

Text Books List

Mathematics-II

- ✓ Mathamatics I
A.Sarkar, Naba Prakashani
- ✓ Engineering Mathamatics
A.Sarkar, Naba Prakashani

Applied Physics –II

- ✓ Applied Physics I
D.Choudhury, Bhagabati Publication
- ✓ Basic Physics
D.Choudhury, Bhagabati Publication

Introduction to IT Systems

- ✓ Introduction to IT System,P. Mondal,
Bhagabati Publication.
- ✓ Computer Applications, P.K. De &
A. Basu, Lakshmi Prakashani

WrokShop

- ✓ Workshop Practice, Swarn Singh,
Katson Books

Applied Chemistry

- ✓ Basic Chemistry
Kaberi Bhattacharya, Lakhi
Prakashani
- ✓ Applied Chemistry
Kaberi Bhattacharya, Lakhi
Prakashani
- ✓ Engineering Drawing
N.D. Bhatt, Charotar Publication

Communication Skills in English

- ✓ Life & Office Skills, British Council

Ramakrishna Mission Shilpamandira

An AICTE Approved
Self-Financed Polytechnic

Belur Math, Howrah



Syllabus Booklet

Semester – I (Part-I)

All Discipline (CE, EE, ETCE & ME)

Based on the Latest Syllabus published by the
West Bengal State Council of Technical & Vocational Education and Skill
Development

Mathematics - I

Unit-1: Algebra

Logarithm:

- ✓ Definition of natural and common logarithm.
- ✓ General Properties of logarithm and simple problems

Complex Numbers:

- ✓ Definition of Complex numbers
- ✓ Real and Imaginary parts of a complex number
- ✓ Equality of two complex numbers
- ✓ Conjugate of a complex number
- ✓ Modulus and Argument of a complex number and simple problems
- ✓ Polar and Cartesian forms of a complex number and their relation
- ✓ Algebraic operations (Addition, Subtraction, multiplication, Division) of complex numbers
- ✓ De Moivre's Theorem (without proof) and simple problems
- ✓ Cube roots of unity and their properties with problems

Quadratic Equations:

- ✓ Definition of Quadratic Equations
- ✓ Finding roots of a quadratic equation
- ✓ Conjugate roots & simple problems
- ✓ Nature of the roots using discriminant & problems
- ✓ Roots & coefficients: Relationship & problems
- ✓ Formation of quadratic equations if roots are given

Binomial Theorem:

- ✓ Definition of factorial of a number
- ✓ Permutation ${}^n P_r$ & combination ${}^n C_r$
- ✓ Binomial Theorem for any index
- ✓ Simple problems on positive index
- ✓ General & Middle Term; problems
- ✓ Expansion of $(1+x)^{-1}$, $(1-x)^{-1}$, $(|x| < 1)$, exponential & logarithmic series.

Unit-2: Vector Algebra

- ✓ Definition of vector; types of vectors
- ✓ Concept of a position vector and Ratio formula & simple problems
- ✓ Rectangular resolution of a vector
- ✓ Equality, addition, subtraction of vectors and multiplication of a vector by a scalar
- ✓ Scalar (dot) Product ; problems
- ✓ Vector (cross) product ; problems
- ✓ Application of dot product - work done by a force, projection of a vector upon another
- ✓ Application of cross product -- finding area of a triangle and parallelogram, moment of a force

Unit-3: Trigonometry

- ✓ Concept of trigonometrical angles
- ✓ Measurement of angles in degree, radian and grade & their relation only
- ✓ Trigonometrical ratios of angles, associated angles, Standard Trigonometric ratios, problems
- ✓ Compound angles formula, multiple Sub-multiple angles & problems
- ✓ Solutions of Trigonometrical Equations, Problems (0 to 2π)
- ✓ Inverse Circular Function & problems
- ✓ Properties of triangle, basic formulae and some problems

Unit-4: Function, Limit & Continuity, Derivative

Function:

- ✓ Definition of variables & constants
- ✓ Definition of function with examples, domain and range of a function
- ✓ Function Type (even/odd, increasing, / decreasing, inverse, periodic)
- ✓ Some problems
- ✓ Graph of trigonometric functions, sin x, cos x, tan x only

Communication Skills in English

Unit 1: Communication

- ✓ Basics of Communication: Introduction, meaning and definition, process of communication etc.
- ✓ Types of communication: formal and informal, verbal, non-verbal and written. Barriers to effective communication.
- ✓ 7 Cs for effective communication (considerate, concrete, concise, clear, complete, correct, courteous).
- ✓ Technical Communication.

Unit 2: Soft Skills for Professional Excellence

- ✓ Introduction: Soft & Hard Skills.
- ✓ Time Management.
- ✓ Motivation
- ✓ Stress Management.
- ✓ Emotional Intelligence.
- ✓ Self-awareness.
- ✓ Problem solving skills
- ✓ Decision Making
- ✓ Interpersonal Skills

Unit 3: Reading Comprehension

- ✓ Comprehension of a written text
- ✓ Note Taking.

Unit 4: Professional Writing

- ✓ Writing Reports
- ✓ Writing Emails
- ✓ Writing Memo
- ✓ Job Application Letters
- ✓ CV/Resume

Unit 5: Vocabulary and Grammar

- ✓ Remedial Grammar and Exercises
- ✓ Parts of speech, active and passive voice, tenses etc.

Communication Skills in English-Lab

Introducing yourself and others:

- ✓ Talking about yourself
- ✓ Describing people
- ✓ Speaking about your free time:
- ✓ Talking about your free time
- ✓ Giving reasons for things you like
- ✓ Discussing daily routines
- ✓ Giving instructions and advice:
- ✓ Giving and following instructions
- ✓ Giving route directions
- ✓ Advising about places/ tourist spots etc.

Out and about:

Talking about:

- Going shopping
- Eating in a restaurant
- Films and Television
- Holidays
- Social Events

Speaking and listening:

- ✓ College Life
- ✓ Talking about the World, Weather, Environment, etc.

Enhancing employability and Professional skills:

- ✓ Job Interviews
- ✓ Group discussions
- ✓ Professional Presentations

Forging Shop

Introduction:

- ✓ Purpose of Smithy/Forging Works
- ✓ Different types of Hearths used for Smithy/Forging works
- ✓ Specification, usage, care and maintenance of various tools and equipment used in the shop.
- ✓ Types of raw materials used in Smithy/Forging shop & their required temperature for it.
- ✓ Types of fuel used in hearth and the maximum temperature obtained.
- ✓ Uses of Fire Bricks & Clays in Smithy/Forging Work Shop.
- ✓ Types of heat treatment processes involved in Smithy / Forging shop and its effect on forged items.
- ✓ Hot forge & cold forge utility.
- ✓ Safety measures & equipment for Smithy/Forging Shop

Practical:

- ✓ Practice / Demonstration of firing of hearth/Furnace, Cleaning of Clinkers and Temperature Control of Fire.
- ✓ Demonstration on basic Forging operations: Upsetting, Drawing down, Setting down, Necking, Cutting, Bending, Fullering, Swaging, Punching and Drifting etc.
- ✓ Demonstration on making of
 - Cube, hexagonal cube, hexagonal bar from round bar.
 - Hexagonal/octagonal flat chisel including tempering of edges.
- Job Preparation–Student group Jobs
- ✓ Job 1, 2: Cold/hot flat chisel, Tongs
- ✓ Job 3: utility tools: Chain-links, door ring, hexagonal bolt / square shank boring tool, fan hook (long S-type) etc.
- ✓ Job- 4, 5: Door hinge, 'L' hook

Electrical Shop

- ✓ Basic concept of voltage and current.
- ✓ Basic laws of electrical engineering (Ohm's law, KVL, KCL etc)
- ✓ Basic elements of electrical circuit (Sources ,Resistors, capacitors, inductors etc)
- ✓ Concept of electrical power, energy.
- ✓ Different voltage and current levels.
- ✓ Structure of electrical power system.
- ✓ Different types of wiring, switches and fuse.
- ✓ Wiring of a room, fluorescent lamp, two way switches (stair case) & calling bell.
- ✓ Earthing: requirement & types
- ✓ Single phase service connection
- ✓ Tools used in electrical workshop,
- ✓ Different electrical meters.
- ✓ Different types of wire joints.
- ✓ Electrical shock ,general safety & precaution

Electronics Shop

- ✓ Active & Passive component.
- ✓ Basic components (Specifications, types, rating, uses)
- ✓ Resistors, Capacitors, Inductors, Coils, Transformers, Relays, Diode, Transistors.
- ✓ Discussion on Multimeter and use.
- ✓ Testing & identification of basic components using Digital Multimeter.
- ✓ Bread board, Vero board, PCB.
- ✓ Soldering and de-soldering practice.
- ✓ Safety measure to be followed in Electronic Shop.

Limit & Continuity:

- ✓ Definition of limit (with left hand limit & right hand limit),
- ✓ Fundamental Theorem on limit,
- ✓ Standard limits and simple problems
- ✓ Continuity of functions, elementary test for continuity (finite limit)

Derivative:

- ✓ Definition of derivatives with some problems
- ✓ Derivatives of standard functions with some problems
- ✓ Rules of differentiation of sum, difference, product and quotient of functions with some problems
- Derivatives of composite functions (Chain Rule) examples
- ✓ Derivatives of inverse circular functions, implicit functions and logarithmic differentiation examples
- ✓ Derivative of parametric functions, derivative of a function with respect to another function with examples
- ✓ Second order derivatives; problems
- ✓ Application of derivatives –Physical & Geometrical interpretation of derivative
- ✓ Checking increasing- decreasing functions
- ✓ Finding velocity & acceleration
- ✓ Maxima-Minima of function of single variable with simple problems

Applied physics-I

Unit 1: Physical world, Units and Measurements

- ✓ Physical quantities
 - a) Fundamental and derived
 - b) Units & systems of units (CGS,SI)
- ✓ Dimensions and dimensional formula of physical quantities
 - a) Principle of homogeneity of dimensions

- b) Dimensional equations and their applications
- c) Limitations of dimensional analysis.
- ✓ Measurements:
 - a) Measuring instruments
 - b) Least count
 - c) Types of Measurement
 - d) Errors in Measurements (systematic and random)
 - e) Mean value, absolute error, relative error, error propagation, error estimation
 - f) Significant figures, Numericals.

Unit 2: Force and Motion

- ✓ Force
 - a) Momentum
 - b) Conservation of linear momentum and its applications
 - c) Impulse of force, Impulsive force
 - d) Newton laws of motion and its applications
- ✓ Circular motion
 - a) Angular displacement
 - b) Angular velocity
 - c) Angular acceleration
 - d) Frequency, Time period
 - e) Concept of Centripetal and centrifugal forces.
 - f) Banking of roads and bending of cyclist
 - g) Numerical problems

Unit 3: Work, Power and Energy

- ✓ Work
 - a) Concept and units
 - b) Positive, Negative and zero work
 - c) Numerical problems
- ✓ Power
 - a) Concept and its units
 - b) Power and work relationship
 - c) Calculation of power
 - d) Numerical problems

- ✓ Energy
 - a) Concept and its units
 - b) Kinetic energy & potential energy
 - c) Work energy theorem
 - d) Conservation of mechanical energy
 - e) Transformation of energy
 - f) Numerical problems

- ✓ Friction
 - a) Concept and types of friction
 - b) Laws of limiting static friction
 - c) Coefficient of friction
 - d) Angle of friction, Angle of repose
 - e) Work done by a moving object on rough inclined plane.
 - f) Reducing friction and its engineering applications
 - g) Numerical problems

Unit 4: Rotational Motion

- ✓ Translational and rotational motion with examples
 - a) Definition of torque and angular momentum and their relation
 - b) Conservation of angular momentum and its applications.
 - c) Moment of inertia and its physical significance
 - d) Radius of gyration for rigid body
 - e) Theorems of parallel and perpendicular axes
 - f) Moment of inertia of rod, disc, ring and sphere
 - g) Numerical problems.

Unit 5: Properties of Matter

- ✓ Elasticity:
 - a) Definition of stress and strain
 - b) Hooke's law, Moduli of elasticity
 - c) Significance of stress-strain curve.
 - d) Numerical problems
- ✓ Surface tension:
 - a) Concept and units
 - b) Cohesive and adhesive forces
 - c) Surface energy, Angle of contact

- d) Capillary rise
- e) Jurin's law
- f) Applications of surface tension
- g) Effect of temperature and impurity on surface tension
- h) Numerical problems

✓ Hydrodynamics:

- a) Specific gravity, Pressure of fluid
- b) Pascal's law
- c) Buoyancy and Buoyant force
- d) Archimedes principle
- e) Fluid motion: stream line & turbulent flow
- f) Reynold's number
- g) Equation of continuity
- h) Bernoulli's Theorem and its applications
- i) Viscosity; Coefficient of viscosity
- j) Terminal velocity
- k) Stoke's law
- l) Numerical problems

Unit 6: Heat and Thermometry

- ✓ Concept of heat and temperature
 - a) Basic concepts of measurements of heat and temperature
 - b) Modes of heats transfer (conduction, convection and radiation with examples)
 - c) Co-efficient of thermal conductivity
 - d) Numerical problems.
- ✓ Expansion of solids, liquids, & gases
 - a) Coefficient of linear, surface and cubical expansions of solids
 - b) Relation among coefficient of linear, surface and cubical expansions of solids
 - c) Specific heats of a substance
 - d) Specific heats C_p & C_v of a gas and their relationship.

Washer, Locking arrangement and their conventional representations.

Unit 7: AutoCAD

- ✓ Basic 2D Commands & Simple 2D Drawings.

Carpentry Shop

Introduction:

- ✓ Raw materials used in carpentry shop: wood & alternative materials.
- ✓ Hand & M/c Tools: Specification, usage, care & maintenance of various tools, equipment and machineries used in the Carpentry shop.
- ✓ Types of wood.
- ✓ Hard & soft wood: Difference.
- ✓ Timber: characteristics, usage, defects
- ✓ Difference between wood & timber.
- ✓ Seasoning of wood.
- ✓ Different types of joints such as cross half-lap joint, through ten on and mortise joint, dove tail joints, etc.
- ✓ Auxiliary materials for Carpentry.
- ✓ Safety measures in carpentry shop.
- ✓ Study on and practice of the following machines: a) Wood turning lathe b) Surface planer c) Circular saw d) Band saw e) Drilling machine.

Practical jobs:

- ✓ Demonstration of use of different tools, equipment and machineries.
- ✓ Demonstration of different wood working processes, like planing, marking, chiseling, grooving, turning of wood etc.
- ✓ Job Preparation -Individual Works
 - 1) Cross half lap joint
 - 2) Tee-dove tail joint
 - 3) Through mortise & tenon joint
- ✓ Production of utility articles (Group work)
 - 4) Making Handles of chisels

Fitting Work Shop

Introduction:

- ✓ Demonstration of different tools and equipment used in fitting shop.
- ✓ Study of measuring instrument such as micrometer, vernier calipers, bevel protractors.
- ✓ Care and maintenance of the above mentioned tools and equipment.
- ✓ Study of drilling machines and power tools used in fitting shop.
- ✓ Safety measure in Fitting shop.

Practical job:

- ✓ Demonstration of different fitting job operations like chipping, filing, drilling, tapping, sawing, cutting etc.
- #### Job Preparation -Individual Works:
- ✓ One simple fitting job involving practice of chipping, filing, marking, drilling, tapping, cutting etc.
 - ✓ Job no 1: "T" Fitting

Welding Shop

- ✓ Purpose of welding, advantages & disadvantage so fit over other joining processes.
- ✓ Types of welding processes (in brief)
- ✓ Specification, usage, care & maintenance of various welding machines, tools & equipment.
- ✓ Selection of welding methods and electrodes.
- ✓ Safety measures & equipment required for working in welding shop

Sheet Metal Shop

- ✓ Briefing on different types of sheet metal: Stainless Steel, Copper, Brass, Corrugated Sheet Metal, Galvanized Sheet Metals etc., and their uses.
- ✓ Demonstration of different types of Tools & machines and their use in sheet metal work.

Applied Chemistry Lab

- ✓ Identification of Basic Radicals by Dry and wet Test
- ✓ Identification of Acid Basic Radicals by Dry and wet Test
- ✓ Preparation of standard oxalic acid and standard potassium dichromate solution.
- ✓ To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution and phenolphthalein as indicator.
- ✓ Standardization of potassium permanganate solution using standard oxalic acid
- ✓ Standardization of sodium thiosulphate using standard potassium dichromate solution by Iodometry.
- ✓ Iodometric estimation of copper in copper sulfate sample.
- ✓ Iodometric estimation of iron in iron oxide sample.
- ✓ Volumetric estimation of total acid number (TAN) of given oil.
- ✓ Volumetric estimation of -
 - Total hardness of water sample using standard EDTA solution.
 - Alkalinity of water sample using 0.01N sulphuric acid.
- ✓ Determine the conductivity of given water sample.
- ✓ Verify first law of electrolysis: copper sulfate using copper electrode.
- ✓ To apply thin layer chromatography for separation of mixture of inorganic/organic compounds.
- ✓ Qualitative detection of Arsenic in a given sample of water (~5 ppm solution of sodium arsenite)

- ✓ Determination of dissolved oxygen in a sample of water.
- ✓ Determination of pH value of unknown solution.

