Centenary Celebrated Sharnbasveshwar Vidya Vardhaka Sangha's

ಶರಣಬಸವ ವಿಶ್ವವಿದ್ಯಾಲಯ
SHARNBASVA UNIVERSITY

A State Private University approved by Govt. of Karnataka vide Notification No. ED 144 URC 2016 dated 29-07-2017
Recognised by UGC under Section 2f vide No. F.8-29/2017 (CPP-I/PU), dated 20-12-2017 & AICTE, CoA, PCI New Delhi

SYLLABUS FOR PH.D. ENTRANCE EXAMINATION 2026

Faculty of Engineering & Technology

Part I: Research Methodology (Common to all engineering branches)
(Weightage 50%)

Module 1:

Research Methodology: Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Module 2:

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs

Module 3:

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of

Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Module 4:

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests

Module 5:

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated

Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

References:

Text Books:

- C.R. Kothari, Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International, 4th Edition, 2018.
- Ranjit Kumar, "ResearchMethodologyastep-bystepguideforbeginners. (For the topic Reviewing the literature under module 2)" , SAGE PublicationsLtd, 3rd Edition, 2011.
- Study Material (For the topic Intellectual Property under module 5), Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books:

- Trochim, "Research Methods: the concise knowledge base" , Atomic Dog Publishing, 2005.
- Fink A, "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications, 2009.

Computer Science/ Information Science (Weightage 50%)

Unit 1

Data Structures and its applications:

Introductions, primitive, arrays, strings, stacks recursion, queues, linked lists, trees, sorting and searching

Reference:

1.Erns Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, Universities Press,
2.Seymour Lipschutz, Data Structures Schaum's Outlines, McGraw Hill

Unit 2

Discrete Mathematical Structures:

Fundamentals of logics, properties of Integers, principles of counting, relations and functions, inclusion and exclusion, graph theory

Reference:

Ralph P, Grimaldi: Discrete and Combinatorial Mathematics, Pearson Education.

Unit 3

Software Engineering:

Introduction, requirement engineering,, RUP, UML, software testing, project planning, agile software development.

Reference:

Ian Sommerville: Software Engineering,, Pearson Education

Unit 4

Computer Organization:

Machine instructions and programs, input/output organization, memory, Arithmetic, and basic processing unit

Reference:

Carl Hamacher, honk° Vranesic, Safwat Zaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002

Unit 5

Design and Analysis of Algorithms:

Introduction to algorithms, performance, divide and conquer, greedy, dynamic programming, backtracking

Reference:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin. Pearson.

2. Computer Algorilhms/C4—I., Ellis Horowitz, Shirai Salmi and Rajasekaran,Universiuts Press

Unit 6

Operating system:

Introduction, multi threaded programming, Deadlocks, virtual memory management, secondary storage structures and protections,

Reference:

Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles , Wiley-India.

Unit 7

Data Communication and Computer Network; Introduction, Digital transmission, bandwidth utilization, Data link control, media access control, wired LAN and Ethernet. Application layer, Transport layer, Network layer, Network security

Reference:

Behrouz A, Forouzan, Data Communications and Networking

James F Kurose and Keith W Ross, Computer Networking, A Top•Down Approach, Sixth edition, Pearson

Unit 8

Object Oriented Modelling and Design(c++/Java):

Introduction, use case modelling, Process overview, use case realization, Design patterns

Reference:

1. Michael Olaha, James Rumbaugh: Object Oriented Modelling and Design with UML, Pearson Education

2.Erich Gamma. Richard I lelm. Ralph Johnson and john Vlissides: Design Patterns —Elements of Reusable Object-Oriented SoRwarc, Pearson Education

Unit 9

Data Base Management System:

Introduction, relational model, Relational algebra, SQL, Normalization, transaction processing, External Sorting.

Reference:

Fundamentals of Database Systems, Ram/. Elmasri and Shamkant II, Navathe,, Pearson,

Unit 10

System modelling and simulation:

Introduction, statistical modelling, queuing models, random number generation, input modelling, estimation, verification, calibration and validation.

