

BHARATI VIDYAPEETH DEEMED UNIVERSITY
Faculty of Engineering
Ph.D. Coursework Syllabus - Electronics Engineering

Teaching scheme

Lectures: 04 Hrs/week

Examination Scheme

Theory: 100Marks

Duration: 3 Hrs

UNIT-I: Engineering Research Fundamentals

Fourier Transform and analysis, Discrete Mathematics, use of mathematical tools in engineering research, scientific visualization, device modeling, system specification and modeling, system analysis, requirement analysis and optimization.

UNIT-II: Digital Signal Processing

Adaptive filter design, adaptive signal processing, stochastic process, FIR filter, LMS algorithm, convergence analysis, vector space treatment to random variables, orthogonal decomposition of signal subspaces, lattice filter, systolic implementation, singular value decomposition, DSP processors, design tools like Mat lab.

UNIT-III: Digital Image and Speech Processing

Image transforms, discrete linear orthogonal, transform coding of color images, morphological image processing, object recognition and image understanding texture image analysis, motion picture analysis, image data compression, LPC in speech signals, speech analysis, time and frequency domain parameters, speech coding, frequency domain coders, text to speech synthesis, speech reorganization, speaker identification.

UNIT-IV: Advanced Digital Communication Systems

Review of probability theory and random variables, random processes, advanced modulation technique behavior of communication system in the presence of noise, entropy, mutual information, data compression, asymptotic equi-partition property, universal source coding, channel capacity, differential entropy, optical receivers, optical link design, power penalties, optical switches - coupled mode analysis of directional couplers, electro-optic switches, and optical communication

System, optical networking, satellite communication systems.

UNIT-V: Microcontroller and Embedded Systems

Microcontroller architectures, memory, I/O devices, interfacing, memory controllers, memory arbitration schemes, interfacing processors, embedded RISC processors, embedded system-on-chip processors, continuous timer blocks, switched capacitor blocks, I/O blocks, embedded system hardware and processor requirements, special purpose processors, I/O design & communication protocols, co-design approach, formal approach to specification, specification languages, specification refinement and design, real time operating system, embedded systems and reactive systems, hard and soft real time systems, specification and modeling, inter process communication, scheduling.

UNIT-VI: Artificial Neural Network and Fuzzy Logic

Design of neural network systems, back propagation, and multifunction hybrid networks, fuzzy evidence, possibility, and probability logic, statistical aspects of learning, dimensions, radial basic function network, radial basic function as ill posed surface reconstruction, self organization maps, cooperative and adaptive processes, vector quantization.

UNIT-VII: Wireless Communication and Computer Networks

Wireless communication for voice, data, and multimedia, source and channel coding, analysis of wireless data networks, wireless local area networks, multiple access techniques, computer simulation of radio channels.

Internet Telephony and voice over IP (VoIP) - RTP and RTCP, Broadband ISDN and ATM Networks- ATM protocols, IP switching and MPLS- Overview of IP over ATM and its evolution to IP switching, Policy servers, Web in QoS domain, architecture for Web QoS, Web Access – Intelligent web browsing and web caching, Internet and web traffic measurement and characterization, network management, optical communication networks- DWDM based transport network, optical IP routers and switching.

UNIT-VIII: Mobile Computing

Mobile IP Goals, assumptions and requirements, entities, IP packet delivery, agent Advertisement and Discovery, registration, tunneling and encapsulation, optimization reverse tunneling, Ad-hoc Networks - characteristics, performance issues, routing in mobile hosts, architecture, datagram protocol, transport layer security, transaction protocol, session protocol, application environment, wireless telephony application.

UNIT-IX: Power Electronics and Industrial Drives

Power flow control, HVDC, facts, load curves, unit commitment, use of optimization methods, load dispatch centre functions, contingency analysis, preventive, emergency and restorative control, power line communication, active Power Factor Correction techniques, performance analysis of AC/DC drives and applications relating to new developments.

UNIT-X: Microwave and Antenna

Microwave components, amplifier design, plane waves at a media interface, waveguides, dielectric wave guide, radiation, arrays, propagation of radio waves, microwave antenna, antenna measurement, open ranges, Anechoic chamber, compact ranges, near field and far field measurements, computational electromagnetic methods.

UNIT-XI: Soft Computing

Problem partitioning, abstraction, top-down and bottom-up design, structured approach. functional versus object-oriented approach, design specification and verification metrics, monitoring and control, top-down and bottom-up, structured programming, information hiding, programming style, and internal documentation. Verification, metrics, monitoring and control, levels of testing functional testing, structural testing, test plane, test cases specification, reliability assessment.

UNIT-XII: VLSI Design Technology

Circuit layout simulation, device simulation, digital system design, CMOS design, combinational and sequential circuit concepts, full custom and semi custom design, complexity of design, need of design automation, physical design and verification, design rules, basic structure of CPLD and FPGA cells, hardware description languages, levels of description, behavioral and structural descriptions, FPGA design flow, mixed signal design, simulation and synthesis.

BHARATI VIDYAPEETH DEEMED UNIVERSITY
Faculty of Engineering
Ph.D. Coursework Syllabus - Computer engineering and Information Technology

Teaching scheme

Lectures: 04 Hrs/week

Examination Scheme

Theory: 100Marks

Duration: 3 Hrs

UNIT-I: System Software: (08 Hours)

Language translators, Assemblers and Macro Processor , Compilers and Interpreters, Linkers and Loaders , Operating Systems, Parallel Systems, Distributed Systems, Real-Time Systems, System Design And Implementation.

UNIT-II: System Architecture: (08 Hours)

Recent trends in Architecture and their related frameworks, clustering, micro architecture.

UNIT-III: System communication: (08 Hours)

All kind of communication, data security, mobile programming (J2EE), Mobile database, embedded System.

UNIT-IV: Software Engineering: (08 Hours)

Software development, Computer based systems, Software quality assurance, Software configuration management, Software design, Software Testing, Object Oriented Software Engineering.

UNIT-V: Computer Network: (08 Hours)

Network design, Internet, X.25, Ethernet, Wireless LANs, Client server model, Point-to-Point-Access (PPP), VOIP, Satellite networks, VPNs, ISDN,ATM and DSL Networks.

UNIT-VI: Algorithms and Complexity: (08 Hours)

Formal models of computation, NP-Completeness, Complexity classes such as RP, NC, #P, PSPACE. Algorithmic paradigms. Parallel, randomized and on-line algorithms. Graph Algorithms. Geometric algorithm, Numerical algorithms. Internet algorithms.

UNIT-VII: Advanced Database Systems (08 Hours)

Distributed Databases. Multi-dimensional and high dimensional data. Uncertain and Probabilistic Data. Data warehousing and Data mining. Data mining models. Data marts, Multidimensional databases.

UNIT-VIII: Computer Vision (08 Hours)

Computer-aided graphics design, Multimedia, Visualization, Rendering, and Animation, Image and video retrieval, motion capture, point based methods. Sensor and Imaging.

Signal Representation. Non-linear Image Processing. Feature Estimation. Image and Video Compression Standards. Classification.