Engineering Graphics

Unit 1 & 2: 1st Plate: Lettering, Scale & Geometrical Construction:

- ✓ LETTERING- Letters and numerals (single stroke, vertical, capital).
- ✓ SCALES- 2 problems on plain scale and on diagonal scale.
- ✓ GEOMETRICAL CONSTRUCTION- Curve passing through five no. of points, regular polygons, ellipse, parabola, hyperbola & cycloid.

Unit 3: 2nd Plate

Orthographic Projection of Lines & Solids:

- ✓ Projection of Line- Two problems on straight line, inclined with one plane and parallel to other.
- ✓ Projection of Solid- Four problems on pyramid, prism, cylinder, cone; axis inclined to one plane and parallel to other.

Unit 4: 3rd Plate

Conversion of Pictorial Views Into Orthographic Views:

- ✓ Isometric View Into Orthographic Projection - Three problems on isometric view into orthographic projection of simple 3D objects.

Unit 5: 4th Plate

Isometric Projection & View:

- ✓ Orthographic Views Into Isometric View, and Projections - Problems on regular solids.
- ✓ Construction of Isometric Scale.

Unit 6: 5th Plate: Freehand Sketches:

- ✓ Thread Terminology & Profiles, Nuts, Bolts, Studs, Set Screws,

Applied Physics - I Lab

- ✓ Determination of volume of a hollow Cylinder by using slide callipers.
- ✓ Area of cross section of a thin wire using a screw gauge.
- ✓ To determine radius of curvature of a convex and a concave mirror surface by using a spherometer.
- ✓ Determination of Specific Gravity of a heavy Insoluble Solid By Hydrostatic Balance.
- ✓ To determine the relative density of sand by using a specific gravity bottle.
- ✓ Viscosity of a liquid by Stoke's law
- ✓ To verify Boyle's law.
- ✓ Measurement of volume of using Travelling microscope
- ✓ Determination of the surface tension of water by capillary rise method.
- ✓ Determination of the Young's modulus of steel by searle's method.
- ✓ Density of a solid rod using common balance, and slide calliper's, Screw gauge (for diameter of the rod).
- ✓ Young's modulus (Y) of the material of a beam by the method of flexure.

Introduction to IT Systems

Number system & Codes

- ✓ Binary, octal, hexadecimal and decimal number systems
- ✓ Binary addition and subtraction
- ✓ Signed and Unsigned binary numbers
- ✓ 1's and 2's complement format.

Boolean Algebra:

- ✓ Basic logic circuits: Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, ExNOR with truth tables), Universal Gates,
- ✓ De-Morgan's theorem

Computer Hardware:

- ✓ CPU, Memory, Display, Keyboard, Mouse, HDD, SSD, & other Peripheral Devices.
- ✓ Printer & their classification
- ✓ Various port of a mother board
- ✓ Classification of Computer
- ✓ Organization of a Computer System
- ✓ Computer generation, Classification of software & their usage.

Algorithm & Flowcharts:

- ✓ Algorithm & Flowcharts : Definition, Characteristics, Advantages and disadvantages, Symbols of flowchart
- ✓ Examples of Algorithm & Flowchart of Various programs.

HTML5, JavaScript

HTML 5:

- ✓ Introduction HTML
- ✓ HTML, Head, Body, Style, Script
- ✓ Break, body, center, div, form, heading level (1 to 6), image, font, order list, under list, paragraph, table, data cell etc.
- ✓ Formatting Tags : Link, bold, italic, underline, strong, emphasized text, small, del, subscript, superscript, etc.
- ✓ Input, label, text, select, textarea, button, option, checkbox, radio, hidden filed, date, file, color etc.

Java Script:

- ✓ Introduction, Features & Application, Advantage, JavaScript Syntax
- ✓ Embedding Script in HTML File: Internal & External
- ✓ Comments lines, Character set, Identifier, Keywords, Variable, Data type,
- ✓ Operators: Arithmetic, Logical, Comparison, Assignment, bitwise
- ✓ Input / Output Statement
- ✓ Conditional Statement: If, If-Else, Switch
- ✓ Loops: For, While, Do/while examples.

Intro. to IT Systems Lab

- ✓ Components of computer system: Input & Output Devices; Memory handling; Storage devices.
- ✓ Identification of Hardware components, ports / interfaces, cables, etc.
- ✓ **HTML5, JavaScript**
- ✓ Webpage design with HTML, CSS & JavaScript

MS Word :

- ✓ Formatting Word Document
- ✓ Mail merge, Shapes, Table
- ✓ Create : Bio-data & Cover Page etc.

MS Excel:

- ✓ Apply Custom Formats and Layouts
- ✓ Format Cells, Sorting, Filter
- ✓ Apply Borders, Design Borders
- ✓ Custom Formatting

Simple & Advanced formulas:

- ✓ Simple Text, Mathematical functions
- ✓ Conditional & Logical Functions
- ✓ Lookup, vlookup, hlookup,
- ✓ Index, Match, Scenarios, Goal seek

Charts :

- ✓ Bar Charts, Pie Chart, Donut chart,
- ✓ Histograms, Line Graph, Trend,
- ✓ Pivot tables

MS-Power Point

- ✓ Power Point Slide Template.
- ✓ Create Animation, transition
- ✓ Add: movie, sound, tables, chart etc
- ✓ Changing slide colour scheme.
- ✓ Slide navigator: Create, Save, Print.

Applied Chemistry

Unit 1: Atomic Structure:

- ✓ Rutherford model of atom
- ✓ Bohr's theory (expression of energy and radius to be omitted), and hydrogen spectrum explanation based on Bohr's model of atom

- ✓ Heisenberg uncertainty principle
- ✓ Quantum numbers - orbital concept. Shapes of s, p and d orbitals, Pauli's exclusion principle
- ✓ Hund's rule of maximum multiplicity
- ✓ Aufbau rule, electronic configuration

Type of chemical bonding:

- ✓ Ionic, covalent, metallic and hydrogen bonds.
- ✓ Example of each type. Hybridization, sp³, sp², sp
- ✓ Example: BeCl₂, BF₃, CH₄, NH₃, H₂O; structure of diamond, graphite.
- ✓ Solution – idea of solute, solvent and solution, methods to express the concentration of solution-
- ✓ Molarity, ppm, mass percentage, volume percentage & mole fraction.

Unit 2: Water

- ✓ Graphical presentation of water distribution on Earth (pie or bar diagram)
- ✓ Classification of soft and hard water based on soap test, salts causing water hardness
- ✓ Unit of hardness, numericals
- ✓ Cause of poor lathering of soap
- ✓ Problems caused by use of hard water in boiler (corrosion, scale, sludge, foaming, priming, etc),
- ✓ Quantitative measurement of water hardness by EDTA method,
- ✓ Total dissolved solids (TDS)
- ✓ alkalinity estimation.
 - a) Water softening techniques - soda lime, zeolite, ion exchange
 - b) Municipal water treatment - sedimentation, coagulation, filtration, sterilization.
- ✓ Water for human consumption
- ✓ Indian standard specification of drinking water (understand data & standards).

Unit 3: Engineering Materials

Natural occurrence of metals:

- ✓ Minerals, ores of iron, aluminium, copper, gangue (matrix), flux, slag

Metallurgy:

- ✓ Brief account of general principles of metallurgy
- ✓ Extraction of iron from haematite ore using blast furnace, aluminium from bauxite along with reactions,
- ✓ Reactions during copper extraction

Alloys:

- ✓ Definition, purposes of alloying, ferrous alloys and non-ferrous with examples, properties & applications.
- ✓ General chemical composition, composition based applications: Port land cement and hardening, Glasses Refractory and Composite materials.

Polymers :

- ✓ Monomer, homo and co polymers, degree of polymerization, simple reactions involved in preparation
- ✓ Application of thermoplastics and thermosetting plastics (PVC, PS, PTFE, nylon-6, nylon-66, Bakelite)
- ✓ Rubber and vulcanization of rubber.

Unit 4: Fuels and Lubricants

Fuels:

- ✓ Fuel and fuel Combustion
- ✓ Classification of fuels, calorific values (HCV & LCV), calculation of HCV & LCV using Dulong's formula
- ✓ Proximate analysis & ultimate analysis of coal solid fuel
- ✓ petrol & diesel - fuel rating (octane, cetane numbers)
- ✓ Chemical composition, calorific values and applications of LPG, CNG, water gas, coal gas, producer gas and biogas

Lubrication :

- ✓ Function and characteristic properties of good lubricant
- ✓ Classification with examples
- ✓ Lubrication mechanism :
- ✓ Hydrodynamic, boundary lubrication
- ✓ Physical properties (viscosity, viscosity index, oiliness, flash & fire point, cloud & pour point)
- ✓ Chemical properties (coke number, total acid number saponification value) of lubricants.

Unit 5: Electro Chemistry

- ✓ Electronic concept of oxidation
- ✓ Reduction and redox reactions

Definition of terms:

- ✓ Electrolytes, Non-electrolytes with suitable examples
- ✓ Faradays laws of electrolysis and simple numerical problems.
- ✓ Elementary concept of pH and buffer. Industrial Application of Electrolysis–Electrometallurgy, Electroplating, Electrolytic refining
- ✓ Application of redox reactions in electrochemical cells – Primary cells - dry cell,
- ✓ Secondary cell - commercially used lead storage battery, fuel, Solar cells.

Corrosion of Metals:

- ✓ Definition, Types of corrosion (chemical, electrochemical)
- ✓ H₂ liberation, O₂ absorption mechanism of Electrochemical corrosion, factors affecting rate of corrosion

Corrosion preventive measures:

- ✓ Internal: Purification, alloying and heat treatment
- ✓ External: a) metal (anodic, cathodic) coatings, b) organic inhibitors.

Sheet Metal Shop

Job involving soldering, riveting etc:

- ✓ Taper tray, Pipe joint by locked grooved joint, Cabinet, Square hopper, Mug, Materials Estimation
- ✓ Bill of Materials.

Forging Shop

- ✓ Cold / Hot flat chisel, Door ring
- ✓ Fan hook (Long S-type), Ring Tongs

Life & Office Skills

Self analysis and Management:

- ✓ Self-analysis(SWOT analysis)
- ✓ SMART GOAL & Time management

Listening Skill & Body language:

- ✓ Benefits of good communication
- ✓ Communication barriers to avoid.
- ✓ Listening skills, Body Language.

Conversation & Presentation Skills:

- ✓ Building an effective communication to interact with audience.
- ✓ Methods of planning a presentation.

GD, Interview and CV:

- ✓ Techniques of "Group Discussion"
- ✓ Techniques of "Personal Interview".
- ✓ Preparation of CV.

Project:

- ✓ Facing a mock interview session arranged in the campus.

Text Books List

Mathematics-II

- ✓ Engineering Mathematics-II, A. Sarkar, Naba Publication
- ✓ Mathematics – II BK Pal, UN Dhur.

Applied Physics –II

- ✓ Applied Physics – II, D.Choudhuri, Bhagabati Publication
- ✓ Text books of Physics for Class XI & XII (Part I & II); N.C.E.R.T., Delhi.

Introduction to IT Systems

- ✓ Introduction to IT System, P. Mondal, Bhagabati Publication.
- ✓ Computer Applications, P.K. De & A. Basu, Lakshmi Prakashani

EEEE

- ✓ Fundamentals of Electrical & Electronics Engineering, P Das & TK Nag, Bhagabati.
- ✓ Electrical Technology Vol – I, J.B. Gupta, S.K. Kataria & Sons

Environmental Science

- ✓ Environmental Engineering, Dr. Aloka Devi, Bhagabati Publication
- ✓ Applied Chemistry, Kaberi Bhattacharya, Lakshmi Prakashani

Engineering Mechanics

- ✓ A Text Book of Engineering Mechanics, AR Basu, Dhanpat Rai.
- ✓ Engineering Mechanics, DS Kumar, SK Kataria & Sons
- ✓ Applied Mechanics, RS Khurmi, S. Chand & Co

Internship - I

- ✓ Workshop Practice, Swarn Singh, Katson Books
- ✓ Engineering Graphics, N.D. Bhat, Charotar Publishing House;
- ✓ A Textbook of Engineering Drawing, R. K. Dhawan, S. Chand & Co
- ✓ Life & Office Skills, British Council

Ramakrishna Mission Shilpamandira

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Belur Math, Howrah

Syllabus Booklet

Semester – II

**Based on the Latest Syllabus published by the
West Bengal State Council of Technical & Vocational Education and Skill Development**

Mathematics - II

Unit-1: Determinants

- ✓ Definition of determinants of order 2 & 3
- ✓ Minors and cofactors
- ✓ Determinants: Properties & problems
- ✓ Chios Method for 4th order
- ✓ Cramer's Rule for simultaneous linear equations (up to 3 unknowns).

Matrix:

- ✓ Definition of Matrix and its order.
- ✓ Types of Matrices (rectangular, square, row, column, upper & lower triangular, diagonal, scalar, identity, null)
- ✓ Singular & non-singular matrices with simple problems
- ✓ Equality of matrices & Simple prob.
- ✓ Algebraic of matrices Addition, & subtraction
- ✓ Matrix Multiplication(2x2); problems
- ✓ Transpose of a matrix; problems
- ✓ Orthogonal matrix; problems
- ✓ Symmetric & skew symmetric matrices with simple problems
- ✓ Adjoint & inverse of matrix (order 3)

Unit-2:Co-ordinate Geometry (2D)

Coordinate System:

- ✓ Cartesian & Polar Coordinate system & their relations.
- ✓ Distance between two points
- ✓ Internal & external division of a line segment & simple problems.
- ✓ Triangle Area; Collinearity condition

Straight Line:

- ✓ Definition; Gradient (slope)
- ✓ Equations of straight line in various standard forms & simple problems
- ✓ Angle between two straight lines
- ✓ Conditions of parallelism and perpendicularity & simple problems
- ✓ Perpendicular distance from a point to a line, between 2 parallel lines

Circle:

- ✓ Definition, Equation of a circle

- ✓ Centre-radius form, diameter form, Standard form and their equation
- ✓ Simple problems

Conic Section Parabola:

- ✓ Definition & Types, equation,
- ✓ Vertex, axis, eccentricity, focus, directrix, latus rectum & problem

Ellipse:

- ✓ Definition & types, Equation,
- ✓ Vertex, axis, eccentricity, focus, directrix, latus rectum & problem.

Trigonometry & Calculus (Revision):

- ✓ Trigonometry: Concepts & Formulas
- ✓ Derivative : Concepts & Formulas

Unit-3 : Integral Calculus

Indefiniteintegral:

- ✓ Integration as inverse process of differentiation; Rules for integrations (sum, difference, scalar multiple)
- ✓ Integration of standard functions
- ✓ Integration by substitution
- ✓ Integration by parts & partial fraction

DefiniteIntegral:

- ✓ Definite integral Properties, problems
- ✓ Applications: i) area of bounded region ii) Volume & Surface Area of solid generated by revolving about an axis

Unit-4: Ordinary Differential Eqⁿ

1st Order Differential Equation:

- ✓ Definition of ordinary differential equation, order & degree.
- ✓ Formation of differential equation.
- ✓ Solution of Differential equation of First order and first degree by -
- ✓ Separation of Variables
- ✓ Homogeneous, Exact, & Linear differential equations
- ✓ Bernoulli's differential equation
- ✓ **2nd order differential equation:**
- ✓ Solution of 2nd order Differential equations with constant coefficients
- ✓ Complementary Functions (CF)
- ✓ Particular Integral & Problems.

- ✓ Voltage and Current relationship in Star and Delta connections;
- ✓ Voltage & current through resistance, inductance & capacitance: sinusoidal excitation (phasor representation)
- ✓ A.C in resistor, inductor & capacitor
- ✓ A.C in R-L series, R-C series, R-L-C series and parallel circuits;
- ✓ A. C. Power & power triangle.

Unit 6 : Transformer & Machines:

- ✓ Construction and principle of different type of transformers;
- ✓ EMF equation & transformation ratio of transformers; Auto transformers;
- ✓ Construction, Working, Basic Equations & Characteristic of Motors

FEEE Lab

- ✓ Multimeter, Resistor Colour Code, Capacitance measurement
- ✓ R load: Voltage, current, & power.
- ✓ R-L load: Voltage, current, & power.
- ✓ R-C load: Voltage, current, & power.
- ✓ R-L-C load: Voltage, current, power
- ✓ Transformer (1-φ): Turns Ratio
- ✓ Transformer: Efficiency under load.
- ✓ Electric Pump : Starter Connection
- ✓ Kirchhoff's Current & Voltage laws
- ✓ Ammeter etc. Internal resistance
- ✓ Truth tables of different logic gates
- ✓ Diode, BJT testing by multimeter; Forward V-I characteristics.
- ✓ De Morgan's Laws
- ✓ Op-Amp: amplifier, adder, subtractor

Internship – I

Internship will consist of training in:

1. Technical Skills:
 - Engineering Graphics
 - Workshops: Carpentry, Fitting, Welding, Sheet Metal, & Forging
2. Life & Office Skills

Engineering Graphics

Section of solid:

- ✓ Cube, Pentagonal Pyramid, Cylinder, Cone

Development of surfaces:

- ✓ Square Prism, Cylinder, Square Pyramid, Cone

Missing views, Isometric & Sectional views:

- ✓ Orthographic: Missing, Isometric views
- ✓ Sectional Views of Machine Components (half & full)
- ✓ Civil Engg. drawing

Carpentry Shop

Introduction:

- ✓ Wood working Machines: (Wood turning lathe, Circular saw machine, Drilling machine, Thickness planer)
- ✓ Demonstration of above Machines

Practical jobs:

- 1) Through Mortish & Tenon joint
- 2) Dove tail Tee- half lap joint
- 3) Handle of Chisel (Group Job)

Project: Wooden Tray (Group Tasks)

- ✓ Wooden Tray: Materials Estimation
- ✓ Bill of Materials.

