SCHOOL OF MECHANICAL ENGINEERING

Section-1: Mechanics and Design

Engineering Mechanics - Trusses and frames; Free body diagrams and equilibrium, virtual work; impulse and momentum (linear and angular), kinematics and dynamics of particles & of rigid bodies in plane motion and energy formulations, collisions.

Mechanics of Materials - Elastic constants, Stress and strain, Poisson's ratio, thin cylinders, Mohr's circle for plane stress and plane strain, shear force and bending moment diagrams, deflection of beams, bending and shear stresses, torsion of circular shafts, energy methods, Euler's theory of columns, thermal stresses, testing of materials with universal testing machine, strain gauges and rosettes, testing of hardness and impact strength.

Kinetics and Dynamics Machines - Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Machine Design - Design for static and dynamic loading, Failure theories, fatigue strength and the S-N diagram, gears, shafts, rolling and sliding contact bearings, springs, brakes and clutches, principles of the design of machine elements like riveted, bolted and welded joints

Vibrations - Effect of damping, Free and forced vibration of single degree of freedom systems, resonance, vibration isolation, critical speeds of shafts.

Section-2: Fluid Mechanics and Thermal Engineering

Thermodynamics - Properties of pure substances, thermodynamic systems and processes, the behaviour of ideal and real gases, calculation of work and heat in various processes, zeroth and first laws of thermodynamics, the second law of thermodynamics, thermodynamic relations and thermodynamic property charts and tables, availability and irreversibility.

Fluid Mechanics - Fluid statics, properties, manometry, buoyancy, stability of floating bodies, forces on submerged bodies, control-volume analysis of mass, fluid acceleration, momentum and energy, differential equations of continuity and momentum, dimensional analysis, Bernoulli's equation, viscous flow of incompressible fluids, elementary turbulent flow, boundary layer, flow through pipes, bends and fittings and head losses in pipes.

Applications - Power Engineering, I.C. Engines, Refrigeration and air-conditioning and Turbomachinery

Heat-Transfer - One dimensional heat conduction, modes of heat transfer, heat transfer through fins, resistance concept & electrical analogy, lumped parameter system, unsteady heat conduction, Heisler's charts, dimensionless parameters in free and forced convective heat transfer, thermal boundary layer, heat transfer correlations for flow over flat plates and through pipes, heat exchanger performance, effect of turbulence, LMTD & NTU methods; Stefan-Boltzmann law, radiative heat transfer, Wien's displacement law, view factors, black and grey surfaces and radiation network analysis.

Section-3: Materials, Manufacturing and Industrial Engineering

Engineering Materials - Phase diagrams, structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

Casting, Forming and Joining Processes –Casting, Different types of patterns, moulds and cores, Different types of castings, solidification and cooling, riser & gating system, fundamentals of hot and cold working processes, Plastic deformation and various forming processes of bulk (drawing, rolling, forging, extrusion) and sheet (deep drawing, shearing, bending), principles of powder metallurgy, metal forming processes, brazing, Principles of welding, soldering & adhesive bonding.

Machining & Machine Tool Operations -Basic machine tools, Mechanics of machining, single and multi-point cutting tools, tool life and wear, tool geometry and materials, the economics of machining, principles of work holding, principles of non-traditional machining processes, design of jigs and fixtures.

Computer Integrated Manufacturing - Concepts of CAD/CAM and their integration tools.

Metrology and Inspection - Linear and angular measurements, Limits, fits and tolerances & comparators; gauge design, interferometry, alignment and testing methods, form and finish measurement, tolerance analysis in manufacturing and assembly.

Production Planning and Control - Aggregate production planning, forecasting models, materials requirement planning and scheduling.

Operations Research - Simplex method, linear programming, transportation, network flow models, assignment, simple queuing models and PERT & CPM.Inventory Control - Safety stock inventory control systems, Deterministic models.

ELECTRONICS AND COMMUNICATIONS ENGINEERING

Section 1: Networks, Signals and Systems Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks. Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

Section 2: Electronic Devices Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.

Section 3: Analog Circuits Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and opamp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

Section 4: Digital Circuits Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state

machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

Section 5: Control Systems Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

Section 6: Communications Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

Section 7: Electromagnetics Electrostatics; Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers

ELECTRICAL ENGINEERING

Section 1: Electric Circuits Network graph, KCL, KVL, Node and Mesh analysis, Transient response of dc and ac networks, Sinusoidal steady-state analysis, Resonance, Passive filters, Ideal current and voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem, Two-port networks, Three phase circuits, Power and power factor in ac circuits.

