5.3 Details of PGCET Syllabus

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5.3.1 CIVIL ENGINEERING (CE)

ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.
Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.


STRUCTURAL ENGINEERING

Mechanics: Bending moment and shear force in statically determinate beams. Simple stress and strain relationship: Stress and strain in two dimensions, principal stresses, stress transformation, Mohr’s circle. Simple bending theory, flexural and shear stresses, unsymmetrical bending, shear centre. Thin walled pressure vessels, uniform torsion, buckling of column, combined and direct bending stresses.

Structural Analysis: Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/energy methods, analysis by displacement methods (slope deflection and moment distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

Concrete Structures: Concrete Technology- properties of concrete, basics of mix design. Concrete design—basic working stress and limit state design concepts, analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of prestressed concrete, analysis of beam sections at transfer and service loads.

Steel Structures: Analysis and design of tension and compression members, beams and beam- columns, column bases. Connections- simple and eccentric, beam-column connections, plate girders and trusses. Plastic analysis of beams.
GEOTECHNICAL ENGINEERING

**Soil Mechanics:** Origin of soils, soil classification, three-phase system, fundamental definitions, relationship and interrelationships, permeability & seepage, effective stress principle, consolidation, compaction, shear strength.


WATER RESOURCES ENGINEERING


**Hydrology:** Hydrologic cycle, rainfall and its measurement, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.


ENVIRONMENTAL ENGINEERING

**Water requirements:** Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment. Unit operations and unit processes of domestic wastewater, sludge disposal.

**Air Pollution:** Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

**Municipal Solid Wastes:** Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

**Noise Pollution:** Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

TRANSPORTATION ENGINEERING

**Highway Planning:** Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements.

**Traffic Engineering:** Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

**Basic concept on Air Port** Planning , runway design , Harbour and railways.

SURVEYING

Importance of surveying, principles and classifications, mapping concepts, coordinate system, map projections, measurements of distance and directions, leveling, theodolite traversing, plane table surveying, errors and adjustments, curves.

5.3.2 MECHANICAL ENGINEERING (ME)

ENGINEERING MATHEMATICS

**Linear Algebra:** Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

**Calculus:** Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima,
Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

**Differential equations**: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

**Complex variables**: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

**Probability and Statistics**: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.


**APPLIED MECHANICS AND DESIGN**

**Engineering Mechanics**: Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

**Strength of Materials**: Stress and strain, stress-strain relationship and elastic constants, Mohr’s circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler’s theory of columns; strain energy methods; thermal stresses.

**Theory of Machines**: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.

**Vibrations**: Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

**Design**: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

**Balancing of machines**: Reciprocating and rotary masses. Inline engine, V-engine.

**FLUID MECHANICS AND THERMAL SCIENCES**

**Fluid Mechanics**: Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli’s equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

**Heat-Transfer**: Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

**Thermodynamics**: Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle. irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

**Applications**:

*Power Engineering*: Steam Tables, Rankine, Brayton cycles with regeneration and reheat.


*Refrigeration and Air-conditioning*: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle, moist air: psychrometric chart, basic psychrometric processes.

**Turbomachinery**: Pelton-wheel, Francis and Kaplan turbines, impulse and reaction principles, velocity diagrams.

**MANUFACTURING AND INDUSTRIAL ENGINEERING**


**Metal Casting**: Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

**Forming**: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy.

**Joining**: Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

Arc welding, Spot welding, Submerged arc welding, TIG, MIG, Gas welding.

**Machining and Machine Tool Operations**: Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures.
Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems.

Operations Research: Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

5.3.3 ELECTRICAL ENGINEERING (EE)

ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.


ELECTRICAL ENGINEERING

Electric Circuits and Fields: Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, ideal current and voltage sources, Thevenin’s, Norton’s and Superposition and Maximum Power Transfer theorems, two-port networks, three phase circuits; Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere’s and Biot-Savart’s laws; inductance; dielectrics; capacitance.

Electrical Machines: Single phase transformer - equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers - connections, parallel operation; auto-transformer; energy conversion principles; DC machines - types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors - principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines - performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

Power Systems: Basic power generation concepts; transmission line models and performance; cable performance, insulation; corona and radio interference; distribution systems; per-unit quantities; bus impedance and admittance matrices; load flow; voltage control; power factor correction; economic operation; symmetrical components; fault analysis; principles of over-current, differential and distance protection; solid state relays and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts.

