

## 7.9 Syllabus for PGAT-2018:

**PGAT TEST for M. Tech / M. Arch will be of 2 hours duration containing 90 questions. Out of this 90 questions,**

**30 questions will be common to all branches of PGAT candidates.**

**(a) 20 Engineering Mathematics**

**(b) 10 Analytical and Logical Reasoning.**

**60 questions will be of Branch specialization.**

**For M Pharm it will be 1 hour examination and of 60 questions from the branch alone.**

### **M PLAN:**

Entrance Test: Candidate has to appear PGAT entrance test of 1 hour duration, 60 Multiple Choice Questions.

10 questions will be of Logical Reasoning type, 10 questions will be Arithmetic reasoning and 40 questions will be of basic Architectural concept related.

**7.9.1. All candidates seeking admission to 1st year Master Degree courses in Engineering/ Technology/ Architecture will have to appear the respective courses of examination suitably choosing the question they want to appear as it will decide the M Tech branch they will be eligible for. (Refer Table-14: Admission to First Year M.Tech / M.Pharm / M.Arch/ M Plan)**

**7.9.2. Candidates seeking admission to M.Pharm course have to appear 60 questions. The syllabus is as per BPUT B. Pharm.**

**7.9.3. Detailed Syllabi for the PGAT Test is mentioned below, branch wise.**

**7.9.4. ENGINEERING MATHEMATICS (Common Question of 20 nos. for all branches excepting M. Pharm)**

**Ordinary Differential Equations:** First order differential equations, separable equations, exact differential equations.

Linear differential equations of second and higher order, homogeneous equation with constant co-efficient. Euler Cauchy equations, solution by undetermined co-efficients, solution by variation of parameters.

Linear algebra: matrices, vectors, determinants and linear system of equations, matrices and linear system of equations, matrix eigen value problems, symmetric, skew symmetric and orthogonal matrices.

Fourier series: Fourier series, Expansions functions of any period, even and odd functions, half range expansion.

Laplace transformation and its use in solving differential equations. Convolution integral equations.

## 7.10. Syllabus for Architecture (AR)

**City planning:** Evolution of cities; principles of city planning; types of cities & new towns; planning regulations and building bye laws; eco-city concept; sustainable development.

**Housing:** Concept of housing; neighborhood concept; site planning principles; housing typology;

Housing standards; housing infrastructure; housing policies, finance and management; housing programs in India; self-help housing.

**Landscape Design:** Principles of landscape design and site planning; history of landscape styles; landscape elements and materials; plant characteristics & planting design; environmental considerations in landscape planning.

**Computer Aided Design:** Application of computers in architecture and planning; understanding elements of hardware and software; computer graphics; programming languages—C and Visual Basic and usage of packages such as AutoCAD, 3D-Studio, 3D Max.

**Environmental Studies in Building Science:** Components of Ecosystem; ecological principles concerning environment; climate responsive design; energy efficient building design; thermal comfort; solar architecture; principles of lighting and styles for illumination; basic principles of architectural acoustics; environment pollution, their control & abatement.

**Visual and Urban Design:** Principles of visual composition; proportion, scale, rhythm, symmetry, harmony, datum, balance, form, colour, texture; sense of place and space, division of space; barrier free design; focal point, vista, imageability, visual survey, figure-background relationship.

**History of Architecture:** *Indian*— Indus valley, Vedic, Buddhist, Indo-Aryan, Dravidian and Mughal

periods; *European*— Egyptian, Greek, Roman, medieval and renaissance periods— construction and architectural styles; vernacular and traditional architecture.

**Development of Contemporary Architecture:** Architectural developments and impacts on society since industrial revolution; influence of modern art on architecture; works of national and international architects; art nouveau, eclecticism, international styles, post modernism, deconstruction in architecture.

**Building Services:** Water supply, sewerage and drainage systems; sanitary fittings and fixtures; plumbing systems, principles of internal & external drainage systems, principles of electrification of buildings, intelligent buildings; elevators & escalators, their standards and uses; air-conditioning systems; fire fighting systems, building safety and security systems.