Fitting Work Shop

Introduction:

- ✓ Limits, Fits and Tolerance.
- ✓ Screw Threads

Practical job:

- ✓ 'T' Fitting & Step Fitting

Welding Shop

- ✓ Lap joint on M.S plate, Flat position
- ✓ Butt joint on M.S plate, position Flat
- ✓ Hard soldering; brazing /gas welding
- ✓ Spot welding on M.S sheet

Mini project:

- ✓ Window Grill & Materials Estimation
- ✓ Bill of Materials.

Unit 4– Local Administration

- ✓ District Administration
- ✓ Municipal Corporation
- ✓ Zila Panchayat

Unit 5– Election Commission

- ✓ Role and Functioning
- ✓ Chief Election Commissioner
- ✓ State Election Commissioner

Environmental Chemistry Lab

1. Identification of acid and basic radicals by dry and wet tests.
2. Identification of unknown salts.
3. Hardness of water (NaCO₃ method)
4. Iron content in Mohr's salt using KMnO₄ and K₂Cr₂O₇ separately.
5. Determination of Iron in Iron ore Solution by KMnO₄.
6. Neutralization of weak acid and weak base by conductivity meter.
7. Total chlorine residuals (Iodometric).
8. Saponification value of an oil.
9. Preparation of Bakelite.
10. Preparation of Potash alum.
11. Electroplating.
12. Copper in Cu²⁺ solution (hypo).
13. Strength of HCl by titration against NaOH Solution using pH meter.

Fundamentals of Electrical & Electronics Engineering

Unit 1: Electronic Components & Signals:

- ✓ Passive & Active Components:
 - Resistance, Capacitor, Inductor
 - Diode, BJT, FET, MOS, CMOS
 - Applications.
- ✓ Energy level diagrams of insulator, conductor & semiconductor.
- ✓ Intrinsic & Extrinsic semiconductor, Doping concentration
- ✓ Formation of P-Type and N-Type semiconductor and their properties.
- ✓ P-N junction Diode & its properties.

- ✓ Signals: DC/AC, Voltage/Current, Periodic/Non-periodic signals
 - ✓ Average, RMS, Peak value
 - ✓ Different types of signal waveforms
 - ✓ Sources: Ideal/Non-ideal, Voltage, & Current, Independent, & Dependent.
 - ✓ Charge, current, voltage, resistance, inductance, Capacitance, power, energy and their units.
 - ✓ Resistances in series and parallel
 - ✓ Kirchhoff's Current & Voltage laws
 - ✓ Simple problems on D.C. Circuits
- ##### Unit 2 : Overview of Analog Circuits:
- ✓ PNP & NPN transistor, Configurations
 - ✓ Input / Output Characteristics
 - ✓ Operational Amplifiers: Ideal & Practical, Open & closed loop
 - ✓ Amplifier, Adder, Differentiator Integrator.

Unit 3: Overview of Digital Electronics:

- ✓ Boolean Algebra, Operations
- ✓ Karnaugh Map (K-Map) ≤4 variables
- ✓ Gates: Functional Block Approach
- ✓ Flip Flops (Storage Elements)
- ✓ Counters: Ripple, Up/down, Decade.
- ✓ Digital IC Gates (TTL Type).

Unit 4 : Electric & Magnetic Circuits:

- ✓ EMF, Current, Potential Difference, Power, Energy;
- ✓ MMF, magnetic force, permeability, hysteresis loop, reluctance, leakage factor, BH curve;
- ✓ Electromagnetic induction, Faraday's laws, Lenz's law; Dynamically, & Statically Induced EMF
- ✓ Self & mutual inductance Equations
- ✓ Electric & Magnetic Circuit Analogy

Unit 5 : A.C. Circuits:

- ✓ Cycle, Frequency, Time Period, Amplitude, Angular velocity, RMS, Average value, Form & Peak Factors
- ✓ Impedance, phase angle, power factor
- ✓ Sinusoidal quantities in exponential, complex, and polar forms (Phasor)

Unit-5 : Partial Differentiation :

- ✓ Definition & meaning of partial derivative.
- ✓ Evaluation of partial derivatives.
- ✓ Homogeneous functions:
- ✓ Euler's theorem on Homogeneous functions for 2 variables & Problems.

Unit-6: Statistics & Probability

Statistics:

- ✓ Introduction & definition of Statistics
- ✓ Random & continuous variables
- ✓ Frequency distribution: Definition.
- ✓ Measure of Central Tendency (mean, median, mode) & Simple problems
- ✓ Dispersion Measure (SD) problems
- ✓ Mean & SD of Composite group

Probability:

- ✓ Def. of random experiment, sample space, event, occurrence of events
- ✓ Events: Exhaustive, Equally likely, Impossible, Mutually exclusive, etc
- ✓ Probability definition (classical & axioms), problems
- ✓ Total theory of probability, compound theorem probability, Conditional probability, & problem.

Applied physics II

Unit -1: Wave Motion & Applications

Simple Harmonic Motion (SHM):

- ✓ Definition and expression for displacement, velocity, acceleration, time period, frequency
- ✓ Study of vibrations of cantilever & determination of its time period
- ✓ Free, damped and forced vibrations with examples, Numerical problems

Wave motion:

- ✓ Transverse and longitudinal waves
- ✓ Definitions of wave velocity, frequency, wave length relationship
- ✓ Equation of a plane progressive wave
- ✓ Principle of superposition of waves

and beat formation, Numericals

Acoustics of buildings:

- ✓ Reverberation of sound
- ###### Ultrasonic Waves :
- ✓ Introduction and properties
 - ✓ Engineering & medical applications of ultrasonics

Unit – 2: Optics

Basic optical laws:

- ✓ Reflection, refraction, refractive index
- ✓ Images; image formation by thin lens
- ✓ Lens & lens maker's formula
- ✓ Power of lens, Magnification
- ✓ Total internal reflection
- ✓ Critical angle and conditions for total internal reflection
- ✓ Numerical problems

Optical Instruments:

- ✓ Simple, compound microscope
- ✓ Astronomical telescope, Numericals
- ✓ Interference and diffraction of light

Unit – 3: Electrostatics

Electric field:

- ✓ Coulombs law, unit of charge
- ✓ Electric lines of force & properties
- ✓ Electric flux, Gauss law
- ✓ Application of Gauss law: Electric field due to a charged sphere / plate
- ✓ Electric potential & potential diff.
- ✓ Numerical problems

Capacitor & Capacitance:

- ✓ Capacitor and its working
- ✓ Types of capacitors
- ✓ Capacitance and its units
- ✓ Capacitance of a parallel plate capacitor
- ✓ Capacitors in Series / parallel
- ✓ Dielectric and its effect on capacitance
- ✓ Dielectric break down
- ✓ Numerical problems

Unit – 4: Current Electricity

Electric Current:

- ✓ Direct and alternating current
- ✓ Ohm's law, Resistance and its units

- ✓ Specific resistance
- ✓ Conductance, Specific conductance
- ✓ Series & parallel resistances circuits
- ✓ Factors affecting resistance of a wire
- ✓ Carbon resistance & colour coding
- ✓ Kirchhoff's law, Wheatstone bridge
- ✓ Carrey Foster Bridge & applications
- ✓ Concept of potential difference & Electro motive force (EMF)
- ✓ Numerical problems

Heating effect of current:

- ✓ Electric Work, Electric Power
- ✓ Electric energy and its units
- ✓ Joule's law for Heating effect of electric current, Numerical problems

Thermoelectricity:

- ✓ Thermocouple, Seebeck effect
- ✓ Thermo E.M.F, Neutral temperature and Inversion temperature
- ✓ Peltier effect, Numerical Problems

Unit -5: Electromagnetism

Magnetic effect of electric current:

- ✓ Magnetic field and its origin
- ✓ Lorentz force, Biot- Savart law
- ✓ Application to Straight Conductor & circular loop
- ✓ Concept of magnetic dipole
- ✓ Force on current carrying conductor
- ✓ Torque on rectangular coil placed in magnetic field
- ✓ Numerical problems

Electromagnetic induction:

- ✓ Magnetic Flux, Flux density
- ✓ Faraday's Laws
- ✓ Moving coil galvanometer
- ✓ Conversion of a galvanometer into ammeter and voltmeter
- ✓ Magnetic material Types; dia, para and ferromagnetic; their properties
- ✓ Numerical problems

Unit-6: Semiconductor Physics:

- ✓ Energy bands in solids
- ✓ Types of materials (insulator, semi-

conductor, conductor)

- ✓ Intrinsic and extrinsic semiconductors
- ✓ p-n junction, junction diode and V-I characteristics
- ✓ Diode as rectifier: half & full wave
- ✓ Transistor
- ✓ Transistor as an amplifier CE mode
- ✓ Photocells, Solar cells
- ✓ LED: Principle, & Applications

Unit-7: Modern Physics

Atomic structure:

- ✓ Bohr's atom model; Energy levels;
- ✓ Ionization and Excitation potentials

X-rays:

- ✓ Production of X-rays :Coolidge tube
- ✓ Continuous and characteristic-X-rays
- ✓ Soft and hard X-rays
- ✓ Properties of X-rays
- ✓ Uses or application of X-rays
- ✓ Numerical problems

Laser:

- ✓ Spontaneous and stimulated emission
- ✓ Basic components of Laser
- ✓ He-Ne laser characteristics
- ✓ Holography & Applications of lasers

Fiber Optics:

- ✓ Introduction to optical fibers
- ✓ Mechanism of light propagation through Optical fiber, Applications

Nanoscience and nanotechnology

Applied Physics - II Lab

1. Verify laws of resistances in series by P.O.box.
2. Verify laws of refraction (snell's law) using a glass slab.
3. Focal length and magnifying power of a convex lens by u-v method.
4. Ohm's law (Graphical Method)
5. Resistance of a galvanometer (half deflection method).
6. Galvanometer to ammeter/voltmeter.

Air Pollution:

- ✓ Sources (Natural and man-made)
- ✓ Particulate pollutants: PM10, PM2.5
- ✓ Environmental Effects, Control: Bag filter, Electrostatic precipitator, Cyclone separator, Scrubber

Gaseous Pollutants:

- ✓ Environmental Effects & Control: Absorption, Adsorption, Catalytic converter
- ✓ National Ambient Air Quality Standard
- ✓ Global warming, Green House effect
- ✓ Ozone layer depletion, Acid rain

Noise Pollution:

- ✓ Sources, Units & Measuring devices
- ✓ Effects & Prevention, & Limits

Unit-3 :Water and Soil Pollution

Water Pollution:

- ✓ Water Sources& Pollutants
- ✓ Turbidity, pH, Total dissolved solid
- ✓ Total suspended solid, Total solids
- ✓ Fe, Arsenic and Fluoride
- ✓ Definition of DO, BOD, COD
- ✓ BIS water quality standard
- ✓ Flow diagram of drinking watertreatment

Acid, Base, Salt

- ✓ Solubility product, Common-ion-effect

Chemical equilibrium:

- ✓ Equilibrium; Irreversible, Reversible, Exothermic, Endothermic Reactions.
- ✓ Catalyst, Catalysis, Promoter, Catalysis poison, Auto catalyst.
- ✓ Le Chatelier's principle.

Waste water Treatment:

- ✓ Primary Treatment: Coagulation, flocculation, sedimentation
- ✓ Secondary Treatment, Activated Sludge, Trickle filter, Bio-reactor
- ✓ Tertiary Treatment: Membrane Separation Technology, Reverse osmosis
- ✓ General standards for Discharge of Environmental Pollutants

Soil Pollution:

- ✓ Excessive use of fertilizer

- ✓ Pesticides And Insecticides
- ✓ Preventive Measures

Unit-4 : Renewable sources of Energy

Solar Energy:

- ✓ Basics of solar energy
- ✓ Solar water heater
- ✓ Solar drier and Solar stills.

Biomass:

- ✓ Biomass as energy source.
- ✓ Flow Chart of Biogas production
- ✓ Storage and utilization of biogas

Other Energy Sources:

- ✓ Basic Concept & Application of:
 - Tidal energy, Geothermal energy
 - Hydrogen, Ocean Energy Resources

Unit-5 : Solid Waste Management:

- ✓ Sources, & Characteristics:
 - Municipal Solid Waste
 - Bio-medical waste, and E- waste
- ✓ Industrial Metallic & Nonmetallic waste: lubricants, plastic, rubber
- ✓ Effects & Management 4R (Reduce, Reuse, Recycle & Recover)
- ✓ Composting, Sanitary landfill, Incineration, Open Dumping.

Indian Constitution

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, Council of Ministers
- ✓ Lok Sabha and Rajya Sabha

Unit 3– State Government

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

- ✓ Centre of Gravity of Simple Solids: Cube, Cuboid, Cylinder, Sphere.
- ✓ Centre of Gravity of composite solids. Basics only.

Unit-VI : Simple Lifting Machines:

- ✓ Definition of Lifting Machine, Applications and Advantages.
- ✓ Machine: Load, Effort, Mechanical Advantage, Velocity Ratio, Efficiency
- ✓ Law of machine, Ideal Machine.
- ✓ Friction in Machine, Maximum Mechanical Advantage & Efficiency,
- ✓ Reversible & non-reversible machines; conditions for reversibility
- ✓ Velocity ratios of (i) Simple, & Differential Axle & Wheel (ii) Worm & worm wheel (iii) Single purchase & Double Purchase Crab Winch (v) Simple Screw Jack (vi) Simple Pulley Block., Simple numericals.

Unit VII: Motion in a Plane

Rectilinear Motion:

- ✓ Displacement-Time & Velocity-Time diagrams, Motion equations.
- ✓ Newton's 2nd Law of linear motion
- ✓ Momentum & its Conservation
- ✓ Simple numerical problems.

Curvilinear Motion:

- ✓ Angular displacement/velocity, Linear/Angular velocity Relation.
- ✓ Angular acceleration, Linear & angular acceleration Relationship.
- ✓ Centripetal and centrifugal force
- ✓ Numerical problems

Work, Power, Energy:

- ✓ Concept & math expression (& SI units) of Work, Power & Energy.

Engineering Mechanics Lab

1. Single purchase crab winch: Find MA, VR, η , law of machine.
2. Double purchase crab winch: Find MA, VR, η , law of machine.

3. Worm and worm wheel: Find MA, VR, η , law of machine.
4. Differential Axle and Wheel: Find MA, VR, η , law of machine.
5. Simple Screw Jack: Find MA, VR, η , law of machine.
6. Horizontal plane: Coefficient of friction for motion.
7. Inclined plane: Coefficient of friction for motion.
8. Resultant of concurrent force system (Analytical/Graphical Method).
9. Polygon Law of forces: Resultant of concurrent forces (Experimental)
10. Resultant of Parallel force system: (Analytical/Graphical Method).
11. Verify Lami's theorem (graphical)
12. Centroid of Plane Lamina
13. Jib crane: Forces in the members.

Environmental Science & Indian Constitution

Environmental Science

Unit-1 : Industrial Chemistry:

Corrosion, Metallurgy,

Organic Chemistry:

- ✓ Preparation & properties of Methane, Ethylene, & Acetylene.
- ✓ Functional Groups, Isomer, Homologous series,
- ✓ Polymers: Thermoset & thermoplastic materials:
- ✓ Petroleum & Petro-chemicals

Radioactivity:

Radioactivity and Radioactive elements, Natural Radioactivity, properties of α, β, γ – rays, Radioactive decay, difference between radioactive change and chemical change, half-life period. Nuclear reactions – Fission & Fusion reaction.

Unit-2 : Air and Noise Pollution:

- ✓ Definition of pollution pollutant

7. V-I characteristics of semiconductor diode (Ge, Si); & its Knee voltage.
8. Laws of resistances in parallel (using Ammeter and Voltmeter).
9. Specific resistance of a wire (with Meter Bridge)
10. Acceleration due to gravity (g) (by pendulum).
11. Frequency of unknown tuning fork (Sonometer method)
12. Velocity of sound (Resonance Air Column Method).
13. Frequency of unknown tuning fork (Resonance Air Column Method).
14. Lines of force due to a bar magnet; Finding of neutral points
15. Zener diode as voltage regulator.
16. Specific heat of a solid (Method of Mixtures).
17. Verify the laws of reflection of light.