Control Systems: Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Niquist techniques; Bode plots; root loci.

Electrical and Electronic Measurements: Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor; instrument transformers; digital voltmeters and multimeters; phase, time and frequency measurement; Q-meters; oscilloscopes; potentiometric recorders; error analysis.

Analog and Digital Electronics: Characteristics of diodes, BJT, FET; amplifiers - biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers - characteristics and applications; simple active filters; VCOs and timers; combinational logic circuits; Schmitt trigger; multi-vibrators; sample and hold circuits; A/D and D/A converters; architecture, programming and interfacing.

Power Electronics and Drives: Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs - static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters - fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives.
5.3.4 ELECTRONICS AND COMMUNICATION ENGINEERING (EC)

ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms. Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.


ELECTRONICS AND COMMUNICATION ENGINEERING


Digital circuits: Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories. Microprocessor(8085): architecture, programming, memory and I/O interfacing.


Control Systems: Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots.

Electronic Measurements and Instrumentation: Basic concepts, standards and error analysis; Measurements of basic electrical quantities and parameters; Electronic measuring instruments and their principles of working: analog and digital, comparison, characteristics, application. Transducers: Electronic measurements of non electrical quantities like temperature, pressure, humidity etc; basics of telemetry for industrial use.

Electromagnetic: Elements of vector calculus: divergence and curl; Gauss’ and Stokes’ theorems, Maxwell’s equations: differential and integral forms. Wave equation, Poynting vector. Plane waves; propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines: characteristic impedance; impedance transformation; Basics of Antennas; Dipole antennas; radiation pattern; antenna gain.
Communications: Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, super heterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM. Fundamentals of Wireless Propagation environment, Colour TV Transmission & reception systems, Basics of DTH, HDTV, Plasma & LCD, Optical sources, detectors, fibres, optical network components, optical measurements, basics of optical networks.

Microwave Engineering: Microwave Tubes and solid state devices, Microwave generation and amplifiers, Waveguides and other Microwave Components and Circuits, Microstrip circuits, Microwave Antennas, Microwave Measurements, Masers, lasers; Microwave propagation. Microwave Communication Systems terrestrial and Satellite based.

Computer Engineering: Number Systems. Data representation; Programming; Elements of a high level programming language C/C++; Use of basic data structures; Fundamentals of computer architecture; Processor design; Control unit design; Memory organisation, I/O System Organization. Microprocessors: Architecture and instruction set of Microprocessors 8085 and 8086, Assembly language Programming. Microprocessor based system design: typical examples. Personal computers and their typical uses. Microcontroller 8051 family Architecture, programming and interface

5.3.5 INSTRUMENTATION AND CONTROL (IC)

ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.


INSTRUMENTATION ENGINEERING


**Signals and Systems:** Periodic and aperiodic signals. Impulse response, transfer function and frequency response of first- and second-order systems. Convolution, correlation and characteristics of linear time invariant systems. Discrete time system, impulse and frequency response. IIR and FIR filters. Amplitude and frequency modulation and demodulation. Sampling theorem, Frequency and time division multiplexing. Amplitude shift keying, frequency shift keying and pulse shift keying for digital modulation.


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**5.3.6 CHEMICAL ENGINEERING (CH)**

**ENGINEERING MATHEMATICS**

**Linear Algebra:** Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

**Calculus:** Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

**Differential equations:** First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

**Complex variables:** Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

**Probability and Statistics:** Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.

**Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations Integration by trapezoidal and Simpson’s rule, single and multi-step methods for differential equations.


**Chemical Process Industries:** Water, Unit processes and applications, Coal, Industrial gases and carbon, Inorganic chemical industries and inorganic acid, cleaner production technology, its uses and applications and processing, Chlor-alkali and Heavy Inorganic industry, natural products industries, Paints, Pigments, Biotechnology and its application, Nitrogenous Fertilizer industry.


**Mass Transfer:** Molecular and Eddy Diffusion in fluids, Inter phase mass transfer, Gas Absorption, Liquid-Liquid extraction and leaching, Distillation, Humidification and dehumidification, Adsorption and ion...
Instrumentation and Process Control: Laplace transforms, Response of First and second Order Systems, The control systems, Controllers and final control elements, Closed loop transfer functions, Stability, Control system design by frequency response, Controller Mechanism, Setting of different modes of controllers, P & I Process and Instrumentation Diagrams, Measurement of process variables, sensors and their dynamics transfer functions and dynamic.