UNIT-IX: AI and Expert System: (08 Hours)

Advanced techniques in AI, Natural Language processing, Reasoning, problem solving, Robotics, Knowledge management system, Decision Support System.

UNIT-X: Research Platform and documentation Tool: (06 Hours)

Latex, Mat lab, required Simulator, etc.

UNIT-XI: Internet and Web-based Technologies: (08 Hours)

Cloud computing, Data Security and storage. PaaS, SaaS, IAM, Cluster-on-Demand. PVM and MPI, Architecture of cluster-based systems.

UNIT-XI: Grid Computing: (06 Hours)

Grid Programming models, Grid systems. Grid security infrastructure.

Text Books / References

- 1) Siberschatz A., "Operating System Concepts", 5 ed., Addison Wesley, 1997;
- 2) Dietel H, "An Introduction to Operating System", Addison Wesley, 1990
- 3) M. R. Bhujade, "Parallel Computing", Newage International Pvt. Ltd., 1995.

- 4) Stallings, William, "Computer organization and architecture, designing for performance", Prentice Hall of India, 1997
- 5) Wireless Communication Technology: Blake Thomas Learning Series.
- 6) Mobile Communication Jochetl Schiller: Addison Wesley.
- 7) Data Management for Mobile Computing: Evaggelia Pitowa and George Samaras.
- 8) R. S. Pressman, "Software Engineering", 6 ed., McGraw Hill, 2004
- 9) Ian Sommerville, "Software Engineering", 6 ed, Addison-Wesley, 2000
- 10) William Stalling, "High Speed Networks and Internets", 2nd Edition, Pearson Education
- 11) Tanenbaum A "Computer Networks", 4th Edition, PHI ISBP 81-203-2175-8
- 12) William Stalling, ISDN and B-ISDN with Frame Relay and ATM, LPE, Pearson 4th Edition 2000
- 13) V. Aho, J. E. Hopcroft and J. D. Ullman, the Design and Analysis of Algorithms, Addison-Wesley, 1974.
- 14) T. H. Cormen, C. E. Leiserson and R. L. Rivest, Introduction to Algorithms, MIT Press, 1990.
- 15) M. R. Garey and D. S. Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, 1979.
- 16) Database System Concepts, 6th Ed. Avi Silberschatz, Hank Korth, and S. Sudarshan. McGraw Hill, 2010.
- 17) Advanced database systems By Nabil R. Adam, Bharat K. Bhargava
- 18) Gonzalves and Woods, Digital image Processing, Addison Wesley 1993.

- 19) Fundamentals of Computer Graphics, 3rd ed., Peter Shirley, A K Peters, 2009
- 20) Computer Graphics using open GL, 3rd ed., F. S. Hill Jr. and S. M. Kelley, Pearson Education Low Price Indian Edition, 2006
- 21) P.Jackson, Introduction to Expert Systems, Addison-Wesley
- 22) Russell and Norvig, Artificial Intelligence: A Modern Approach, Prentice-Hall, 2nd edition.
- 23) Knowledge Management- Elias M. Awad Hasan M. Ghazri, Pearson Education
- 24) By Tim Mather, Subra Kumaraswamy, Shahed Latif Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance O'Reilly Media, Inc., 2009
- 25) C.S.R Prabhu, Grid and Cluster Computing by PHI Pvt. Ltd 2008.

BARATI VIDYAPEETH DEEMED UNIVERSITY
Faculty of Engineering
Ph.D. Coursework Syllabus - Civil Engineering

Teaching scheme

Lectures: 04 Hrs/week

Examination Scheme

Theory: 100Marks

Duration: 3 Hrs

UNIT-I: HYDRAULIC ENGINEERING (8 Hrs)

Fluid Flow-Differential form of continuity and momentum equation, Rapidly varying and gradually varied flows Turbulent flows, Surface and ground water hydrology, data analysis, correlation, regression analysis, Stochastic process, time series analysis, auto correlation analysis and synthetic flow generation, Computational Hydraulics, Applications of numerical methods, Hydraulic transients, Dam break analysis using software's.

UNIT-II: (8 Hrs)

Hydraulics of Spillways and energy dissipaters, static and dynamic uplift pressure in stilling basins, pressure fluctuation in Hydraulic Jump, Sediment problems, significant sediment properties, Shield's analysis, critical tractive stress, Mode of sediment transport, Scour around bridge piers in uniform and non uniform sediments,Hydroinformatics, Remote sensing and GIS applications, application of ANN

UNIT-III: STRUCTURAL ENGINEERING (8 Hrs)

Stresses- 2D,3D, Thermal Stresses, Torsion of open and thin walled sections, Principal Stress-strain, Theories of failures ,buckling of columns. Deflection , moving loads, energy methods, elastic analysis methods, arches Elasticity problems-2D and 3D applications, Kirchoff and Mindlin theory of plates, Finite Element Method , Structural dynamics, Forced and Damped vibration, model analysis, response spectra, seismic design of multistoried buildings, codal provisions

UNIT-IV: (8 Hrs)

Material Science for Civil Engineering, Rheology of concrete, Modern concrete and concreting techniques, advanced concrete materials, composites, laminates and its applications. Reinforced Concrete and Pre-stressed concretes, Concepts and design, Codal provisions system, optical networking, satellite communication system.

UNIT-V: GEOTECHNICAL ENGINEERING (8 Hrs)

Stress distribution under earth embankments and evaluation of settlement profile. Field problems to monitor movement of slopes, foundations, influence of effective

stress of a shift in the ground surface. Foundations in difficult soils; expansive soils, chemically aggressive environment, soft soils, fill, region of subsidence, method of construction in difficult soils.

UNIT-VI: (8 Hrs)

Elastic and Plastic analysis of stress distribution on yielding bases. Analysis of piles and pile groups. Elastic continuum and elastoplastic analysis of piles, on –linear load-deflection response, uplift capacity of group piles. Exploration studies for different Infrastructure projects, Investigation methods, Analysis and required measures, resending results of site investigation.

UNIT-VII: CONSTRUCTION MANAGEMENT (8 Hrs)

CPM, PERT networks, Cost/Resources based networks, scheduling, monitoring and updating, resource planning and allocation, LOB, network crashing, ladder network ,Means of Finance, Working Capital Requirements, Project Cash Flow Projections and statements, Project Balance sheet, profit balance sheet, profit loss account statements, concept of debit equity ratio, tax-need and types, international financing management.

UNIT-VIII: (8 Hrs)

Decision Theory,Game Theory,Linear programming,Non linear programming, dynamic programming, unconstrained programming, dichotomous , fibbonacci, golden section, local and global maxima.

UNIT-IX: ENVIRONMENTAL ENGINEERING (8 Hrs)

Environmental Systems in treatment technologies , water- quality , quantity, treatment processes and distribution, waste water- sources, generation, collection, and characteristics, systems of treatment, advanced treatment

Solid waste – Source, generation, characteristics,. Collection, recycling and recovery processes, treatment methods.