Introduction to IT Systems

Unit -1: Basic Internet skills:

- ✓ Understanding Browser & Examples
- ✓ Definition of Search Engine & efficient use
- ✓ Search Engine working principles
- ✓ ISP (Internet Service Provider)
- ✓ Email Address & Structure
- ✓ Email working principles & their protocols
- ✓ Digital India portals, Vision, initiatives and college portals.

Number system & Codes

- ✓ Binary, octal, hexadecimal and decimal number systems
- ✓ Inter conversion, BCD numbers
- ✓ Gray code, Excess-3 code
- ✓ ASCII, Unicode, EBCDIC codes.
- ✓ Binary addition and subtraction
- ✓ Signed and Unsigned binary numbers
- ✓ 1's and 2's complement format.

Boolean Algebra:

- ✓ Basic logic circuits: Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, ExNOR and their truth tables), Universal Gates,
- ✓ Laws of Boolean algebra,
- ✓ De-Morgan's theorem,

Computer Hardware:

- ✓ CPU, Memory, Display, Keyboard, Mouse, HDD, SSD, & other Peripheral Devices.
- ✓ Printer & their classification
- ✓ Various port of a mother board
- ✓ Classification of Computer
- ✓ Organization of a Computer System
- ✓ Computer generation, Classification of software & their usage.

Unit -2: Operating Systems

Overview of Operating Systems:

- ✓ What is an OS, Brief history.

Background and Basics:

- ✓ Computer System review
- ✓ Types of OS, Computer Architecture
- ✓ Classification : Batch, Multi-programmed batch, Timesharing
- ✓ Computer System Structures
- ✓ Operating System Structures

Unit -3: Algorithm & Flowcharts

- ✓ Algorithm & Flowcharts : Definition, Characteristics, Advantages and disadvantages
- ✓ Symbols of flowchart
- ✓ Examples of Algorithm & Flowchart of Various programs.

Unit -4: HTML5, CSS, JavaScript

HTML 5:

- ✓ Introduction HTML,
- ✓ HTML, Head, Body, Style, Script
- ✓ Break, body, center, div, form, heading level (1 to 6), image, font, order list, under list, paragraph, table, data cell etc.

- ✓ Formatting Tags : Link, bold, italic, underline, strong, emphasized text, small, del, subscript, superscript, etc.
- ✓ Input, label, text, select, textarea, button, option, checkbox, radio, hidden filed, date, file, color etc.

Cascading Style Sheets(CSS):

- ✓ CSS Introduction & Advantage
- ✓ HTML vs CSS; CSS Styling type : Inline, Internal, External
- ✓ CSS formatting (Styling): Text, Font, Background, List, Table, etc
- ✓ CSS Box Model : Border, Margin, Padding, Content Area, CSS Outline
- ✓ CSS syntax : Id & Class; Display
- ✓ CSS layout – Positioning: static, relative, fixed, absolute, Floating, Clear, Align, CSS Navigation Bar
- ✓ CSS Image Gallery, Image Opacity

JavaScript:

- ✓ Introduction, Features & Application, Advantage, JavaScript Syntax
- ✓ Embedding Script in HTML File: Internal & External
- ✓ Comments lines, Character set, Identifier, Keywords, Variable, Data type,
- ✓ Operators: Arithmetic, Logical, Comparison, Assignment, bitwise
- ✓ Input / Output Statement
- ✓ Conditional Statement: If, If-Else, Switch
- ✓ Looping Statement: For, While, Do/while & their examples.

Unit-5: Network Utilities & Devices :

- ✓ Computer Network & their components
- ✓ Network Classification
- ✓ Network topology, IP address
- ✓ Introduction to Computer Security
- ✓ Ethics & Safety measures
- ✓ Cyber Stalking, Fraud, and Abuse
- ✓ Denial of Service Attacks (Scanning – WireShark)
- ✓ Computer virus, Malware (Hacking)

Intro. to IT Systems Lab

Unit 1, 2, 3, 4:

- ✓ Browser features & Settings, Search engines, writing search queries,
- ✓ e-governance / Digital India portals
- ✓ Operating system fundamentals
- ✓ Components of computer system: Input & Output Devices; Memory handling; Storage devices.
- ✓ Wikipedia pages on Internet: Identification of Hardware components, ports / interfaces, cables, etc.

Unit 5 & 6:

- ✓ Install Linux and Windows operating system on identified lab machines.
- ✓ Overview of various peripherals (printer, scanner, etc.) to computer;

Unit 7:

- ✓ Webpage design with HTML, CSS & JavaScript

Unit 8 : MS Office

MS Word :

- ✓ Formatting Word Document
- ✓ Mail merge, Shapes, Table
- ✓ Create : Bio-data & Cover Page etc.

MS Excel:

- ✓ Apply Custom Formats and Layouts
- ✓ Format Cells, Sorting, Filter
- ✓ Apply Borders, Design Borders
- ✓ Custom Formatting

Simple & Advanced formulas:

- ✓ Simple Text, Mathematical functions
- ✓ Conditional & Logical Functions

Reference formulas like:

- ✓ Lookup, vlookup, hlookup,
- ✓ Index, Match, Scenarios, Goal seek

Charts :

- ✓ Bar Charts, Pie Chart, Donut chart,
- ✓ Histograms, Line Graph, Trend, Pivot tables

Unit 9:MS-Power Point:

- ✓ Power Point Slide Template.
- ✓ Create Animation, transition
- ✓ Add: movie, sound, tables, chart etc

- ✓ Changing slide colour scheme.
- ✓ Slide navigator: Create, Save, Print.

Unit 10:Using Internet:

- ✓ Create Email
- ✓ Online Google Office Tools: (Docs, Sheets, Slides, Forms):
- ✓ Save/Shareon Google Drive (Cloud)

Engineering Mechanics

Unit-I : Basics of Mechanics:

- ✓ Concept of Engineering Mechanics– Statics & Dynamics;
- ✓ Space, time, mass, particle,
- ✓ Flexible body and rigid body.
- ✓ Scalar Quality and Vector Quality;
- ✓ Addition & Subtraction of Vectors
- ✓ Basic units, Derived Units, SI units.

Force:

- ✓ Definition, Units, Representation (Vector, & Bow's notation)
- ✓ Characteristics and Effects of a Force
- ✓ Principle of transmissibility of force.
- ✓ Force systems and its classification
- ✓ Co-planar Force System.

Coplanar Concurrent Force System

Composition of Forces:

- ✓ Parallelogram Law, Triangle Law and Polygon Law of Forces.
- ✓ Resultant by Analytical & Graphical methods. Vector diagram.
- ✓ Resolution of Forces: Orthogonal components of a force.
- ✓ Simple problems on composition & resolution of forces

Unit-II : Moments & Couples

Moment:

- ✓ Moment of a force about a point
- ✓ Physical significance of Moment
- ✓ system of parallel & inclined forces – Varignon's Theorem, Problems

Couples:

- ✓ Definition of moment of a couple
- ✓ Physical significance of Couples

- ✓ Equivalent couples– Resultant of any number of coplanar couples
- ✓ Replacement of a force about a point by an equal like parallel force & a couple. Simple problems.

Unit-III: Condition of Equilibrium

Coplanar Concurrent Force System:

- ✓ Lami's Theorem. Triangle Law & Polygon Law of equilibrium
- ✓ Concept of Free Body diagram.
- ✓ Equilibrium of Co-planar system of non-concurrent forces:
- ✓ Conditions of equilibrium of non-concurrent parallel forces (Like & Unlike)
- ✓ Simple problems (excluding statically in-determinant Type).
- ✓ Types of beams, and loads
- ✓ Supports: Simple, hinged, roller, fixed
- ✓ Simply Supported Beam: Reaction; with or without overhang; Point Load & Uniformly Distributed load.
- ✓ Simple Problems

Unit-IV : Friction:

- ✓ Friction: Relevance in Engineering
- ✓ Types & Laws of friction.
- ✓ Limiting Friction, Friction Coefficient
- ✓ Angle of friction, Cone of Friction, Angle of Repose.
- ✓ Relation between Coefficient of Friction and Angle of Friction.
- ✓ Equilibrium on inclined plane subject to forces parallel & inclined to plane.
- ✓ Simple Problems

Unit-V:Centroid, Centre of Gravity:

- ✓ Concept & definition.
- ✓ Centroid of Uniform Plane Lamina: Triangular, Rectangular, Circular, Semi-circular &, quadrant of Circle.
- ✓ Centroid of Composite sections (i) T, I, & Z-sections, (ii) angle-sections, (iii) Channel-sections, (iv) cut-out sections, (vii) Built-up sections
- ✓ Simple Problems

- ✓ Zener diode Characteristics, & Breakdown Voltage.
- ✓ Input & output characteristics of BJT in CE or CB mode.
- ✓ Characteristics of JFET / MOSFET.
- ✓ Construct a single stage CE Amplifier; observe input & output waveforms.

- ✓ Relaxation Oscillator using UJT & observe output waveform by CRO.
- ✓ Construct $\pm 12V$ power supply on with / without filter circuit.
- ✓ IC regulator 78XX & 79XX.

Digital Electronics laboratory

- ✓ Verification truth table of basic, universal and exclusive gates
- ✓ Half & Full Adder using logic gates
- ✓ Half & Full subtractor with logic gates
- ✓ Encoder and Decoder circuit.
- ✓ Multiplexer and Demultiplexer circuit
- ✓ SR latch using NAND & NOR gates
- ✓ SR flip flop using NAND / NOR gates and clock.
- ✓ IC version D, JK & T flip flops.
- ✓ Binary Asynchronous counter (4-bit)
- ✓ Binary synchronous counter (3-bit)
- ✓ Shift register in SISO, SIPO, PISO and PIPO Configuration
- ✓ D/A converter using Op-Amp IC
- ✓ A/D converter using IC 0808 / 0804

Electrical Workshop-I

- ✓ Wire gauge as measuring instrument; current capacity of wires.
- ✓ Insulation resistance by megger. (for cable, transformer and motors)
- ✓ Types of earthing and measure the earth resistance by earth tester.
- ✓ Construction of 3 and 4 point starter and measure its step resistance.
- ✓ Dismantle & assemble of ceiling, table fan, names of different parts.
- ✓ Ceiling fan resistor type fan regulator

- Connection, reversal of rotation.
- ✓ Winding of ceiling fan.
- ✓ Fire Classes, fire alarm, extinguisher.
- ✓ battery types, specification, charging methods, electrolyte specific gravity.
- ✓ Design of 1 phase transformer.

Text Books List

Introduction to Electric Generation Systems

- ✓ J.B. Gupta, A Course in Electrical Power- S. K Kataria and Sons
- ✓ Soni, Gupta, Bhatnagar, A Course in Electrical Power. – Dhanpat Rai and Sons

Electrical Circuits

- ✓ Network Analysis & Synthesis by Ravish R. Singh, McGraw-Hill
- ✓ Introduction to network, Filters and Transmission Lines by A. K. Chakraborty, Dhanpat Rai & Sons

Electrical & Electronic Measurement

- ✓ Sawhney A.K., Electrical and Electronics Measurements & Instrumentation, Dhanpai Rai & Sons

DC Machines & Transformers

- ✓ Ashfaq Hussain, Electric Machines, Dhanpai Rai & Sons
- ✓ Bhattacharya, S. K., Electrical Machines, McGraw Hill Education

Analog and Digital Electronics

- ✓ Electronics Devices & Circuits by JB Gupta, Kataria & Sons
- ✓ Electronic Principle by Sahadev, Dhanpat Rai & Sons.
- ✓ Fundamental Digital Circuits by A. Anand Kumar, PHI
- ✓ Digital Circuits and Design by S. Salivahnan & A. Arivazhgan, Vikash Publishing House

Ramakrishna Mission Shilpamandira

An AICTE Approved
Self-Financed Polytechnic

Belur Math, Howrah



Syllabus Booklet

Diploma in Electrical Engineering [EE]

Semester – III (Part-II)

Based on the Latest Syllabus published by the
West Bengal State Council of Technical & Vocational Education and Skill Development

Introduction to Electric Generation Systems

Coal Based Thermal Power Plant

- ✓ Selection of site, Layout and working with block diagram
- ✓ Features and Function of the following equipments –(a) Boiler (b) Economiser (c) Super Heater & Reheater (d) Air Pre-Heater (e) F.D. Fan & I.D. Fan, Chimney (f) Steam Turbine (g) Condenser (h) Feed Water Heater & feed water pump (i) De-aerator (j) Spray pond & Cooling Tower (k) D.M. Water plant (l) Coal Handling Plant (m) Ash Handling (n) ESP (o) concept of zero discharge system.
- ✓ Basic concept of Rankine Cycle
- ✓ Fuel combustion: Stokers, Pulverisers, Fluidised Bed Combustion (concept only)
- ✓ Concept of Super Critical Boiler
- ✓ Classification of coal, Calorific Value, Power plant coal selection
- ✓ Coal power plant: Merits, Demerits
- ✓ Thermal, Electrical and Overall Efficiency, numerical problems.
- ✓ List of important coal power plants in India with their capacities

Nuclear Power Plant

- ✓ Selection of site, Layout and working with block diagram
- ✓ Nuclear Fission & Fusion, Chain Reaction, Half-Life period
- ✓ Construction & Working of Nuclear Reactor. Function of equipments: (a) Core (b) Fuel rod (c) Moderator (d) Control rod (e) Thermal shielding (f) Reflector
- ✓ Nuclear fuels : Fissile & Fertile materials, Types of reactors
- ✓ Disposal of nuclear waste

- ✓ Merits & Demerits of nuclear power plant
- ✓ List of important nuclear power plants in India with their capacities

Gas and Diesel Power Plant

Gas Turbine Power Plant

- ✓ Selection of site, Layout and working with block diagram
- ✓ Fuels and different elements used in gas turbine power plant
- ✓ Merits and Demerits of Gas Turbine Power Plant

Diesel Electric Power Plant

- ✓ Layout and working with block diagram, working of different elements used in diesel power plant
- ✓ Merits & Demerits of Diesel Electric Power Plant
- ✓ Field of application

Large Hydro Power Plants

- ✓ Selection of site; Layout and working with schematic diagram
- ✓ Dam Components & Functions: Storage reservoir, Dam, Spillway, Penstock, Surge Tank etc.
- ✓ Water Turbines: Type, construction, operation and use.
- ✓ Pumped Storage Plant
- ✓ Merits & Demerits
- ✓ Simple numerical problems
- ✓ List of important Large Hydro Plants in India with their capacities

Economics of Power Generation & Interconnected Power Station

- ✓ Terms – Connected Load, Firm Power, Cold, Hot &, Operating Reserve, Spinning Reserve, Average &, Maximum Demand
- ✓ Base Load Plant & Peak Load Plant
- ✓ Load Curve, Load Duration Curve, Integrated Duration Curve, Mass Curve, simple numerical problems

- ✓ Need of filters & Types: a) Series inductor, b) Shunt capacitor, c) LC filter, d) π filter.
- ✓ Circuit operation of the filters, limitations & advantages

Unit : 2 - Transistors:

Bipolar Junction Transistor (BJT)

- ✓ Transistor configurations: CB, CE, CC
- ✓ Circuit diagram & input & output characteristics of each configuration
- ✓ Comparison between three Configuration
- ✓ Transistor parameters – input & output resistance, α , β & their interrelation
- ✓ Related numerical problems
- ✓ Transistor specification – $V_{CE\text{ sat}}$, $I_{C\text{ max}}$, V_{CE0} , I_{CE0} , V_{CE} Breakdown, α , β , Power dissipation.
- ✓ Basic Common Emitter Amplifier and D.C Load Line
- ✓ Importance of DC load line and AC load line, Operating point
- ✓ selection of Q point and stabilization
- ✓ Related numerical problems
- ✓ Need of biasing, Name of different biasing methods of transistor.
- ✓ Voltage Divider biasing method
- ✓ Power Amplifier: Classification – Class A, Class B, Class AB, Class C amplifiers.

Field effect transistor (JFET)

- ✓ Symbol, Construction of JFET, working principle
- ✓ V-I characteristics of JFET, pinch-off voltage, drain resistance, transconductance, amplification factor and their relationship.
- ✓ Types of MOSFET, construction, working principle and applications

Unijunction transistor (UJT)

- ✓ Symbol, Construction, Working principle and characteristics of UJT

Unit 3: Feedback Amplifiers, Oscillators

- ✓ Concept of Positive and Negative feedback, Voltage gain of amplifier for negative and positive feedback.
- ✓ Introduction to oscillator, Block diagram of sine wave oscillator, requirement of oscillation, Barkhausen criterion
- ✓ Wien bridge & Colpitt oscillator: operating principle, frequency.

Unit 4: Combinational Logic Circuits

- ✓ Half adder, Full adder
- ✓ Half subtractor, Full subtractor
- ✓ N bit parallel adder
- ✓ Parity Generator and checker
- ✓ Digital comparator, Code converter
- ✓ Encoder, Decoder
- ✓ Multiplexer, Demultiplexer

Unit 5: Sequential Logic Circuits

- ✓ RS, D, T, JK, JK Master Slave Flip Flops using basic gates, preset, & clear
- ✓ Asynchronous Synchronous Counter, Mod-N, Up Down, & Ring counter
- ✓ Shift register, Serial in Serial out, Serial in Parallel out, Parallel in serial out, Parallel in Parallel out

Unit 6: Data Converters, Memory Devices

- ✓ D/A Converter: Basics, Weighted Resistor, & R-2R Ladder converters
- ✓ A/D Converter: Successive approximation, & Dual slope method
- ✓ Concept: Static & Dynamic Memory,
- ✓ SDRAM, DDR RAM, PROM, EEROM, EPROM
- ✓ DTL, TTL and ECL Gates
- ✓ Comparison of Logic families

Analog & Digital Electronics Lab

- ✓ Construct full-wave rectifier circuit & draw input, output waveforms – with filters and without filters.

