2nd edition T. Rappaport Prentice Hall,
4. Wireless Communication and Networking John W. Mark, Weihua Zhuang
5. Modelling and Analysis of Computer Communication Networks Jeremiah F. Hayes

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	ENTREPRENEURSHIP AND START-UPS	ECPC-602	3L-1T-0P	4

Course Contents:

UNIT -I

Introduction to Entrepreneurship and Start – Ups. Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation Types of Business Structures, Similarities/differences between entrepreneurs and managers.

UNIT -II

Business Ideas and their implementation. Discovering ideas and visualizing the business Activity map Business Plan

UNIT -III

Idea to Start-up. Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis

UNIT -IV

Management Company's Organization Structure, Recruitment and management of talent. Financial organization and management.

UNIT -V

Financing and Protection of Ideas. Financing methods available for start-ups in India Communication of Ideas to potential investors – Investor Pitch Patenting and Licenses.

UNIT -VI

Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy

Learning Outcome: Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business

5. Strategic Marketing Planning
6. New Product or Service Development
7. Business Plan Creation

Books.

1. The Startup Owner's Manual The Step-by-Step Guide for Building a Great Company
Steve Blank and Bob Dorf
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses
3. Demand: Creating What People Love Before They Know They Want It Adrian J. Slywotzky with Karl Weber Headline Book Publishing
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way.

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	MECHATRONICS	ECOE-603	3L-1T-0P	4

Course Contents:

UNIT -I

Introduction to Mechatronics: Mechatronics; Importance of Mechatronics; Systems: Measurement systems; Control systems and their types; Closed-loop control System; Automatic water level controller; Sequential controllers-washing machine
Measurement System terminology: Displacement, Position & Proximity Sensors; Velocity and Motion Sensors; Force Sensors; Fluid Pressure Sensors; Flow Sensors; Liquid Level Sensors; Temperature Sensors; Light Sensors; Selection of Sensors.

UNIT -II

Mechanical Actuation Systems: Types of motion; Freedom and constraints; Loading; Gear Trains; Pawl & Ratchet; Belt & Chain drives; Bearings: Selection, Ball & Roller bearings; Mechanical aspects of motor selection. **Electrical Actuation Systems**: Switches & Relays; Solenoids; D.C Motors; A.C.Motors; Stepper Motors: Specifications and Control of stepper motors; Servomotors: D.C Servomotor and A.C Servomotor. **Pneumatic & Hydraulic Systems:** Power supplies; DCV; PCV; Cylinders; Rotary actuators.

UNIT -III

Mathematical Model: Introduction to Mathematical model; Mechanical System building blocks; Electrical System building blocks; Fluid System building blocks; Thermal System building blocks. **System Model**: Engineering.Systems: Rotational, Translational Systems; Electro-Mechanical System; Hydro-Mechanical System. **Input/Output Systems:** Interfacing; Input/output ports; Interface requirements: Buffers, Handshaking, Polling and interrupts, Serial interfacing; Introduction to PIA; Serial communications interface Example of interfacing of a seven-segment display with a decoder
.

UNIT -IV

Programmable Logic Controller (PLC): Definition; Basic block diagram and structure of PLC; Input/Output processing; PLC Programming: Ladder diagram, its logic functions, Latching and Sequencing; PLC mnemonics; Timers; Internal relays and Counters; Shift registers; Master and Jump Controls; Data handling; Analog input/output; Selection of PLC.

UNIT -V

Design Examples & Advanced Applications in Mechatronics: Design process stages;

Traditional Vs Mechatronics designs; Possible design solutions: Timed switch, Wind-screen wiper motion, Bath room scale; Case studies of Mechatronics systems: A pick-and-place robot, Car park barrier, Car engine management system, Automatic Camera and Automatic Washing Machine only. **Sensors for Condition Monitoring Systems of Production Systems**: Examples of Monitoring methods: Vibration monitoring, Temperature monitoring, Wear behavior monitoring; Mechatronics control in automated manufacturing: Monitoring of Manufacturing processes, On-line quality monitoring, Model based systems, Hardware in-the-loop simulation, Supervisory control in manufacturing. inspection, Integration of heterogeneous systems.

Books:

1. Mechatronics – W. Bolton, Pearson Education India.
2. A Text Book on Mechatronics – R.K.Rajput, S.Chand& Co, New Delhi.
3. Mechatronics – M.D.Singh & Joshi, Prentice Hall of India.
4. Mechatronics – HMT, Tata McGraw Hill, New Delhi.
5. Mechatronics System – Devadas Shetty, PWS Publishing

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
DIPLOMA ELECTRONICS & TELECOMMUNICATION	PRODUCT DESIGN	ECOE-604	3L-1T-0P	4

Course outcomes:

At the end of the course, the student will be able to:
CO1 Understand the basic concepts of product design and development process.
CO2 Illustrate the methods to define the customer needs.
CO3 Describe an engineering design and development process.
CO4 Understand the intuitive and advanced methods used to develop and evaluate a concept.
CO5 Apply modelling and embodiment principles in product design and development process.

Course Contents:

UNIT -I

Definition of a product. Types of product; Levels of product; Product-market mix; New product development (NPD) process; Idea generation methods; Creativity; Creative attitude; Creative design process; Morphological analysis; Analysis of interconnected decision areas Brain storming.

UNIT -II

Product life cycle. The challenges of Product development; Product analysis Product characteristics Economic considerations Production and Marketing aspects; Characteristics of successful Product development; Phases of a generic product development process Customer need identification Product development practices and industry-product strategies.

UNIT -III

Product design. Design by evolution Design by innovation; Design by imitation Factors affecting product design Standards of performance and environmental factors Decision making and iteration Morphology of design (different phases) Role of aesthetics in design.

UNIT -IV

Introduction to optimization in design. Economic factors in design; Design for safety and reliability Role of computers in design Modeling and Simulation The role of models in engineering design Mathematical modeling Similitude and scale models Concurrent design Six sigma and design for six sigma Introduction to optimization in design Economic factors and financial feasibility in design Design for manufacturing; Rapid Prototyping (RP) Application of RP in product design Product Development versus Design.

UNIT -V

Design of simple products. dealing with various aspects of product development; Design starting from need till the manufacture of the product

Books:

1. Product Design and Development, Karl T. Ulrich and Steven D. Eppinger, Tata McGraw.
2. Engineering Design –George E. Dieter.
3. An Introduction to Engineering Design methods Vijay Gupta.
4. Merie Crawford : New Product management, McGraw-Hill Irwin.
5. Chitale A K and Gupta R C, "Product Design and Manufacturing. Prentice Hall of India,

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Semester-VI

COMPUTER NETWORKING AND DATA COMMUNICATION LAB

1. To study the different physical equipment used for networking.

2. Study the different internetworking devices in a computer network.

3. Study the working of basic networking commands To study PC to PC communication using parallel port.

5. Study of LAN in Star Topology.

6. Study of LAN in Bus Topology.

7. Study of LAN in Tree Topology.

8. Study and configuration of modem of computer.

9. Study of wireless communication.

10. Studying PC Communication using LAN.

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	BASIC MECHANICAL ENGINEERING	MEPC-331	3L-1T-0P	4

Course outcomes:

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

CO1 Understand basics of thermodynamics and components of a thermal power plant

CO2 Understand basics of heat transfer, refrigeration and internal combustion engines

CO3 Understand mechanism of thermal power plant and boiler operation

CO4 Identify engineering materials, their properties, manufacturing methods encountered in engineering practice.

CO5 Understand functions and operations of machine tools including milling, shaping, grinding and lathe machines

Course Content

UNIT-I

Introduction to Thermodynamics - Role of Thermodynamics in Engineering and Science, Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Elementary introduction to Zeroth, First and Second laws of thermodynamics, Heat and Work Interactions for various non-flow and flow processes; Concept of Heat Engine, Heat Pump & Refrigerator, Efficiency/ COP; Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, T-S and P-V Diagrams, Concept of Entropy (Definition only).

Unit-II

Heat transfer & Thermal Power Plant: Modes of Heat Transfer; Conduction: Composite Walls and Cylinders, Combined Conduction and Convection: Overall Heat Transfer Co-efficient, Simple Numerical Problems: Thermal Power Plant Layout; Rankine Cycle; Fire Tube and Water Tube boilers, Babcock & Wilcox, Cochran Boilers.

Unit-III

Steam Turbines: Impulse and Reaction Turbines; Condensers: Jet & Surface Condensers Cooling Towers; **Internal Combustion Engines and Refrigeration:** Otto, Diesel and Dual cycles; P-V and T-S Diagrams; IC Engines: 2 - Stroke and 4 - Stroke I.C. Engines, S.I. and C.I. Engines.

Unit-IV

Materials and Manufacturing Processes: Engineering Materials, Classification and their Properties; Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing, Gas Welding, Arc Welding, Soldering, and Brazing.