Reference:

Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation,

Civil Engineering (weightage 50%)

Unit 1. Structural Engineering

Statically determinate and indeterminate structures, degree of indeterminacy. Analysis of determinate and indeterminate structures, simple stresses and strains. Relationship between elastic constants. Theory of simple bending, flexural and shear stresses, principal stresses and principal planes. Theories of failures. Deflection of beams and trusses. Influence lines for determinate structures.

Unit 2. Concrete Technology

Properties of fresh and hardened concrete, basics of concrete mix design, high strength /performance concrete. Special concretes such as polymer concrete, self-compacting concrete, fiber reinforced concrete, no fines concrete, light weight concrete etc.

Unit 3.Geotechnical Engineering

Soil mechanics: fundamental definitions, three phase system, relationships and inter relationships, index properties of soil, classification of soils, permeability and seepage, effective stress principle, consolidation, compaction and shear strength. Earth pressure theories and stability of slopes.

Foundation engineering: foundation types, shallow foundations-bearing capacity, settlement analysis in sands and clays. Stress distribution in soil

Unit 4. Hydraulics and Water Resources Engineering.

Open channel and pipe flow. Hydrology -hydrology cycle: precipitation; evaporation, transpiration and infiltration; hydrography, unit hydrograph flood estimation. Water requirement for crops, duty and delta. Distribution system for canal irrigation-determination of required canal capacity, canal losses. Alignment of main and distributary canals.

Unit 5. Transportation Engineering.

Geometric design of highways, railways and airports. Wind analysis and site selection of airport. Pavement materials and mix design of bituminous concrete. Flexible and rigid pavements-components and design. Traffic flow characteristics.

Unit 6. Environmental Engineering.

Water quality. Water treatment, systems of sanitation, system of sewerage, choice of sewerage system, design and planning of sewerage system. Sewage treatment

Unit 7.Design of Concrete Structures

Principles of limit state design, limit state of collapse and limit state of serviceability. Design of beams, design of slabs, design of columns and design of isolated footings.

Unit 8.Design of Steel Structures.

Design of tension, compression and flexural members. Connections: simple and eccentric. Column bases

Unit 9. Surveying

Principles of plane and geodetic surveying. Compass and theodolite surveying, levelling and contouring, curves, areas and volumes. Total station surveying.

Reference books:

Books prescribed for B.E/M.Tech, in civil engineering can be used for preparation of exam

Electronics and Communication (Weightage 50%)

Unit 1
Electronic Devices: Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS Capacitor, MOSFET, SCR, IGBT, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process. Thick and thin film techniques.

Unit 2
Analog Circuits: Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op- amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation. Voltage regulators.

Unit 3
Digital Circuits: Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, Logic Families. logic gates, CMOS implementations, Logic gates, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM and DRAM. Cache Memories. Sensors, Transducers – Display Devices – LED and LCDs.

Unit 4
Networks: Network theorems; Superposition, Thevenin's and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis; Time domain analysis of simple linear circuits; Transients, Resonance – Series and Parallel Resonance Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks.

Unit 5
Signals and Systems: Continuous-time signals; Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: Various types,

discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

Unit 6

Communications: Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error detection correction and Hamming code; Basics of Spread spectrum communications, TDMA, FDMA, CDMA and OFDM. CCN: Basics, Ethernet, Internet Relevant Protocols Services.

Unit 7

Control Systems: Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; error coefficient, steady state error, Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems, Closed loop response - M & N Circles, Nichols Chart. Basics of Non Linear controls, Industrial Automation and Robotics.

Unit 8

Electromagnetics: Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Pointing vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers, Dipole and Yagi antennas

Unit 9

Computer Organization: Organization and architecture. Computer components and functions. Various generations of computers. Addressing—Zero, single, two and three address machines. Hardwired and microprogramming. Arithmetic Circuits-Binary adder, subtractor, multiplier and divider circuits. Fast adder. BCD adder, Floating point representation and arithmetic operations. I/O devices. RISC, CISC machines, Parallel computing and organization.