- ✓ Vector group & connections of 3- Φ transformer –IS:2026 (part-IV)-1977.
- ✓ Practical application of zig-zag connection in earthing transformer.
- ✓ Tertiary winding and its utility.
- ✓ Different cooling methods.
- ✓ Parallel operation of three phase transformer-need & conditions
- ✓ Power and distribution transformer
- ✓ Criteria for selection of Power and distribution transformer
- ✓ AmorphousCore transformer: 3- Φ distribution transformerIS:1180-1989
- ✓ 3- Φ Autotransformer – Construction; working principle & application.
- ✓ Transformer Scott-connection, &Open delta connection – working principle, connection diagram & practical application.
- ✓ Phasing out test on 3- Φ transformer.

Unit 6: Special Purpose Transformers

- ✓ Isolation transformer: Construction, working principle and applications.
- ✓ Welding transformer: Construction, working principle and applications.
- ✓ Pulse transformer: Construction, working principle and applications
- ✓ Transformers 'K' factor: overheating due to non-linear loads &harmonics.

DC Machines &Transformers Lab

- ✓ Study the construction of transformer.
- ✓ Polarity test of 1- Φ transformer.
- ✓ Determine equivalent circuit parameters of 1- Φ transformer & estimate the losses by performing O.C. test and S.C. test.
- ✓ Regulation & efficiency of 1-phase transformer by direct loading method.
- ✓ Efficiency of a single-phase transformer by Back-to-Back test.
- ✓ To perform heat run test of a single-phase transformer.

- ✓ Parallel operation of two 1 phase transformers: for load sharing.
- ✓ Connections (vector grouping) of 3phase transformer
- ✓ Dismantle and study the DC machine.
- ✓ O.C.C. of a D.C. generator & find the critical resistance.
- ✓ Performance of D.C. shunt generator by load test & draw characteristics.
- ✓ Starting and reversing of DC motor.
- ✓ Speed Control of DC shunt motor above & below rated speed.
- ✓ Performance of D.C. shunt motor by load test. Draw load Characteristics.
- ✓ Performance of D.C. series motor by load test; draw load characteristics.
- ✓ To compute the efficiency of a D.C. motor by Swinburne's test.
- ✓ Check the functioning and testing of the isolation transformer.
- ✓ Check the functioning and testing of pulse transformer

Analog and Digital Electronics

Unit: 1-Diode

Zener Diode

- ✓ Construction, Symbol, Circuit for (Forward & Reverse) characteristics, Zener & Avalanche Breakdown
- ✓ Zener specifications: voltage, power dissipation, break over &maximum reverse current, dynamic resistance.

Rectifiers and Filters

- ✓ Need of rectifier, Types of 1- Φ rectifiers - Half wave & full Wave rectifier (Bridge & Centre tapped).
- ✓ Rectifiers operation of: Current, & Voltage Input & output waveforms.
- ✓ Average & rms voltage & current, Ripple factor / frequency, Form factor, diode PIV, Rectifier efficiency

- ✓ Factors affecting cost of generation: Demand / Load / Diversity Factor, Plant Use &Plant Capacity Factor. Numericals
- ✓ Types of Tariff: Flat Rate, Block Rate, Two / Three Part, Numericals
- ✓ Significance of Interconnected Power System
- ✓ Choice of size & number of units, combined operation of power plants
- ✓ Reasons and impact of grid system faults, State Grid and National Grid
- ✓ Brownout and Blackout

Introduction to Electric Generation Systems Laboratory

- ✓ Demonstration of different parts of coal based thermal power plant.
- ✓ Demonstration of different types of boilers used in thermal power plant
- ✓ Demonstration of different parts of large hydro power plants
- ✓ Demonstration of water turbines used in large hydro power plant
- ✓ Demonstration of different parts of nuclear power plant
- ✓ Demonstration of different parts of diesel generator power plant
- ✓ Demonstration of gas power plant.
- ✓ Energy cost estimation of a residential, commercial and industry

Electrical Circuits

Unit 1: Network Theorems

- ✓ Mesh Analysis & Node Analysis
- ✓ Star/delta & delta/star transformation
- ✓ Superposition theorem
- ✓ Thevenin's & Norton's theorems
- ✓ Maximum power transfer theorem
- ✓ Related Numerical problems

Unit 2: Single Phase A.C 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 ¶llel circuit; impedance, reactance; impedance triangle, Power factor, Active, Reactive, Apparent power, power triangle, vector diagram
- ✓ Resonance, Bandwidth, Quality factor & voltage magnification in series ¶llel R-L-C circuit
- ✓ Related Numerical problems

Unit 3: Three Phase A.C Circuits

- ✓ Phasor and complex representation of three phase supply
- ✓ Phase sequence and polarity
- ✓ Types of three-phase connections, Relationship between Phase and line quantities in three phase star and delta system with derivation
- ✓ Concept of balanced and unbalanced load, neutral shift in unbalanced load
- ✓ Three phase power, active, reactive & apparent power in star & delta system
- ✓ Related Numerical problems

Unit 4: Transient Analysis

- ✓ Introduction
- ✓ Simple R-L &R-C Circuit supplied from a DC voltage source
- ✓ Time Constant, Numerical problems

Unit 5: Laplace Transform

- ✓ Definition & Properties
- ✓ Laplace Transform of Unit Step, Impulse, Ramp, Exponential, Sine, Cosine Function.
- ✓ Initial value &Final Value Theorem
- ✓ Laplace Transformations for solving differential equations describing simple electrical circuits
- ✓ Related Numerical problems

Unit 6: Two Port Network

- ✓ Open circuit Impedance and Short circuit Admittance parameters
- ✓ Transmission parameters and their Inter relations
- ✓ Related Numerical problems

Electrical Circuits Lab

- ✓ Verification of KCL & KVL.
- ✓ Verification of Thevenin's Theorem.
- ✓ Verification of Norton's Theorem.
- ✓ Maximum power transfer theorem.
- ✓ Analysis of RL & RC series circuit.
- ✓ RLC series circuit & resonance.
- ✓ RLC parallel circuit & resonance.
- ✓ Circuit parameters for three phase balanced and unbalanced load.
- ✓ Determination of AC response in dual trace oscilloscope.

Electrical and Electronic Measurement

Unit 1: Fundamentals of Measurements

- ✓ Measurement Purpose, Significance
- ✓ Measuring instruments: Static dynamic characteristics, Classification, Calibration.
- ✓ Types of Errors in instruments
- ✓ Essential requirements in indicating type instruments.

Voltage & Current Measurement

- ✓ Construction, working principle, salient features, merits & demerits, application of instruments: PMMC, MI, Electrodynamometer, Rectifier type ac voltmeter, Clamp on meter.
- ✓ Range extension methods in voltmeter and ammeter.
- ✓ Calibration of ammeter, voltmeter.
- ✓ CT & PT: types, construction, error & its reduction, accuracy class, Burden, Precautions, Application.

Unit 3: Electric Power Measurement

- ✓ Dynamometer type wattmeter: Construction and working principle, Multiplying factor and extension of range, Different types of errors and their compensation.
- ✓ Active power in 3- Φ circuit for balanced load by one wattmeter, two wattmeter, & three wattmeter methods, related problems.
- ✓ Measurement of active power in three phase circuit for unbalanced load.
- ✓ Effect of power factor variation on wattmeter readings in two wattmeter method – Numerical problems.
- ✓ Measurement of reactive power in three phase circuit.
- ✓ Maximum Demand indicator - Construction and working principle.

Unit 4: Electric Energy Measurement

- ✓ 1- Φ & 3- Φ electronic energy meter: Constructional & working principle, Types of errors and compensation.
- ✓ 1- Φ & 3- Φ Induction type energy meter Constructional & working principle, errors and compensation.
- ✓ Calibration of single-phase electronic energy meter using direct loading.

Unit 5: Other Meters & CRO

- ✓ Classification of resistance and their measurement techniques.
- ✓ Construction, working principle, application of Wheatstone bridge., Kelvin's double bridge, ohm meter (series & shunt), Megger, Earth tester
- ✓ Anderson bridge for inductance.
- ✓ Schering bridge for capacitance
- ✓ Power factor meter Working principle & circuit diagram (1- Φ & 3- Φ)
- ✓ Working, block diagram, application of digital frequency meter, tri-vector meter, LCR meter, Synchroscope, multimeter, signal/function generator.

- ✓ CRO & DSO: type, construction, functional block diagram, application.

Electrical & Electronic Measurement Lab

- ✓ Measurement using clamp-on meter, digital multimeter, L-C-R meter.
- ✓ 3- Φ power Measurement by single wattmeter, & two wattmeter method.
- ✓ Calibration of 1- Φ energy meter by direct loading, Phantom loading.
- ✓ Measurement of unknown inductance using Anderson bridge.
- ✓ Measurement of unknown capacitance using Schering bridge
- ✓ Measurement of low resistance using Kelvin's double bridge.

DC Machines & Transformers

Unit 1: General Introduction of Rotating Machines

- ✓ Electro-Mechanical energy conversion for generator & motor modes

Unit 2: DC Generator

- ✓ Construction, Working & types
- ✓ Armature winding : Lap & Wave
- ✓ E.m.f equation, methods of building up of e.m.f . Critical resistance and Critical speed (Numerical).
- ✓ Open circuit & external characteristics for various generators
- ✓ D.C. generator types & Applications.
- ✓ Flux distribution, Armature reaction & remedial measures in DC machines
- ✓ Commutation method, Concept of reactance voltage.
- ✓ Function of interpole & compensating winding.
- ✓ Parallel operation of dc generator.

Unit 3: DC Motor

- ✓ Working principle, Back e.m.f., Speed and Torque equation.
- ✓ Starters: 3-point & 4-point starter

- ✓ Characteristics of Series, Shunt & Compound motors.
- ✓ Methods of speed control.
- ✓ Losses and Efficiency (Numerical).
- ✓ Braking methods – Regenerative, Counter current & dynamic braking.
- ✓ Applications different DC motors.
- ✓ Brushless DC motors: Construction; working principle and applications.

Unit 4: Single phase Transformer

- ✓ Construction, Shell type, core type, different parts & their functions.
- ✓ Material used: CRGO, CRNGO, HRGO, amorphous core.
- ✓ Principle of operation.
- ✓ E.m.f. equation, transformation ratio, rating of transformers. (Numerical)
- ✓ Ideal and practical transformer.
- ✓ Performance under no-load condition with phasor diagram. (Numerical)
- ✓ Performance under load condition with phasor diagram. (Numerical)
- ✓ Equivalent circuit. (Numerical)
- ✓ Per unit representation of impedance.
- ✓ Voltage Regulation at upf, lagging pf & leading pf. (Numerical)
- ✓ Losses, Efficiency, Maximum & All-day efficiency, back to back test
- ✓ Open Circuit & Short Circuit tests – Estimation of losses & Equivalent circuit parameters. (Numerical)
- ✓ Polarity test of transformer.
- ✓ Parallel operation of 1- Φ transformers
- ✓ Tap-changing, Off load & On-load.
- ✓ 1- Φ Auto transformer: Construction, Working principles & application.
- ✓ Application of 2 winding transformer.

Unit 5: Three Phase Transformer

- ✓ Construction, different parts and their function. Different types of winding.
- ✓ Bank of three 1- Φ transformers & single unit 3- Φ transformer.

Internship: C & Python

Programming in C

- ✓ **Basics of C** - Structure of a C program, Comments, Program statements, Identifiers, Data types, Variables, Operators, Expressions & precedence.
- ✓ Non-formatted & formatted input output.
- ✓ **Selection statements** – if, if-else, nested if, nested if-else, comma operator, conditional operator, switch.
- ✓ **Looping statements** while, for, do-while; goto, break, continue, exit.
- ✓ **Arrays:** One dimensional array, Declaration & initialization, Accessing & operations, header files & their use, Functions from ctype.h, string.h; 1-dim array program.
- ✓ **Functions** - Concept of function & Use, Call-by-value Vs Call by-reference, Simple programs.

Python Programming

- ✓ **Python IDE** - Python Hello World, print(), Define/Declare String Variable Types
- ✓ **Data Structures:** LIST, TUPLE — Pack, Unpack, Compare, Slicing, Delete, Key
- ✓ **Dictionary:** Update, Cmp, Len, Sort, Copy, Items, str Example, Add Key/Value Pair
- ✓ **Operators:** Arithmetic, Comparison, Logical, Assignment, Bitwise & Precedence
- ✓ **Loops:** Conditional Statements IF...Else, ELIF & Switch Case; For & While Loops — Enumerate, Break, Continue Statement; break, continue, pass statements Examples.
- ✓ **Strings:** Replace, Join, Split, Reverse, Uppercase & Lowercase; Python functions: strip(), count(), format(), len() find(); example
- ✓ **User Defined Functions (UDF):** Parameterized & non Parameterized with return statement; UDF Function

Text Books List

Power Electronics Converters & Application

- ✓ Power Electronics, PS Bimbhra, Khanna

Electric Power Transmission & Distribution

- ✓ Principles of Power System, VK Mehta, S. Chand & Co.
- ✓ Textbook on Power System Engineering, Sony, Gupta, Bhatnagar, Dhanpat Rai

Induction, Synchronous and Special Electrical Machines

- ✓ Electrical Machines, SK Bhattacharya, McGraw Hill Education
- ✓ Electric Machines, Ashfaq Husain & Haroon Ashfaq, Dhanpat Rai

Renewable Energy Power Plants

- ✓ Non-Conventional Energy Resources, BH Khan, McGraw Hill.
- ✓ Non-Conventional Energy Resources, S Hasan Saeed & DK Sharma, Kataria

Switchgear and protection

- ✓ Switchgear & Protection, Gupta JB, Kataria
- ✓ Power System Protection & Switchgear, Badri Ram, Vishwakarma, McGraw-Hill

C Programming Lab

- ✓ Programming with C, T Jayapooan
- ✓ Programming in ANSI C, E. Balagurusamy

Hysteresis, Universal, Repulsion, Linear induction Induction generator

Ramakrishna Mission Shilpamandira

An AICTE Approved
Self-Financed Polytechnic

Belur Math, Howrah

Syllabus Booklet

Diploma in Electrical Engineering [EE]

Semester – IV (Part-II)

Based on the Latest Syllabus published by the
West Bengal State Council of Technical & Vocational Education and Skill Development

Power Electronics Converters & Applications

Unit-1: Power Semiconductor Devices

Thyristor (SCR):

- ✓ Construction, symbol, operation & two transistor analogy.
- ✓ V-I characteristics of SCR (Holding, & Latching current, Break over voltage).
- ✓ Dynamic characteristics of SCR
- ✓ Thyristor ratings (Continuous, Repetitive & Non repetitive /Surge ratings)
- ✓ Thyristor specifications – Rated voltage, current & power, dv/dt, di/dt, Gate current, temperature.
- ✓ Snubber circuit operation with different types & basic calculations.
- ✓ Snubber circuit, Freewheeling diode.
- ✓ SCR mounting & cooling.

Thyristor Types:

- ✓ Diac, Triac, SCS: Operation Principle, Specification, characteristics, applications
- ✓ IGBT - Operation Principle, Specification, characteristics, applications
- ✓ Overview: Power BJT, Power MOSFET, & GTO.
- ✓ Comparison among Thyristor, BJT, MOSFET, IGBT and GTO as switch.

Unit-2: Thyristors: Turn-on & Turn-off SCR turn-on methods:

- ✓ Gate triggering; High Voltage, Thermal, Illumination, & dv/dt triggering methods
- ✓ Gate trigger circuits–Resistance, and Resistance-Capacitance circuits.
- ✓ UJT Triggering: PUT: relaxation oscillator & synchronized UJT circuit.
- ✓ Pulse transformer, & optocoupler based triggering.(opto-triac, opto-transistor)

SCR turn-off methods:

- ✓ Class A- series resonant commutation, Class B- shunt-Resonant commutation.
- ✓ Class C: complimentary symmetry commutation, Class D auxiliary commutation.
- ✓ Class E: external pulse commutation, Class F: line or natural commutation.

Unit-3: Converter and Inverter

AC to DC Converter:

- ✓ Single phase fully controlled half wave converter with resistive &, R-L load (with & without freewheeling diode)
- ✓ Single phase fully controlled full wave midpoint converter.
- ✓ Single phase semi controlled (half bridge) full wave converter resistive load and R-L load
- ✓ Single phase fully controlled full wave converter resistive load and R-L load
- ✓ Single phase fully controlled full wave converter R-L load
- ✓ Three phase half wave converter with resistive load with R-L load.
- ✓ Three phase semi controlled converter with resistive load with R-L load.
- ✓ Three phase fully controlled bridge converter with resistive load with R-L load.
- ✓ 1- ϕ noncirculating / circulating dual converter

Cycloconverter:

- ✓ Principle of operation of 1- ϕ & 3- ϕ cycloconverter, basic circuit diagram, input & output waveforms and applications.