Unit-V

Machine Tools and Machining Processes: Machine Tools: Lathe Machine and types, Lathe Operations, Milling Machine and types, Milling Operations, Shaper and Planer Machines: Differences, Quick-Return Motion Mechanism, Drilling Machine: Operations, Grinding Machine: Operations

Program Learning Outcomes:

- To understand General Principles of Mechanical Engineering
- To understand laws of thermodynamics, thermal and thermodynamic Processes
- To understand working principles of Thermal Machines and Power Transmitting Devices
- To understand basic materials and manufacturing processes

Reference Books:

1. Basic Mechanical Engineering – M.P. Poonia & S.C. Sharma, Khanna Publishing House, Delhi
2. Elements of Mechanical Engineering – M. L. Mathur, F. S. Mehta and R. P. Tiwari, Jain Brothers, New Delhi
3. Engineering Heat Transfer – Gupta & Prakash, Nem Chand & Brothers, New Delhi
4. Workshop Technology (Vol. 1 and 2) – B. S. Raghuvanshi, Dhanpath Rai and Sons, New Delhi.
5. Basic Mechanical Engineering – J Benjamin

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	COMPUTER AIDED MACHINE DRAWING PRACTICE	MEPC-332	0L-0T-1P	1

Course outcomes:

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

CO1 Understand the representation of materials used in machine drawing

CO2 Draw the development of surfaces for sheet metal working applications.

CO3 Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded joints.

CO4 Construct an assembly drawing using part drawings of machine components

CO5 Represent tolerances and the levels of surface finish of machine elements.

'Course Content

Topics for practice:

1. Introduction to CAD software.
2. Drawing aids and editing commands.
3. Basic dimensioning, hatching, blocks and views.
4. Isometric drawing, printing and plotting
5. Machine Drawing practice using Auto CAD:

Detailed drawings of following machine parts are to be given to the students to assemble and draw the sectional or plain elevations, plans and side views with dimensioning and bill of materials using cad software (12 exrcises).

1) Sleeve & Cotter Joint
2) Spigot & Cotter Joint
3) Knuckle Joint
4) Stuffing Box
5) Screw Jack
6) Foot Step Bearing
7) Universal Coupling
8) Plummer Block
9) Simple Eccentric
10) Machine Vice
11) Connecting Rod
12) Protected Type Flanged Coupling.

Program Learning Outcomes:

- To use computer aided drafting,
- To prepare geometrical model of various machine elements
- To draw the different views of machine elements
- To interpret the drawing in engineering field and illustrate three dimensional objects

Reference Books:

1. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 2003.
2. Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Machine Drawing, Tata McGraw Hill Book Company, New Delhi, 2000.
3. Kannaih, P., Production Drawing, New Age International , 2009

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	MATERIAL SCIENCE & ENGINEERING	MEPC-333	3L-1T-0P	4

Course outcomes

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

CO1 Explain about crystal structures and atomic bonds.

CO2 Describe about classification of ferrous metals and their properties.

CO3 Explain about non-ferrous metals, cutting tool materials and composites along with their properties.

CO4 Describe about the various metallic failures and knowledge in testing of materials.

CO5 Explain the principle of corrosion, their types and its prevention methods along with the various surface engineering processes.

Course Content

UNIT-I

Crystal structures and Bonds: Unit cell and space lattice: Crystal system: The seven basic crystal systems; Crystal structure for metallic elements: BCC, FCC and HCP; Coordination number for Simple Cubic, BCC and FCC; Atomic radius: definition, atomic radius for Simple Cubic, BCC and FCC; Atomic Packing Factor for Simple Cubic, BCC, FCC and HCP; Simple problems on finding number of atoms for a unit cell.

Bonds in solids: Classification - primary or chemical bond, secondary or molecular bond; Types of primary bonds: Ionic, Covalent and Metallic Bonds; Types of secondary bonds: Dispersion bond, Dipole bond and Hydrogen bond.

Unit-II

Phase diagrams, Ferrous metals and its Alloys: Isomorphs, eutectic and eutectoid systems; Iron-Carbon binary diagram; Iron and Carbon Steels; flow sheet for production of iron and steel; Iron ores – Pig iron: classification, composition and effects of impurities on iron; Cast Iron: classification, composition, properties and uses; Wrought Iron: properties, uses/applications of wrought Iron; comparison of cast iron, wrought iron and mild steel and high carbon steel; standard commercial grades of steel as per BIS and AISI; Alloy Steels – purpose of alloying; effects of alloying elements – Important alloy steels: Silicon steel, High Speed Steel (HSS), heat resisting steel, spring steel, Stainless Steel (SS): types of SS, applications of SS – magnet steel – composition, properties and uses

Unit-III

Non-ferrous metals and its Alloys: Properties and uses of aluminium, copper, tin, lead, zinc, magnesium and nickel; Copper alloys: Brasses, bronzes – composition, properties and uses; Aluminium alloys: Duralumin, hindalium, magnelium – composition, properties and uses; Nickel alloys: Inconel, monel, nic Perome – composition, properties and uses. Anti-friction/Bearing alloys: Various types of bearing bronzes - Standard commercial grades as per BIS/ASME.

Unit-IV

Failure analysis & Testing of Materials: Introduction to failure analysis; Fracture: ductile fracture, brittle fracture; cleavage; notch sensitivity; fatigue; endurance limit; characteristics of fatigue fracture; variables affecting fatigue life; creep; creep curve; creep fracture; Destructive testing: Tensile testing; compression testing; Hardness testing: Brinell, Rockwell; bend test; torsion test; fatigue test; creep test. Non-destructive testing: Visual Inspection; magnetic particle inspection; liquid penetrant test; ultrasonic inspection; radiography.

Unit-V

Corrosion & Surface Engineering: Nature of corrosion and its causes; Electrochemical reactions; Electrolytes; Factors affecting corrosion: Environment, Material properties and physical conditions; Types of corrosion; Corrosion control: Material selection, environment control and design; Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishing of surfaces; Organic coatings; Electroplating and Special metallic plating; Electro polishing and photo- etching ;– Conversion coatings: Oxide, phosphate and chromate coatings; Thin film coatings: PVD and CVD; Surface analysis; Hard-facing, thermal spraying and high-energy processes; Process/material selection. Pollution norms for treating effluents as per standards.

Program Learning Outcomes:

- To understand crystal structures and atomic bonds.
- To understand the properties of different types of ferrous metals and alloys.
- To understand the properties of different types of non-ferrous metals and alloys.
- To understand various metallic failures and acquire the knowledge of testing of materials.
- To understand the concept of corrosion and its prevention.

Reference Books:

1. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpath Rai and Sons, New Delhi. 2003.
2. Material Science & Engineering – R.K. Rajput, S.K. Kataria & Sons, New Delhi, 2004.

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DIPLOMA (MECHANICAL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	FLUID MECHANICS & HYDRAULIC MACHINERY	MEPC-334	3L-1T-2P	6

Course outcomes

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

CO1 Measure various properties such as pressure, velocity, flow rate using various instruments.
CO2 Calculate different parameters such as co-efficient of friction, power, efficiency etc of various Systems.
CO3 Describe the construction and working of turbines and pumps.
CO4 Test the performance of turbines and pumps.
CO5 Plot characteristics curves of turbines and pumps.

Course Content

UNIT-I

Properties of fluid: Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility.

Fluid Pressure & Pressure Measurement: Fluid pressure, Pressure head, Pressure intensity, Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure, Simple and differential manometers, Bourdan pressure gauge, Concept of Total pressure on immersed bodies, center of pressure, Simple problems on Manometers.

Unit-II

Fluid Flow: Types of fluid flows, Path line and Stream line, Continuity equation, Bernoulli's theorem, Principle of operation of Venturimeter, Orifice meter and Pitot tube, Derivations for discharge, coefficient of discharge and numerical problems.

Flow Through Pipes: Laminar and turbulent flows; Darcy's equation and Chezy's equation for frictional losses, Minor losses in pipes, Hydraulic gradient and total gradient line, Numerical problems to estimate major and minor losses

Unit-III

Impact of jets: Impact of jet on fixed vertical, moving vertical flat plates, Impact of jet on curved vanes with special reference to turbines & pumps, Simple Numericals on work done and efficiency.

Unit-IV

Hydraulic Turbines: Layout of hydroelectric power plant, Features of Hydroelectric power plant, Classification of hydraulic turbines, Selection of turbine on the basis of head and discharge available, Construction and working principle of Pelton wheel, Francis and Kaplan turbines, Draft tubes – types and construction, Concept of cavitation in turbines, Calculation of Work done, Power, efficiency of turbines, Unit quantities and simple numericals.

Unit-V

Centrifugal Pumps: Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency. Numericals on calculations of overall efficiency and power required to drive pumps.

Reciprocating Pumps: Construction, working principle and applications of single and double acting reciprocating pumps, Concept of Slip, Negative slip, Cavitation and separation.

Program Learning Outcomes:

- To understand fluid flow & related machinery for power generation, water supply and irrigation.
- To Select and use appropriate flow measuring device.
- To Select and use appropriate pressure measuring device.
- To understand and analyze the performance of pumps and turbines.