Section 2: Electromagnetic Fields Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits,Self and Mutual inductance of simple configurations.

Section 3: Signals and Systems Representation of continuous and discrete-time signals, Shifting and scaling operations, Linear Time Invariant and Causal systems, Fourier series representation of continuous periodic signals, Sampling theorem, Applications of Fourier Transform, Laplace Transform and z-Transform.

Section 4: Electrical Machines Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase transformers: connections, parallel operation; Auto-transformer, Electromechanical energy conversion principles, DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, starting and speed control of dc motors; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Operating principle of single phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance, regulation and parallel operation of generators, starting of synchronous motor, characteristics; Types of losses and efficiency calculations of electric machines.

Section 5: Power Systems Power generation concepts, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field

distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, GaussSeidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Section 6: Control Systems Mathematical modeling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Stability analysis, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, State transition matrix.

Section 7: Electrical and Electronic Measurements Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multimeters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Section 8: Analog and Digital Electronics Characteristics of diodes, BJT, MOSFET; Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: Biasing, Equivalent circuit and Frequency response; Oscillators and Feedback amplifiers; Operational amplifiers: Characteristics and applications; Simple active filters, VCOs and Timers, Combinational and Sequential logic circuits, Multiplexer, Demultiplexer, Schmitt trigger, Sample and hold circuits, A/D and D/A converters, 8085Microprocessor: Architecture, Programming and Interfacing.

Section 9: Power Electronics Characteristics of semiconductor power devices: Diode, Thyristor, Triac, GTO, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost converters; Single and three phase configuration of uncontrolled rectifiers, Line commutated thyristor based converters, Bidirectional ac to dc voltage source converters, Issues of line current harmonics, Power factor, Distortion factor of ac to dc converters, Single phase and three phase inverters, Sinusoidal pulse width modulation.

SCHOOL OF COMPUTING SCIENCE AND ENGINEERING:

Data Structures

- Advanced Sorting Methods
- Algorithm Design Paradigms
- Complexity of Algorithm
- Depth-first and Breadth-first Algorithms
- Kinetic Data Structures

Algorithms

- Asymptotic analysis
- Asymptotic notation
- Basic concepts of complexity classes
- Connected components
- Dynamic programming
- Notions of space and time complexity
- Tree and graph traversals
- Worst and average case analysis
- Computational Geometry
- Growth of Functions
- Heuristic Methods

Operating Systems

- Agreement Protocols for handling Processor Failures
- Comparative Performance Analysis
- Distributed Mutual Exclusion
- Distributed Operating Systems
- Local and Global states
- Process Deadlocks
- Resource Models
- Synchronization Mechanisms

- Coordination of Processes and related Algorithms
- Failure Handling and Recovery Mechanisms
- Multiprocessor Operating Systems and related Thread Handlings
- Token and Non-token based Algorithms

Database Systems

- Database design
- Indexing and Hashing
- Relational model
- Storage and File Structures
- Extended Relational Model
- Mobile Databases and Web-enabled Database Systems
- Transactions and Concurrency control

Computer Organization and Architecture

- Cache and main memory
- CPU control design
- Design and synthesis of combinational and sequential circuits
- Instruction pipelining
- Machine instructions and addressing modes
- Number representation and computer arithmetic
- Secondary storage
- Structured Memory Design for Parallel Systems

Software Engineering

- Team Software Process
- Systems Modelling Language
- Requirement and feasibility analysis
- Process Models- Iterative
- Planning and managing the project
- Personal Software Process

- Domain specific modelling
- Software architecture and design patterns
- Software reliability and Advanced testing techniques
- Aspect oriented programming

Computer Networks

- LAN technologies
- Application layer protocols
- Flow and error control techniques
- Introduction to intelligent networking
- Performance analysis of networks

Theory of Computation

- Models of computation
- Finite Automata
- Pushdown Automata
- Nondeterministic and NFA
- DPDA and PDAs and Languages accepted by these structures
- Grammars
- Languages
- Non-computability and Examples of non-computable problems

Artificial Intelligence & Soft Computing

- Natural language processing
- Machine Learning and Neural Networks
- Fuzzy Systems
- Pattern Recognition and Text Processing
- Intelligent Systems and Applications, Intelligent Interfaces
- Swarm Intelligence
- Genetic Algorithm
- Robotics and Kinematics