Air- sources and characteristics of air pollutant, air pollution control and treatment technologies.

UNIT-X: (8 Hrs)

Environmental Management Systems, EIA, life cycle assessment, Environmental Economics, Environmental quality modeling, Air quality models, surface and sub surface water quality modeling, softwares in Environmental Engineering, GIS and GPS techniques and applications in Environmental studies.

UNIT-XI: TRANSPORTATION ENGINEERING (8 Hrs)

Transport system- planning, travel demand forecasting, trip generation, Transport network-D Matrix, Expressways-BRT,Urban transport- Mass and rapid transits system, urban goods movement, External commodity movement,Highways- Financing-Credit financing, Private financing, BOT, BOOT, Dedicated Road funds.

UNIT-XII:**(8 Hrs)**

Bridges-Scour depth, Economic span, Forces on Bridges, IRC load Specification, Bearing for bridges, Airport - layout, runway configuration & design, geometric standards, safety distance, turning radius, taxiway, heliports, Dock and Harbours- Planning and design of structure such as Jetties, Wharves, break water and off shore structures, Railways- Modern techniques in railway track engineering, monorail, High speed trains.

Reference Books:

1. Fluid Mechanics, White Tata McGraw Hill.
2. Open Channel Flow-Hanis Chowdhary
3. Computational Hydraulics-Abbott-Nogion Institute of Technology
4. Mechanics of Sediment Transportation & Alluvial stream problems- Garde.R.J,Ranga Raju,New Age International Ltd.
5. Timoshenko and Goodier-Theory of Elasticity, McGrew-Hill publications.
6. S.Crandall, N.Dahl and T.Lardner-Mechanics of Solids McGrew-Hill publications.
7. Anil K Chopra-Dynamics of Structures Theory and Applications to Earthquake
8. Engineering, Prentice-Hall publications.
9. R.W.Clough and J.Penzin- Dynamics of Structures McGrew-Hill publications.
10. R.C.Roy –Structural Dynamics an Introduction to Computer Methods, John Wiely
11. &sons publications.
12. S. Timoshenko and W.Krieger, Theory of plates and Shells, McGrew-Hill.
13. Bowles JE(1996),Foundation Analysis and Design,McGraw Hill
14. Das.B.M(1997),Advanced Soil Mechanics,Taylor and Francis
15. Das.B.M(1993),Principles of soil Dynamics,Brooks/Cole
16. Poulos HG and DavisEH(1980)PileFoundation Design,John Wiley and Sons
17. Karl Terzaghi (1954)Theoretical soil Mechanics,Chapman and Hall
18. Air Pollution:Stern.
19. Waste water Treatment for pollution control ;Arceivala and Dr.Asolekar.
20. Industrial Waste water Treatment: Nelson-Numero.
21. Industrial Waste water Treatment:Dr.A.D.Patwardhan.
22. Kiely.G Environmental Engineering: Mc Graw Hill 1996 ISBN:007091272.
23. Wanielista ,M.Kersten,R and R Eaglin Hydrology: Water Quality and Quality
24. control,Wiley Inter science,1996 ISBN:0471072591.
25. Frank Harris,Modern construction Equipments and Methods.
26. Vector Johnson.D,Essentials of Bridge Engineering,Oxford IBH,Pub Company.
27. Arora,Khanna,Airport Engineering,NEM Chand and Brod,Roorkee.
28. Railway Track Engineering,Mundra .C.K ,Tata Mc Graw Hill
29. Docks and Harbour Engineering- Oza,

BARATI VIDYAPEETH DEEMED UNIVERSITY
Faculty of Engineering
Ph.D. Coursework Syllabus - Chemical Engineering

Teaching scheme

Lectures: 04 Hrs/week

Examination Scheme

Theory: 100Marks

Duration: 3 Hrs

UNIT-I: Chemical Engineering mathematics (08 Hours)

Introduction to applied mathematics, Non-linear & linear algebraic equations to Chemical engineering problems, Differentiation & integration of Chemical Engineering problems, Application of ordinary & partial differential equations to Chemical Engineering problems

UNIT-II: Chemical Engineering process principles (09 Hours)

Thermodynamic principles, Chemical equilibrium & dynamics, Effect of controlling variables on chemical reactions, Mechanisms of various types of reactions, Equilibrium and kinetic based processes, Identification & analysis of Heat transfer-Mass transfer and Reaction kinetic controlled processes

UNIT-III: Advanced Reaction Engineering (08 Hours)

Catalytic and non catalytic processes, Chemical- Biochemical and polymer reactions and reactor engineering, Configurations of chemical reactors, Mathematical modeling & simulation of reactions and reactor

UNIT-IV: Advanced Heat & Mass Transfer (08 Hours)

Effect of diffusion and dispersion in a chemical reactor, Heat & Mass transfer effects in conventional chemical engineering operation

UNIT-V: Fluid Dynamics of Complex Fluids (08 Hours)

Vector & tensor analysis in fluid dynamics, Rheology of complex fluids, Flow of complex fluids, effect of temperature-pressure and process conditions on the properties of complex fluids

UNIT-VI: Advanced Instrumentation & Control (08 Hours)

Response analysis, Controls & process control strategies, Process dynamics & analysis

UNIT-VII: Advanced Materials & Processes (08 Hours)

Newer materials, Synthesis & characterization (biomaterials, nonmaterial, newer resins & adsorbants/catalyst designer solvents, Hybrid Membranes) advance processes,

(Membrane distillation, Membrane bioreactor, Supercritical extraction & process integration)

UNIT-VIII: Advanced Separation Process Technology (09Hours)

Reactive separation, Reactive extractions, Super critical extractions, Membrane based separation (emulsion liquid membrane, membrane reactors), Hybrid separations, Chromatographic separations, Devising separation strategies & process economics, Newer separation contactors (dispersed & continuous phase analysis, packing type & utility, newer designs and micro reactors)

UNIT-IX: Advanced Biochemical Engineering (08 Hours)

Objective & fundamentals of Biological treatment, Process kinetics and design considerations, Fermentation of bioreactors, Biopolymer synthesis, processing and applications

UNIT-X: Advanced Environmental Science & Technology (08 Hours)

Green house emission & controlling, Air & water pollution problems & treatment methodologies, Economics of treatment methods, Biological treatment methods of Industrial practice

UNIT-XI: Analytical methods for Chemical Engineering. (08 Hours)

Basic concepts of GC, HPLC, GC-MS, GPC, TLC, UV&IR, NMR, Size analysis, BET method, Pore size distribution, XRD, XRF, SEM, TEM, Advanced analytical techniques, Atomic absorption, spectrophotometer, inductive couple plasma chromatography and other techniques, Analysis of inorganic, organics & specialty materials

UNIT-XII: Synthesis and Design of Chemical Processes (08Hours)

Safety and health consideration, Fire, Explosions, Toxic release, Intensification of Hazardous materials, Minimization of Waste, Life cycle analysis, Treatment of Solid particle emission and Gaseous Emissions, Patent and Patent rights

Text Books:

- 1) Peter V O Neil "Advanced Engineering Mathematics". 5th Edition
- 2) 'Erwin Kreyszig "Advanced Engineering Mathematics" (Wiley Eastern Ltd).
- 3) Smith J.M. "Chemical Engineering Kinetics", Tata Mcgraw Hill Publication
- 4) Coulson J.M. & Richardson "Chemical Engineering Vol. II" Pergaon Press Oxford New York.
- 5) Grogins P.H. "Unit Processes in Organic Synthesis " 5th Edition Tata Mcgraw Hill Publication
- 6) Leven spiel O "Chemical Reaction Engineering" 3rd Edition, Wiley Publication.
- 7) Treybal R.E. "Mass Transfer Opertations" 3rd Edition ,Mcgraw Hill International Publisher
- 8) Bird R.B et all "Transport Phenomena" 2nd Edition ,Wiley (India Publisher)

- 9) Stephanopoulos G. "Chemical Process control" –An Introduction to Theory & Practice
- 10) Smith .R. "Chemical Process Design" Mcgraw Hill International Publisher
- 11) King C.J. "Seperation Processes" Tata Mcgraw Hill Publication
- 12) Bailey J.O. & Olis D.F. "Biochemical Engineering" Mcgraw Hill International Publisher
- 13) Humphray A.E "Biochemical Engineering Academic Press"
- 14) Rao C. S. "Environmental Pollution Control Engineering" Wiley (India) Publisher.
- 15) Metcalf Eddy, "Waste water Engineering ,Treatment and Reuse" 4th Edition Tata Mcgraw Hill Publication
- 16) Galen E. "Instrumental Methods of Chemical analysis" Tata Mcgraw Hill Publication
- 17) Dodge B. F. "Chemical Engineering Thermodynamic" Mcgraw Hill International Publisher
- 18) Denbeigh K.G. "Thermodynamic" Cambridge University press.

Reference Books:

- 1) Kirk And Othmer "Encyclopedia of Chemical Technology" 5th Edition vol. 1-27 Wiley Publisher.
- 2) Ullamens , "Encyclopedia of Industrial chemistry And Engineering" Wiley Publisher.
- 3) Mcketta J.J. Encyclopedia of Chemical Processing and Design" Vol.1-69 amazon.Co.(UK)

BARATI VIDYAPEETH DEEMED UNIVERSITY
Faculty of Engineering
Ph.D. Coursework Syllabus - Electrical Engineering

Teaching scheme

Lectures: 04 Hrs/week

Examination Scheme

Theory: 100Marks

Duration: 3 Hrs

UNIT-I: Computer methods in Power Systems:

Computer methods for load flow, Optimal power flow, Fault analysis and Stability.

UNIT-II: Restructured Power Systems:

Electricity Act 2003, Deregulation, Market reforms, Advanced Pricing methods, Integration of IPP & DGs to Grid in India.

UNIT-III: Energy Management & Renewable Energy Technologies:

Methods of Energy conservation & management, Wind, Solar, Tidal, Biomass and Hybrid systems, Micro and mini Hydel systems and Grid connectivity of non conventional energy sources and associated regulatory norms.

UNIT-IV: Power System Protection:

Numerical protection for transmission line, synchronous generator, transformer and Relay coordination.

UNIT-V: Power System Analysis:

Modeling of Synchronous machines, Excitation system, and Transmission line Power System Stabilizers and voltage stability.

UNIT-VI: High Voltage Engineering:

Advanced insulating materials, Insulation testing under adverse conditions, Design considerations in EHV and corona, Standards relating EHV Transmission.

UNIT-VII: Power Quality:

Power quality issues, Harmonics and mitigation, Power quality monitoring, IEEE 1159 standard.

UNIT-VIII: Modeling of Linear & non Linear Control Systems:

SISO, MIMO systems & nonlinearities.

UNIT-IX: Advanced Control Systems.

Sliding mode control, Output feedback, Optimal, Fuzzy & neural control, SCADA.

UNIT-X: Applications of Power Electronics to Power Systems.

FACTS, HVDC, Multi level inverters, Space vector modulation

UNIT-XI: Advanced Drives & Control.

Advanced industrial drives, their controls & Controller design.

UNIT-XII: Advanced Materials for Electrical Engineering.

Magnetic, materials, Conducting & insulating materials, Composites & nano-materials, their applications for Electrical Engineering.

BARATI VIDYAPEETH DEEMED UNIVERSITY
Faculty of Engineering
Ph.D. Coursework Syllabus – Mechanical Engineering

Teaching scheme

Lectures: 04 Hrs/week

Examination Scheme

Theory: 100Marks

Duration: 3 Hrs

UNIT-I: Advances in Heat Transfer

Overview of the subject of heat transfer with orientation to applications, Analytical solutions for temperature distribution, Problems related to anisotropic materials, Transient Conduction, Principle of Fluid flow and Convective heat transfer. Concept of velocity and thermal boundary layers, Navier-stokes equations and convection equation, Boundary layer approximations and special conditions, Reynolds analogy, Chilton-Colburn analogy, The Blasius solution, mixed boundary layer considerations, Marcos and Bergles correlation. Convection correlations, Heat transfer enhancement, passive, active and compound techniques. Mixed convection, Environmental radiation, Radiation exchange between surfaces, Multimode heat transfer, Cooling of Electronic Equipment, Ablative, transpiration and high speed cooling

UNIT-II: I.C. Engines and Hybrid Technology

Measurement & Testing of I.C. Engines, performance maps, Engine Materials, Engine Design, experimental development, Electronic Injection System, electronic control system, Engine Emissions & Control, Simulation Technique, engine selection parameters, recent trends in IC engines, Hybrid Vehicles and Technology, Alternate Fuels, Combustion & Combustion Chambers In SI / CI Engines, Supercharging & Turbo charging.

UNIT-III: Advanced Thermodynamics

Equation of State, Equation of state for real gases, generalized Compressibility chart, Law of corresponding states, Properties of Pure Substances, Phase change process of pure substances, PVT surface, P-v & P-T diagrams, Laws of thermodynamics, Increase of entropy principle, T-ds relations, entropy generation, Onsager equation. Exergy analysis of thermal systems, Thermodynamic Property Relations, Chemical Thermodynamics, Third law of thermodynamics, Nerst heat theorem and heat death of universe Gas Mixtures – Mass & mole fractions, Dalton's law of partial pressure, Amagat's law, Kay's rule.

Statistical Thermodynamics- Fundamentals, equilibrium distribution, Significance of Lagrangian multipliers, Partition function for Canonical Ensemble, partition function for an ideal monatomic gas, equipartition of energy, Bose Einstein statistics, Fermi-Dirac statistics,

UNIT-IV: Tribology

Introduction, economic aspects, ; Regimes of Lubrication; Viscosity – its representation and Measurement; lubrication of bearings, friction control and wear prevention. Properties and testing of lubricants. Mechanics of fluid flow - Reynolds equation and its limitations. Idealized bearings : Infinitely long plane pivoted shoe and fixed shoe sliders, Infinitely long journal bearings, Infinitely short (narrow) bearings, Lightly loaded infinitely long journal bearing (Petross' solution). Finite bearings : Approximate analytical solution, Numerical solution and Electrical analogy method. Hydrostatic oil bearings : Thrust and journal bearings. Squeeze film bearings. Gas-lubricated bearings; hydrodynamic bearings, hydrostatic bearings porous bearings. Elastohydrodynamic lubrication. Fluid inertia and turbulence and hydrodynamic instability. Friction and wear of metals. , Rolling Element; Lubrication Systems - Selection and Design Considerations; Maintenance .