**Building Construction and Management:** Building construction techniques, methods and details; building systems and prefabrication of building elements; principles of modular coordination; estimation, specification, valuation, professional practice; project management techniques e.g., PERT, CPM etc.

**Materials and Structural Systems:** Behavioral characteristics of all types of building materials e. g. mud, timber, bamboo, brick, concrete, steel, glass, FRP, different polymers, composites; principles of strength of materials; design of structural elements in wood, steel and RCC; elastic and limit state design; complex structural systems; principles of pre-stressing; tall buildings; principles of disaster resistant structures.

**Planning Theory:** Regional planning; settlement system planning; history of human settlements; growth of cities & metropolises; principles of Ekistics; rural-urban migration; urban conservation; urban renewal; Five-year plan; structural and sectoral plan.

**Techniques of Planning:** Planning survey techniques; preparation of urban and regional structure plans, development plans, action plans; site planning principles and design; statistical methods of data.

**Traffic and Transportation Planning:** Principles of traffic engineering and transportation planning; traffic survey methods; design of roads, intersections, grade separators and parking areas; hierarchy of roads and levels of services; traffic and transport management in urban areas, intelligent transportation system; mass transportation planning; para-transits and other modes of transportation, pedestrian & slow-moving traffic planning.

**Infrastructure, Services and Amenities:** Principles of water supply and sanitation systems; water treatment; solid waste disposal systems; waste treatment, recycle & reuse; urban rain water harvesting; power supply and communication systems—network, design & guidelines; demography related standards at various level soft hesettlements for health, education, recreation, religious & public-semipublic facilities.

**Development Administration and Management:** Planning laws; development control and zoning regulations; laws relating to land acquisition; development enforcements, urban land ceiling; land management techniques; planning and municipal administration; disaster mitigation management; 73<sup>rd</sup> & 74<sup>th</sup> Constitutional amendments; valuation & taxation; revenue resources and fiscal management; public participation and role of NGO & CBO; Institutional networking & capacity building.

## **2. Syllabus for Chemical Engineering(CHE)**

**Process Calculations and Thermodynamics:** Laws of conservation of mass and energy; use of tie components; recycle, bypass and purge calculations; degree of freedom analysis. First and Second laws of thermodynamics. First law application to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: equation of state and departure function, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibria.

**Fluid Mechanics and Mechanical Operations:** Fluid statics, Newtonian and non-Newtonian fluids, Bernoulli equation, Macroscopic friction factors, energy balance, dimension analysis, shell balances, flow through pipeline systems, flow meters, pumps and compressors, packed and fluidized beds, elementary boundary layer theory, size reduction and size separation; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, mixing and agitation; conveying of solids.

**Heat Transfer:** Conduction, convection and radiation, heat transfer coefficients, steady and unsteady Heat conduction, boiling, condensation and evaporation; types of heat exchangers and evaporators and their design.

**Mass Transfer:** Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage wise and continuous contacting and stage efficiencies; HTU & NTU concepts design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.

**Chemical Reaction Engineering:** Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

**Instrumentation and Process Control:** Measurement of process variables; sensors, transducers and their dynamics, transfer functions and dynamic responses of simple systems, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response and controller tuning, cascade, feed forward control.

**Plant Design and Economics:** Process design and sizing of chemical engineering equipment such as compressors, heat exchangers, multistage contactors; principles of process economics and cost estimation including total annualized cost, costindexes, rate of return, payback period, discounted cash flow, optimization in design.

**Chemical Technology:** Inorganic chemical industries; sulfuric acid, NaOH, fertilizers(Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil and Fats); petroleum refining and petrochemicals; polymerization industries; polyethylene, polypropylene, PVC and polyester synthetic fibers. analysis; application of G.I.S and remote sensing techniques in urban and regional planning; decision making models.