Unit 10

Microprocessors and Microcontrollers: Microprocessor family. Evolution, advances in architecture. 8086 processor—Architecture, pin details, functions, Instruction set, assembler directives, Simple programs. Interrupts and interrupt handling. I/O and memory interfacing. Buses—RS232 and USB. Microcontroller—8051, architectural details, Instruction sets, Interrupts, Programming Arm Processor-Basics. Embedded system.

Reference Books/Text Books:

Books prescribed for B.E/M.Tech, in civil engineering can be used for preparation of exam

Electrical and Electronics Engineering (Weightage 50%)

Chapter 1: Electromagnetism

Faraday's laws ,Lenz' law,Fleming's rules, ,concept of self and mutually induced emfs and self and mutual inductances and coefficient of coupling

Chapter 2: Network analysis:

Kirchoff's laws and applications, star- delta transformation, source transformation technique, Mesh analysis and Node analysis concept of super mesh and super node analysis, super position ,Thevenin's, Norton's ,Maximum power transfer and Reciprocity theorems, Fundamentals of AC circuits
Resonance: Series and parallel resonance, resonant frequency, acceptor and rejector circuits, selectivity, band width,half power frequencies,
Transient analysis: Transient analysis of RL and RC circuits under DC excitations ,Behavior of circuit elements under switching action , Evaluation of initial conditions, Laplace transforms- initial and final value theorems , determination of Laplace transforms and inverse Laplace transforms , Three phase circuits- analysis with balanced and unbalanced loads, Network parameters - Impedance, Admittance and Transmission parameters.

Chapter 3: Measurements:

 Moving coil and Moving iron instruments, Measurement of resistance, inductance and capacitance using bridges, Measurement of power and energy, **Extension of Instrument Ranges-** Desirable features of ammeters and voltmeters. Shunts and multipliers. Construction and theory of instrument transformers, Desirable characterises, Errors of CT and PT.

Chapter 4: Power systems:
Hydroelectric Power Plants-merits and demerits of hydroelectric power plants,
Steam Power Plants- Merits and demerits of plants,
Nuclear Power Plants- Merits and demerits,
Substations-Introduction to Substation equipment; Transformers, High Voltage Fuses, High Voltage Circuit Breakers and Protective Relaying, High Voltage Disconnect Switches, Lightning Arresters, High Voltage Insulators and Conductors, Voltage Regulators, Storage Batteries, Reactors, Capacitors, power line carrier communication equipment. Classification of substations – indoor and outdoor, Selection of site for substation, Bus-bar arrangement schemes and single line diagrams of substations.

Line Parameters- Introduction to line parameters- resistance, inductance and capacitance. Calculation of inductance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Advantages of single circuit and double circuit lines. . Calculation of capacitance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Advantages of single circuit and double circuit lines.

Corona- Phenomena, disruptive and visual critical voltages, corona loss. Advantages and disadvantages of corona. Methods of reducing corona.

Distribution: Primary AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems – Three phase 4 wire system and single phase 2 wire distribution, AC distributors with concentrated loads. Effect of disconnection of neutral in a 3 phase four wire system.

Reliability and Quality of Distribution System: Introduction, definition of reliability, failure, probability concepts, limitation of distribution systems, power quality, Reliability aids.

Chapter 5: Electrical machines:

DC machines - working, characteristics and their applications , starting and speed control of dc motor, Direct & indirect methods of testing of DC motors-Brake test, Swinburne's test, Retardation test, Hopkinson's test, Field's test, merits and demerits of tests.

AC machines- Transformer-Construction, types, working, types, EMF equation, transformation ratio, Efficiency, regulation , maximum efficiency,   Open circuit and short circuit tests, Equivalent resistance. Transformer connection for three phase operation– star/star, delta/delta, star/delta, zigzag/star and V/V, comparative features. Phase conversion-Scott connection for three-phase to two-phase conversion. Labeling of three-phase transformer Polarity test, Sumpner's test, separation of hysteresis and eddy current losses , Parallel Operation of Transformer, Load sharing in case of similar and dissimilar transformers. ,Auto transformers.

Alternator: Alternator on load. Excitation control for constant terminal voltage. Voltage regulation. Open circuit and short circuit characteristics, Assessment of reactance-short circuit ratio, synchronous reactance, Voltage regulation by EMF, MMF and ZPF methods.