Plant Design and Economics: Process design aspects, Selection of process equipments, Process auxiliaries, Process utilities, Plant location and layout, Cost estimation, Estimation of total product, Depreciation, Profitability, cost indexes, Rate of return, Pay back period, discounted cash flow, optimization in design, Economic considerations in process and equipment design.

Environment and Safety: Various types of environmental pollution in general and in chemical and allied industry in particular, sources and causes of environmental pollution, effect of pollution on environment, methodologies for environmental pollution prevention (including process technology upgradation, development, etc.), Fire and explosion hazards rating- HAZOP and HAZAN.

Petroleum Refining and Petrochemicals: Types of crude, Evaluation of oil stocks and refinery product, Properties of crude and products, Processing of petroleum, crude and refinery products, Thermal and Catalytic cracking processes employed in refineries, Atmospheric and Vacuum distillation, Treating operations of petroleum products, Oil fields and refineries in India, Manufacturing process of: Chemicals from C1, C2, C3, C4 compounds, aromatics, polymers, etc., Engineering problems.

Polymer Technology: Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, polymerization methods: addition and condensation; their kinetics, metallocene polymers and other newer techniques of polymerization, copolymerization, monomer reactivity ratios and its significance, kinetics, different copolymers, random, alternating, azeotropic copolymerization, block and graft copolymers, techniques for copolymerization-bulk, solution, suspension, emulsion, Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, crosslinking and vulcanization, vulcanization kinetics.

Polymer processing: Compression molding, transfer molding, injection molding, blow molding, reaction injection molding, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer.

5.3.7 ENVIRONMENTAL ENGINEERING (EN)

ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivative, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.


**Water supply & sewage system:** Design of water distribution system, design of sewage collection system, sources of water & its quality.

**Water& Wastewater treatment:** Primary, secondary & tertiary treatment, screens, grit chamber, coagulation, flocculation, sedimentation, biological treatments of wastewater (aerobic & anaerobic), adsorption, disinfection, filtration, water softening, reverse osmosis, ion exchange method, sludge treatment & disposal.

**Air pollution:** Sources & effects of air pollutants, criteria air pollutants, effects of meteorological parameters on ambient air quality, thermal inversion, control of particulates, Ambient Air quality Standards & limits.

**Noise Pollution:** Noise as a pollutant, measurement of noise, units of expressions, effects of noise, permissible limits.


**Industrial Water Pollution:** Principles of water pollution control—Reduction of strength & volume, Neutralization, Equalization, Discharge standards, Effluent Standards, Stream Standards, Effluent Quality and treatment flow sheet for dairy industry, textile process house and distillery.

**Municipal solid waste management:** Municipal solid waste characteristic, Quantities, composition and generation, engineered system for solid waste management, secured landfill site, energy recovery.

5.3.8 METALLURGICAL ENGINEERING (MT)

**ENGINEERING MATHEMATICS**

**Linear Algebra:** Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

**Calculus:** Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

**Differential equations:** First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

**Complex variables:** Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

**Probability and Statistics:** Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.

**Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations Integration by trapezoidal and Simpson’s rule, single and multi-step methods for differential equations.

**METALLURGICAL ENGINEERING**

**Thermodynamics and Rate Processes:** Laws of thermodynamics, activity, equilibrium constant, applications to metallurgical systems, solutions, phase equilibria, Ellingham and phase stability diagrams, thermodynamics of surfaces, interfaces and defects, adsorption and segregation; basic kinetic laws, order of reactions, rate constants and rate limiting steps; principles of electro chemistry—single electrode potential, electro-chemical cells and polarizations, aqueous corrosion and protection of metals, oxidation and high temperature corrosion characterization and control; heat transfer conduction, convection and heat transfer coefficient relations, radiation, mass transfer diffusion and Fick’s laws, mass transfer coefficients; momentum transfer concepts of viscosity, shell balances, Bernoulli’s equation, friction factors.