Reference Books:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi
2. Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, New Delhi.
3. Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N. and Seth S.M., Standard Book House. New Delhi
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons, New Delhi
6. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi

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DIPLOMA (MECHANICAL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	MANUFACTURING ENGINEERING	MEPC-335	3L-1T-2P	6

Course outcomes:

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

CO1 Know and identify basic manufacturing processes for manufacturing different components.

CO2 Operate & control different machines and equipments.

CO3 Produce jobs as per specified dimensions and inspect the job for specified dimensions.

CO4 Select the specific manufacturing process for getting the desired type of output.

CO5 Adopt safety practices while working on various machines.

Course Content

UNIT-I

Cutting Fluids & Lubricants: Introduction; Types of cutting fluids, Fluids and coolants required in turning, drilling, shaping, sawing & broaching; Selection of cutting fluids, methods of application of cutting fluid; Classification of lubricants (solid, liquid, gaseous), Properties and applications of lubricants.

Lathe Operations: Types of lathes – light duty, Medium duty and heavy duty geared lathe, CNC lathe; Specifications; Basic parts and their functions; Operations and tools – Turning, parting off, Knurling, facing, Boring, drilling, threading, step turning, taper turning.

Unit-II

Broaching Machines: Introduction to broaching; Types of broaching machines – Horizontal type (Single ram & duplex ram), Vertical type, Pull up, pull down, and push down; Elements of broach tool; broach teeth details; Nomenclature; Tool materials.

Drilling: Classification; Basic parts and their functions; Radial drilling machine; Types of operations; Specifications of drilling machine; Types of drills and reamers.

Unit-III

Welding: Classification; Gas welding techniques; Types of welding flames; Arc Welding – Principle, Equipment, Applications; Shielded metal arc welding; Submerged arc welding; TIG / MIG welding; Resistance welding - Spot welding, Seam welding, Projection welding; Welding defects; Brazing and soldering: Types, Principles, Applications.

Milling: Introduction; Types of milling machines: plain, Universal, vertical; constructional details – specifications; Milling operations: simple, compound and differential indexing; Milling cutters – types; Nomenclature of teeth; Teeth materials; Tool signature of milling cutter; Tool & work holding devices.

Unit-IV

Gear Making: Manufacture of gears – by Casting, Moulding, Stamping, Coining Extruding, Rolling, Machining; Gear generating methods: Gear Shaping with pinion cutter & rack cutter; Gear hobbing; Description of gear hob; Operation of gear hobbing machine; Gear finishing processes; Gear materials and specification; Heat treatment processes applied to gears.

Press working: Types of presses and Specifications, Press working operations - Cutting, bending, drawing, punching, blanking, notching, lancing; Die set components- punch and die shoe, guide pin, bolster plate, stripper, stock guide, feed stock, pilot; Punch and die clearances for blanking and piercing, effect of clearance.

Unit-V

Grinding and finishing processes: Principles of metal removal by Grinding; Abrasives – Natural & Artificial; Bonds and binding processes: Vitrified, silicate, shellac, rubber, bakelite; Factors affecting the selection of grind wheels: size and shape of wheel, kind of abrasive, grain size, grade and strength of bond, structure of grain, spacing, kinds of bind material; Standard marking systems: Meaning of letters & numbers sequence of marking, Grades of letters; Grinding machines classification: Cylindrical, Surface, Tool & Cutter grinding machines; Construction details; Principle of centre less grinding; Advantages & limitations of centre less grinding; Finishing by grinding: Honing, Lapping, Super finishing; Electroplating: Basic principles, Plating metals, applications; Hot dipping: Galvanizing, Tin coating, Parkerising, Anodizing; Metal spraying: wire process, powder process and applications; Organic coatings: Oil base Paint, Lacquer base, Enamels, Bituminous paints, rubber base coating; Finishing specifications.

Program Learning Outcomes:

- To understand the importance of cutting fluids & lubricants in machining.
- To study various types of basic production processes. To select, operate and control the appropriate processes for specific applications.
- To understand the concept of gear making and list various gear materials.
- To understand the importance of press tools and understand various die operations.
- To understand Grinding and finishing processes.

Reference Books:

1. Manufacturing technology – P N Rao, Tata McGraw-Hill Publications
2. Elements of workshop Technology (Volume I & II) – S. K. Hajra Chaudary, Bose & Roy, Media Promoters and Publishers Limited.
3. Production Technology (Volume I & II) – O. P. Khanna & Lal, Dhanpat Rai Publications Manufacturing Technology, Metal Cutting & Machine tools– P. N. Rao, Tata McGraw-Hill Publications

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DIPLOMA (MECHANICAL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester-III

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	THERMAL ENGINEERING – I	MEPC-336	3L-1T-2P	6

Course outcomes:

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

CO1 Know various sources of Energy and their applications.

CO2 Classify I.C. engines and understand their working and constructional features.

CO3 Draw the energy flow diagram of an I.C. engine and evaluate its performance.

CO4 Describe the constructional features of air compressor and working of different air compressors.

CO5 Know the applications of refrigeration and Classify air-conditioning systems.

Course Content

UNIT-I

Sources of Energy: Brief description of energy Sources: Classification of energy sources - Renewable, Non-Renewable; Fossil fuels, including CNG, LPG; Solar Energy: Flat plate and concentrating collectors & its applications (Solar Water Heater, Photovoltaic Cell, Solar Distillation); Wind Energy; Tidal Energy; Ocean Thermal Energy; Geothermal Energy; Biogas, Biomass, Bio-diesel; Hydraulic Energy, Nuclear Energy; Fuel cell.

Unit-II

Internal Combustion Engines: Assumptions made in air standard cycle analysis; Brief description of Carnot, Otto and Diesel cycles with P-V and T-S diagrams; Internal and external combustion engines; advantages of I.C. engines over external combustion engines; classification of I.C. engines; neat sketch of I.C. engine indicating component parts; Function of each part and materials used for the component parts - Cylinder, crank case, crank pin, crank, crank shaft, connecting rod, wrist pin, piston, cooling pins cylinder heads, exhaust valve, inlet valve; Working of four-stroke and two-stroke petrol and diesel engines; Comparison of two stroke and four stroke engines; Comparison of C.I. and S.I. engines; Valve timing and port timing diagrams for four stroke and two stroke engines.

Unit-III

I.C. Engine Systems: Fuel system of Petrol engines; Principle of operation of simple and Zenith carburetors; Fuel system of Diesel engines; Types of injectors and fuel pumps; Cooling system - air cooling, water cooling system with thermo siphon method of circulation and water cooling system with radiator and forced circulation (description with line diagram). Comparison of air cooling and water cooling system; Ignition systems – Battery coil ignition and magneto ignition (description and working). Comparison of two systems; Types of lubricating systems used in I.C. engines with line diagram; Types of governing of I.C. engines – hit and miss method, quantitative method, Qualitative method and combination methods of governing; their applications; Objective of super charging.

Unit-IV

Performance of I.C. Engines: Brake power; Indicated power; Frictional power; Brake and Indicated mean effective pressures; Brake and Indicated thermal efficiencies; Mechanical efficiency; Relative efficiency; Performance test; Morse test; Heat balance sheet; Methods of determination of B,P., I.P. and F.P.; Simple numerical problems on performance of I.C. engines.

Unit-V

Air Compressors: Functions of air compressor; Uses of compressed air; Types of air compressors; Single stage reciprocating air compressor - its construction and working (with line diagram) using P-V diagram; Multi stage compressors – Advantages over single stage compressors; Rotary compressors: Centrifugal compressor, axial flow type compressor and vane type compressors.

Refrigeration & Air-conditioning: Refrigeration; Refrigerant; COP; Air Refrigeration system: components, working & applications; Vapour Compression system: components, working & applications; Air conditioning; Classification of Air-conditioning systems; Comfort and Industrial Air-Conditioning; Window Air-Conditioner; Summer Air-Conditioning system, Winter Air-Conditioning system, Year-round Air-Conditioning system.

Program Learning Outcomes:

- To give a good understanding of and thorough insight into all important aspects of thermal systems, energy control and the general issue of energy.
- To understand the principles & working of various power producing & power absorbing devices.
- To study, analyze and evaluate the operation and the performance of I.C. engines, compressors and refrigerators, to apply pinch technology and to critically analyze and describe the global behavior of integrated thermal systems.

Reference Books:

1. Thermal Engineering – R. K. Rajput,8th Edition, Laxmi publications Pvt Ltd, New Delhi.
2. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai.
3. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi.

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	**MEASUREMENTS & METROLOGY**	**MEPC-431**	**3L-1T-2P**	**6**

Course outcomes

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

CO1 Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in Metrology.

CO2 Distinguish between various types of errors.

CO3 Understand the principle of operation of an instrument and select suitable measuring device for a particular application.

CO4 Appreciate the concept of calibration of an instrument.

CO5 Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.

Course Content

UNIT-I

Introduction to measurements: Definition of measurement; Significance of measurement; Methods of measurements: Direct & Indirect; Generalized measuring system; Standards of measurements: Primary & Secondary; Factors influencing selection of measuring instruments; Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic and Random error. **Measuring instruments:** Introduction; Thread measurements: Thread gauge micrometre; Angle measurements: Bevel protractor, Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators, Types of comparators; Surface finish: Definition, Terminology of surface finish, Talysurf surface roughness tester; Co-ordinating measuring machine.