### 3. Syllabus for Civil Engineering (CE)

#### **STRUCTURALENGINEERING**

**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 and frames.

#### **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.

**Foundation Engineering:** Sub-surface investigations-scope, drilling bore holes, sampling, penetration

tests, plate load test. Earth pressure theories, effect of water table, layered soils. Stability of slopes-

infinite slopes, finite slopes. Foundation types-foundation design requirements. Shallow foundations- bearing capacity, effect of shape, water table and other factors, stress distribution, settlement analysis in sands & clays. Deep foundations-pile types, dynamic & static formulae, load capacity of piles in sands & clays, negative skin friction.

#### **WATER RESOURCES ENGINEERING**

**Fluid Mechanics and Hydraulics:** Properties of fluids, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, flow measurements in channels, tanks and pipes. Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

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

**Irrigation:** Duty, delta, estimation of evapo-transpiration. Crop water requirements. Design of lined and unlined canals, waterways, headworks, gravity dams and spillways. Design of weirs on

permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, sodic soils.

### ***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 waste water treatment, quantity of characteristics of domestic waste water, primary and secondary treatment Unit operations and unit processes of domestic waste water, 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.

## **4. Syllabus for Computer Science/Information Technology (CSE/IT)**

**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.

## **5. Syllabus for Electrical Engineering (EE)**

**Electric Circuits and Fields:** Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; 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.

**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; Fourier, Laplace and Z transforms.

**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 Nyquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state space model; state transition matrix, controllability and observability.

**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 and sequential logic circuits; multiplexer; Schmitttrigger; multi-vibrators; sample and hold circuits; A/D and D/A converters; 8-bit microprocessor basics, 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; basic concepts of adjustable speed dc and ac drives.

## **6. Syllabus for Mechanical Engineering (ME)**

### ***APPLIED MECHANICS AND DESIGN***

**Engineering Mechanics:** Freebody diagrams and equilibrium; trusses and frames; 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.

### **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, bend 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 law of thermodynamics; thermodynamic system and processes; Carnot cycle. Irreversibility and availability; behavior of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

**Applications:** *Power Engineering:* Steam Tables, Rankine, Brayton cycles with regeneration and reheat. *I.C. Engines:* air-standard Otto, Diesel cycles. *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**

**Engineering Materials:** Structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

**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.

**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.

## 7. Syllabus for Metallurgical Engineering (MTE)

**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 electrochemistry—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 steelmaking—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 steelmaking, 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 aluminium 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 practice sins and 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 informing; 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, defect in welded joints; powder metallurgy; NDT using dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission and magnetic particle methods.

## 8. Syllabus for Textile Engineering (TE)

**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; physical and chemical methods of fibre and blend identification and blend analysis. Molecular architecture, amorphous and crystalline phases, glass transition, plasticization, crystallization, melting, factors affecting  $T_g$  and  $T_m$ ; Process of viscose and acetate preparation. Polymerization of nylon-6, nylon-66, poly(ethyl 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 uptake 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; ring and 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, airjet 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; 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. Classification, production and areas of application of nonwoven fabrics. Basic woven fabric constructions and their derivatives; crepe, cord, terry, gauze, leno and double cloth constructions. Peirce's equations for fabric geometry; elastical 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, yarn 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. FAST and Kawabata instruments and systems for objective fabric evaluation. Statistical data analysis of experimental results. Correlation analysis, significance tests and analysis of variance; frequency distributions and control charts.

**Preparatory Processes:** Chemistry and practice of preparatory processes for cotton, wool and silk. Mercerization of cotton. Preparatory processes for nylon, polyester and acrylic and polyester/cotton blends.

**Dyeing:** Classification of dyes. Dyeing of cotton, wool, silk, polyester, nylon and acrylic with appropriate dye classes. Dyeing polyester/cotton and polyester/wool blends. Batch wise and continuous dyeing machines. Dyeing of cotton knitted fabrics and machines used. Dye fibre interaction. Introduction to thermodynamics and kinetics of dyeing. 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 cotton with reactive dyes. Printing of wool, silk, nylon with acid and metal complex dyes. Printing of polyester with disperse dyes. Methods of dye fixation after printing. Resist and discharge printing of cotton, silk and polyester. Printing of polyester/cotton blends with disperse/reactive combination. Transfer printing of polyester. Developments in inkjet printing.

