Syllabus
for
Chemical, Polymer and Thermal Engineering (MTQP01)

Chemical, Polymer and Thermal Engineering (MTQP01)

Note:

i. There will be one Question Paper which will have 100 questions.

ii. All questions will be complulsory.

iii. The Question Paper will have two Parts i.e. Part A and Part B:

iv. Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.

v. Part B will have 75 questions based on Subject-Specific Knowledge.

Chemical, Polymer and Thermal Engineering (MTQP01)

Unit 1: Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.

Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Divergence theorem, Green's theorem.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables.

Complex variables: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis

Numerical Methods: Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression and correlation analysis.

Unit 2: Thermodynamics and Process Calculation

Steady and unsteady state mass and energy balances including multiphase, multi-component, reacting and non-reacting systems. Use of tie components; recycle, bypass and purge calculations; Gibb's phase rule and degree of freedom analysis.

First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

Unit 3: Fundamentals of Polymer Science and Technology

Monomers, functionality, initiators, inhibitors, retarders, polydispersity conformation and configuration of macromolecules, stereo isomerism and tacticity in polymers, geometrical isomerism. Polymer structure and properties: Crytalline and amorphous polymers, crystallinity, Basic determinants of polymer properties. Polymer chain flexibility. Structure-property relationship, Factors affecting chain flexibility. Glass transition temperature and crystalline melting points. Factors affecting Glass transition temperature Molecular weight and molecular weight distribution, molecular weight distribution curves, PDI, methods of molecular weight determination-end group analysis, colligative property measurements, light scattering, ultracentrifugation, viscometry etc. Polymer fractionation techniques, GPC. Basic aspects of polymer synthesis, techniques of polymerization: mass, solution, suspension, emulsion and gas phase polymerization, mechanism and kinetics ofRadical/ chain polymerization, Mode of termination - chain transfer to monomer, initiator, chain transfer agent, Inhibition & retardation. living and non-living chain polymerization, co-ordination polymerization, co-polymerization, ionic polymerization, ring opening polymerization . Newer Techniques in Polymerization:Metathesis polymerization, Controlled polymerization methods, viz, Nitroxide mediated polymerization (NMD), Atom Transfer Radical Polymerization (ATRP), Group Transfer Polymerization (GTP), Reversible Addition Fragmentation Termination Modification of polymers, cross-linking, polymer architecture, Applications and limitations of polymers, future prospects, Polymer viscoelasticity, rubber elasticity, polymer solutions.

Unit 4: Fluid Mechanics and Mechanical Operations

Fluid statics, surface tension, Newtonian and non-Newtonian fluids, transport properties, shellbalances including differential form of Bernoulli equation and energy balance, equation of continuity, equation of motion, equation of mechanical energy, Macroscopic friction factors, dimensional analysis and similitude, flow through pipeline systems, velocity profiles, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds, Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop. Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.

Unit 5: Heat and Mass Transfer

Equation of energy, steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations; design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.

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, membrane separations(micro-filtration, ultra-filtration, nano-filtration and reverse osmosis)

Unit 6: Process Control and Instrumentation

Measurement of process variables; sensors and transducers; P&ID equipment symbols; process modeling and linearization, transfer functions and dynamic responses of various systems, systems with inverse response, process reaction curve, controller modes (P, PI, and PID); control valves; transducer dynamics; analysis of closed loop systems including stability, frequency response, controller tuning, cascade and feed forward control.

First principles model development; dynamics of first, second and higher order linear systems, open loop and closed loop systems; linearization; feedback control; stability, Design of controller; dynamics of some complex processes; control valves and introduction to real time computer control of process equipment; cascade, feed forward, adaptive control, ratio control. Introduction to advance control strategies; Introduction to process instrumentation Process Flow Diagram (PFD), Actuators: Pneumatic Valve, Hydraulic actuator, Electric actuator; Sensors: Temperature Measuring Devices, Pressure Measuring Devices; Flow Measuring Devices.

Unit 7: **Chemical Technology and Plant Design**

Inorganic chemical industries (sulfuric acid, phosphoric acid, chlor-alkali industry), 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).

Principles of process economics and cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, optimization in process design and sizing of chemical engineering equipments such as heat exchangers and multistage contactors.

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Syllabus
for
Civil, Structural and Transport Engineering (MTQP02)

Note:

i. ***There will be one Question Paper which will have 100 questions.***
ii. ***All questions will be complulsory.***
iii. ***The Question Paper will have two Parts i.e. Part A and Part B:***
iv. ***Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.***
v. ***Part B will have 75 questions based on Subject-Specific Knowledge.***

Civil, Structural and Transport Engineering (MTQP02)

Unit 1: Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.

Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Divergence theorem, Green's theorem.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables.

Complex variables: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis

Numerical Methods: Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression and correlation analysis.

Unit 2: Geotechnical Engineering

Soil Mechanics: Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two - dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; One- dimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters, Stress-Strain characteristics of clays and sand; Stress paths.