Unit-II

Transducers and Strain gauges: Introduction; Transducers: Characteristics, classification of transducers, two coil self-inductance transducer, Piezoelectric transducer; Strain Measurements: Strain gauge, Classification, mounting of strain gauges, Strain gauge rosettes-two and three elements. **Measurement of force, torque, and pressure:** Introduction; Force measurement: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Eddy current, Hydraulic dynamometer; Pressure measurement: Mcloed gauge.

Unit-III

Applied mechanical measurements: Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Displacement measurement: Linear variable Differential transformers (LVDT); Flow measurement: Rotometers, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer. **Miscellaneous measurements**: Humidity measurement: hair hygrometer; Density measurement: hydrometer; Liquid level measurement: sight glass, Float gauge; Biomedical measurement: Sphygmomonometer.

Unit-IV

Limits, Fits & Tolerances: Concept of Limits, Fits, and Tolerances; Selective Assembly; Interchangeability;Hole And Shaft Basis System; Taylor's Principle; Design of Plug; Ring Gauges; IS 919-1993 (Limits, Fits & Tolerances, Gauges} IS 3477-1973; concept of multi gauging and inspection. **Angular Measurement**: Concept; Instruments For Angular Measurements; Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level; Principle of Working of Clinometers; Angle Gauges (With Numerical on Setting of Angle Gauges). **Screw thread Measurements**: ISO grade and fits of thread; Errors in threads; Pitch errors; Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch; Two wire method; Thread gauge micrometer; Working principle of floating carriage dial micrometer.

Unit-V

Gear Measurement and Testing: Analytical and functional inspection; Rolling test; Measurement of tooth thickness (constant chord method); Gear tooth vernier; Errors in gears such as backlash, runout, composite. **Machine tool testing**: Parallelism; Straightness; Squareness; Coaxiallity; roundness; run out; alignment testing of machine tools as per IS standard procedure.

Program Learning Outcomes

- To study advances in technology, measurement techniques, types of instrumentation devices, innovations, refinements.
- To study the principles of instrumentation, transducers & measurement of non-electrical parameters like temperature, pressure, flow, speed, force and stress.

Reference Books:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed.,2006.
2. Metrology & Measurement – Anand K Bewoor,Vinay kulakarni, Tata McGraw Hill, New Delhi, 2009
3. Principles of Industrial instrumentation and control systems – Channakesava. R. Alavala, DELMAR cenage learning, 2009.

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	STRENGTH OF MATERIALS	MEPC-432	3L-1T-0P	4

Course outcomes:

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

CO1 Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces.

CO2 Calculate thermal stresses, in bodies of uniform section and composite sections.

CO3 Define resilience, proof – resilience and modulus of resilience and obtain expressions for instantaneous stress developed in bodies subjected to different loads.

CO4 Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams of for UDL and Point loads.

CO5 Calculate the safe load, safe span and dimensions of cross section.

CO6 Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring.

Course Content

UNIT-I

Simple Stresses and Strains: Types of forces; Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagram for M.S. and C.I. specimens; Significance of factor of safety; Relation between elastic constants; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite sections; Related numerical problems on the above topics. **Strain Energy:** Strain energy or resilience, proof resilience and modulus of resilience; Derivation of strain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/ shock load; Related numerical problems.

Unit-II

Shear Force & Bending Moment Diagrams: Types of beams with examples: a) Cantilever beam, b) Simply supported beam, c) Over hanging beam, d) Continuous beam, e) Fixed beam; Types of Loads – Point load, UDL and UVL; Definition and explanation of shear force and bending moment; Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Over hanging beam with point loads, at the centre and at free ends, f) Over hanging beam with UDL throughout, g) Combination of point and UDL for the above; Related numerical problems.

Unit-III

Theory of Simple Bending and Deflection of Beams: Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending; Bending Equation $M/I = \sigma/Y = E/R$ with derivation; Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross-section; Definition and explanation of deflection as applied to beams; Deflection formulae without proof for

cantilever and simply supported beams with point load and UDL only (Standard cases only); Related numerical problems.

Unit-IV

Torsion in Shafts and Springs: Definition and function of shaft; Calculation of polar M.I. for solid and hollow shafts; Assumptions in simple torsion; Derivation of the equation $T/J=f_s/R=G\theta/L$; Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts; Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

Unit-V

Thin Cylindrical Shells: Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell; Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells; Related numerical Problems for safe thickness and safe working pressure.

Program Learning Outcomes

- To understand the concept of Simple Stresses and Strains.
- To understand the concept of Strain Energy.
- To understand the concept of Shear Force and Bending Moment Diagrams.
- To understand the concept of Theory of Simple Bending and Deflection of Beams.
- To understand the concept of Torsion in Shafts and Springs.
- To understand the concept of Thin Cylindrical Shells.

Reference Books:

1. Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi
2. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
3. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	**THERMAL ENGINEERING – II**	**MEPC-433**	**3L-1T-2P**	**6**

Course outcomes:

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

CO1 Explain the working cycle of gas turbines, and the working of Jet and Rocket Engines apart from identifying the fuels used for Jet and Rocket propulsion.
CO2 Compute the work done, enthalpy, internal energy and entropy of steam at given conditions using steam tables and Mollier chart.
CO3 Distinguish between water tube and fire-tube boilers and explain the function all the mountings and accessories.
CO4 Calculate Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.
CO5 State the necessity of governing and compounding of a turbine.
CO6 Explain the principle of working of a steam turbine and distinguish between the impulse turbines and reaction turbines.

Course Content

UNIT-I

Gas Turbines: Air-standard Brayton cycle; Description with p-v and T-S diagrams; Gas turbines Classification: open cycle gas turbines and closed cycle gas turbines; comparison of gas turbine with reciprocating I.C. engines and steam turbines. Applications and limitations of gas turbines; General lay-out of Open cycle constant pressure gas turbine; P-V and T-S diagrams and working; General lay-out of Closed cycle gas turbine; P-V and T-S diagrams and working.

Jet Propulsion: Principle of jet propulsion; Fuels used for jet propulsion; Applications of jet propulsion; Working of a turbojet engine; Principle of Ram effect; Working of a Ram jet engine; Principle of Rocket propulsion; Working principle of a rocket engine; Applications of rocket propulsion; Comparison of jet and rocket propulsions.

Unit-II

Properties of Steam: Formation of steam under constant pressure; Industrial uses of steam; Basic definitions: saturated liquid line, saturated vapour line, liquid region, vapour region, wet region, superheat region, critical point, saturated liquid, saturated vapour, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat; Determination of enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart for the following processes: Isochoric process, Isobaric process, Hyperbolic process, Isothermal process, Isentropic process, Throttling process, Polytropic process; Simple direct problems on the above using tables and charts; Steam calorimeters: Separating, throttling, Combined Separating and throttling calorimeters – problems.

Unit-III

Steam Generators: Function and use of steam boilers; Classification of steam boilers with examples; Brief explanation with line sketches of Cochran, Babcock and Wilcox Boilers; Comparison of water tube and fire tube boilers; Description with line sketches and working of modern high pressure boilers Lamont and Benson boilers; Boiler mountings: Pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve, (dead weight type, spring loaded type, high pressure and low water safety alarm); Boiler accessories: feed pump, economiser, super heater and air pre-heater; Study of steam traps & separators; Explanation of the terms: Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency; Formula for the above terms without proof; Simple direct problems on the above; Draught systems (Natural, forced & induced).

Unit-IV

Steam Nozzles: Flow of steam through nozzle; Velocity of steam at the exit of nozzle in terms of heat drop using analytical method and Mollier chart; Discharge of steam through nozzles; Critical pressure ratio; Methods of calculation of cross-sectional areas at throat and exit for maximum discharge; Effect of friction in nozzles and Super saturated flow in nozzles; Working steam jet injector; Simple numerical problems.

Unit-V

Steam Turbines: Classification of steam turbines with examples; Difference between impulse & reaction turbines; Principle of working of a simple De-lavel turbine with line diagrams- Velocity diagrams; Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency; Methods of reducing rotor speed; compounding for velocity, for pressure or both pressure and velocity; Working principle with line diagram of a Parson's Reaction turbine–velocity diagrams; Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height. Bleeding, re-heating and re-heating factors (Problems omitted); Governing of steam turbines: Throttle, By-pass & Nozzle control governing.

Program Learning Outcomes

- To understand the working and applications of Gas turbines & Jet Propulsion.
- To understand the methods of computing various properties of steam.
- To understand the working of various Steam Boilers, functions of various accessories and mountings of boilers.
- To understand the Working of Steam Nozzles and Steam turbines.
- To understand the necessity of compounding and governing of a turbine.