## **9. Syllabus for Electronics Engineering (ELE)**

**Network:** Mesh and nodal Analysis, Network theorems: superposition, Thevenin and Norton's maximum power transfer, Wye-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits. 2-port network parameters: driving point and transfer functions. State equations for networks. Series and parallel resonance

**Analog Electronics:** Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers. p-n junction diode, Zener diode, tunnel diode Characteristics of diode, BJT, JFET and MOSFET. Diode circuits. Transistors at low and high frequencies, Amplifiers, single and multi-stage. Feedback amplifiers. Operational amplifiers, characteristics and circuit configurations. Precision rectifier. V-to-I and I-to-V converter. Opamp based active filters. Oscillators and signal generators.

**Digital Electronics:** Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, 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.

**Signals, Systems and Communications:** Periodic and aperiodic signals. continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT,

z-transform, transfer function, Impulse and frequency response of first- and second order systems. Convolution, correlation and characteristics of linear time invariant systems. Pulse transfer function. IIR and FIR filters. Amplitude and frequency modulation and demodulation. Sampling theorem, pulse code modulation. Frequency and time division multiplexing. Amplitude shift keying, frequency shift keying and pulse shift keying for digital modulation.

### **Control Systems:**

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. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

### **Electromagnetics:**

Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems, Maxwell's equations: differential and integral forms. Wave equation, Poynting vector. Planewaves: propagation through various media; reflection and refraction; phase and group velocity; skin depth.

## **10. Syllabus for Biotechnology (BT)**

**Microbiology:** Prokaryotic and eukaryotic cell structure; Microbial nutrition, growth; Microbial metabolism (aerobic and anaerobic respiration, photosynthesis); Nitrogen fixation; Chemical basis of mutations and mutagens; Microbial genetics (plasmids, transformation, transduction, conjugation); Viruses, Bacteria **Biochemistry:** Bio molecules and their conformation; Weak inter-molecular interactions in bio macro molecules; Chemical and functional nature of enzymes; Kinetics of single substrate and bi- substrate enzyme catalyzed reactions; Bioenergetics; Metabolism (Glycolysis, TCA and Oxidative phosphorylation); Membrane transport and pumps; Cell cycle and cell growth control;

**Molecular Biology and Genetics:** Molecular structure of genes and chromosomes; DNA replication and control; Transcription and its control; Translational processes, Mendelian inheritance; Linkage, recombination and chromosome mapping; Chromosomal variation; Molecular basis of genetic diseases and applications.

**Process Biotechnology:** Bioprocess technology for the production of cell biomass and primary/secondary metabolites, such as baker's yeast, ethanol, citric acid, amino acids, antibiotics; Chromatographic and membrane based bio separation methods; Immobilization of enzymes and cells and their application for bioconversion processes. Aerobic and anaerobic biological processes for stabilization of solid / liquid wastes ;Bioremediation.

**Bioprocess Engineering:** Kinetics of microbial growth, substrate utilization and product formation; Simple structured models; Sterilization; Batch, fed-batch and continuous processes; Mass transfer in bio reactors; Scale-up concepts; Various types of microbial and enzyme reactors; Instrumentation in bioreactors.

**Plant and Animal Biotechnology:** Special features and organization of plant cells; Totipotency;

Regeneration of plants; Autotrophic and heterotrophic growth; Plant growth regulators and elicitors; Production of secondary metabolites by plant suspension cultures, Techniques in raising transgenics.

**Characteristics of animal cells:** Metabolism, regulation and nutritional requirements form as

scultivation of animal cell cultures; Kinetics of cell growth and product formation, Hybridoma technology; Live stock improvement; Cloning in animals; Genetic engineering in animal cell culture;

**Immunology:** The origin of immunology; Inherent immunity; Humoral and cell mediated immunity; Antigen; B and T cells and Macrophages; Major histo compatibility complex (MHC); Antigen processing and presentation; Molecular basis of antibody diversity; Polyclonal and monoclonal antibody; Complement; Antigen-antibody reaction; Immune tolerance; Hyper sensitivity; Autoimmunity;

**Recombinant DNA Technology:** Restriction and modification enzymes; Vectors: plasmid, bacteriophage and other viral vectors, cosmids, Tiplasmid, yeast artificial chromosome; cDNA and genomic DNA library; Gene isolation; Gene cloning; Expression of cloned gene; Transposons and gene targeting; DNA labeling; DNA sequencing; Polymerase chain reactions; DNA finger printing; Southern and northern blotting; In-situ hybridization; RAPD; RFLP; Site-directed mutagenesis; Gene transfer technologies; Gene therapy.