Foundation Engineering: Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes – Finite and infinite slopes, Bishop's method; Stress distribution in soils – Boussinesq's theory; Pressure bulbs, Shallow foundations – Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations – dynamic and static formulae, Axial load capacity of piles in sands and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction.

Unit 3: Water Resources Engineering

Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications; Potential flow, Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth; Concept of lift and drag.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow, gradually varied flow and water surface profiles.

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, surface runoff models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's Law.

Irrigation: Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapotranspiration; Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures

Unit 4: Structural Engineering

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Frictions and its applications; Centre of mass; Free Vibrations of undamped SDOF system.

Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, Transformation of stress; buckling of column, combined and direct bending stresses.

Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis.

Construction Materials and Management: Construction Materials: Structural Steel – Composition, material properties and behaviour; Concrete - Constituents, mix design, short-term and long-term properties. Construction Management: Types of construction projects; Project planning and network analysis - PERT and CPM; Cost estimation.

Concrete Structures: Working stress and Limit state design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete beams.

Steel Structures: Working stress and Limit state design concepts; Design of tension and compression members, beams and beam- columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Concept of plastic analysis -beams and frames.

Unit 5: Transportation Engineering

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments. Geometric design of railway Track – Speed and Cant. Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes

Traffic Engineering: Traffic studies on flow and speed, peak hour factor, accident study, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Traffic signs; Signal design by Webster's method; Types of intersections; Highway capacity.

Unit 6: Environmental Engineering

Water and Waste Water Quality and Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment. Sewerage system design, quantity of domestic wastewater, primary and secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications.

Air Pollution: Types of pollutants, their sources and impacts, air pollution control, air quality standards, Air quality Index 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)

Unit 7: **Geomatics Engineering**

Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves. Photogrammetry and Remote Sensing - Scale, flying height; Basics of remote sensing and GIS.

Unit 8: Geotechnical Earthquake Engineering

Vibration and Measuring Instruments: Theory of vibration - Basic Definition - Governing equation for single degree freedom system - Forced vibrations. Rotating mass type excitation - Base excitation - Isolation vibration measuring instruments. Seismology and earthquakes (basic concepts only), Quantification of earthquake, Intensity and magnitudes.

Ground Motion Parameters: Ground motion parameters, Estimation of Ground motion parameters, Waves in unbounded media, waves in a layered body, Attenuation of stress waves, Seismic hazard analysis. Evaluation of Dynamic soil properties

Wave Propagation and Analysis of Site Effects: Wave propagation Analysis - Site Amplification Need for Ground Response Analysis, Method of analysis, One Dimensional Analysis, Equipment linear Analysis site effects, Design Ground Motion, Developing Design Ground Motion. Application of software package Shake-2000

Seismic Design of Footings and Walls: Seismic Design of Foundations, Retaining Walls & Slopes - Seismic design requirements for foundation, Seismic bearing capacity, Seismic settlement, Design loads. Seismic slope stability analysis - Internal stability and weakening instability, Seismic design of retaining walls: Dynamic response of retaining walls, Seismic displacement of retaining walls, Seismic design consideration.

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Syllabus
for
Dairy Technology (MTQP03)

Note:

i. There will be one Question Paper which will have 100 questions.

ii. All questions will be complulsory.

iii. The Question Paper will have two Parts i.e. Part A and Part B:

iv. Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.

v. Part B will have 75 questions based on Subject-Specific Knowledge.

Dairy Technology (MTQP03)

Milk production management and Dairy Development

- Indian and exotic breeds of dairy animals; Management of dairy animals; milking procedure and practices for quality milk production; Dairy farm records and their maintenance; Milksecretion and milk let-down.
- Socio-economic and geographical features of Indian dairying; annual milk production and per capita availability
- Five-year plans and dairy development; co-operative dairy organizations, Anand pattern, and perspectives; Operation Flood- I, II, III programmed; Dairy Development Corporations, Co-operative Dairy Federations.

Introduction to Dairy Microbiology

- Milk production hygiene and critical risk factors affecting microbiological quality on-farm;
- Microorganisms associated with raw milk and their classification based on growth temperature– psychographs, mesophiles, thermoduric and thermophiles; Mastitis milk: Microflora of mastitis milk and its importance in the dairy industry
- Good Hygiene Practices (GHP) during milk production operations
- Collection and transportation of milk;
    a) Organization of milk collection routes
    b) Practices for collection of milk, preservation at the farm, refrigeration, natural microbial inhibitors, immunoglobulin, lactoferrin, lysozymes, and lactoperoxidase (LP) systems.
    c) Microbial quality of milk produced on the farm
    d) Chemical tests for grading raw milk.
    e) Microbiological tests for grading raw milk; Microbial metabolites and their role in spoilages - souring, curdling, gassiness, ropiness, proteolysis, lipolysis, abnormal flavors, and color; Antimicrobial systems in raw milk; Food poisoning, food infections, toxic-infections, and other milk-borne diseases and theircontrol; isolation and identification of conventional and emerging dairy pathogens;detection of microbial toxins, drug residues in milk and their public healthimportance.