Reference Books:

1. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai & Publication, New Delhi
2. Thermal Engineering – R.K. Rajput, Laxmi Publication New Delhi

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	**TOOL ENGINEERING**	**MEPE-434**	**3L-1T-0P**	**4**

Course outcomes:

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

CO1 Understand concepts, principles and procedures of tool engineering

CO2 Classify and explain various tools and tool operations

CO3 Select proper tool and a die for a given manufacturing operation to achieve highest productivity

CO4 Estimate tool wear and tool life

Course Content

UNIT-I

Metal Cutting: Mechanics of Metal cutting; requirements of tools; cutting forces; types of chips; chip thickness ratio; shear angle ; simple numerical only; types of metal cutting process; orthogonal; oblique and form cutting; **Cutting fluids:** types; characteristics and applications. **Tool wear:** Types of wear; Tool life; Tool life equations.

Unit-II

Machinability: definition; factors affecting machinability; machinability index. **Tool materials**: Types; characteristics; applications; Heat treatment of tool steels; Specification of carbide tips; Types of ceramic coatings. **Cutting Tool Geometry**: Single point cutting tool; drills; reamers; milling; cutters.

Unit-III

Types of dies and construction: Simple Die; Compound Die; Progressive Die; Combination Die.

Punch & Die mountings: pilots; strippers; misfeed detectors; Pressure Pads; Knock outs; stock guide; Feed-Stop; guide bush; guide pins.

Unit-IV

Die Design Fundamentals: Die Operations; blanking; piercing; shearing; cropping; notching; lancing; coining; embossing; stamping; curling; drawing; bending; forming; Die set; Die shoe; Die area; Calculation of clearances on die and punch for blanking and piercing dies; Strip layout; Calculation of material utilization factor.

Unit-V

Forming Dies: Bending methods; Bending Dies; bend allowance; spring back; spanking; bending pressure; pressure pads; development of blank length. **Drawing:** operations; Metal flow during drawing; Calculation of Drawing blank size; variables affecting metal flow during drawing; single action and double action dies; combination dies. **Fundamentals of other Tools:** Constructional features of - Pressure Die casting dies; metal extrusion dies; injection molding dies; forging dies; plastic extrusion dies.

Program Learning Outcomes

- To understand metal cutting and forming process and factors affecting machinability.
- To develop knowledge of tools, dies and tool materials.
- To understand processes for increased productivity and quality.

Reference Books:

1. Tool Design - Donaldson Anglin, Tata McGraw Hill.
2. Production Technology- H.M.T.Jain, Tata McGraw Hill.
3. A Text Book of Production engineering – P.C. Sharma, S.Chand & Co.
4. Production Technology, R.K.Jain, Khanna Publishers.

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-IV

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	COMPUTER INTEGRATED MANUFACTURING	MEPE-435	3L-1T-0P	4

Course outcomes:

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

CO1 Understand the formulation of Liner Programming

CO2 Analyze and Convert the problem into a mathematical model.

CO3 Understand the dual LP and Primal Dual relation problems

CO4 Understand and implement the transportation problems at workplace

CO5 Solve the assignment problems, solving linear programming approach using software

Course Content

UNIT-I

Concept of Computer Integrated Manufacturing (CIM); Basic components of CIM; Distributed database system; distributed communication system, computer networks for manufacturing; future automated factory; social and economic factors

Unit-II

Computer Aided Design (CAD): CAD hardware and software; product modelling, automatic drafting; engineering analysis; FEM design review and evaluation; Group Technology Centre.

Unit-III

Computer Aided Manufacturing (CAM), Computer assisted NC part programming; Computer assisted robot programming; computer aided process planning (CAPP); computer aided material requirements planning (MRP)

Unit-IV

Computer aided production scheduling; computer aided inspection planning; computer aided inventory planning, Flexible manufacturing system (FMS); concept of flexible manufacturing.

Unit-V

Integrating NC machines, robots, AGVs, and other NC equipment; Computer aided quality control; business functions, computer aided forecasting; office automation.

Program Learning Outcomes

- To understand General Principles of Mechanical Engineering.
- To understand laws of thermodynamics, thermal and thermodynamic Processes
- To understand working principles of power developing and power absorbing devices
- To understand basic materials and manufacturing processes

Reference Books:

1. CAD, CAM, CIM - P.Radhakrishnan and S.Subramanyan, New Age International Publishers.
2. Computer Integrated Manufacturing - Paul G. Rankey, Prentice Hall.

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	ADVANCED MANUFACTURING PROCESSES	MEPC-531	3L-1T-0P	4

Course outcomes:

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

CO1 Understand various classifications of manufacturing processes

CO2 Understand working principles of mechanical energy based processes

CO3 Understand working principles of electrical energy based processes

CO4 Understand working principles of chemical and electro-chemical energy based processes

CO5 Understand working principles of thermal energy based processes

Course Content

UNIT-I

Jigs & Fixtures: Definition of jig; Types of jigs: Leaf jig, Box and Handle jig, Template jig, Plate jig, Indexing jig, Universal jig, Vice jigs - constructional details of the above jigs; General consideration in the design of drill jigs; Drill bush; Types of fixtures: Vice fixtures, Milling fixtures, Boring fixtures, Grinding fixtures - constructional details of the above fixtures; Basic principles of location; Locating methods and devices; Basic principles of the clamping; Types of clamps: Strap clamps, Cam clamps, Screw clamps, Toggle clamps, Hydraulic and Pneumatic clamps.

Unit-II

Jig Boring: Introduction; Jig boring on vertical milling machine; Types jig boring machines: Open front machine, Cross rail type machine - constructional details & their working; System of location of holes. **Plastic Processing:** Processing of plastics; Moulding processes: Injection moulding, Compression moulding, Transfer moulding; Extruding; Casting; Calendering; Fabrication methods-Sheet forming, Blow moulding, Laminating plastics (sheets, rods & tubes), Reinforcing; Applications of Plastics.

Unit-III

Modern Machining Processes: Introduction – comparison with traditional machining; Ultrasonic Machining: principle, Description of equipment, applications; Electric Discharge Machining: Principle, Description of equipment, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, applications; Wire cut EDM: Principle, Description of equipment, Controlling parameters; applications; Abrasive Jet Machining: principle, description of equipment, application; Laser Beam Machining: principle, description of equipment, application; Electro Chemical Machining: description of equipment, application.

Unit-IV

CNC Milling Machines: Vertical and horizontal machining center: Constructional features,Axis identification, Electronic control system. Automatic tool changer and tool magazine. CNC programming: Preparatory functions (G code), miscellaneous functions (M code), Part programming including subroutines and canned cycles. Principles of computer aided part programming. **Machine Tool Automation:** Introduction and Need; (A) Single

spindle automates, transfer lines. (B) Elements of control system, Limit switches, Proximity switches, Block diagram for feedback and servo control system, Introduction to PLC, Block diagram of PLC.

Unit-V

Special Purpose Machines (SPM): Concept, General elements of SPM, Productivity improvement by SPM, Principles of SPM design. **Maintenance of Machine Tools:** Types of maintenance, Repair cycle analysis, Repair complexity, Maintenance manual, Maintenance records, Housekeeping. Introduction to Total Productive Maintenance (TPM).

Program Learning Outcomes

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications.

Reference Books:

1. Production Technology – HMT, Banglore, Tata Mc-Graw Hill
2. CNC machines – Pabla B. S. & M. Adithan, New Age international limited.
3. Non conventional Machining – P. K. Mistra, Narvasa Publishining House
4. Manufacturing Processes – Begman & Amsted, John Willey and Sons.

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	**THEORY OF MACHINES & MECHANISMS**	**MEPC-532**	**3L-1T-0P**	**4**

Course outcomes:

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

CO1 Know different machine elements and mechanisms.

CO2 Understand Kinematics and Dynamics of different machines and mechanisms.

CO3 Select Suitable Drives and Mechanisms for a particular application.

CO4 Appreciate concept of balancing and Vibration.

CO5 Develop ability to come up with innovative ideas.

CO6 Understand different types of cams and their motions and also draw cam profiles for various motions

Course Content

UNIT- I

Cams and Followers: Concept; Definition and application of Cams and Followers; Classification of Cams and Followers; Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation; Drawing of profile of radial cam with knife-edge and roller follower with and without offset with reciprocating motion (graphical method).

UNIT –II

Power Transmission: Types of Drives – Belt, Chain, Rope, Gear drives & their comparison; Belt Drives - flat belt, V– belt & its applications; Material for flat and V-belt; Angle of lap, Belt length. Slip and Creep; Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission (Simple numericals); Chain Drives – Advantages & Disadvantages; Selection of Chain & Sprocket wheels; Methods of lubrication; Gear Drives – Spur gear terminology; Types of gears and gear trains, their selection for different applications; Train value & Velocity ratio for compound, reverted and simple epicyclic gear train; Methods of lubrication; Law of gearing; Rope Drives – Types, applications, advantages & limitations of Steel ropes.

UNIT- III

Flywheel and Governors: Flywheel - Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine (no Numericals); Coefficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance; Governors - Types and explanation with neat sketches (Centrifugal, Watt and Porter); Concept, function and applications & Terminology of Governors; Comparison between Flywheel and Governor.