UNIT-V: Vibration Analysis

Introduction; Boundary value and eigenvalue problems; Self-adjoint and non-self-adjoint systems; Vibration of rods, shafts and strings; Bending vibration of bars; Two-dimensional problems; Variational Characterization of the eigenvalues; The response problem; discretization of continuous systems; Rayleigh-Ritz method, Assumed modes

method, Method of weighted residuals; System response by approximate methods; Vibration of a system with time-dependent boundary conditions; Transform method solution of continuous systems Nonlinear vibrations : State space formulation, Limit cycles, perturbation techniques, Random Vibrations: Autocorrelation and cross-correlation, spectral density, response to random inputs, Rayleigh distribution.

Balancing techniques for flexible rotors. Balancing standards. Torsional vibration analysis of rotating machines including branched systems-response to steady state and transient excitations.

UNIT-VI: CAD-Geometric Modelling:

Introduction - Dimensions of models, Types of models, Construction of solid models. Wire frame Models, Wire frame Entities, Curve Representation. Parametric Representation of Analytic Curves - Review of Vector Algebra, Lines, Circles, Ellipses, Parabolas, Hyperbolas, Conics. Parametric Representation of Synthetic Curves - Hermite Cubic Splines, Bezier Curves, B-Spline Curves, Rational Curves. Curve Manipulations - Displaying, Evaluating Points on Curves, Blending, Segmentation, Trimming, Intersection. Transformation Design and Engineering Applications - Problems. Numericals on modeling of curves

UNIT-VII: Surface Modelling

Introduction - Surface Models, Surface Entities, Surface Representation. Parametric Representation of Analytic Surfaces - Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder. Parametric Representation of Synthetic Surfaces - Hermit Bicubic Surface, Bezier Surface, B-Spline Surface, Coons Surface, Blending Surface, Offset Surface, Triangular Patches, Sculptured Surface, Rational Parametric Surface. Surface Manipulations - Displaying, Evaluating Points & Curves on Surfaces, Segmentation, Trimming, Intersection, Projection, Transformation. Design & Engineering applications - Problems.

UNIT-VIII: CAM

CNC machining centres and FMS, CIM, Adaptive control system in CNC. Automated assembly and inspection tools.

laminated object manufacturing: Principle, of operation, LOM materials. Process details, application.

SOFTWARE FOR RP: STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools.

CAD based Assembly

Introduction, Assembly Modeling - Parts Modeling & Representation, Hierarchical Relationships, Mating Conditions. Inference of position from mating conditions. Representation schemes - Graph structure, Location graph, Virtual Link. Generation of Assembling Sequences - Precedence Diagram, Liaison-Sequence analysis, Precedence Graph. Assembly Analysis – Problems.

UNIT-IX: ADVANCED FLUID MECHANICS AND CFD

ADVANCED FM-Incompressible and in-viscid flow in two dimensions: The continuity equation, Stream function for uniform stream, sources and sink, flow field due to source and sink, doublet, two dimensional flow past solid bodies, and vortex potential, Velocity functions, two dimensional airfoil theory, conformal transformation, Thin airfoil theory, airfoil of finite span, effect of viscosity and compressibility.

Viscous fluid flow: Equation of continuity, equation of motion, derivation of N S equations, energy equations in incompressible flows. Limiting cases of small viscosity, exact solution, theory of hydrodynamic lubrication. Two dimensional laminar boundary layer, flow separation, effect of pressure gradient, the exact solution, boundary layer thickness, skin friction, approximate methods of solution, momentum integral equation, two-dimensional flow with zero pressure gradient, flow with pressure gradient, boundary layer circulation, stresses stability of laminar boundary layer. Turbulent flow, additional turbulent stresses. Boussinesq's hypothesis, Prandtl's mixing length hypothesis, universal velocity distribution, turbulent flow in pipes, turbulent boundary layer with zero pressure gradient.

Three-dimensional flow: Equation of continuity, Stoke's stream function, flow, velocity potential function, standard flow patterns, uniform flow source doublet, line source line sink and uniform flow function, flow past stream-lined body.

Gas Dynamics: Compressible effect, steady 1D compressible flow, perfect gas flow in a duct, isentropic flow with friction, normal and oblique shocks

COMPUTATIONAL FLUID DYNAMICS- Basic Concepts: Dimensionless form of equations; Simplified mathematical models; Hyperbolic, Parabolic & Elliptic systems; Properties of numerical solutions (Consistency, Stability, Conservation, Convergence and Accuracy)

Finite Difference Methods: Discretisation; Boundary conditions; error propagation; Introduction to spectral methods; examples. Numericals.

Finite volume method: Surface & volume integrals; Interpolation & differentiation; Boundary conditions; Examples.

Linear & Non linear equation systems: Gaussian Elimination; LU decomposition; Tridiagonal Systems; Iterative methods; convergence; ADI & other splitting methods; multi-grid method; Coupled equations; Simultaneous solutions, sequential solutions & under relaxation. Non linear systems ,Initial value problem & Boundary value problems; Implicit & Explicit Schemes; 2D and 3D examples. Heat and Mass transfer Problems; Multi Phase Flows

UNIT-X: OPTIMIZATION METHODS IN MECHANICAL SYSTEM DESIGN

Introduction: Engineering application of optimization, multivariable optimization Statement of a optimization problem. Design Vector, Design constraints, objective function, classification of optimization problems.

Classical optimization technique: Single variable optimization, with equality Constraints solution by direct substitution, solution by the method of constrained Variation. Solution by the method of lagrange multipliers, multivariable optimization with inequality constraints Kuhn – Tucker condition.

Non-linear programming: (One Dimensional minimization method) Numerical method, Unimodal function, Unrestricted search, Exhaustive search. Dichotomous search,

Fibonacci and Golden section method.

Interpolation method: Quadratic and Cubic Nonlinear programming (Unrestricted Optimization Technique) Random search methods, Univariate method, Powell's method, Simplex method.

UNIT-XI: FINITE ELEMENT ANALYSIS

Calculus of variation, Introduction to calculus of variations, Introduction to equilibrium equations in elasticity, Euler's Lagrange's equations, Principle of virtual work, virtual displacements, Principles of minimum potential energy, boundary value, initial value problems, Flexibility approach, Displacement approach, Different problems in structural analysis.

FEM Procedure, Derivation of FEM equations by variation principle polynomials, Concept of shape functions, Derivation for linear simplex element, Need for integral forms, Interpolation polynomials in global and local coordinates.