3- ph Induction motor - working, speed -Torque charactaristic , starting and speed control.

Single phase induction motors-Split phase ,capacitor start, capacitor start and run, shaded pole type motors.

Chapter 6: Electronics:

Diode Circuits: Diode clipping and clamping circuits.

Transistor Biasing and Stabilization: Operating point, analysis and design of fixed bias circuit, self- bias circuit, Emitter stabilized bias circuit, voltage divider bias circuit, stability factor of different biasing circuits. Transistor switching circuits.

Feedback Amplifiers: Feedback concept, different types, practical feedback circuits, **Power Amplifiers-** Amplifier types, analysis and design of different power amplifiers, **Oscillators-**

Principle of operation, analysis and derivation of frequency of oscillation of phase shift oscillator, Wien bridge oscillator, RF and crystal oscillator and frequency stability.

Principles of Combinational Logic: Definition of combinational logic, canonical forms, Generation of switching equations from truth tables, Karnaugh maps, combinational logic design, Decoders, BCD decoders, Encoders, digital multiplexers, Using multiplexers as Boolean function generators, Adders and subtractors, Cascading full adders, Look ahead carry, Binary comparators.SR flip-flops, JK flip-flops

Sequential Circuit Design: Mealy and Moore models, State machine notation, Synchronous Sequential circuit analysis

Chapter 7: Power electronics:
Introduction, Diode Characteristics, Reverse Recovery Characteristics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Freewheeling diodes ,Freewheeling diodeswith RL load.

Diode Rectifiers: Introduction, Diode Circuits with DC Source connected to R and RL load, Single-Phase Full-Wave Rectifiers with R load , Single-Phase Full-Wave Rectifier with RL Load
. **Power Transistors:** Introduction, Power MOSFETs – Steady State Characteristics, Switching Characteristics Bipolar Junction Transistors

Characteristics Power Diode Types, Schottky Diodes, Freewheeling diodes ,Freewheeling diodes with RL load .

.**Thyristors:** Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor Turn-On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, *di/dt*Protection, *dv/dt*Protection, DIACs, Thyristor Firing Circuits,

Controlled Rectifiers- Introduction, Single phase half wave circuit with RL Load, Single phase half wave

circuit with RL Load and Freewheeling Diode, Single phase half wave circuit with RLE Load, Single-Phase

Full Converters with RLE Load, Single-Phase Dual Converters, Principle of operation of Three-Phase duel

Converters.

AC Voltage Controllers: Introduction, Principle of phase control & Integral cycle control, Single-Phase

Full-Wave Controllers with Resistive Loads, Single- Phase Full-Wave Controllers with Inductive Loads,

Three-Phase Full-Wave Controllers.

Introduction, principle of step down and step up chopper with RL load,

performance parameters, DC-DC converter classification**.**

DC-AC Converters: Introduction, principle of operation single phase bridge inverters, three phase bridge

inverters, voltage control of single phase inverters, Harmonic reductions, Current source inverters

Chapter 8: Control systems

Introduction to Control Systems: Introduction, classification of control systems.

Mathematical models of physical systems: Modelling of mechanical system elements, electrical systems, Analogous systems, Transfer function, Single input single output systems, Procedure for deriving transfer functions, time response of first order systems, time response of second order systems, steady state errors and error constants, types of control systems

Frequency Response Analysis: Co-relation between time and frequency response – 2nd order systems only.

Design of Control Systems: Introduction, Design with the PD Controller, Design with the PI Controller, Design with the PID Controller, Design with Phase-Lead Controller, Design with Phase - Lag Controller, Design with Lead-Lag Controller.

Chapter 9:Power System Stability: Introduction, Dynamics of a Synchronous Machine, Review of Power Angle Equation, Simple Systems, Steady State Stability, Transient Stability, Equal Area Criterion, Factors Affecting Transient Stability, Multi machine stability studies, classical representation.