System Programming and Principles of Programming Languages

- Functional and logic programming languages
- Theory of programming languages
- Programming Environments,
- Translators for Declarative and Functional Languages
- Analysis and implementation of functional and logic programming languages
- Automatic Generation of Compilers, Compilers for Non conventional Architectures
- Code Optimization
- Theory of code optimization
- Optimizing and parallelizing compilers
- Complexity Theory
- Logic in Computer Science
- Algorithmic information theory
- Computational number theory
- Applications of grid Computing

Computer Graphics

- Computer Vision and Image Understanding
- Computer aided graphics design
- High Performance computing
- Visualization
- Rendering
- Image and video retrieval, motion capture, point based methods
- Virtual Reality

Simulation & Modelling

- Statistical independence
- Bernoulli Process
- Renewal Process

- Random Incidence
- Markov Modulated Bernoulli Process
- Irreducible Finite Chains with Aperiodic States
- Discrete-Time Birth-Death Processes
- Markov property
- Finite Markov Chains
- Continuous time Markov chain
- Hidden Markov Model
- Characteristics of queuing system, Poisson's formula, breadth-death system, equilibrium of queuing system, analysis of M/M/1 queues, FSM, Petri-net Model.

Web Engineering

- Web Engineering Models
- Web Servers
- Architecture of browser and search engines
- Web Security issues, security audit of websites, web effort estimation, productivity
- Measurement, Quality usability and reliability
- Semantic web, Ontology
- XML, HTML, DHTML, SGML

Web Technology & E Commerce

- Electronic Commerce and physical Commerce
- Different type of e-commerce, e-commerce scenarios, advantages of e-commerce
- Business models: Feature of B2B e-commerce, Business models, Integration
- E-Services: category of e-services, Web- enabled services, Matchmaking services, information-selling on the web.
- Internet payment system, SET Protocol for credit card payment
- E-Governance
- WAP Architecture

Information Theory Coding

- Information Measures
- Review probability theory
- Random variables
- Processes, Mutual Information, Entropy, Uncertainty
- Shannon's theorem, redundancy
- Huffman Coding
- Discrete random Variable
- Gaussian random variables, Bounds
- Linear block codes, cyclic codes, BCH codes,Reed-Solomon codes, space time codes, concatenated codes, turbo coding and LDPC codes

Mobile &Pervasive Computing

- Mobile computing
- Adaptability
- Mobility Management
- Context –Aware Computing and its applications
- Introduction to Adhoc and Sensor Networks
- Approaches to Security

Data Mining

- Data integration models and algorithms
- Graphical models
- Information extraction and retrieval
- Forecasting and smart e-business
- Sensor and Bioinformatics data mining
- Text and Web data mining

Multimedia and Animation

- High Performance computing

- Visualization
- Rendering
- Animation
- Image and video retrieval; motion capture; point based methods.

Middleware Technologies

- Exposure toMarkup languages - HTML,DHTML, VRML, SGML, XML etc.
- CGI, Applets & Servlets
- Distributed objects, object request brokers, component technology
- CORBA

Discrete Mathematics:

Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions.

Linear Algebra:

Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.

Calculus:

Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.

Probability:

Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

GALGOTIAS UNIVERSITY
(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

SCHOOL OF CIVIL ENGINEERING

SYLLABUS FOR Ph D ENTRANCE TEST (SOCE)

1. Structural Engineering (40 percentage weightage)

Axial Stress and Strain, Concepts of Elastic Constants, Principle stresses and strains, Torsion of shafts of circular section, Shear Force and Bending Moment, bending stresses and shear stresses in beams, Deflection of Beams, Deflection of Plane Trusses, Analysis of statically determinate plane trusses by method of joints, calculation of deflection in statically determinate trusses, Theory of Columns, Theorem of Three Moments, Strain Energy Method, Influence Lines, Two hinged and three hinged parabolic arches, circular arches cables, Moment distribution method

RCC - Material Properties and Design, Compressive strength, tensile strength, design stress,strain curve of concrete, modulus of elasticity, grades of concrete, different types and grades of reinforcing steel, design stress-strain curve of steel, Introduction to design concepts, Introduction to Limit State Design , partial safety factors, characteristic load and strength. Introduction to stress block parameters, concept of balanced, under reinforced and over reinforced sections, limit state of collapse in flexure of rectangle and flanged sections with examples. Limit state of collapse in shear and torsional strength of sections with examples, Limit state design of beams, Limit State Design of Slabs, Limit State Design of Compression Members

Steel Structures- Design of Connections, Riveted, Welded and Bolted, Design of beams
Simple and built-up beams, design of laterally supported and unsupported beams, concept of shear, Design of column, built up section, single and double lacing, batten, Plate girders, design of plate girders, curtailment of flange plates, design of stiffeners and splices, gantry girder,
Roof Trusses, Calculation of dead load, live load, wind load, Design of joints, supports, members for pitched roof truss, purlins.