**Extractive Metallurgy:** Minerals of economic importance, comminution techniques, size classification, Flotation, gravity and other methods of mineral processing; agglomeration, pyro- hydro- and electro-metallurgical processes; material and energy balances; principles and processes for the extraction of non-ferrous metals—aluminium, copper, zinc, lead, magnesium, nickel, titanium and other rare metals; iron and steel making principles, role structure and properties of slags, metallurgical coke, blast furnace, direct reduction processes, primary and secondary steel making, ladle metallurgy operations including deoxidation, desulphurization, sulphide shape control, inert gas rinsing and vacuum reactors; secondary refining processes including AOD, VAD, VOD, VAR and ESR; ingot and continuous casting; stainless steel making, furnaces and refractories.

**Physical Metallurgy:** Crystal structure and bonding characteristics of metals, alloys, ceramics and polymers, structure of surfaces and interfaces, nano-crystalline and amorphous structures; solid solutions; solidification; phase transformation and binary phase diagrams; principles of heat treatment of steels, cast iron and
aluminum alloys; surface treatments; recovery, recrystallization and grain growth; industrially important ferrous and non-ferrous alloys; elements of X-ray and electron diffraction; principles of scanning and transmission electron microscopy; industrial ceramics, polymers and composites; electronic basis of thermal, optical, electrical and magnetic properties of materials; electronic and opto-electronic materials.

**Mechanical Metallurgy:** Elasticity, yield criteria and plasticity; defects in crystals; elements of dislocation theory; types of dislocations, slip and twinning, source and multiplication of dislocations, stress fields around dislocations, partial dislocations, dislocation interactions and reactions; strengthening mechanisms; tensile, fatigue and creep behaviour; super-plasticity; fracture - Griffith theory, basic concepts of linear elastic and elasto-plastic fracture mechanics, ductile to brittle transition, fracture toughness; failure analysis; mechanical testing - tension, compression, torsion, hardness, impact, creep, fatigue, fracture toughness and formability.

**Manufacturing Processes:** Metal casting - patterns and moulds including mould design involving feeding, gating and risering, melting, casting practices in sand casting, permanent mould casting, investment casting and shell moulding, casting defects and repair; hot, warm and cold working of metals, Metal forming fundamentals of metal forming processes of rolling, forging, extrusion, wire drawing and sheet metal forming, defects in forming; Metal joining - soldering, brazing and welding, common welding processes of shielded metal arc welding, gas metal arc welding, gas tungsten arc welding and submerged arc welding; welding metallurgy, problems associated with welding of steels and aluminium alloys, defects in welded joints; powder metallurgy; NDT using dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission and magnetic particle methods.

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### 5.3.9 TEXTILE ENGINEERING (TE)

#### ENGINEERING MATHEMATICS

**Linear Algebra:** Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

**Calculus:** Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

**Differential equations:** First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

**Complex variables:** Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

**Probability and Statistics:** Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.

**Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations Integration by trapezoidal and Simpson’s rule, single and multi-step methods for differential equations.

#### TEXTILE TECHNOLOGY/ENGINEERING

**Textile Fibres:** Classification of textile fibres; Essential requirements of fibre forming polymers; Gross and fine structure of natural fibres like cotton, wool and silk. Introduction to important bast fibres; properties and uses of natural and man-made fibres.

Molecular architecture, amorphous and crystalline phases, glass transition, plasticization, crystallization, melting, factors affecting Tg and Tm. Polymerization of nylon-6, nylon-66, poly (ethylene terephthalate), polyacrylonitrile and polypropylene; Melt Spinning processes, characteristic features of PET, polyamide and polypropylene spinning; wet and dry spinning of viscose and acrylic fibres; post spinning operations such as drawing, heat setting, tow-to-top conversion and different texturing methods.

Methods of investigating fibre structure e.g., Density, X-ray diffraction, birefringence, optical and electron microscopy, I.R. absorption, thermal methods (DSC, DMA/TMA, TGA); structure and morphology of man-made fibres, mechanical properties of fibres, moisture sorption in fibres; fibre structure and property correlation.