Inverter:

- ✓ 1- ϕ & 3- ϕ inverter: line, & forced commutated, series, parallel, bridge inverter
- ✓ Operation of basic series, parallel inverter.
- ✓ Operation of single-phase Half bridge, Full bridge inverters
- ✓ PWM inverter : Single & Multiple pulse width modulated inverter, Sinusoidal PWM

Unit-4: DC Chopper

- ✓ Principles of chopper & Classification
- ✓ Step-up & Step-down chopper, problems.
- ✓ Two quadrant & four quadrant operation.
- ✓ Type-A, B, C, D & E chopper– operating principle & applications, Jones chopper, Morgan chopper, Chopper control circuits.

- ✓ Arc formation, methods of arc extinction (High / Low resistance), Arc voltage, Recovery / Re-striking voltage, RRRV
- ✓ Circuit breakers: Concept, Classification, Construction, Specification & Applications
- ✓ EHV/HV Circuit Breakers: Minimum Oil (MOCB), Air Blast (ABCB), Sulphur Hexafluoride (SF₆), & Vacuum (VCB) type
- ✓ LV Circuit Breakers: Air (ACB), Miniature (MCB), Moulded Case (MCCB) type.
- ✓ Earth leakage circuit breaker (ELCB /RCCB); Comparison of fuse & MCCB
- ✓ HT/LT Breaker Ratings: breaking/ making capacity, rated operating duty, rated voltage; Selection of MCCB for motor; Auto-recloser, Gas Insulated Switchgear idea

Unit 3 : Protective Relaying:

- ✓ Fundamentals: Sensitivity Selectivity, Speed, Reliability, Simplicity, Economy.
- ✓ CT & PT for protection: rating of CT & PT; Accuracy Class of CT and their significance
- ✓ CVT & CCVT Requirements, Circuit diagram, working principle & application.
- ✓ Zones of protection: primary & back-up.
- ✓ Electromagnetic relays Operating principles & construction (Attracted armature type, Solenoid type, Watt-hour meter type)
- ✓ Thermal relays: Principles and construction.
- ✓ Block diagram & working of static relays & Microprocessor based relays.
- ✓ Overcurrent relay: Instantaneous, Definite time delay, inverse extremely inverse & IDMT Relay Time-current characteristics.
- ✓ Current/Time setting, PSM – Numericals.
- ✓ Directional Relay: Construction, Nature, Constant product / Polar characteristics, Dead zone, 300, 600 & 900 connection.
- ✓ Distance Protection Relay: Applications
- ✓ Impedance relays: Reactance relay, MHO relay: Operating characteristics, effect of arc resistance on performance.
- ✓ Differential Relay: Current differential protection for internal fault Fed from one / both ends. Voltage balance differential protection– Schematic diagram & operation
- ✓ Operating & restraining coil for both.

Unit 4 : Equipment Protection:

Protection of Alternators

- ✓ Fault Types, protection against Loss of excitation, over speed, rotor overheating (load unbalance), motoring, Percentage differential protection field suppression.

Transformer protection

- ✓ Fault Types, Percentage biased differential protection – problems, WTI & OTI; Over-fluxing, OC/ EF & Restricted Earth Fault (REF) Protection schemes, Buchholz Relay: Construction, Operation, merit & demerits, Rate of Rise of Pressure Relay.

Protection of Motor

- ✓ Abnormalities & faults; Short circuit & OC protection, Single phase preventer.

Busbar & Transmission Line Protection

- ✓ Busbar: Differential, Fault bus protection.
- ✓ Transmission line: OC (Time / current graded), Distance & Pilot wire protection.

Unit 5 : Overvoltage Protection

- ✓ Causes of over voltages. Lightning phenomena & lightning overvoltages.
- ✓ Shielding Protection from direct stroke
- ✓ Types of lightning arresters & surge absorbers, Construction & operation.
- ✓ Protection against traveling waves.
- ✓ Insulation co-ordination.

Switchgear & Protection Lab

- ✓ Introduction to switchgear devices: Component Identification.
- ✓ Rewirable Fuse: Performance analysis.
- ✓ HRC fuse: Structure & characteristics
- ✓ MCB: Construction & characteristics.
- ✓ Thermal Over Load Relay: Design & Time-current Characteristics.
- ✓ MCCB: construction and performance.
- ✓ RCCB: Performance analysis.
- ✓ Induction type relay: characteristics.
- ✓ MOCB Construction & performance.
- ✓ Transformer Biased Differential Relay.
- ✓ Digital Voltage, & Current relays.
- ✓ Lightning arrester: VI characteristics.
- ✓ Study of Distance relay

- ✓ Solar Map of India: Beam, Diffuse & Global solar power radiation.
- ✓ Radiation on inclined surface.
- ✓ Pyranometer: Solar Radiation Measurement.
- ✓ Solar Collectors: Liquid Flat plate; Parabolic Trough, Parabolic Dish, Fresnel Reflectors.
- ✓ Solar Photovoltaic (PV) system: Electron-Hole Pair generation by Photon absorption, Photo-electric, Photo-conductive, & Photo voltaic effect.

- ✓ Solar cell: Principle; Current-voltage (I-V), & power voltage (P-V) characteristics of, Maximum power point (MPP), dark current, Fill factor, short circuit current (Isc), Open circuit voltage (Voc), Cell efficiency.
- ✓ Concept of PV module, PV panel, PV array.
- ✓ Classification of PV system – Centralized & Distributed Solar PV Systems.
- ✓ Solar Photovoltaic (PV) and Concentrated Solar Power (CSP) power plants: Layout, Components, Construction, Principles, Applications, Roof top solar PV system.

Unit 3: Wind Energy & Wind Power Plant

- ✓ Wind Map of India: Wind power density W/m^2 , Lift & drag; long path theory
- ✓ Energy estimation of wind, power lift, drag coefficient; tip speed ratio.
- ✓ Types of wind turbines: Horizontal axis / Vertical axis small wind turbine: direct drive/geared type, components & working
- ✓ Wind energy conversion system (WECS): Constant Speed Electric Generators: Squirrel Cage / Wound Rotor Induction Generators (SCIG / WRIG).
- ✓ Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), Wound Rotor / permanent Magnet synchronous generator (WRSG / PMSG).
- ✓ Geared type wind power plants: Components, Layout, Working principle.
- ✓ Direct drive type wind power plants: Components, Layout, Working principle.

Unit -4: Micro-hydro Power Plants:

- ✓ Energy conversion process of hydro power plant; Classification of hydro power plant: High, medium & low head.

- ✓ Layouts of micro-hydro power plants.
- ✓ Construction & working of hydro turbines: High head: Pelton turbine, Medium head: Francis turbine, Low head: Kaplan turbine.
- ✓ Safe Practices for microhydro power plants

Unit -5: Biomass- based Power Plants:

- ✓ Solid, liquid & gaseous fuel Properties for biomass power plants (bagasse, wood chips, rice husk, municipal waste) (Jatropha, bio-diesel), (gobar gas).
- ✓ Bio-chemical (biogas), Thermo-chemical (Municipal waste), Agro-chemical based (bio-diesel) power plant:Layout & working

Renewable Energy Power Plants Laboratory

- ✓ Plot I-V characteristic of solar PV module.
- ✓ Thermal performance of a solar cooker.
- ✓ Performance of a Thin Plate type solar cooker
- ✓ Performance of a Disc type solar cooker.
- ✓ Study Evacuated tube & Flat plate collectors.
- ✓ Measure thermal performance of air dryer.
- ✓ Study of Solar Parabolic Trough collector.
- ✓ Study of wind power model.

Switchgear and Protection

Unit 1: Fundamental:

- ✓ Necessity & functions of protective system.
- ✓ Normal & abnormal conditions, Faults: Types & causes; Asymmetrical & Symmetrical; Concept of positive, negative & zero sequence.
- ✓ Current limiting reactors & their arrangements.
- ✓ Short circuit fault calculations in lines fed by generators through transformers
- ✓ Symmetrical fault Short-circuit KVA problems

Unit2 : Circuit interrupting devices:

- ✓ Basic fuse terminology: Fuse element, Rated current, Fusing current, Fusing factor, Prospective current, Cut-off current, Arcing time, rupturing capacity, total operating time, Fuse Characteristics
- ✓ HRC fuses: construction, types, working, characteristics, selection & applications
- ✓ Vertical / Horizontal break, pantograph Type Isolator.

Unit-5: DC and AC drives

- ✓ Speed control of separately excited DC motor by single phase fully controlled, & three phase fully controlled converters.
- ✓ Speed control of DC series motor with chopper control.
- ✓ Speed control of 3- ϕ induction motor with variable frequency PWM VSI.
- ✓ Speed control of 3- ϕ Induction motor with variable voltage variable frequency control.

Unit-6: Power Supply

- ✓ UPS: Principle of operation & Block diagram of on load & Off load type UPS.
- ✓ SMPS: Principle of operation & application of forward converter and flyback converter.

Power Electronics Converters & Applications Lab

- ✓ Experiment on Transistor as a switch.
- ✓ 555 Timer in astable and monostable mode.
- ✓ Test the power electronic switches –SCR, IGBT, SCS and TRIAC.
- ✓ Test the proper functioning of DIAC to determine the break over voltage.
- ✓ Determine latching & holding current, & V-I characteristics of SCR.
- ✓ Test variation of R, C in R & RC triggering circuits on firing angle of SCR.
- ✓ Relaxation oscillator by using PUT.
- ✓ Buck, Boost and Buck-Boost converter.
- ✓ Class–A, B, C turn off circuits.
- ✓ Class– D, E, F turn off circuits.
- ✓ Output waveform of half wave-controlled rectifier with resistive load, and load voltage.
- ✓ Output waveform & V_L of Full wave controlled rectifier with R, & RL load freewheeling diode
- ✓ Firing angle control using Diac & Triac control circuit on lamp, motor or heater; Output power.
- ✓ Speed control of DC motors using SCR.
- ✓ Variable voltage variable frequency drive.
- ✓ Study on On line and Offline UPS.
- ✓ Study on SMPS.
- ✓ UJT triggering: effect of variation of R, C.
- ✓ Simulate firing angle control on SCILAB
- ✓ 3 ϕ Induction motor using PWM inverter. Interpret speed-torque characteristics.

Electric Power Transmission & Distribution

Unit -1: Basics of T & D:

- ✓ Single line diagrams with components of electric T & D systems.
- ✓ Classification: Primary & secondary Transmission, Primary & secondary Distribution, standard voltage level in India
- ✓ Classification of transmission lines: based on type of voltage level, length
- ✓ Characteristics of high voltage for power transmission
- ✓ Kelvin's laws for economic choice of conductor size– related problem

Unit-2: Transmission Line Parameters & Performance

- ✓ Line Parameters: Concepts of R, L and C of line parameters and types of lines
- ✓ Performance of Short Transmission line: Efficiency, regulation and its derivation
- ✓ Effect of power factor, Ferranti Effect.
- ✓ Medium Transmission line: Modeling, nominal 'T', / 'π', end condenser methods
- ✓ Long line: Model, Surge impedance
- ✓ Transposition of conductors and its necessity, Skin effect, & Proximity effect

Unit-3: Extra High Voltage Transmission

- ✓ Extra High Voltage AC transmission: Necessity, Advantages, Limitations, Applications, Lines in India, Corona effect
- ✓ High Voltage DC (HVDC) Transmission: Necessity, Components, Limitations, Applications, HVDC Lines in India, Layout of monopolar, bi-Polar & homo-polar transmission lines
- ✓ FACTS controllers: Types, & Application
- ✓ Wireless transmission of electrical power

Unit – 4: A.C Distribution System

- ✓ AC distribution: Components, Classification, requirements of an ideal distribution system
- ✓ Feeder & distributor: Factors for design
- ✓ Distribution schemes: radial, ring, grid, advantages, disadvantages & applications

- ✓ Sending & Receiving end voltage & drop.
- ✓ Methods of solving A.C.-1 phase & 3-phase (balanced) distribution system-problems
- ✓ Distribution Sub-Station: Classification, site selection, advantages, limits, & applications
- ✓ 1-Line diagram 33/11KV &, 11KV/400V sub-station: Schemes, Symbols, Components

Unit – 5: Components of T&D Line:

- ✓ Overhead Conductors: Material Properties, types & trade names
- ✓ Sag in Overhead Lines, Calculations
- ✓ Stringing chart & its uses, conductor Spacing Length of span, Relevant IE Rules
- ✓ Line supports, Requirements,
- ✓ Types of line structures, Specifications, Methods of erection.
- ✓ Line Insulators: Material Properties, Selection; Types & applications, Insulator Failure: Causes; Creepage distance.
- ✓ String efficiency & Methods of improving it for three suspension insulator.
- ✓ Underground Cables: Classification, Construction, of PVC, PILC FRLS XLPE & Gas filled(SF₆) cables, Comparison with overhead lines, Cable laying
- ✓ Pf Improvement: Static /, Synchronous condenser, static VAR compensator

Electric Power Transmission & Distribution Laboratory

- ✓ Power factor improvement with Capacitors.
- ✓ Overhead conductor, Line supports insulator
- ✓ Study of Underground cables.
- ✓ Short, & medium transmission line parameter
- ✓ Performance of long transmission line.
- ✓ Study of 11 KV/400V sub- station.
- ✓ Study of turbines used in Power stations.
- ✓ Study of HVDC transmission line.
- ✓ Study of flexible AC transmission line.
- ✓ Transmission network in West Bengal study

Induction, Synchronous & Special Electrical Machines

Unit-I : Three Phase Induction Motor

- ✓ Production of rotating magnetic field
- ✓ Synchronous speed, rotor speed, slip.

- ✓ Working principle, Constructional details of Squirrel cage and Slip ring induction motor.
- ✓ Rotor quantities: frequency, induced emf, Pf at starting & running condition numericals.
- ✓ Induction motor as generalized transformer, Equivalent circuit, phasor diagram.
- ✓ Torque vs. slip (or speed) characteristics.
- ✓ Starting, full load & maximum torque relations, Effect of rotor circuit resistance & supply voltage on Torque-Slip characteristics
- ✓ Power flow diagram, Losses & efficiency.
- ✓ Starters: Need & types, DOL, stator / rotor resistance, stator reactance, auto transformer, star delta, & soft starters. Numericals.
- ✓ Speed control: stator voltage, pole changing, rotor resistance, & Variable Voltage Variable Frequency (VVVF) methods.
- ✓ Braking: Plugging, Rheostatic, Regenerative
- ✓ Cogging & Crawling; remedies
- ✓ Double cage, & deep-bar rotor concept.
- ✓ Motor selection for different applications as per load torque–speed, 4-quadrant operation
- ✓ Maintenance of 3 ϕ induction motor.

Unit-II: Single Phase Induction Motors

- ✓ Double revolving field theory
- ✓ How to make motors self-starting?
- ✓ 1- ϕ IM: Construction & working of: Resistance start (Split phase) motor, Capacitor start & run, Capacitor start capacitor run, shaded pole, repulsion, series /universal, & hysteresis motor.
- ✓ 1- ϕ motors: Torque-speed characteristics.
- ✓ Motor Selection; Applications based on torque-speed, 1 ϕ IM Maintenance.

Unit-III: Three Phase Alternators

- ✓ Alternator: Construction & Working.
- ✓ Moving & stationary armatures. Advantages of Stationary Armature & Rotating Field.
- ✓ Methods of excitation: Static excitation, Brushless Excitation, DC Generator
- ✓ Salient / non-salient Pole; Single & Double layer, Concentrated & Distributed Windings
- ✓ Pitch factor, distribution & winding factors.
- ✓ E.M.F. equation of alternator, pitch factor and distribution factor.(Numerical)
- ✓ Phasor diagram: lagging, leading & unity pf

Induction, Synchronous & Special Electrical Machines Lab

- ✓ Slip measurement of 3- ϕ induction motor using tachometer, Stroboscope
- ✓ Direction reversal of 3- ϕ induction motor.
- ✓ Identify parts (along with function & materials) for 3 ϕ & 1 ϕ Induction Motors.
- ✓ No-load & Blocked-rotor tests on 3 ϕ SCIM & its equivalent circuit.
- ✓ Direct load test on 3- ϕ SCIM & plot: Efficiency / pf vs output, pf vs motor current, torque–slip/speed characteristics
- ✓ Control speed of 3- ϕ SCIM: Stator Voltage control, Frequency / Pole changing method
- ✓ Start & speed control of 3- ϕ WRIM through rotor resistance.
- ✓ Effect of capacitor on starting & running condition of a single-phase IM, method of reversing its direction of rotation.
- ✓ Effect of excitation and speed on induced e.m.f of a 3- ϕ alternator and plot the OCC.
- ✓ Direct loading test on alternator to determine the regulation and efficiency.
- ✓ 3- ϕ alternator OC & SC test, Regulation & η (Synchronous impedance method)
- ✓ Synchronize 3- ϕ alternators for parallel operation by 3 lamp & Synchroscope methods; study load sharing feature.
- ✓ Starting of 3- ϕ synchronous motor. Plot V- & inverted V-curve of the same motor.
- ✓ Control the speed & reverse the direction of rotation of stepper motor
- ✓ Control the speed and reverse the direction of rotation of AC / DC servomotor

Renewable Energy Power Plants

Unit -1: Introduction:

- ✓ Classification of energy resources.
- ✓ Significance, Features & availability of Non-conventional energy resources.