2. Environmental Engineering (30 percentage weightage)

Water sources, classification and distribution,factors governing water demands and seasonal variations, Effect of population dynamics on water demand, Principles for forecasting of water-demand and its calculations, Self-purification of surface water bodies – Oxygen sag curve, permissible values for drinking water, Water Treatments Units, principles and processes for pretreatment and treatment of raw water, pre-chlorination and chlorination, principles and objectives for designing chlorination systems, General design considerations for designing water treatment plants, Unit Operations & Processes, Principles, functions and design of screen, grit chambers, flash mixers, flocculators, sedimentation tanks and sand filters- Slow sand and rapid sand filters, layouts, Flash mixer, Clariflocculator, Slow sand and rapid sand filters. Disinfection Processes in Water treatment, Water supply systems.

Wastewater Treatment, Physical, chemical and biological principles involved in wastewater treatment and designing of unit-operations and processes, Permissible standards for wastewater

disposal, Pre and Primary Treatment, Unit operations and processes, Principles, functions and design of flash mixers, screens, sedimentation tanks and sand filters, Disinfection, Aeration, grit chambers and primary sedimentation tanks, Secondary Treatment-Activated Sludge Process and Trickling filters, other treatment methods, Stabilization Ponds and Septic Tanks, Sewage Disposal and Sludge Management, Waste Disposal System, Wastewater Treatment, Typical layouts, Screens-Grit Chamber, Sedimentation tanks, Trickling filter, Activated Sludge, sludge Digester, Septic tanks, Soil Dispersion System, Waste Stabilization pond.

3. Geotechnical Engineering (10 percentage weightage)

Weight volume relations and Index properties,Theory of compaction, Soil water and Permeability, Effective and neutral stresses, Flow of water through soils, Darcy's law –Seepage and flow-nets, Quick sand conditions, Stress distribution in soils, Vertical pressure distribution-Boussinesq's equation for point load and uniformly distributed loads of different shapes– Newmark's influence chart, Westergaard's equation – Isobar diagram – Pressure bulb - Contact pressure, Earth Pressures Theories, Compressibility and Consolidation, Pre-consolidation pressure, Primary consolidation, Terzaghi'sconsolidation theory, Determination of C_v by Taylor's and Casagrande's methods, Shear strength of soils, Stress analysis by Mohr's circle, Mohr's strength theory, Shear strength of soils, Mohr - Coloumb strength envelope, Laboratory shear tests

4. Water Resources Engineering (10 percentage weightage)

Fluid Properties and Hydrostatics, Hydrostatic forces on plane, centre of buoyancy, metacentre.
Fluid Dynamics, Types of flows, Euler and Bernoulli's equations and their applications , Navier-Stokes Equations, Open Channel Flow, Flow through pipes , Darcy's law – Minor losses – Multi reservoir problems, pipe network design, Moody's diagram, Hagen Poiseuille equation, Turbulent flow, Dimensional Analysis, Raleigh and Buckingham theorems, Boundary layers,
Hydrologic design , Hydrologic features , Hydro Meteorology, Precipitation and Abstraction, Formation of precipitation, forms of precipitation, types of precipitation, Rainfall measurement , Process of evaporation, transpiration, Infiltration factors affecting evaporation, Measurement of evaporation and infiltration indices

5. Transportation Engineering (10 percentage weightage)

Transportation modes, Highway alignment and field surveys, Master Plan, Transport economics, Traffic Studies – Volume, speed, origin and destination studies, Introduction to Multi-modal Transportation, Automated Transport systems, High urban transport, Impact of transport on environment, Highway classification (Rural and Urban roads), Road Geometrics, Horizontal Alignment Design, Super Elevation, Extra widening, Transition curves, Set back distance, Design of Vertical curves, Traffic characteristics, road user & vehicular characteristics, traffic studies, traffic operations, traffic control devices, intelligent transport systems, Intersections, Interchanges, Parking Layout & Road signs, Material requirement for pavements, Soil classification for Highway, Soil tests, CBR and Plate Load Test, Aggregate, materials testing and

specification, Bitumen, material testing and specification construction of bituminous and rigid pavements, Highway Maintenance, Material recycling, Pavement Analysis, Factors affecting pavement thickness, Soil, Wheel load, Temperature, environmental factors, Flexible Pavement Design, Axle Load surveys, CBR method of Design, Rigid Pavement Design, IRC method.