**Yarn manufacture and yarn structure & properties:** Principles of opening, cleaning and mixing/blending of fibrous materials, working principle of modern opening and cleaning equipments; the technology of carding, carding of cotton and synthetic fibres; Drafting operation, roller and apron drafting principle, causes of mass irregularity introduced by drafting; roller arrangements in drafting systems; principles of cotton combing, combing cycle, mechanism and function, combing efficiency, lap preparation; recent developments in comber; Roving production, mechanism of bobbin building, roving twist; Principle of ring spinning, forces acting on yarn and traveler; modification in ring & traveler designs; mechanism of cop formation, causes of end breakages; working principle of ring doubler and two for one twister, single and folded yarn twist, properties of double yarns, production of core spun yarn, compact spinning, principle of non conventional
methods of yarn production such as rotor spinning, air jet spinning, wrap spinning, twist less spinning and
friction spinning.
Yarn contraction, yarn diameter, specific volume & packing coefficient; twist strength relationship in spun
yarns; fibre configuration and orientation in yarn; cause of fibre migration and its estimation, irregularity
index, properties of ring, rotor and air-jet yarns.

Fabric manufacture and Fabric Structure: Principles of cheese and cone winding processes and machines;
random and precision winding; package faults and their remedies; yarn clearers and tensioners; different
systems of yarn splicing; features of modern cone winding machines; different types of warping creels;
features of modern beam and sectional warping machines; different sizing systems, sizing of spun and
filament yarns, modern sizing machines, different sizing ingredients; principles of pirn winding processes and
machines; primary and secondary motions of loom, effect of their settings and timings on fabric formation,
fabric appearance and weaving performance; dobby and jacquard shedding; mechanics of weft insertion with
shuttle; warp and weft stop motions, warp protection, weft replenishment; functional principles of weft
insertion systems of shuttle-less weaving machines, principles of multiphase and circular looms.

Principles of weft and warp knitting: basic weft and warp knitted structures. Basic woven fabric constructions
and their derivatives; crepe, cord, terry, gauze, leno and double cloth constructions. Peirce's equations for
fabric geometry; elastica model of plain woven fabrics; thickness, cover and maximum sett of woven fabrics.

Textile Testing: Sampling techniques, sample size and sampling errors. Measurement of fibre length, fineness,
crimp, strength and reflectance; measurement of cotton fibre maturity and trash content; HVI and AFIS for
fibre testing. Measurement of yarn count, twist and hairiness; tensile testing of fibres, yarns and fabrics;
evenness testing of slivers, rovings and yarns; testing equipment for measurement test methods of fabric
properties like thickness, compressibility, air permeability, drape, crease recovery, tear strength, bursting
strength and abrasion resistance. Statistical data analysis of experimental results. Correlation analysis,
significance tests and analysis of variance; frequency distributions and control charts.

Preparatory processes for nylon, polyester and acrylic and polyester/cotton blends.

Dyeing: Classification of dyes. Dyeing of cotton and polyester with appropriate dye classes. Dyeing
polyester/cotton blends. Batchwise and continuous dyeing machines. Dyeing of cotton knitted fabrics and
machines used. Methods for determination of wash, light and rubbing fastness. Evaluation of fastness
properties with the help of grey scale.

Printing: Styles of printing. Printing thickeners including synthetic thickeners. Printing auxiliaries. Printing of
Resist and discharge printing of cotton and polyester. Printing of polyester/cotton blends with
disperse/reactive combination. Transfer printing of polyester. Developments in inkjet printing.

Finishing: Mechanical finishing of cotton. Stiff. Soft, wrinkle resistant, water repellent, flame retardant and
enzyme (bio-polishing) finishing of cotton. Milling, decatizing and shrink resistant finishing of wool. Antistat
finishing of synthetic fibre fabrics. Heat setting of polyester.

Energy Conservation: Energy crisis, Energy conservation in spinning, weaving, processing, humidification and
lighting.

Pollution: Treatment of textile effluents. Air pollution, Water pollution, Noise pollution, Dust pollution,
Management of solid hazardous wastes, ISO-14001.

5.3.10 COMPUTER ENGINEERING AND INFORMATION TECHNOLOGY (CO)

ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems,
Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima,
Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals,
Stokes, Gauss and Green’s theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations
with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace
transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean,
median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations Integration by
trapezoidal and Simpson’s rule, single and multi-step methods for differential equations.
Digital Logic:
Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).

Computer Organization and Architecture:
Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.

Programming and Data Structures:
Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.

Algorithms:
Analysis, Asymptotic notation, Notions of space and time complexity, Worst and Average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.

Theory of Computation:
Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability.