Unit -2: Solar PV & Thermal Plants:

- ✓ Solar Radiation Geometry – Latitude, Longitude, Declination, Surface / solar azimuth angle, Slope of surface, Hour angle, Angle of incidence.

- ✓ Limit Switch, Float, & Centrifugal Switch: Types, Specs, Applications.

Group Projects

- ✓ DC Regulated Power Supply
- ✓ Digital Temperature Meter
- ✓ Digital Ammeter
- ✓ Process Temperature Controller
- ✓ Tachometer (using Proximity sensors)
- ✓ Wireless Remote Controller for light & fan
- ✓ Automatic Streetlight Controller
- ✓ Liquid Level Controller
- ✓ Digital Weight Meter
- ✓ Laser Distance meter(+area calculation)

Textbooks List

Microcontroller & its Applications

- ✓ N Senthil Kumar, M Saravanan, S Jeevanathan, Microprocessors & Microcontrollers, Oxford University
- ✓ V Udayasankara, MS Mallikarjuna Swamy, 8051 Microcontroller, McGraw Hill

Building Electrification

- ✓ JB Gupta, A Course in Electrical Installation, Estimating & Costing, SK Kataria
- ✓ KB Raina, SK Bhattacharya, Electrical Design Estimating and Costing, New Age International

Industrial Automation & Control

- ✓ S.K. Bhattacharya, B. Singh, Control of Machines, New Age International

Illumination Practices

- ✓ JB Gupta, Utilization of Electric Power & Electric Traction, SK Kataria
- ✓ H Partab, Art & Science of Utilization of Electrical Energy, Dhanpat Rai

Electrical Engineering Practice

- ✓ JB Gupta, Utilization of Electric Power & Electric Traction, SK Kataria

Ramakrishna Mission Shilpamandira

An AICTE Approved
Self-Financed Polytechnic

Belur Math, Howrah



Syllabus Booklet

Diploma in Electrical Engineering [EE]

Semester – V (Part-III)

Based on the Latest Syllabus published by the
West Bengal State Council of Technical & Vocational Education and Skill Development

Microcontroller & It's Applications

Unit 1: Introduction to Microcontrollers

- ✓ 8085 microprocessor architecture with functional block diagram.
- ✓ Evolution of microcontrollers.
- ✓ Block diagram, & elements of microcomputer, types of buses.
- ✓ Von Neuman & Harvard Architecture
- ✓ Microprocessor vs Microcontrollers
- ✓ Need of Microcontroller.
- ✓ Microcontrollers Family, specifications
- ✓ Versions of Microcontroller 8951, 89C1051, 89C2051, 89C4051 with their specifications & comparison.

Unit 2: Architecture of μ C 8051

- ✓ 8051 Block diagram & block functions
- ✓ Pin diagram & functions.
- ✓ Concept of Internal & External memory (RAM & ROM)
- ✓ Internal RAM structure
- ✓ Reset and clock circuit.
- ✓ Various registers and SFRs of 8051

Unit 3: 8051 Instruction Set, Programs

- ✓ Overview of 8051 instruction set.
- ✓ Various addressing modes.
- ✓ Classification of instructions.
- ✓ Data transfer instructions.
- ✓ Arithmetic and Logical instructions.
- ✓ Branching instructions.
- ✓ Bit manipulation instructions.
- ✓ Stack, subroutine & interrupt related instructions.
- ✓ Programs based on above: Addition, Subtraction, Multi-byte addition, Multiplication of two numbers, BCD to Hex conversion, Hex to BCD & HEX to ASCII conversion etc.

4: 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 Assembly program using simulators like RIDE or KEIL.
- ✓ Various directives of Assembly language programming, Exercises.
- 5. 8051 Internal Peripherals, Programs**
- ✓ I/O ports- List, diagram, read write operation, instructions related Special Function Registers (SFR).
- ✓ Timers/counters: list, SFRs, modes of programming, operations with diagram.
- ✓ Serial communication- Basics, baud rate, related SFRs, programming modes, operations with diagram.
- ✓ Interrupts- related SFRs, types, operations with diagram. Power saving operation- modes, related SFR
- ✓ Applications: Measurement of voltage, current, frequency, Generation of square, triangular, staircase waveform.
- ✓ Over current Relay operation.
- ✓ Speed control of D.C. motor.

Microcontroller & Apps Lab

- ✓ Microcontroller Hardware kit (Development Board) identification.
- ✓ Use of software KEIL, & ProgISP.
- ✓ Embedded C programs for LED blinking/ sequences using delay/timer
- ✓ Embedded C programs using Analog/ Digital inputs, Digital/ PWM outputs, frequency changing etc.
- ✓ Interrupt Programming for 8051
- ✓ Serial Communication with 8051
- ✓ Over voltage/under voltage relay circuit with suitable hardware circuit.
- ✓ Using 8051, develop, run & test stepper motor operation with fixed number of steps; determine angular displacement per step & total angular rotation.
- ✓ Using 8051, develop, run and test Traffic light Control using 8051.

Illumination Practices Lab

- ✓ Verify the laws of illumination.
- ✓ Control circuit of twin fluorescent lamp.
- ✓ Prepare control circuit of LED lamp.
- ✓ Illumination level assessment in workplace using lux meter.
- ✓ Fit the given lamps in the selected mounting, calculate space height ratio
- ✓ Interpret polar curves of given lamp.
- ✓ Measure the illumination output of different lamps (Incandescent, fluorescent, CFL, LED, HPSV, MH) and calculate their luminous efficacy.
- ✓ Plot iso-lux contour of indoor lamps.
- ✓ Design an illumination scheme of a conference hall of medium size.
- ✓ Design an illumination scheme of a workshop of your Institute.
- ✓ Prepare an indoor room design using lighting design software.

Electrical Engg. Practice

Unit 1: Transmission Lines

- ✓ Properties of T&D Conductor Material (Cu, Al, Steel): Cost, Resistivity, Density, Specific Weight, Linear Expansion Coefficient, Strength, Specific Heat Capacity, Permeability.
- ✓ Stranded conductor: lay direction, lay length, lay ratio
- ✓ ACSR used in India (IS 398 Part 2): Name, Nominal Cross section area, arrangement of Al, & Steel cables, Current carrying capacity.

Unit 2: Substations

- ✓ Substation components, & layout
- ✓ Substation CT, Circuit Breaker: Live Tank, and Dead Tank concept
- ✓ MOV, Line Trap, Power Line Carrier Communications
- ✓ Substation Busbar Configurations

- ✓ Study of Single Line Diagram of 400kV, 220kV, 132 kV substations.
- ✓ Gas Insulated Substation layout & components, advantages, Applications.

Unit 3: Cables

- ✓ Importance of cables in industry, classification
- ✓ Cable components & related terms: conductor material & shape, insulation, inner / outer sheath, armour, fillers, Nomenclature,
- ✓ PVC, XLPE, EVA, FRLS, LSZH, XLPO Insulation material, their Properties & Applications - weight, dielectric strength, / loss, effect of moisture / fungus, bending radius, max operating temperature, rated / short circuit current, applications

Unit 4. Battery

- ✓ Overview of battery types
- ✓ Lead Acid battery: specifications, charging & discharging, Applications

Project

Learning Modules

- ✓ Op-Amp: Inverting, Non-Inverting Amplifier, Integrator & Differentiator
- ✓ Thermal Sensors: RTD, Thermocouple
- ✓ Temperature Controller: On -Off, PID
- ✓ PT and CT: Types, Specs, Application. Measurement of voltage and current.
- ✓ Opto-coupler (PC-817, MCT2E, MOC 3041)
- ✓ Regulated Power Supplies: Series regulator using Op-Amp feedback
- ✓ Regulated Power supplies using LM723, LM317 & TL431
- ✓ Proximity Sensors: Types, Specification, Applications of different sensor types.
- ✓ Photo-electric sensors: Types, Specs, Applications.
- ✓ Distance sensor (IR Sensor)
- ✓ Strain Gauge: Types, Specification, Applications.

- ✓ Develop SCADA mimic diagram for:
 - Tank level control.
 - Flow control in a given system.
 - Traffic light control.

Illumination Practices

Unit: 1 Fundamentals of illumination

- ✓ Electromagnetic radiation & Light;
- ✓ EM spectrum: UV, Visible, Infrared.
- ✓ Definition of (As per CIE): Light, Luminous Flux / Intensity, Lumen, Candela, Illuminance, Lux, luminance, brightness, contrast, luminous efficacy.
- ✓ Glare: Discomfort & disability glare.
- ✓ Blackbody/Selective radiator, CRI, CCT
- ✓ Human eye as optical system: concept. Spectral sensitivity of human eye: Photopic, Scotopic, Mesopic vision
- ✓ Laws of illumination: Inverse Square Law; Lambert's Cosine Law; numerical

Unit : 2 Measurement

- ✓ Polar curves and its applications.
- ✓ Luxmeter: Construction, working.
- ✓ Measurement of illuminance by luxmeter; measurement of luminous flux by integrating sphere concept.
- ✓ Application of Polar Photometer & Goniophotometer.
- ✓ CIE standard source of illuminant.

Unit: 3 Lamps and Luminaires

- ✓ Principle of incandescence; gaseous discharge lamps. Electromagnetic & Electronic ballast – Operation & comparison; Ignitor & its function.
- ✓ Construction, principle, connection diagram, technical features, application:
 - Incandescent & Halogen lamps.
 - Low pressure discharge lamps: CFL, Fluorescent lamp; sodium vapour lamp.
 - High pressure discharge lamps: sodium / mercury vapour, & metal halide lamps
 - LED, LASER (concept), Optical fibre
- ✓ Luminaire – Types, Design consideration, Ingress protection (IP).

4: Illumination Control, Control Circuit

- ✓ Lighting control & energy conservation
- ✓ Dimmer: resistance type; auto-transformer type.
- ✓ Electronic Dimmer: working principle and operation of: Thyristor operated, & Triac operated dimmer.
- ✓ Photo cell: Construction, principle
- ✓ Occupancy sensor: PIR; Ultrasonic sensors : Range, rating & applications

Unit: 5 Interior lighting design

- ✓ Illumination level for various interior application IS 3646 (Part-I).
- ✓ Space height ratio, utilization factor, light loss factor overall uniformity, glare index, CRI, Light power density (LPD); ECBC.
- ✓ Lighting calculation methods: Watt /m2 method, Lumens or light flux method, Point to point method. Numericals
- ✓ Design considerations for interior lighting of: a) Residential, b) Commercial, c) Industrial premises.

Unit 6: Exterior lighting design

- ✓ Road Lighting: Throw, spread and tilt angle, outreach, overhang.
- ✓ Classification of roads according to luminance level.
- ✓ Lighting arrangement types: Single side, staggered, opposite, central arrangement.
- ✓ Luminaires Classification: Symmetrical, Asymmetrical, double asymmetrical.
- ✓ Flood lighting: Related terms: Beam factor, beam angle, waste light factor, NIMA classification.
- ✓ Design of flood lighting; numericals.
- ✓ Selection of lamps, luminaires for flood lighting in railway yard, sports ground.

Building Electrification

Unit 1: Indian Electricity Rules (1956)

- ✓ Rule 28: Voltage level definitions.
- ✓ Rule 30, 31: Service lines & apparatus / cutouts on consumer premises. Rule 46: Periodical inspection & testing of consumer's installation. Rule 47: Testing of consumer's installation.
- ✓ Rule 54, 55: Declared voltage / frequency of supply to consumer. Rule 56: Sealing of meters, cut-outs.
- ✓ Rule 77: Clearances above ground of lowest conductor. Rule 79: Clearances between conductors & trolley wires.
- ✓ Rule 87: Lines crossing or approaching each other. Rule 88: Guarding
- ✓ Classification of electrical accessories- controlling, holding, safety, outlet BIS symbols of following accessories:
 - Switch – Types by construction: surface / flush / pull / rotary / knife / pendent switch, Main-switch (ICDP, ICTP).
 - Switch Types by working: single/ double pole, two-way, two-way centre off, intermediate, series parallel switch
 - Lamp Holders Types including pendent, Bayonet cap, batten, angle, bracket, tube light holder, screw (Edison, goliath Edison), swivel lamp holder.
 - Socket outlets, plugs: two, three, multi pin sockets, two and three-pin plug.
 - Others- Iron connector, adaptor, ceiling rose, distribution box, neutral link, bus-bar chamber.
- ✓ Wooden/ mica boards, Moulded/ MS Concealed boxes of different sizes. Modular accessories.

Unit 2: Wires & Underground Cables

- ✓ Conductors: - wire, cable, bus bar, stranded conductor, cable, armored cable, flexible cable, solid conductor, PVC wires, CTS wire, LC wire, FR (Fire retardant) wire.

- ✓ Wire size per BIS, measurement Tools, Wire jointing methods.
- ✓ Classification of cables: low tension, high tension, extra high tension cables, solid, oil filled & gas filled type
- ✓ Cable insulation materials –Class of Insulation; vulcanized rubber (VIR), polyvinyl chloride (PVC), cross linked polythene (XLPE), impregnated paper.
- ✓ Cable Selection of size, type from data
- ✓ Cable jointing / laying methods.

Unit 3: Residential Illumination

- ✓ Luminous flux / intensity, Lumen, Lux, Illuminance or illuminance, Space - height ratio, utilization / depreciation factor, luminous efficacy.
- ✓ Laws of Illumination-Inverse Square Law, Cosine Law (related numerical).
- ✓ Factors affecting illumination, Types of lighting arrangements. Luminous flux of different light sources
- ✓ Lux level required for different places as per SP 72: 2010, Lighting design of a room for estimation of lamps.

Unit: 4 Wiring Methods & wiring layout

- ✓ Classification of wiring methods:
 - ✓ PVC casing-capping wiring- wiring rules according to IS: 732-1983
 - ✓ Conduit wiring- Metal vs PVC conduit, wiring types: Surface, Concealed, accessories, BIS rules of conduit wiring
 - ✓ Selection Factors of wiring methods.
 - ✓ Comparison of various wiring systems.
 - ✓ BIS rules for domestic installations.
 - ✓ Design, working and drawing of:
 - Simple light and fan circuits; Stair case, & Go-down wiring; Bedroom, & Corridor lighting; Series parallel circuit, Master switch control circuit
 - Lighting circuit using - Intermediate switch, Call bell circuit using bell indicator, Design of wiring circuits according to user's requirement.

Unit: 5 Residential Bldg Electrification

- ✓ Residential Buildings: reading of CE building drawing, Interpretation of electrical installation plan and electrical diagrams, electrical symbols (IS: 732)
- ✓ Electrical installation for residential building (NEC- 2011 part I section 9)
- ✓ Residential vs industrial load, rules for lighting installations; Positioning.
- ✓ Light and fan circuit, Power circuit
- ✓ Wiring and circuit Schematic diagram according to IS: 2042(Part-I)-1962: multiline & single line representation
- ✓ Load assessment: Selection of size of conductor, main switch, switch gear.
- ✓ Design, drawing, estimation, costing of a residential installation 5kW load max; Steps in preparing estimate; Calculation of wire length, materials, labour cost.
- ✓ Wiring installation testing IS 732-1982: Testing of Insulation resistance, earth continuity path; polarity of switches.
- ✓ Service Connection: Underground and overhead. Required material calculation

6: Electrical Installation Protection

- ✓ Fuses: Rewirable, cartridge fuses (HRC, LRC), Fuse material, Selection, rating.
- ✓ Miniature circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB): Principle Construction, rating and uses.
- ✓ Earth, earth electrode / terminal, earthing wire / lead, earth current, fault / leakage current, System / equipment earthing; requirements.
- ✓ Earth resistance Measurement (earth tester), & reduction Methods.
- ✓ Methods of earthing IS 3043: 1987 & procedure- Driven pipe, pipe & plate earthing, modern methods of earthing

Building Electrification Lab

- ✓ Select electric wire using measuring / testing instruments.

- ✓ Wiring installation from service mains, energy meter, MCB, control of lamp, fan and socket from switch board in PVC surface conduit wiring system.
- ✓ Control a lamp from 2 different places using PVC surface conduit wiring.
- ✓ Make a report on design, estimation of lighting load of a class room
- ✓ Design 2 BHK residential installation scheme. Estimate material required. Draw detail wiring layout & make a chart for the materials required.
- ✓ Draw different earthing systems; make a chart of materials required
- ✓ Measurement of three phase energy using static energy meter including maximum demand, reactive power, TOD in addition to active power.
- ✓ Select transformer rating & associated equipments for indoor substation of commercial building/ complex
- ✓ Study smart meter & associated system for commercial building/ complex
- ✓ Design electrical installation system of single building complexes.