UNIT -IV

Brakes, Dynamometers, Clutches & Bearings: Function of brakes and dynamometers; Types of brakes and Dynamometers; Comparison between brakes and dynamometers; Construction and working of i) shoe brake, ii) Band Brake, iii) Internal expanding shoe brake iv) Disc Brake; Concept of Self Locking & Self energizing brakes; Numerical problems to find braking force and braking torque for shoe & band brakes; Construction and working of i) Rope Brake Dynamometer, ii) Hydraulic Dynamometer, iii) Eddy current Dynamometers; Clutches- Uniform pressure and Uniform Wear theories; Function of Clutch and its application; Construction and working of i) Single plate clutch, ii) Multiplate clutch, iii) Centrifugal Clutch iv) Cone clutch and v) Diaphragm clutch. (Simple numericals on single and Multiplate clutch); Bearings – i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot. Torque & power lost in friction (no derivation). Simple numerical.

UNIT- V

Balancing & Vibrations: Concept of balancing; Balancing of single rotating mass; Graphical method for balancing of several masses revolving in same plane; Concept and terminology used in vibrations, Causes of vibrations in machines; their harmful effects and remedies.

Program Learning Outcomes

- To understand different types of cams and their motions and also to draw cam profiles for various motions.
- To understand the mechanism of various types of drives available for transmission of power.
- To understand the design of Brakes, Dynamometers, Bearings and Clutches and their function and working.
- •To understand the need for balancing of masses in the same plane
- To know different types of governors.

Reference Books:

1. Theory of machines – S.S .Rattan ,Tata McGraw-Hill publications.
2. Theory of machines – R.K.Bansal ,Laxmi publications
3. Theory of machines – R.S. Khurmi & J.K.Gupta , S.Chand publications.

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	INDUSTRIAL ENGINEERING & MANAGEMENT	MEPC-533	3L-1T-0P	4

Course outcomes:

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

CO1 Explain the different types of layout and plant maintenance with safety

CO2 List and explain the need of method study and work measurements

CO3 Explain the production planning and quality control, and its functions

CO4 Understand the basic principles, approaches and functions of management and identify concepts to specific situations.

CO5 List and explain the different financial sources and methods of inventory management

Course Content

UNIT-I

Plant Engineering: Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Material handling equipment; Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance.

Plant Safety: Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Conciliation; Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.

UNIT-II

Work Study: Productivity; Standard of living; Method of improving Productivity; Objectives; Importance of good working conditions. **Method Study:** Definition; Objectives; Selection of a job for method study; Basic procedure for conduct of Method study; Tools used; Operation process chart; Flow process chart; Two handed process chart; Man Machine chart; String diagram and flow diagram.

Work Measurement: Definition; Basic procedure in making a time study; Employees rating factor; Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Calculation of standard time; Numerical Problems; Basic concept of production study; Techniques of Work Measurement; Ratio delay study; Synthesis from standard data; Analytical estimating and Pre determined Motion Time System (PMTS).

UNIT-III

Production Planning and Control: Introduction; Major functions of Production Planning and Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Controlling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Production and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Principles of Product and Process Planning; Make or Buy decision; Numerical problems. **Quality Control:** Definition; Objectives; Types of Inspection: First piece, Floor and Centralized Inspection; Advantages and Disadvantages; Statistical Quality Control; Types of Measurements; Method of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve (O.C curve); Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Quality Management System Registration/Certification procedure; Benefits of ISO to the organization.

UNIT-IV

Principles of Management: Definition of Management; Administration; Organization; F.W.Taylor's and Henry Fayol's Principles of Management; Functions of Manager; Types of Organization: Line, Staff, Taylor's Pure functional types; Line and staff and committee type; Directing; Leadership; Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; Modern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero defect concept; 5S Concept; Management Information Systems. **Personnel Management:** Responsibility of Human Resource Management; Selection Procedure; Training of Workers; Apprentice Training; On the Job training and Vestibule School Training; Job Evaluation and Merit Rating; Objectives and Importance; Wages and Salary Administration; Components of Wages; Wage Fixation; Type of Wage Payment: Halsey's 50% Plan, Rowan's Plan and Emerson's efficiency plan; Numerial Problems.

UNIT-V

Financial Management: Fixed and Working Capital; Resources of Capital; Shares Preference and Equity Shares; Debentures; Type of debentures; Public Deposits; Factory Costing: Direct Cost; Indirect Cost; Factory Overhead; Selling Price of a product; Profit; Numerical Problems; Depreciation; Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method; Numerical Problems.

Material Management: Objectives of good stock control system; ABC analysis of Inventory; Procurement and Consumption cycle; Minimum Stock, Lead Time, Reorder Level-Economic Order Quantity problems; Supply Chain.

Program Learning Outcomes

- To take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively.
- To eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes.
- To use the Charts to record the Activities of the people, materials and Equipment to find alternative methods which minimize waste and to implement the best method.

Reference Books:

1. Industrial Engineering & Management, S.C. Sharma, Khanna Book Publishing Co. (P) Ltd., Delhi
2. Industrial Engineering and Management, O.P. Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi – 110002.

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	REFRIGERATION AND AIR-CONDITIONING	MEPE-534	3L-1T-0P	4

Course outcomes

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

CO1 Define refrigeration and types of Refrigeration cycles

CO2 Explain Vapour Compression and Vapour Absorbtion System working principles

CO3 Identify the components required for refrigeration system.

CO4 Identify the controlling components for a refrigeration system.

CO5 Explain the working principles of Air-conditioning.

Course Content

UNIT-I

Introduction to Refrigeration: Definition of Refrigeration; Refrigerating effect-unit of refrigeration- Coefficient of performance; Types of Refrigeration-Ice, dry ice, Steam jet, Throttling, Liquid nitrogen refrigeration; Carnot refrigeration Cycle; Air refrigeration- Bell - Coleman cycle, PV& TS diagram; Advantage and disadvantages in air refrigeration; Simple problems.

Unit-II

Refrigeration systems: Basic Components, Flow diagram of working of Vapour compression cycle; Representation of the vapour compression cycle on P-H, T-S & P-V Diagram; Expression for Refrigerating effect, work done and power required; Types of Vapour Compression cycle; Effects of super heating and under cooling, its advantages and disadvantages; Simple Vapour absorptions cycle and its flow diagram; Simple Electrolux system for domestic units; Comparison of Vapour absorption and vapour compression system; Simple problems on vapour compression cycle.

Unit-III

Refrigeration equipments: Compressor - types of compressors; Hermetically sealed and Semi hermetically sealed compressor; Condensers - Air Cooled, water cooled, natural and forced draught cooling system; Advantages and disadvantages of air cooled and water cooled condensers; Evaporators -natural, convection, forced convection types.

Refrigerants and lubricants: Introduction to refrigerants; Properties of good refrigerants; Classification of refrigerants by group number and commonly used refrigerants in practice; Detection of refrigerants leakage; Charging the system with refrigerant; Lubricants used in refrigeration and their properties.

Unit-IV

Refrigerant flow controls: Capillary tube; Automatic Expansion valve; Thermo static expansion valve; High side and low side float valve; Solenoid valve; Evaporator pressure regulator.

Application of refrigeration: Slow and quick freezing; Cold storage and Frozen storage; Dairy refrigeration; Ice making industry; Water coolers.

Unit-V

Air conditioning: Introduction to Air conditioning; Factors affecting Air conditioning; Psychometric chart and its use; Psychometric process-sensible heating and cooling, Humidifying and dehumidifying; Adiabatic saturation process; Equipments used in air conditioning cycle; Air conditioning units and plants.

Refrigeration and Air-conditioning tools: Tools used in refrigeration and Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; Servicing procedure.

Program Learning Outcomes

- To understand the basics of Refrigeration cycles.
- To understand basics of vapour compression and vapour absorbtion systems.
- To identify components and refrigerants and lubricants of a refrigeration system.
- To understand control strategies for refrigeration system.
- To understand the basics about air conditioning systems.

Reference Books:

1. Refrigeration and Air Conditioning – Sadhu Singh, Khanna Book Publishing Co., New Delhi
2. Refrigeration and Air Conditioning – S. Domakundawar, Dhanpat Rai publications.
3. Refrigeration and Air Conditioning – R.S. Khurmi S. Chand publications.

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	**AUTOMOBILE ENGINEERING**	**MEPE-535**	**3L-1T-0P**	**4**

Course outcomes

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

CO1 Identify the components of an automobile with their working

CO2 Explain the concepts of cooling and lubricating systems.

CO3 Explain the concepts of Ignition and Transmission and steering systems.

CO4 Identify different suspension systems and their applications.

CO5 Differentiate the special vehicles according to the usage.

Course Content

UNIT-I

Introduction to basic structure of an automobile: Basic engine components; Cylinder block; Cylinder head; Gaskets; cylinder liners, types of cylinder liners; Piston and piston pin; piston rings, types of piston rings; Connecting rod; Crank shaft; Cam shaft; Crankcase; Engine valves; Flywheel and Governer.