Weighted residual Methods: Concept of weighted residual method, Derivation of FEM equations by Galerkin's method, Solving cantilever beam problem by Galerkin's approach, Derivation of shape functions for CST triangular elements, Shape functions for rectangular elements, Shape functions for quadrilateral elements.

Higher order Elements: Concept of iso-parametric elements, Concept of sub-parametric and super-parametric elements, Concept of Jacobin matrix.

Numerical Integration: Numerical Integration, one point formula and two point formula for 2D formula, Different problems of numerical integration evaluation of element stiffness matrix, Automatic mesh generation schemes, Pascal's triangle law for 2D shape functions polynomial, Pascal's triangle law for 3D shape function polynomials, Shape function for beam elements, Hermite shape functions.

Convergence: Convergence criteria, Compatibility requirements, Geometric isotropy invariance, Shape functions for iso-parametric elements, Special characteristics of stiffness matrix, Direct method for deriving shape functions using Lagrange's formula, Plane stress problems.

UNIT-XII: ROBOT TECHNOLOGY

Introduction: Definition, types and representation of robots, Construction of manipulators, Advantages and disadvantages of various kinematics structures. Applications. Pneumatic, Electric and Hydraulic actuators, characteristics and control, Non-servo robots, motion planning, Feedback systems, encoders, Servo control, PTP & CP.

Kinematics, Homogeneous Co-ordinates, solution of Inverse kinematics problems. Multiple solutions, Jacobean work-envelopes, Trajectory planning, manipulator dynamics and force control.

Dynamics of Robotic Manipulators: Introduction, Bond Graph Modeling of Robotic Manipulators, Examples of Bond Graph Dynamic Modeling of Robotic Manipulator. Brief Discussion on Lagrange–Euler (LE) Dynamic Modeling of Robotic Manipulators: - Preliminary Definitions, Generalized Robotic Coordinates, Dynamic Constraints, Velocity & Acceleration of Moving Frames, Robotic Mass Distribution & Inertia Tensors, Newton’s Equation, Euler Equations, The Lagrangian & Lagrange’s Equations. Application of Lagrange–Euler (LE) Dynamic Modeling of Robotic Manipulators: - Velocity of Joints, Kinetic Energy T of Arm, Potential Energy V of Robotic Arm, The Lagrange L , Two Link Robotic Dynamics with Distributed Mass, Dynamic Equations of Motion for A General Six Axis Manipulator.

Robot Teaching: Introduction, Various Teaching Methods, Task Programming, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation, WAIT, SIGNAL & DELAY Commands, Branching, Robot Language Structure, various Textual Robot Languages Such as VAL II, RAIL, AML and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Etc,

Robot Sensing & Vision: Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.

Robot sensors, vision, Ranging, LASER Acoustic, tactile, Developments in sensor technology, sensory control, Programming languages-VAL, RAIL, AML.

Mobile Robots- Introduction, land surface robots-arrangement of wheels and tracks navigation for land vehicles – control and communications, types of operation of mobile robots, legged robots-Leg number and arrangement – control – climbing robots submersible robots in air and space – Automated Guided Vehicles (AGV) Walking Devices.

UNIT-XIII: MECHATRONIC SYSTEM DESIGN

Introduction: Definition and Introduction to Mechatronic Systems. Modeling & Simulation of Physical systems Overview of Mechatronic Products and their functioning measurement systems. Control Systems, simple Controllers.

Study of Sensors and Transducers: Pneumatic and Hydraulic Systems, Mechanical Actuation System, Electrical Actual Systems, Real time interfacing and Hardware components for Mechatronic

MEMS and Microsystems: Introduction, Working Principle, Materials for MEMS and Microsystems, Micro System fabrication process, Overview of Micro Manufacturing, Micro system Design, and Micro system Packaging.

Data Presentation Systems: Basic System Models, System Models, Dynamic Responses of System.

Advanced Applications in Mechatronics: Fault Finding, Design, Arrangements and Practical Case Studies, Design for manufacturing, User-friendly design.

Modeling and Simultaneous of Measurement System: Lumped analysis, first order and second order systems: Frequency response and time constant calculation. Response of a generalized instrument to random data input, FFT analysis, Measurement Design, Construction and Analysis of liquid and gas thermometers, resistance thermometer with wheat stone bridge. Thermo -electric effect. Construction, testing and calibration of thermocouples and thermopiles, Analysis of effect of bead size and shielding on time constant and frequency response. Characteristics of thermocouple.

Optical techniques:

Pyrometers. radiation thermometers and interferometers.

Humidity measurement Conventional methods, electrical transducers: Dunmox humidity and microprocessor based dew point instrument. Calibration humidity sensors.

Air Pollution sampling and measurement; Units for pollution measurement, gas sampling techniques, particulate sampling technique, gas chromatography.

Data Acquisition systems: Fundamentals of digital signals and their transmission, A/D-and D/A converters, Basic components of data acquisition system. Computer interfacing of digital instrument and data acquisition systems; Digital multiplexes, Data acquisition board (DAQ), Digital image processing fundamentals.

Vibration measurement and its methods, Various sensors. FFT and its methods. Non contact type vibration sensors.

Reference books:

1. Incropera and Dewitt. Fundamentals of heat and mass transfer. John Wiley and sons.
2. Yunus Cengel: Heat transfer - an practical application. Tata Mc Graw Hill.
3. M.N. Ozisik - Heat transfer a basic approach - Mc Graw Hill Int.
4. A Bejan – Convective heat transfer.- John Wiley and sons.
5. J.P. Holman- Heat transfer, Mc Graw Hill, Int.
6. S.P. Sukhatme, Heat transfer, University Press
7. The Internal Combustion Engine in Theory and Practice Volume I & II by Charles Fayette Taylor, The MIT Press
8. Internal Combustion Engines- V Ganesan, 2nd edition, TaTa McGraw Hill
9. Automotive Technology, Jack Erjavec,3rd edition, Delmar Thomson Learning
10. Design and Simulation of four stroke engines, Gordon P Blair, SAE International
11. Gasoline Engine Management, Bosch handbook,2nd edition, Professional Engineering Publication
12. Internal Combustion Engines, C.R. Ferguson & A.R. Kirkpatrick, Delhi, 2001
13. . Cengel, Thermodynamics, TMH
14. 2. Howell & Dedcius: Fundamentals of engineering Thermodynamics, McGraw Hill,
15. 3. Van Wylen & Sontag: thermodynamics, John Wiley & Sons, Inc.,USA