Industrial Automation & Control

Unit : 1 Introduction

- ✓ Automation: Need & benefits, Types: Fixed, Programmable, Flexible
- ✓ Systems used for Industrial automation: Magnetic control PLC, SCADA,
- Unit : 2 Magnetic Control Systems:**
- ✓ Operation & Applications of Contactor control circuit components – (i) Switches – Push button, Selector, Limit switch, Pressure, Float type, Proximity, (ii) Electromagnetic Contactor (iii) Time delay relays (OFF / ON delay).
- ✓ Magnetic control of ac motor:
- ✓ Control & Power circuits of –
 - (i) Reversing direction of rotation of IM with Interlocking systems.

- (ii) Simple ON-OFF motor control,
- (iii) Automatic Sequential motor control
- (iv) DOL / Automatic Star-Delta starter

Unit: 3 PLC Fundamentals

- ✓ Evolution of PLC. Building blocks of PLC: CPU, Memory organization, Input output modules (discrete, analog), Specially I/O Modules, Power supply
- ✓ Fixed and Modular PLC and their types, Redundancy in PLC module, I/O module selection criteria.

4 PLC Programming & Applications

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

5: Electric Drives, special machines

- ✓ Electric drives: Types, functions, characteristics, 4 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 6: Supervisory Control and Data Acquisition System (SCADA)

- ✓ Basic components of Data Acquisition System, Components of a PC-based Data Acquisition System.

- ✓ SCADA: Introduction, Benefits; Typical architecture/ block diagram,
- ✓ Introduction to SCADA hardware and software, Applications

Industrial Automation & Control Lab

- ✓ Testing push button switches, timer and electromagnetic contactor.
- ✓ Make control & power circuit for forward / reverse rotation of induction motor using contactor circuit.
- ✓ Make control & power circuit for automatic star-delta starter of IM using contactor circuit.
- ✓ Identify various parts of the PLC and front panel status indicators.
- ✓ Use PLC to test the START STOP logic using two inputs and one output.
- ✓ Ladder program for given applications using: timer, counter, comparison, logical, arithmetic instructions
- ✓ PLC to control devices: lamp, motor, pushbutton switches, proximity sensor
- ✓ Measure temperature of a liquid using RTD / Thermocouple and PLC.
- ✓ Ladder program to blink LED/lamp.
- ✓ Develop & Test Ladder program for:
 - Sequential control of lamps/DC motors.
 - Traffic light control system.
 - Pulse counting (limit /Proximity switch)
 - Automated elevator control.
 - Stepper motor forward / reverse control.
 - Tank water level control.
 - Stepper motor speed control (drivers)
- ✓ DC chopper circuit using SCR.
- ✓ Identify various front panel controls of VFD (smart drive).
- ✓ Control speed of AC motor using VFD (Variable Frequency Drive).
- ✓ Use functions of SCADA simulation editors to develop simple project.

Preparation for entrepreneurial ventures

- ✓ Business Idea- Concept, Characteristics of a Promising Business Idea, Uniqueness of the product or service and its competitive advantage over peers
- ✓ Feasibility Study – Concept – Locational, Economic, Technical and Environmental Feasibility. Structure and Contents of a standard Feasibility Study Report
- ✓ Business Plan – Concept, rationale for developing a Business Plan, Structure and Contents of a typical Business Plan
- ✓ Project Report- Concept, its features and components
- ✓ Basic components of Financial Statements- Revenue, Expenses (Revenue & capital exp), Gross Profit, Net Profit, Asset, Liability, Cash Flow, working capital, Inventory. Funding Methods- Equity or Debt.

Establishing Small Enterprises

- ✓ Legal Requirements and Compliances needed for establishing a New Unit-
 - NOC from Local body
 - Registration of business in DIC
 - Statutory license or clearance
 - Tax compliances

Start-up Ventures

- ✓ Concept & Features
- ✓ Mobilisation of resources by start-ups: Financial, Human, Intellectual and Physical
- ✓ Problems and challenges faced by start-ups.
- ✓ Start-up Ventures in India – Contemporary Success Stories & Case Studies to be discussed in the class.

Financing start-up ventures in India

- ✓ Communication of Ideas to potential investors – Investor Pitch
- ✓ Equity Funding, Debt funding – by Angel Investors, Venture Capital Funds, Bank loans to start-ups
- ✓ Govt Initiatives including incubation centre to boost start-up ventures
- ✓ MSME Registration for Start-ups – its benefits

Exit strategies for entrepreneurs

- ✓ Merger and acquisition exit, Initial Public Offering (IPO), Liquidation, Bankruptcy – Basic Concept only

Seminar

- ✓ Based on any theoretical paper/ laboratory/ previous semester project or any other topics as instructed by concerned teacher.
- ✓ Based on final semester project. (group/ individual student)

Major Project

- ✓ Project should be undertaken in consultation with guide teacher

Text Books List

Study material will be given by subject teacher.

Ramakrishna Mission Shilpamandira

An AICTE Approved
Self-Financed Polytechnic

Belur Math, Howrah



Syllabus Booklet

Diploma in Electrical Engineering [EE]

Semester – VI (Part-II)

Based on the Latest Syllabus published by the
West Bengal State Council of Technical & Vocational Education and Skill Development

Energy conservation & Audit

Unit-1: Energy Conservation Basics

- ✓ Energy Scenario: Primary & Secondary Energy, Energy demand and supply, National scenario.
- ✓ Energy conservation & Energy audit – concept, need & difference.
- ✓ Indian Electricity Act 2003; relevant clauses of energy conservation
- ✓ BEE and its Roles in energy conservation
- ✓ Star Labeling: Concept, Need and its benefits

Unit-2: Energy Conservation in Electrical Machines:

- ✓ Need for energy conservation in induction motor and transformer.
- ✓ Energy conservation techniques in induction motor by –
 1. Improving Power quality.
 2. Motor survey
 3. Matching motor with loading.
 4. Minimizing the idle and redundant running of motor
 5. Operating in star mode lower output power.
 6. Rewinding of motor
 7. Replacement by energy efficient motor
 8. Periodic maintenance
- ✓ Energy conservation techniques in Transformer by –
 1. Load sharing
 2. Parallel operation
 3. Isolating techniques.
 4. Replacement by energy efficient transformers.
 5. Periodic maintenance.
- ✓ Energy Conservation Equipment:
 - i) Soft starter
 - ii) Automatic star delta

- iii) Variable Frequency Drives
 - iv) Automatic p.f. controller (APFC)
 - v) Intelligent p.f. controller (IPFC)
- ✓ Energy efficient motor – features, advantages, applications & limitations.
 - ✓ Energy efficient transformers, amorphous transformers, epoxy Resin cast transformer / Dry type of transformer.
- ### Unit-3: Energy conservation in Electrical Installation systems:
- ✓ Aggregated Technical and commercial losses (AT&C) – Power system at state, regional, national and global level.
 - ✓ Causes of Technical losses and measures to reduce it –
 - i) Controlling I²R losses
 - ii) Optimizing distribution voltage
 - iii) Balancing phase currents
 - iv) Compensating reactive power flow
 - v) Demand side management
 - ✓ Causes of Commercial losses and measures to reduce it –
 - i) In meter reading
 - ii) In metering
 - iii) Theft of electricity by any means
 - ✓ Energy conservation equipment: Maximum Demand Controller, KVAR Controller, Automatic Power Factor controller (APFC); Active harmonic filter.
 - ✓ Energy Conservation in Lighting
 - i) Replacing Lamp sources.
 - ii) Using energy efficient luminaries.
 - iii) Using light controlled gears.
 - iv) Installation of separate transformer / servo stabilizer for lighting.
 - v) Periodic survey and adequate maintenance programs.
 - ✓ Energy Conservation techniques in fans, Electronic regulators.

Theory of Supply:

- ✓ Law of supply, determinants of supply, supply function,

Market Mechanism:

- ✓ Classification of Market, Determine equilibrium price using demand and supply
- ✓ Extension in demand and increase in demand.

Unit– II: Theory of Production & Costs

- ✓ Definition of production, factors of production, production function, Short-run (Law of variable proportion) & long-run in production (Return to scale)

Theory of Cost:

- ✓ Short-run and Long run cost curves, Concept of TFC, TVC, TC, AC, AVC, MC, Relation between AC & MC, LAC curve

Unit– III Different Types of Market & Role Of Government

- ✓ Discussion about various types of market & their characteristics, Profit Maximization concept, Long run & Short run equilibrium.
- ✓ Role of government in Socialist, capitalist, Mixed economy structure

Group-B

Concept of project

- ✓ Definition & classification of projects.
- ✓ Importance of Project Management.
- ✓ Project life Cycle [Conceptualization→Planning→Execution→Termination]

Feasibility analysis of a project

- ✓ Economic and Market analysis
- ✓ Financial analysis: Basic techniques in capital budgeting– Payback period method, Net Present Value method, Internal Rate of Return method

- ✓ Environmental Impact study– adverse impact of the project on the environment.
- ✓ Project risk and uncertainty: Technical, economical, socio-political, and environmental risks
- ✓ Evaluation of the financial health of a project–Understanding the basic concept of Fixed & Working Capital, Debt & Equity, Shares, Debentures etc., and different financial ratios like Liquidity Ratios, Activity Ratios, Debt-equity ratio & Profitability Ratio (Basic concept only).

Project administration

- ✓ Gantt Chart– a system of bar charts for scheduling and reporting the progress of a project (basic concept)
- ✓ Concept of Project Evaluation and Review Technique (PERT) and Critical Path method (CPM): basic concept and application with real-life examples

Entrepreneurship and Start-ups

Entrepreneurship: Introduction & process

- ✓ Concept, Competencies, Functions and Risks of entrepreneurship.
- ✓ Entrepreneurial Values & Attitudes and Skills
- ✓ Mindset of an employee/manager and an entrepreneur
- ✓ Types of Ownership for Small Businesses
 - Sole proprietorship
 - Partnerships
 - Joint Stock company- public limited & private limited companies
- ✓ Difference between entrepreneur and Intrapreneur

- ✓ Buffers, Handshaking, Polling and interrupts, Serial interfacing, Introduction to PIA, Serial communications interface,
- ✓ Example of interfacing of a seven-segment display with a decoder.

Programmable Logic Controller (PLC):

- ✓ Function of PLC in Mechatronics.
- ✓ Basic block diagram and components of PLC.
- ✓ Function of Input & Output module.
- ✓ PLC Programming steps, Ladder diagram, logic functions, Latching and Sequencing, Timers, Internal relays and Counters, Shift registers, Master and Jump Controls.
- ✓ Data handling, Analog input / output.
- ✓ Selection criteria of PLC.
- ✓ Applications of PI, PD, PID controller.

Applications in Mechatronics:

- ✓ Design process stages,
- ✓ Case studies of Mechatronics systems: A pick-and-place robot.
- ✓ Car parking.
- ✓ Automatic water level measurement.
- ✓ Sequential control of washing M/c.
- ✓ Automatic Camera.

Mechatronics Lab

- ✓ To show the method to interface PLC with HMI.
- ✓ To show the method to interface PLC with AC Drive.
- ✓ To interface RTD with PLC and HMI.
- ✓ To interface rotary encoder with PLC and HMI.
- ✓ To interface flow sensor with PLC

- and HMI.
- ✓ To study Instruction set of Delta drive and its operation.
- ✓ Interfacing drive with external devices and its operation.
- ✓ To control motor using Drive and PLC programming.

Engineering Economics & Project Management

Group-A

Unit – I: Introduction, Theory of Demand & Supply

- ✓ Distinguish between Micro and Macro Economics.
- ✓ Definition of economics (Adam Smith, Alfred Marshall, Lionel Robbins).
- ✓ Definition of Engg Economics. Why do Engineers need to learn about Economics?
- ✓ Definition of Resource, Resources for production of goods and services for the market.
- ✓ Scarcity of Resources, Alternative uses of resources & Choice of resources.
- ✓ Opportunity Cost, Rationality, Production Possibility Frontier (PPF) curve and its uses, defects.
- ✓ Basic problems of Economy and how those are solve.

Theory of Demand:

- ✓ Law of Demand, Determinants of demand(individual & Market), Demand function, Exception of demand, Draw a market demand curve from individual demand, Reason for downward sloping of demand curve, Price Elasticity of demand, Classification of goods by using price elasticity of demand, Mathematical problem on elasticity.

- ✓ Techniques of Energy Saving in Ventilating systems and Air Conditioners
- ✓ Techniques of Energy Saving in Furnace, Ovens and Boiler.

Unit-4: 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.
- ✓ Energy conservation by improving load factor and power factor.

Unit-5: Energy Audit of Electrical System:

- ✓ Energy audit (definition as per Energy Conservation Act).
- ✓ ABC analysis – its need & application. Evaluation of partial derivatives.
- ✓ Energy audit instruments & their use.
- ✓ Questionnaire for energy audit projects.
- ✓ Energy flow diagram (Sankey diagram) and its importance.

- ✓ Calculation of simple payback period for energy conservation equipment. Energy Audit procedure (walk through audit & detailed audit).
- ✓ Energy Audit report format.
- ✓ Numericals on energy audit.

Energy Audit & Testing Lab

- ✓ Operation of Manual Auto transformer Starter
- ✓ Operation of Rotor Resistance starter.
- ✓ Operation of soft starter
- ✓ Polarity test on induction motor
- ✓ Break Down Voltage test of insulating oil
- ✓ High Pot test on cable
- ✓ IR test on transformer /Motor
- ✓ Study of oil filtration machine
- ✓ Study the maintenance & trouble shooting of induction motor, DC motor, synchronous machine & transformer.
- ✓ Study of Fire Extinguishers and Shock treatment
- ✓ Study of Gyser and Washing M/c.

Energy Utilization & Conservation Lab

- ✓ Experiment to compare power consumption of different types of TL with electromagnetic ballast, electronic ballast and LED lamps by direct measurements and estimate energy saving.
- ✓ Experiment to estimate energy saving by improving power factor using APFC for an electrical load.
- ✓ Collect electricity bill of a residential consumer & suggest suitable means for energy conservation & reduce consumption.

- ✓ Prepare an energy audit report (Phase-I, Phase-II, Phase-III) for a Workshop/ Institute.
- ✓ Wiring of control and power circuit to run a two speed induction motor.
- ✓ Dynamic braking of three phase induction motor.

Electric Vehicles

Unit -1: 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
- ✓ Comparative study of vehicles for economic, environmental aspects.

Unit-2: 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,
- ✓ Types of vehicle power plant,
- ✓ Performance characteristics of IC engine,
- ✓ Need of gear box, electric motor.
- ✓ 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-3: DC-DC Converters for EV and HEV Applications

- ✓ EV and HEV configuration based on power converters
- ✓ Classification of converters – unidirectional and bidirectional
- ✓ Application of Buck, Boost and Buck- Boost converters in EV using block diagram.
- ✓ High Voltage DC (HVDC)

Unit – 4: DC-AC Inverter & Motors for EV and HEVs

- ✓ Principle, operation and Characteristics of permanent magnet synchronous motors, BLDC and switched reluctance motor.
- ✓ Applications of DC-AC Conv. in EV.
- ✓ Application & control of induction motor, permanent magnet synchronous motors, BLDC & switched reluctance motors used in EVs and HEVs.
- ✓ Application of regenerative braking in EV.

Unit – 5: Components of transmission & distribution Line:

- ✓ Overview of batteries: Battery Parameters, types of batteries
- ✓ Battery Charging and Battery Management System.
- ✓ 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.

Electric Vehicles Lab

- ✓ Develop block diagram of Electric vehicle and identify parts
- ✓ State of Charge (SOC) estimation by open circuit voltage.
- ✓ Develop schematic diagram of hybrid electric vehicle and identify the components.
- ✓ Prepare report on Plug in Electric vehicle by visiting a charging station.
- ✓ Experiment on inverter connected with lead acid/ lithium-ion battery.
- ✓ Experiment on Buck Boost converters
- ✓ Experiment on bidirectional converter.
- ✓ Lithium-ion battery modeling and fault detection design
- ✓ Prepare test procedure for equipment used in Electric vehicle.
- ✓ List safety procedures and schedule for handling HEVs and EVs.
- ✓ Assembly of EV charging point and study of charging modes.

Mechatronics

Introduction to Mechatronics:

- ✓ Introduction
- ✓ Advantages of Mechatronics.
- ✓ Basic building blocks of Mechatronic systems.
- ✓ Measurement systems of Mechatronics.
- ✓ Control systems and their types: Closed-loop control System, Multi input multi output system,
- ✓ Measurement System terminology:
 - Displacement, Position & Proximity Sensors.
 - Velocity and Motion Sensors.
 - Fluid Pressure Sensors.
 - Force Sensors.
 - Flow Sensors.

- f) Temperature Sensors.
- g) Liquid Level Sensors.
- h) Light Sensors: Selection of Sensors and their specifications.

Mechanical Actuation Systems:

- ✓ Types of motion.
- ✓ Advantage and limitations
- ✓ 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 & Control of stepper motors.
- ✓ D.C Servomotor and A.C Servomotor, Specifications & Control of servo motors.
- ✓ AC & DC position control system.
- ✓ A/D & D/A converter.

Pneumatic & Hydraulic Systems:

- ✓ Power supplies.
- ✓ Applications of Directional Control Valve (DCV). Pneumatic Control Valve, Cylinders, Rotary actuators.

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 system,
- ✓ Input/output ports,