Unit-II

Cooling and lubrication system: The necessity of cooling system; Types of cooling system- air cooling and water cooling; Air cooling system; Types of water cooling system –Thermosyphon system and pump circulation system; Advantages and disadvantages of air cooling and water cooling systems; The components of water cooling system –fan, radiator, pump and thermostat; The necessity of lubrication system; S.A.E rating of lubrication system; Types of lubrication system; Petrol lubrication and high pressure lubrication system.

Fuel feed system: Conventional fuels and alternative fuels: Cetane and octane numbers; Types of carburettors; Working of simple carburettor; Multi point and single point fuel injection systems; Different fuel transfer pumps; Working of S.U electrical and A.C mechanical pump; Fuel filters; Fuel injection pump; Fuel injectors.

Unit-III

Ignition system: Introduction to ignition system; Battery Ignition systems and magneto Ignition system; Electronic Ignition system; Construction and working of lead acid battery; Elements of charging system; Elements of starting system; Types of lights used in the automobile: **Transmission and steering system:** General arrangement of clutch; Principle of friction clutches; Constructional details of Single plate clutch; Constructional details of multi-plate clutch; Constructional details of centrifugal clutch; Necessity for gear ratios in transmission; Types of gear boxes; Working of sliding mesh gear box; Working of constant mesh gear box; Working of propeller shaft Working of propeller shaft; Working of universal joint; Working of differential; Types of rear axle; Purpose of front axle; Necessity of steering system; Caster, camber and king pin inclination; Rack and pinion steering system; Power steering.

Unit-IV

Suspension system: Necessity of suspension system; Torsion bar suspension systems; Leaf spring and coil spring suspension system; Independent suspension for front wheel and rear wheel;
Working of telescopic shock absorber; Functions of brakes; Types of brakes; Working of internal expanding brake; Working of disc brake

Unit-V

Special vehicles: Introduction to Special vehicles; Tractor; Motor grader; Scrappers; Excavators; Duper trucks.

Program Learning Outcomes

- To understand the basic structure and components of an automobile.
- To understand the concepts of cooling and lubricating systems.
- To understand the concepts of Ignition and transmission and steering systems.
- To understand the classification and necessity of suspension system.
- To identify different special vehicles.

Reference Books:

1. Automobile Engineering Vol I, II, Kirpal Singh, Standard Publishers Distributors, Delhi. 2012.
2. Automobile Mechanics, A.K. Babu, S.C. Sharma, Khanna Publications, New Delhi

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-V

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	POWER PLANT ENGINEERING	MEPE-536	3L-1T-0P	4

Course outcomes

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

CO1 Familiarised with the present and future power scenario of India.

CO2 Enlist various load terminologies in power plants

CO3 Working and classifications in hydro power plant

CO4 Working principles of Diesel, Gas and Nuclear power plants.

CO5 Understand the issues and necessity of safety concepts of power plants.

Course Content

UNIT-I

Introduction to Power plant: Introduction to power plant; Indian Energy scenario in India;Location of power plant; Choice of Power plant; Classification of power plants.

Unit-II

Economics of power plant: Terminology used in power plant: Peak load, Base load, Load factor, Load curve; Various factor affecting the operation of power plant; Methods of meeting the fluctuating load in power plant; Load sharing- cost of power-tariff methods; Performance and operating characteristics of power plant.

Unit-III

Hydro power plant: Introduction to Hydro electric power plant; Rainfall, Runoff and its measurement, Hydrograph, flow duration curve; Selection of sites for hydro electric power plant;

General layout of Hydro electric power plant and its working; Classification of the Plant-Run off river plant, storage river plant, pumped storage plant; Advantages and disadvantages of hydro electric power plant.

Unit-IV

Diesel and Gas turbine plant: The layout of diesel power plant; Components and the working of diesel power plant; Advantages and disadvantages of diesel power plant; Gas turbine power Plant-Schematic diagram, components and its working; Combined cycle power generation- Combined gas and steam turbine power plant operation (only flow diagram).

Nuclear power plant: Introduction; Nuclear Power-Radio activity-Radioactive charge-types of reactions; Working of a nuclear power plant; Thermal fission Reactors- PWR, BWR and gas cooled reactors; Advantages and Disadvantages of Nuclear power plant.

Unit-V

Environmental impact of Power plant: Social and Economical issues of power plant; Green house effect; Acid precipitation-Acid rain, Acid snow, Dry deposition, Acid fog; Air, water, Thermal pollution from power plants; Radiations from nuclear power plant effluents.

Power plant safety: Plant safety concept; Safety policy to be observed in power plants; Safety practices to be observed in boiler operation; Safety in oil handling system; Safety in Chemical handling system; Statutory provision related to boiler operation.

Program Learning Outcomes :

- To understand the present scenario of power in India.
- To recognize various load terminologies used in power plants.
- To understand hydro working principles
- To understand working of Diesel, Gas and Nuclear power plants.
- To understand the issues and safety precautions in power plants.

Reference Books:

1. Power plant Engineering-P.K. Nag 4th edition, Tata McGraw Hill Education, 2014.
2. Power plant Engineering – Frederick T. Morse, Litton Educational Publishing Inc. 1953.
3. A Course in Power Plant Engineering – Subhash C. Arora, S. Domakundwar, Dhanpat Rai, 1984.
4. Power Plant Engineering – P.C. Sharma, S.K.Kataria & sons, 2009.
5. Power System Engineering – R.K. Rajput, Firewell Media,2006.

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	DESIGN OF MACHINE ELEMENTS	MEPC-631	3L-1T-0P	4

Course outcomes:

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

CO1 Analyze the various modes of failure of machine components under different load patterns.

CO2 Design and prepare part and assembly drawings.

CO3 Use design data books and different codes of design.

CO4 Select standard components with their specifications from manufacturer's catalogue.

CO5 Develop drawings on CAD software.

Course Content

UNIT-I

Introduction to Design: Machine Design philosophy and Procedures; General Considerationsin Machine Design; Fundamentals: Types of loads, concepts of stress, Strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses; Bearing pressure Intensity; Crushing; Bending and Torsion; Principal Stresses; Simple Numericals; Creep strain and Creep Curve; Fatigue; S-N curve; Endurance Limit; Factor of Safety and Factors governing selection of factor of Safety; Stress Concentration: Causes & Remedies; Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety & service factor; Properties of Engineering materials; Designation of materials as per IS and introduction to International standards & advantages of standardization; Use of design data book; Use of standards in design and preferred numbers series; Theories of Elastic Failures; Principal normal stress theory; Maximum shear stress theory & Maximum distortion energy theory.

UNIT-II

Design of simple machine parts: Cotter Joint; Knuckle Joint; Turnbuckle; Design of Levers: Hand/Foot Lever & Bell Crank Lever; Design of C–Clamp; Off-set links; Overhang Crank; Arm of Pulley. **Antifriction Bearings**: Classification of Bearings; Sliding contact & Rolling contact; Terminology of Ball bearings: Life Load relationship, Basic static load rating and Basic dynamic load rating, limiting speed; Selection of ball bearings using manufacturer's catalogue.

UNIT-III

Design of Shafts, Keys, Couplings and Spur Gears: Types of Shafts; Shaft materials; Standard Sizes; Design of Shafts (Hollow and Solid) using strength and rigidity criteria; ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley; Design of Sunk Keys; Effect of Keyways on strength of shaft; Design of Couplings – Muff Coupling, Protected type Flange Coupling, Bush-pin type flexible coupling; Spur gear design considerations; Lewis equation for static beam strength of spur gear teeth; Power transmission capacity of spur gears in bending.

UNIT-IV

Design of Power Screws: Thread Profiles used for power Screws - Relative merits and demerits of each; Torque required to overcome thread friction; Self-locking and overhauling property; Efficiency of power screws; Types of stresses induced; Design of Screw Jack; Toggle Jack. **Design of springs**: Classification and Applications of

Springs; Spring terminology; Materials and Specifications; Stresses in springs; Wahl's correction factor; Deflection of springs; Energy stored in springs; Design of Helical, Tension and Compression springs subjected to uniform applied loads like I.C. engine valves, Weighing balance, Railway buffers and Governor springs; Leaf springs: Construction and Application.

UNIT-V

Design of Fasteners: Stresses in Screwed fasteners; Bolts of Uniform Strength; Design of Bolted Joints subjected to eccentric loading; Design of Parallel and Transverse fillet welds; Axially loaded symmetrical section; Merits and demerits of screwed and welded joints.

Ergonomics & Aesthetic consideration in design: Ergonomics of Design: Man–Machine relationship; Design of Equipment for control, environment & safety; Aesthetic considerations regarding shape, size, color & surface finish.

Program Learning Outcomes :

- To enable the student to design and draw simple machine components used in small and medium scale industries.
- To understand the basic philosophy and fundamentals of Machine Design.
- To understand the modes of failures of m/c components and decide the design criteria and equations.
- To analyze and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
- To develop analytical abilities to give solutions to engineering design problems.

Reference Books:

1. Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-575)
2. Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co., Delhi
3. Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
4. Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.
5. Machine design – R.K.Jain, Khanna Publication, New Delhi.