Introduction to Electrical and Electronic Materials: Importance of materials, Classification of electrical and electronic materials, Scope of electrical and electronic materials, operational requirements of electrical and electronic materials,

Conductors: Types of conducting materials, Low resistivity materials, High resistivity materials, Contact materials, Fusible materials, Filament materials

Dielectrics: Introduction to dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric strength and Dielectric loss.

Insulating Materials: Insulating materials and applications – Ceramic, Mica, Porcelain, Glass, Micanite and Glass bonded mica. Polymeric materials – Bakelite, Polyethylene. Natural and synthetic rubber. Paper. .

Magnetic Materials: Origin of permanent magnetic dipole, Magnetic terminology, Relation between relative permeability and magnetic susceptibility. Classification of magnetic materials, Diamagnetic, Paramagnetism, Ferromagnetism, Antiferromagnetism and the corresponding materials. Ferrimagnetism and ferrites – properties and applications, Soft and hard ferrites. Curie temperature, Laws of magnetic materials. Magnetization curve, Initial and maximum permeability. Hysteresis loop and loss, Eddy current loss.

Types of magnetic materials, Soft and hard magnetic materials, Concept of superconductors,

Chapter 10: Power System Protection: Need for protective schemes, Nature and Cause of Faults, Types of Fault, Effects of Faults, Fault Statistics, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection, Performance of Protective Relaying, Classification of Protective Relays, Automatic Reclosing, Current Transformers for protection, Voltage Transformers for Protection.

Relay Construction and Operating Principles: Introduction, Electromechanical Relays, Static Relays – Merits and Demerits of Static Relays, Numerical Relays, Comparison between Electromechanical Relays and Numerical Relays. Introduction, Differential Relays, Simple Differential Protection, Percentage or Biased Differential Relay, Differential Protection of 3 Phase Circuits, Balanced (Opposed) Voltage Differential Protection.

Mechanical Engineering (Weightage 50%)

Unit-1
Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts thermal stresses.
Reference Books
1.   Strength of Materials James M Gere, Barry J .Goodno, Cengage Learning, 2009.
2.   Strength of Materials S. S. Bhavikatti , Vikas publications House, -1 Pvt. Ltd, 2006.

Unit 2
Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints, shafts, belts, pulleys, gears, rolling and sliding contact bearings, brakes and clutches.
Reference Books
1.   Theory and problems of Machine Design (Schaum's Outlines series), Hall, Holowenko, Tata
McGraw Hill Publishing Company Ltd., New Delhi, 2014.
2.   Mechanical Vibrations, G. K. Grover and S.P. Nigam Nemchand and Brothers, Roorkee,2009.

Unit 3
Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope. Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.
Reference Books
1.   Theory of Machines Rattan S. S., Tata McGraw-Hill Publishing, Company Ltd., New Delhi,3rd edition -2009.

Unit 4

Energy Resources: Non-renewable and renewable energy resources, Petroleum based solid, liquid and gaseous fuels, Calorific values of fuels, Combustion and combustion products of fuels, Solar Power: Solar Radiation, Solar constant, Solar Thermal energy harvesting, liquid flat plate collectors, solar ponds, Solar photovoltaic principle. Wind Power: principle of operation of a typical windmill. Hydro Power: Principles of electric power generation from hydropower plants, Nuclear Power: Principles of Nuclear power plants, Bio Fuels: introduction to bio fuels, examples of various biofuels used in engineering applications, Comparison of biofuels with petroleum fuels in terms of calorific value and emission.

Reference Books

1. Non-conventional Energy Sources, G D Rai, Khanna Publishers, New Delhi, India, 1994.
2. Non-Conventional Energy Resources, B H Khan, Tata McGraw-Hill Education, 2006.

Unit 5

Fluid Mechanics and Fluid Dynamics: Fluid properties; fluid statics, manometry, buoyancy, stability of floating bodies; Bernoulli's equation; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow.

Reference Books

1. Fluid Mechanics, Bansal, R. K., Lakshmi Publications, 2004.
2. Fluid Mechanics (SI Units) ,Yunus A. Cengel John M.Cimbala, TMH , 2006.

