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

<table>
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<th>Teaching scheme</th>
<th>Examination Scheme</th>
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<tr>
<td>Lectures: 04 Hrs/week</td>
<td>Theory: 100Marks</td>
</tr>
<tr>
<td>Duration: 3 Hrs</td>
<td>Duration: 3 Hrs</td>
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UNIT-I: System Software:  

UNIT-II: System Architecture:  
Recent trends in Architecture and their related frameworks, clustering, micro architecture.

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

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

UNIT-V: Computer Network:  
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:  
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  

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

**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**

5) Wireless Communication Technology: Blake Thomas Learning Series.
17) Advanced database systems By Nabil R. Adam, Bharat K. Bhargava
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
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 tress, 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)

**UNIT-VII: CONSTRUCTION MANAGEMENT** (8 Hrs)

**UNIT-VIII:** (8 Hrs)
Decision Theory, Game Theory, Linear programming, Non linear programming, dynamic programming, unconstrained programming, dichotomous, fibonacci, 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)
UNIT-XII: 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 share structures, Railways- Modern techniques in railway track engineering, monorail, High speed trains.

Reference Books:

2. Open Channel Flow-Hanis Chowdhary
3. Computational Hydraulics-Abbott-Nogion Institute of Technology
17. Waste water Treatment for pollution control ;Arceivala and Dr.Asolekar.
22. Frank Harris,Modern construction Equipments and Methods.
23. Arora,Khanna,Airport Engineering,NEM Chand and Brod,Roorkee.
25. Docks and Harbour Engineering- Oza,
BARATI VIDYAPEETH DEEMED UNIVERSITY
Faculty of Engineering
Ph.D. Coursework Syllabus - Chemical Engineering

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Teaching scheme                                                                                     Examination Scheme
Lectures: 04 Hrs/week                                                                          Theory: 100Marks
Duration: 3 Hrs                                                                               Duration: 3 Hrs

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UNIT-I: Chemical Engineering mathematics
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
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
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
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
Vector & tensor analysis in fluid dynamics, Rheology of complex fluids, Flow of omplex
fluids, effect of temperature-pressure and process conditions on the properties of complex
fluids

UNIT-VI: Advanced Instrumentation & Control
Response analysis, Controls & process control strategies, Process dynamics & analysis

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

Text Books:
3) Smith J.M. “Chemical Engineering Kinetics”, Tata Mcgraw Hill Publication
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. “Separation Processes” Tata Mcgraw Hill Publication
12) Bailey J.O. & Olis D.F. “Biochemical Engineering” Mcgraw Hill International Publisher
14) Rao C. S. “Environmental Pollution Control Engineering” Wiley (India) Publisher.
16) Galen E. “Instrumental Methods of Chemical analysis” Tata Mcgraw Hill Publication
17) Dodge B. F. “Chemical Engineering Thermodynamic” Mcgraw Hill International Publisher

Reference Books:

2) Ullamens, “Encyclopedia of Industrial Chemistry And Engineering” Wiley Publisher.
BARATI VIDYAPEETH DEEMED UNIVERSITY  
Faculty of Engineering  
Ph.D. Coursework Syllabus - Electrical Engineering  

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Teaching scheme                                                                                   Examination Scheme
Lectures: 04 Hrs/week                                                                           Theory: 100Marks
                                                                                                  Duration: 3 Hrs
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UNIT-I: **Computer methods in Power Systems:**

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

UNIT-III: Advanced Thermodynamics
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

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 timedependent boundary conditions; Transform method
solution of continuous systems Nonlinear vibrations : State space formulation,Limit
cycles, perturbation techniques, Random Vibrations: Autocorrelation and
crosscorrelation, 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,
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 -
Hermite 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**


**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. Boussinessq'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


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, powels 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, Principal 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 Langrage'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.


**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.


UNIT-XIII: MECHATRONIC SYSTEM DESIGN


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


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


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:**

6. S.P. Sukhatme, Heat transfer, University Press
10. Design and Simulation of four stroke engines, Gordon P Blair, SAE International
12. Engineering Publication
14. . Cengel, Thermodynamics, TMH
15. 2. Howell & Dedcius: Fundamentals of engineering Thermodynamics, McGraw Hill,
16. 3. Van Wylen & Sontag: thermodynamics, John Wiley & Sons, Inc.,USA
22. Jones and Hawkings: engineering Thermodynamics, john Wiley & Sons, Inc. USA
25. Wark, Advanced Thermodynamics, McGraw Hill
30. Grimsons: Advanced fluid mechanics
31. Yuan: Fundamentals of fluid mechanics
32. H. R. Vailentine: Applied hydrodynamics
33. J. K. Vennard and Robert L. Street: Elementary fluid mechanics
   a. Operations Research- Principles and Practice by Ravindran, Phillips and Solberg, John Wiely
38. GSG Beveridge and R. S. Schechter, Optimisation Theory and practice.
42. Introduction to the Finite Element method - Desai / ABEL-C.B.S. Publishers & Distributors, New Delhi 2000


44. B. Rooks (ED) “ROBOT VISION AND SENSERY CONTROLS”, Vol3, North Holland.

45. M. P. Groover, “INDUSTRIAL ROBOTICS”, MGHI.

46. Craig, “ROBOTICS”, Addison-Wesley.


48. Y. Koren, “ROBOTICS FOR ENGINEERS”, MGH

49. Kamm, “Understanding Electro-Mechanical Engineering an Introduction to Mechatronics” PHI.


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)

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, Viscoelasticity, Solutions to metal forming problems.

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

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

13. Facilities Planning, Thompkins, J A and White, J. A.
14. Facility layout and Location. Francies, R.L. and White, J. A
17. The MEMS handbook, CRC Press, 2001
27. Human Factors in Design and Manufacturing-Mark S. Sanders, Ernest. J. McCORMICK.
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.
43. Houldcroft P.T elding process technology Cambridge University press 1985
44. Metals handbook – Volume no McGraw Hill Co, Ltd
45. ASM Handbook Vol II