**Bioinformatics:** Major bioinformatics resources, Sequence and structure databases; Sequence analysis (biomolecular sequence file formats, scoring matrices, sequence alignment, phylogeny); DNA microarrays, Molecular modeling and simulations.

## 11. ENVIRONMENTAL ENGINEERING (EVE)

Atmospheric chemistry: Pollutants, contaminants, receptors, sink, pathways of pollutants. Major regions of atmosphere, particles, ions and radicals in atmosphere, Thermochemical and photochemical reaction in atmosphere, smog, NO<sub>x</sub>, SO<sub>x</sub>, hydrocarbons, suspended particulate matter, chemistry of action of pollutant and effects. Water quality parameters, pH, conductance, dissolved oxygen, B.O.D and C.O.D of waste water. Sanitary significance of sulphate, phosphate, nitrate fluoride and cyanide and their effects. Soil chemistry-Inorganic and organic components of soil, nitrogen pathway in soil, Fertilizers. Toxic chemicals in the environment: pesticides, arsenic, cadmium, lead, mercury, carbon monoxide, PAN, MIC, Radioactive wastes.

Microbial metabolism of heavy metals, pesticides etc. Ecology, Definition, Branches and Scope of ecology. Ecological adaptation & concept of limiting factor. Different types of ecosystem in India. Structural and functional attributes of an ecosystem. Biotic and Abiotic components, Food chain, Food web and energy flow. Ecological succession. Biogeochemical cycle. Concept of population & population attributes. Concept of carrying capacity and environmental resistance. Development and evolution of ecosystem. Population interaction. Qualitative and quantitative. Raw water collection and Treated water distribution System

Introduction and overview of urban and rural water supply system:- Sources selection, Population estimation, Design period, Domestic institution, commercial and industrial needs. Preliminary Hydraulic design of pressure conduits system (Dead end method and loop network method. Waste water collection systems, Waste water disposal, Septic tank, Types of surface and underground drainage system, their merits and demerits. Types of sewerage- lateral, sub main, Main intercepting and outfall sewers.

Hydraulic design of gravity sewerage system – Sources, rate of domestic sullage and waste water flow, infiltration, ex-filtration, pick factor, pressure sewers.

Appurtenances – Manhole, Street inlet, Inverted siphon, House drainage connection, Sewer junction and transition. Waste water pumping - types of pumps.

Water sanitation:- Sanitary consideration for location and construction of walls. Water impurities and

biological contamination of water, Water pollution and health, water purification, Drinking water Standards & their significance..Surface Water Treatment System . Waste water treatment system. Characterization of sludge, Air pollution and measurement of Air Pollution. Atmospheric dispersion of stack effluents, Noise pollution.

Composition and Properties of Municipal Solid Waste. Generation, Collection rates, waste handling and separation, storage and processing at the source.

Biomedical waste management: Sources, Hazardous associated with bio-medical wastes, Biosafety, Storage of biomedical wastes, disposal and processing.

EIA under NEPA (National Environmental Policy Act), Methodologies screening and scoping criteria, Rapid

and comprehensive EIA, Environmental health impact assessment. Environmental risk analysis.

## 12. Syllabus for Industrial Engineering (IE)

**Engineering Materials:** Structure and properties of engineering materials and their applications; effect of strain, strain rate and temperature on mechanical properties of metals and alloys; heat treatment of metals and alloys, its influence on mechanical properties.