Compiler Design:
Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

Operating System:
Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

Databases:
ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

Information Systems and Software Engineering:
Information gathering, requirement and feasibility analysis, data flow diagrams, process Specifications, input/output design, process life cycle, planning and managing the Project, design, coding, testing, implementation, maintenance.

Computer Networks:
ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control Techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security basic concepts of public key and private key cryptography, digital signature, firewalls.

Web technologies:
HTML, XML, basic concepts of client-server computing.

5.3.11 BIO-MEDICAL ENGINEERING (BM)

ENGINEERING MATHEMATICS

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.
**Numerical Methods**

**BIO-MEDICAL ENGINEERING**
1. Analog, Digital and Power Electronics
2. Basics of Modelling and Control Theory
3. Microprocessor (8085) and Microcontroller (8051)
4. Basics of communication and networking
5. Digital Signal Processing
6. Human Anatomy & Physiology
7. Biomedical Transducers, Materials and implants
8. Biomechanics
9. Therapeutic, Diagnostic, Analytical and Optical Instrumentation
10. Medical Imaging and Image processing.
11. Bioinformatics and advance medical techniques like telemedicine, remote surgery etc.

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**5.3.12 MECHATRONICS ENGINEERING (MC)**

**Linear Algebra**: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

**Calculus**: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

**Differential equations**: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

**Complex variables**: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.

**Probability and Statistics**: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.


**MECHATRONICS ENGINEERING**

**Basic Mechanical Engineering**
Motion and power transmission mechanisms, Design of mechanisms, Basics of hydraulic and pneumatic systems, Properties of gas and steam, Heat engines, Steam engines, I.C. engines, Pumps, compressors, Refrigeration and air conditioning.

**Basic Electrical and Electronics Engineering**
Fundamentals of electrical and electronics engineering, Programmable Logic Controllers (PLCs), Microprocessors, Microcontrollers and embedded systems, Electric Circuits and fields, Control systems, Electrical and electronic measurement, Analog and digital electronics, Power electronics and drives.

**Manufacturing Technology**
Metal cutting principles and Conventional machining processes, Computer Aided Manufacturing (CAM), Basic part programming, Measuring and gauging standards, Non-traditional manufacturing methods, Location theory and Jig-fixtures design.

**Metal Forming Processes**
Hot and Cold working, Metal forming processes like Extrusion, Drawing, Rolling, Forging, Casting, Welding, etc.
Robotics
Robot fundamentals, Basic configurations, Robot kinematics, Trajectory planning, types of end effectors, drive systems, Robot sensors, applications in manufacturing.

Computer aided Design
Fundamentals of computer graphics, Geometrical modeling, Finite element analysis.

Machine Vision
Digital image fundamentals, image enhancement, image compression, image restoration.

Operations Research
Linear programming, Transportation model assignment model, Network analysis, sequencing problem, decision theory, replacement, queuing model, inventory control.

Material Science and Metallurgy
Iron-Iron Carbon diagram, Heat treatment processes, Ferrous and non-ferrous metals, Non destructive testing.

Strength of Materials
Stress-strain relationship and elastic constants, Mohr’s circle for plane stress and plane strain, thin cylinders, shear force and bending moment diagrams, bending and shear stresses, deflection of beams, torsion of circular shafts, Euler’s theory of columns, strain energy methods, thermal stresses.

5.3.13 PHARMACY (PH)


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5.3.14 Networking, Communication & Web Technology (NW)

ENGINEERING MATHEMATICS
Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.
Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.
Differential equations: First order equations (linear and non-linear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.
Complex variables: Analytic functions, Cauchy’s integral theorem, Taylor and Laurent series.
Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.

Networking, Communication & Web Technology

Digital Logic:
Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).

Computer Organization and Architecture:
Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.

Programming and Data Structures:
Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.

Algorithms:
Analysis, Asymptotic notation, Notions of space and time complexity, Worst and Average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.

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Operating System:
Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

Databases:
ER-model, Relational model (relational algebra, tuple calculus), Database design
(integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

**Information Systems and Software Engineering:**
Information gathering, requirement and feasibility analysis, data flow diagrams, process Specifications, input/output design, process life cycle, planning and managing the Project, design, coding, testing, implementation, maintenance.

**Computer Networks:**
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**Web technologies:**
HTML, XML, basic concepts of client-server computing.