19. 4. Holman, Thermodynamics, 4th edition, McGraw Hill
20. 5. Zimmansky & Dittman, Heat and Thermodynamics, 7th edition, TMH
21. Rao, Y.V.C., Postulational and Statistical thermodynamics, Allied Pub. Inc.
22. Jones and Hawkings: engineering Thermodynamics, John Wiley & Sons, Inc. USA
23. Faires V. M. and Simmag: Thermodynamics. McMillan Pub. Co. Inc. USA
24. Turns, Thermodynamics- Concepts and Applications, Cambridge University Press
25. Wark, Advanced Thermodynamics, McGraw Hill
26. Jones & Dugan, Advanced Thermodynamics, Prentice Hall Int.
27. Bejan, Advanced Thermodynamics, John Wiley, Inc.
28. Computational Fluid Dynamics, T. J. Chung, Cambridge Univ. Press, 2002
29. Partial Differential Equations for Scientists and Engineers, Farlow, John Wiley, 1982
30. Grimsons : Advanced fluid mechanics
31. Yuan : Fundamentals of fluid mechanics
32. H. R. Vaillentine: Applied hydrodynamics
33. J. K. Vennard and Robert L. Street: : Elementary fluid mechanics
34. S. S. Rao, Optimisation – Theory and Application, Wiley Eastern.
 - a. Operations Research- Principles and Practice by Ravindran, Phillips and Solberg, John Wiley
35. Introduction to Operations Research by Hiller and Lieberman, McGraw Hill
36. Engineering Optimization By Kalyanmanai Deb, Prentice Hall of India, New Delhi.
37. R. L. Fox Optimization methods for Engg. Design, Addison – Wesley
38. G.S.G. Beveridge and R. S. Schechter, Optimisation Theory and practice.
39. Ram, Optimisation and Probability in System Engg. Van Nostrand.
40. Concepts and Applications of Finite Element Analysis: COOK. D. Robert. Malus.S.David, Plesha E. Michel, John Wiley & Sons 3rd Edn. New York, 2000
41. Finite Element Analysis -C. S. Krishnanmoorthy, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 1995

42. Introduction to the Finite Element method -Desai / ABEL-C.B.S. Publishers & Distributors, New Delhi 2000
43. J. Duffy, "ANALYSIS OF MECHANISUM AND ROBOT MANIPULATERS", John Willey & Sons, 1980.
44. B. Rooks (ED) "ROBOT VISION AND SENSERY CONTROLS", Vol3, North Holland.
45. M. P. Groover, "INDUSTRIAL ROBOTICS", MGHI.
46. Craig, "ROBOTICS", Addison-Wesley.
47. D. J. Todd, "WALKING MACHINES – AN INTRODUCTION TO LEGGED ROBOTS", Kogan Page Ltd, London, 1985.
48. Y. Koren, "ROBOTICS FOR ENGINEERS", MGH
49. Kamm, "Understanding Electro-Mechanical Engineering an Introduction to Mechatronics" PHI.
50. Fine Mechanics and Precision Instruments. Pergamon Press, 1971.
51. Shetty and Kolk "Mechatronics System Design" Thomson.
52. Mahalik "Mechatronics" TMH.
53. Mechatronics – HMT, TMH.
54. E. O Doebelon -Measurements systems Application and Design

BARATI VIDYAPEETH DEEMED UNIVERSITY
Faculty of Engineering
Ph.D. Coursework Syllabus - Production Engineering

Teaching scheme

Lectures: 04 Hrs/week

Examination Scheme

Theory: 100Marks

Duration: 3 Hrs

UNIT-I: Modeling and Optimization technique (8 Lectures)

Need for optimization, formation of optimization problem, classical optimization methods, differential calculus, unconstrained minimization, univariate conjugate direction gradient, variable metric methods, constrained minimization technique, genetic algorithms, simulated annealing, global optimization. Etc.

UNIT-II: Quantitative Techniques: (8 Lectures)

Optimization techniques, Simulation Using Software, Non-linear Programming, Goal Programming, Inventory Management, Supply Chain Management, Project Management, Resource Optimization

UNIT-III: Robotics and Automation: (8 Lectures)

CAD / CAM, Rapid Prototyping, Flexible Manufacturing Systems And Group Technology (MICLASS, OPTIZ), Cell Formation in GT. Analysis of Vision System, online Inspection through Vision System, Design of Grippers, various sensors in robotics, Robot kinematics and dynamics, Trajectory Planning in robotics, avoiding obstacles by robot.

UNIT-IV: Facility planning: (8 Lectures)

Site selection theories, Physical facilities – Algorithm, Automated Guided Vehicles (AGV's), Material handling systems – Conveyor design., Deterministic models - single and multi facility location models, Job Allocation problems - quadratic assignment problems, Warehouse layout models, plant location problems

UNIT-V: Reliability/ Maintenance: (8 Lectures)

Fault Tree Analysis & Event Tree Analysis, Accelerated reliability testing, Nonparametric reliability evaluation, Failure Modes Effects Analysis & Failure Modes Effects and Criticality Analysis, HASS, HALT, reliability evaluation of complex system,

Evaluation of system reliability, maintainability and availability, AGREE, ARINC, Mean & Median statistical methods, Fair & Kim's Algorithm.

UNIT-VI: WorkStudy&Ergonomics: (8 Lectures)

Time & Motion Study, PMTS, Anthropometry, Critical analysis of work design criteria, Man - machine learning phenomenon, Bio – dynamics analysis, Job evaluation and merit rating.

UNIT-VII: Theory of Plasticity & Metal forming (8 Lectures)

Analysis in drawing and extrusion of metals, theory and practice of Bulk forming processes, Plastic deformation in forging, rolling, Extrusion and Drawing process, Sheet metal forming. Theory of plastic deformation – Yield criteria - Work of plastic deformation

Analysis of forming processes - Energy slab method- open die forging, plate drawing, flat rolling, - Other methods of analysis like FEM, Upper and lower bound solution methods – slip line field.

Review of stress –strain relations, Yield criteria, plastic anisotropy, forming limits and material models, Viscoplasticity, Solutions to metal forming problems.

UNIT-VIII: Knowledge Based system in Manufacturing (8 lectures)

Introduction, Development of data based & knowledge based Knowledge representing system, Fuzzy logic, and neural nets. Inference mechanism, conflict resolution, knowledge acquisition, coding. Expert systems, shells, artificial intelligence. Selective application in manufacturing, product design, process planning, scheduling, robot movement.

UNIT-IX: Finite Element Methods (8 lectures)

Finite element formulation- Vibration method of weighted residual etc., Linear elastic stress analysis -2D,3D and axisymmetric problem analysis of structure, vibration, stability, fluid flow, heat condition etc. Boundary element formulation 2D & 3D stress-analysis

UNIT-X: Advanced Machining / Non conventional Machining (8 Lectures)

Theory and Numerical analysis of abrasive jet machine, Abrasive flow machining, Ultrasonic machining, Electrical Discharge Machining(EDM), Electro Chemical Machining, Electro Chemical Discharge Machining(ECDM), Vibro ECDM, Dry and Near dry EDM, thermal Energy Methods material pressing, LASER machining, Electron Beam Machining, Plasma arc machining, Physical vapour deposition and chemical vapour deposition, high energy rate forming and Electroforming.

UNIT-XI: Advance Welding Technology (8 Lectures)

Welding process – process parameters selection and control, welding consumables, welding equipments, metal transfer and heat flow in different welding process, joint design & design of weldments Welding defects: cause and remedies, Destructive and non destructive inspection. Recent trends in joining of materials including

plastics,ceramics,composite material ,friction welding, fusion welding, ultrasonic welding,explosive welding etc.