**Applied Mechanics:** Engineering mechanics—equivalent force systems, free body concepts, equations of

equilibrium; strength of materials—stress, strain and their relationship, Mohr's circle, deflection of beams, bending and shear stress, Euler's theory of columns.

**Theory of Machines and Design:** Analysis of planar mechanisms, cams and followers; governors and flywheels; design of elements—failure theories; design of bolted, riveted and welded joints; design of shafts, keys, spur gears, belt drives, brakes and clutches.

**Thermal Engineering:** Fluid mechanics—fluid statics, Bernoulli's equation, flow through pipes, equations of continuity and momentum; thermodynamics—zeroth, first and second law of thermodynamics, thermodynamic system and processes, calculation of work and heat for systems and control volumes; air standard cycles; basics of internal combustion engines and steam turbines; heat transfer— fundamentals of conduction, convection and radiation, heat exchangers.

**Machining and Machine Tool Operations:** Basic machine tools; machining processes—turning, drilling, boring, milling, shaping, planing, gear cutting, thread production, broaching, grinding, lapping, honing, super finishing; mechanics of machining—geometry of cutting tools, chip formation, cutting forces and power requirements, Merchant's analysis; selection of machining parameters; tool materials, tool wear and tool life, economics of machining, thermal aspects of machining, cutting fluids, machinability; principles and applications of nontraditional machining processes— USM, AJM, WJM, EDM and Wirecut EDM, LBM, EBM, PAM, CHM, ECM.

**Tool Engineering:** Jigs and fixtures—principles, applications, and design; press tools—configuration, design of die and punch; principles of forging die design.

**Metrology and Inspection:** Limits, fits, and tolerances, interchangeability, selective assembly; linear and angular measurements by mechanical and optical methods, comparators; design of limit gauges; interferometry; measurement of straightness, flatness, roundness, squareness and symmetry; surface finish measurement; inspection of screw threads and gears; alignment testing of machine tools.

**Polymers and Composites:** Introduction to polymers and composites; plastic processing — injection, compression and blow molding, extrusion, calendaring and thermo forming; molding of composites. **Manufacturing Analysis:** Sources of error in manufacturing; process capability; tolerance analysis in manufacturing and assembly; process planning; parameter selection and comparison of production alternatives; time and cost analysis; manufacturing technologies— strategies and selection.

**Product Design and Development:** Principles of good product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering.

**Engineering Economy and Costing:** Elementary cost accounting and methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements.

**Work System Design:** Taylor's scientific management, Gilbreth's contributions; productivity—concepts and measurements; method study, micro-motion study, principles of motion economy; work measurement – stop watch time study, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration; business process reengineering.

**Facility Design:** Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems.

**Production Planning and Inventory Control:** Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; MRP and MRP-II; order control and flow control; routing, scheduling and priority dispatching; push and pull production systems, concept of JIT manufacturing system; logistics, distribution, and supply chain management; Inventory—functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems.

**Operation Research:** Linear programming—problem formulation, simplex method, duality and sensitivity analysis; transportation and assignment models; network flow models, constrained optimization and Lagrange multipliers; simple queuing models; dynamic programming; simulation—manufacturing applications; PERT and CPM, time-cost trade-off, resource leveling.

**Quality Management:** Quality—concept and costs, quality circles, quality assurance; statistical quality control, acceptance sampling, zero defects, six sigma; total quality management; ISO 9000; design of experiments—Taguchi method.

**Reliability and Maintenance:** Reliability, availability and maintainability; distribution of failure and repair

times; determination of MTBF and MTTR, reliability models; system reliability determination; preventive maintenance and replacement, total productive maintenance—concept and applications.

**Management Information System:** Value of information; information storage and retrieval system—database and data structures; knowledge based systems.

**Intellectual Property System:** Definition of intellectual property, importance of IPR; TRIPS and its implications, patent, copyright, industrial design and trademark.

**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:** Minimum application techniques.

**Pollution:** Environment pollution during chemical processing of textiles. Treatment of textile effluents.

### 13. Syllabus for Plastic Engineering (PE)

As per B. Tech Plastic Engineering syllabus of BPUT, Odisha.