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	PRODUCTION & OPERATIONS MANAGEMENT	MEPC-632	3L-1T-0P	4

Course outcomes:

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

CO1 Define operations management and explain its relationship to productivity. And also understand tools and techniques.

CO2 Describe the importance of forecasting and explain the effective application of the different forecasting approaches and methods.

CO3 Explain layout strategy and how operations managers determine facility arrangements and size.

CO4 Describe how operations managers achieve a reasonable work environment and set expectations related to employee productivity.

CO5 Understand make-or-buy decisions, and the selection and integration of suppliers. And how much to order and when to order.

Course Content

UNIT-I

Process Planning and Process Engineering: Process Planning: Introduction, Function, Pre-requisites and steps in process planning, Factors affecting process planning, Make or buy decision, plant capacity and machine capacity. Process Engineering: Preliminary Part Print Analysis: Introduction, Establishing the General Characteristics of work piece, determining the principal Process, Functional surfaces of the work piece, Nature of the work to be Performed, Finishing and identifying operations. Dimensional Analysis: Introduction, types of dimensions, measuring the Geometry of form, Baselines, Direction of specific dimensions. Tolerance Analysis: Causes of work piece variation, Terms used in work piece dimensions, Tolerance stacks. Work piece Control: Introduction, Equilibrium Theories, Concept of location, Geometric Control, Dimensional control, Mechanical control.

UNIT-II

Production Forecasting: Introduction of production forecasting, The strategic role of forecasting in supply chain, Time frame, Demand behavior, Forecasting methods- Qualitative and Quantitative, Forecast accuracy.

Scheduling: Introduction, Objectives in scheduling, Loading, Sequencing, Monitoring, Advanced Planning and Scheduling Systems, Theory of Constraints, Employee scheduling.

UNIT-III

Break-Even Analysis: Introduction, Break-even analysis charts, Breakeven analysis for process, plant and equipment selection.

Aggregate Operations Planning: Aggregate production planning, Adjusting capacity to meet the demand, Demand management, Hierarchical and collaborative planning, Aggregate planning for services.

UNIT-IV

Assembly Line Balancing: Assembly lines, Assembly line balancing, Splitting tasks, Flexible and U-shaped line layouts, Mixed model line balancing, Current thoughts on assembly lines, Computerized assembly line balancing.

UNIT-V

Material Management: Introduction, Importance and objectives, Purchasing and Stores: policies and procedures, Vendor development, selection, analysis and rating.

Program Learning Outcomes :

- One of the most critical areas for success in any business enterprise is how Production and Operations are managed.
- To study the statistics, economics, finance, organizational behaviour and strategy into a consolidated production and operation related decisions.
- To discuss the role of location strategy and the criteria for location decisions.
- To define quality and explain quality management, including TQM and its tools.

Reference Books:

1. Production and Operations Management – K.Aswathappa, K.Shridhara Bhat, Himalaya Publishing House, 2014.
2. Production and Operations Management – Shailendra Kale, McGraw Hill Educations(India) Private Limited,2013.
3. Production and Operations Management – R.Paneerselvam, PHI Learning Private Limited, 2013.

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DIPLOMA (MECHANICAL ENGINEERING)

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Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	ENTREPRENEURSHIP AND START-UPS	MEHS-633	3L-1T-0P	4

Course outcomes:

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. Strategic Marketing Planning
6. New Product or Service Development
7. Business Plan Creation

Course Content

Unit-I

Introduction to Entrepreneurship and Start – Ups. Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation Types of Business Structures, Similarities/differences between entrepreneurs and managers.

Unit-II

Business Ideas and their implementation. Discovering ideas and visualizing the business Activity map Business Plan

Unit-III

Idea to Start-up. Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis

Unit-IV

Management Company's Organization Structure, Recruitment and management of talent. Financial organization and management.

Unit-V

Financing and Protection of Ideas. Financing methods available for start-ups in India Communication of Ideas to potential investors – Investor Pitch Patenting and Licenses.

Unit-VI

Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy

Program Learning Outcomes:

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with various uses of human resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation.
4. Acquiring entrepreneurial quality, competency, and motivation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

Reference Books:

1. The Startup Owner's Manual The Step-by-Step Guide for Building a Great Company
Steve Blank and Bob Dorf
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses
3. Demand: Creating What People Love Before They Know They Want It Adrian J. Slywotzky
with Karl Weber Headline Book Publishing
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way.

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (MECHANICAL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	HEAT TRANSFER	MEOE-634	3L-1T-2P	6

Course outcomes:

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

CO1 Understand the concepts of conduction

CO2 understand the concepts of fins

CO3 Understand the concepts of radiation.

CO4 Understand the concepts of convection

CO5 Understand the basic concepts of heat exchangers.

Course Content

UNIT-I

Conduction: Fourier law of heat conduction for isotropic material; Thermal conductivity; Derivation of the energy equation in three dimensions including transient effect; Non dimensional - thermal diffusivity and Fourier number; Types of boundary conditions (Dirchlet, Neumann, mixed type); One dimensional solution with and without heat generation; Analogy with electrical circuits.

Unit-II

Fins: rectangular and pin fins. Fin effectiveness and efficiency. Critical thickness of insulation. Lumped parameter approach and physical significance of time constant, Biot number, Validity of lumped parameter approach. Introduction to Heissler Chart.

Unit-III

Convection: Introduction, Newton's law of cooling; Momentum and energy equations in two dimensions; non diemnsionalisation, importance of non dimensional quantities and their physical significance. Velocity and thermal boundary layer thickness by integral method. Analogies between momentum, heat and mass transfer. Natural convection, effect of coupling on the conservation equations.

Unit-IV

Radiation : Physical mechanism of thermal radiation, laws of radiation, definition of black body, emissive power, intensity of radiation, emissivity, reflectivity, transmittivity, irradiation, radiosity. Radiation exchange between black bodies, concept of Gray-Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces by radiation network and radiosity matrix method. Radiation shielding.

Unit-V

Heat exchangers: Types of heat exchangers, parallel and counter flow types, Introduction to LMTD. Correction factors, fouling factor. NTU method for heat exchangers.

Program Learning Outcomes:

• To understand the concepts of conduction.

• To understand the concepts of Fins heat transfer.

• To understand the concepts of radiation.
• To understand the concepts of convection.
• To understand the basics of heat exchangers.

Reference Books:

1. Fundamentals of Heat and Mass Transfer by F.P.Incropera and D.P.Dewitt, 4th ed., John Wiley & Sons.
2. Heat Transfer - A Basic Approach by M.N.Ozisik, McGrawhill.
3. Heat Transfer by J.P.Holman, 8th ed., McGrawhill.
4. Elements of Heat & Mass Transfer by Vijay Gupta, 2nd ed., New Age International Publishers.

R.K.D.F. UNIVERSITY, BHOPAL

DIPLOMA (MECHANICAL ENGINEERING)

New Scheme Based On AICTE Flexible Curriculum

Semester-VI

Branch	Subject Title	Subject Code	Contact Hours Per Week	Total Credits
MECHANICAL ENGINEERING	**HYBRID VEHICLES**	**MEOE-635**	**3L-1T-2P**	**6**

Course outcomes:

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

CO1 Understand the basics of electrical vehicle history and components.
CO2 Understand the properties of batteries.
CO3 Understand the electrical machine properties and classifications.
CO4 Understand the properties of electrical vehicle drive systems.
CO5 Understand the concepts of hybrid electric vehicles.

Course Content

UNIT-I

Electric Vehicles: Introduction; History of Hybrid and Electric Vehicles; Social and Environmental importance of Hybrid and Electric Vehicles; Components, Vehicle mechanics: Roadway fundamentals, Vehicle kinetics, Dynamics of vehicle motion; Propulsion System Design.

Unit-II

Battery: Basics; Types; Parameters: Capacity, Discharge rate, State of charge, State of Discharge, Depth of Discharge; Technical characteristics, Battery pack Design, Properties of Batteries.

Unit-III

DC & AC Electrical Machines: Motor and Engine rating; Requirements; DC machines; Three phase A/c machines; Induction machines; Permanent magnet machines; Switched reluctance machines.

Unit-IV

Electric Vehicle Drive Train: Transmission configuration; Components: Gears, Differential, Clutch, Brakes; Regenerative braking, Motor sizing; Fuel efficiency analysis.

Unit-V

Hybrid Electric Vehicles: Types: Parallel, Series, Parallel and Series configurations; Drive train; Sizing of components; Basics of Micro, Mild, Mini, Plug-in and Fully hybrid.

Program Learning Outcomes:

- To understand the basics of electric vehicle history and components.
- To understand properties of batteries.
- To understand the electrical machine properties and classifications.
- To understand the properties of electric vehicle drive systems
- To understand the concepts of hybrid electric vehicles.

Reference Books:

1. Electric & Hybrid Vehicles – A.K. Babu, Khanna Publishing House, New Delhi, 2018
2. Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition, CRC Press,

2011.
3. Electric Vehicle Technology Explained - James Larminie, John Wiley & Sons, 2003.
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals - Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press, 2010.
5. Electric Vehicle Battery Systems - Sandeep Dhameja, Newnes, 2000.