UNIT-XII:Futuristic & Composite material Processes

(8 Lectures)

Composite Materials

Metallic, Ceramic and Polymeric Composites, Classical Laminate Theory, Elastic Properties of Advanced Composites, Micromechanics and Theories of Failure, Design and Analysis of Composite Structures, Vibration and Buckling analysis of Composite Beams, Plates and shells.

Fracture Mechanics

Theories of Failure in Isotropic and Anisotropic materials, Stress Strain Singularities, Stress Intensity Factor, Strain Energy Rate, J-Integral, Fatigue Crack Propagation.

Nanoscience and NanoEngineering

Principles, Methods to manipulate matter at the atomic and “nano” length scales, Characterization and Modeling of Materials at molecular and mesoscopic levels. Physical, Chemical, Mechanical analysis, synthesis and engineering of nano material systems.

Reference/ Text books

1. J.S.Arora - Introduction to optimum design - McGraw Hill book Co-1989.
2. S.S.Rao – Optimization theory and Application- Wiley Easton ltd 1978.
3. Kalyanmoy Deb – Optimization for Engineering Design – Prentice Hall –India Ltd 1995.
4. Gupta P. K. and Hira D. S.: Operations Research, S Chand & Company Ltd.
5. Sharma J. K.: Mathematical Models in Operations Research, Tata McGraw – Hill Publishing Company Limited.
6. Sharma S. D., Kedar Nath: Operations Research, Ram Nath & Co.
7. R. Panneerselvam : Operations Research, Prentice Hall of India Pvt. Ltd
8. Robotics Technology and Flexible Automation – S.R. Deb Tata McGraw Hill.
9. Robotics for Engineers – Yoram Koren, Tata McGraw Hill.
10. Industrial Robotics – Groover, Weiss, Tata McGraw Hill.
11. Robotics – Control, Sensing, Vision and Intelligence – K. S. Fu, R. C. Gonzalez, C. S. G. Lee, McGraw Hill Int.
12. Robotics and Image Processing by P.A. Janakiraman, Tata McGraw Hill 1995
13. Facilities Planning, Thompkins, J A and White, J. A.
14. Facility layout and Location. Francies, R.L. and White, J. A
15. Plant Layout and Material handling James M Apple,2"d Edition., John, Wiely and Sail.
16. MEMS & Microsystem: Design & Manufacture by Tai ran Hsu, Tata McGraw Hill Publisher, 2002.
17. The MEMS handbook, CRC Press, 2001
18. Microsensors, MEMS and smart Devices by Julian W. Gardner & Vijay K. Varadan, John Wiley & Sons, 2001.

19. Nanotechnology' by Nario Taniguchi, , Oxford University Press, 1996
20. Concepts in Reliability in Engineering – L. S. Srinath, Affiliated East West Press.
21. Reliability in Engineering Design – K. C. Kapur and L. R. Lumbersome, Willey.
22. System reliability-Modelling and Evaluation – C. Singh and R. Billinton, Hutchinson.
23. Terotechnology: Reliability Engineering and Maintenance Management - B Bhadury and S.K. Basu, Asian Books, New Delhi 2002.
24. A.K. Gupta: Reliability Engineering & Terotechnology Mc Millan (I) Ltd.
25. Terotechnology & Reliability Engineering: A. K. Gupta, McMillan Co.
26. Maintenance, Replacement & Reliability: A. K. S. Jardine, HMSO, London
27. Human Factors in Design and Manufacturing-Mark S.Sanders, Ernest. J. McCORMICK.
28. Works Organization and Management: Basu S.K., Sahoo K.C., and Datta N.K., Oxford-IBH, 3rd Edn., 1997.
29. Human Engineering- Guide to Equipment design C.T.Morgan, J.S.Cook, A. Chapnis and M.W.Land: McGraw Hill, N.Y, 1963.
30. Barnes, "Motion and Time Study", Wiley International.
31. Theory of Metal Forming Plasticity - Classical and Advanced Topics by Sluzalec, Andrzej , Springer Publications
32. Metal Forming - Process and analysis – by B. Avitzur, Tata Mcgraw Hill
33. Metal working science and Engineering by E.M. Mielnik , McGraw Hill. Inc.
34. Theory of plasticity “-Chakrabarthy J.,- McGraw Hill Co, 1987.
35. Metal forming Mechanics and Metallurgy – Hofsord W.F. and Caddell R.M. – Prentice Hall, Eaglewood, cliffs, 1993
36. Theory of Metal Forming Plasticity - Classical and Advanced Topics by Sluzalec, Andrzej , Springer Publications
37. Kerr R – Knowledge based manufacturing Management, Addison – Wiley 1997.
38. Ramez Elmasri & Shamkant B Navathe “ Fundamentals of Database system” 5TH Edition –Pearson Education
39. Rottson D W “ Principals of artificial intelligence and expert system development “ McGraw Hill 1988
40. O.C Zlenkiwicz, The Finite Element Method 3rd Edition, Total – McGraw Hill 1983
41. R.D Cook , Concept and Application of finite Element Analysis, John Wiley , 2nd Edition 1981
42. Lancaster ,J.F. Metallurgy of welding, brazing and soldering “George Allen & Unwin , London 1985
43. Houldcroft P.T elding process technology Cambrdge University press 1985
44. Metals handbook – Volume no McGraw Hill Co, Ltd
45. ASM Handbook Vol II
46. Engineering Mechanics of Composite Materials, Oxford University Press, Issac Daniel, Ori Ishai, ISBN: 0132951967, 9780132951968
47. Composite Structures: Testing Analysis and Design, J.N. Reddy, A.V. Krishna, ISBN: 3540558799, 973540558798
48. Mechanics of composite materials / Autar K. Kaw, Boca Raton, FL : Taylor & Francis, 2006

49. Composite materials: testing and design (seventh conference) : a conference : Philadelphia, PA, 2-4 April 1984 *Volume 893 of ASTM special technical publication* Author James Martin Whitney Publisher ASTM International, 1986 ISBN0803104472, 9780803104471
50. Fracture mechanics: fundamentals and applications, Author Ted L. Anderson, Edition3, Publisher Taylor & Francis, 2005 ISBN0849316561, 9780849316562
51. Elementary engineering fracture mechanics, Author David Broek Edition4, Publisher Springer, 1986, ISBN 9024725801, 9789024725809
52. Nanoengineering of structural, functional, and smart materials, Mark J. Schulz, Ajit D Kelkar, Mannur J. Sundaresan, Publisher CRC Press, 2005, ISBN0849316537, 9780849316531
53. Nanostructured materials: processing, properties, and applications, C. C. Koch, Edition 2, illustrated Publisher William Andrew, 2007, ISBN0815515340, 9780815515340
54. Nanomaterials: synthesis, properties, and applications, Authors Alan S. Edelstein, Robert C. Cammarata Edition2, Publisher Institute of Physics Pub., 1998, ISBN 0750305789, 9780750305785