Unit 6

Basic and Applied Thermodynamics: Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle. irreversibility and availability; behavior of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion. Vapour power cycles, Air compressors, Vapour compression and Vapour absorption cycles, basic concepts of psychrometry and psychrometric processes,

Reference Books

1. Engineering Thermodynamics, P. K. Nag, Tata McGraw Hill, 2002.
2. Thermodynamics, An engineering approach, Yunus, A. Cenegal and Michael A.Boies, Tata Mac- Graw Hill Publishing Company, 2002.
3. Thermal Engineering. Author, R. K. Rajput. Edition, 5. Publisher, Laxmi Publications, 2003.

Unit 7

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey

surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

Reference Books

1. Heat & Mass transfer, Tirumaleshwar, Pearson education, 2006
2. Heat transfer-A basic approach Ozisik, Tata McGraw Hill. 2002.

Unit 8

Turbines and IC Engines: Steam Turbines: Steam Formation and Properties. Classification, Principle of operation of Impulse and reaction turbines. Gas turbines Classification, Working principles and Operations of Open cycle and closed cycle gas turbines. Water turbines: Classification, Principles and operations of Pelton wheel, Francis turbine and Kaplan turbine. Internal Combustion Engines: Classification, I.C. Engines parts, 2 Stroke and 4 stroke Petrol engines, 4 stroke diesel engines. Air Standard cycles, Normal and Abnormal Combustion in S.I. engines and C.I. engines, Engine performance.

Reference Books

1. Internal combustion engine fundamentals, John B. Heywood, McGraw Hill Book, publication,1998.
2. Internal combustion engines, V. Ganesan, Tata McGraw Hill Book Company,1995,
3. K. R. Gopalkrishna, "A text Book of Elements of Mechanical Engineering"- Subhash Publishers, Bangalore.

Unit 9

Metrology: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly. Engineering Materials: Types and applications of Ferrous & Nonferrous metals and alloys, Composites: Introduction: Definition, Classification and applications principles of powder metallurgy.

Reference Books

1. Engineering Metrology, R. K. Jain, Khanna Publishers, New Delhi,2007.
2. Materials Science, Shackleford & M. K. Muralidhara, Pearson Publication, 2007.
3. Foundations of Materials Science and Engineering, Smith, McGraw Hill, 2009, 3rd Edition

Unit 10

Machine Tools and Operations: Turning, facing, knurling, Thread cutting, Taper Turning by swiveling the compound rest, Drilling, Boring, Reaming, Tapping, Counter Sinking, Counter Boring, -Plane milling, End milling, Slot milling. Automation: Definition, types –Fixed, Programmable & Flexible automation, NC/ CNC machines: advantages and disadvantages.

Reference Books

1. Manufacturing Science, Amitabh Ghosh and Mallik. Affiliated East West Press, 2003. .

2. K.R.Gopalkrishna, "A text Book of Elements of Mechanical Engineering"- Subhash Publishers, Bangalore.

Unit 11

Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Principles of welding, brazing, soldering and adhesive bonding. Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes.

Reference Books

1. Manufacturing & Technology: Foundry Forming and Welding, P.N.Rao, 3 rd Ed., Tata McGraw Hill, 2003.
2. Manufacturing Technology, Serope Kalpakjain, Steuen. R. Sechmid, Pearson Education Asia, 5th Ed. 2006.

Unit 12

Industrial Engineering: Production systems, Systems approach, Productivity, Product design and development, Production Planning and Control, Statistical Quality Control, Operations Scheduling, Linear Optimization Models, Assignment and Transportation Models, Waiting Line models, Capacity Planning, Plant and Facility layout, Plant Location, Production and Assembly Line Balancing, Time and motion study, Work sampling, Predetermined Time Systems, Principles of Motion economy, Industrial safety, Cost concepts and Break Even analysis, Interest and Money time relationship, Demand and Supply Relationship, Market types and competition, Principles of Management, Motivation, Organization, Forecasting.

Reference Books

1. Operations Research S.D. Sharma, Ledarnath Ramanath & Co, 2002.
2. Industrial Engineering and Management, OP Khanna, Dhanpat Rai & Sons. 2000.