Unit operations

- Fluid mechanics- properties of fluids, Bernoulli's equation, and its applications, hydraulic systems; Types of Pumps: Sanitary pumps, Standards for Centrifugal and Positive Rotatory Type of pumps; Refrigeration and air-conditioning; Heat-transfer and thermodynamics; mechanical separations; engineering of mechanics; theory of machine; strength of materials; materials of fabrications.

Dairy Technology (MTQP03)

Market Milk

- Chemical composition of various food of plant and animal origin,
- Structure and functions of food constituents' additives, preservatives, flavors and antioxidants, composition and physio-chemical and nutritional properties of milk and colostrum, the effect of heat processing on nutritive value;
- Chemistry of milk, constituents, nutrients, and milk products; Milk collection and RMRD activities, clarification and storage, Homogenization, pasteurizer, Bactofugation, termination, sterilization, and UHT Processing. Toned, doubled toned, reconstituted, recombined, flavored, homogenized vitaminized, sweet acidophilus milk, sterilized milk, etc.;
- Principles of thermal processing: kinetics of microbial destruction, thermal death curve, Arrhenius equation, D value, Z value, F_0 value, $_{Q10}$ value. Factors affecting thermal destruction of micro-organisms.
- Bacteriological aspects of milk processing - Thermalization, pasteurization, boiling, sterilization, UHT, bactofugation, and membrane filtration. Defects in market milk.

Dairy Engineering

- Sanitization: Materials and sanitary features of the dairy equipment; can washers, bottle washers; CIP cleaning and designing of the system.; Mechanical Separation: Fundamentals involved in separation; Sedimentation; Principles involved in filtration, Principles of centrifugal separation, different types of centrifuges; clarifiers, processors, cream separator, self-desludging centrifuge, Bactofuge;
- Homogenization: Classification, single-stage and two-stage homogenizer pumps; Pasteurization: Batch, flash, and continuous (HTST) pasteurizers, Flow diversion valve;
- Different types of sterilizers: in-bottle sterilizers, autoclaves, continuous sterilization plant, UHT sterilization;
- Filling Operation: Principles and working of different types of bottle filters and capping machine, pouch filling machine (Pre-pack and aseptic filling bulk handling system, Mixing,and agitation:
- Theory and purpose of mixing; Materials and sanitary features of the dairy equipment; Aseptic packaging and equipment; Computerization and Automatic Process Controls in Milk Processing.

Fat-Rich Milk Products

- Composition and processing of cream, butter, ghee, butter oil, low-fat spreads; spoilage ofghee and use of antioxidants, test for the quality of butter, ghee, adulterants, neutralizers and preservatives, their detection, heat stability of milk; Microbiological quality of cream and butter.

Condensed and Dried milk

- Definition, legal standards, and manufacturing: Condensed milk, sweetened condensed milk, evaporated milk, dried milk like skim milk powder (SMP), whole milk powders; Heat stability of milk and condensed milk; Dried Milk: Manufacture of and heat classified powders, Physio-chemical changes taking place during manufacture of dried milk, Physical properties of dried milk, milk during manufacture and storage, their causes and prevention, PFA, BIS and International Standards for dried milk Principles of evaporation, drying. Atmosphere concentration, Vacuum Pan, Fluidization. Care of Vacuum Pan, Atmospheric Drum Dryer. Spray Dryer principles of dairy plant layout and design, Functional Design, the space requirement of Milk Plant; Processing of infant food; Microbiological quality of concentrated dairy products, dried bowls of milk, and infants milk foods; physio-chemical changes in the manufacture and storage of milk powder, lactose, crystallization, and its significance. Defectsin condensed and dried milk.

Dairy Technology (MTQP03)

Fermented milk products

- Microbiology of dairy starters; Classification, Metabolism of Lactic Acid Bacteria and diacetyl production, production of antibacterial substances by lactic starter cultures;
- Preservation, propagation, and quality control of dairy starters and their inhibition by antibiotic residues, detergents, sanitizers, bacteriophages, etc.; chemistry and microbiology of milk fermentations, the chemistry of rennin coagulation of milk and changes occurring during ripening of cheese, cheeses, and application of the probiotic concept in dahi, yogurt, Kefir, Kumiss, Bulgarian milk, cultured buttermilk, leben, Yakult, cheddar and processed cheese; Roleof starter culture in relation to cheese quality; rennet substitutes. Manufacture of different varieties of cheese: Cheddar, Gouda, Swiss, Mozzarella, Cottage; Accelerated ripening of cheese. Microbiological defects in cheese.

Traditional Dairy products

- Indigenous dairy products: Khoa and its related products like Burfi, peda, Milk cake, Kalakhand, Gulabjaman, Rabri, and Basundhi; Channa and its based sweets like Rasogolla, Sandesh, Ras-malai; Paneer; Srikhand; Misti dahi; Kheer and Payasam; Factors affecting the microbiological quality of these products during production, processing, handling, storage, and distribution; physicochemical changes during the manufacture of indigenous milk products, and its chemical and microbial standards (legal specifications)

Ice cream and Frozen milk products

- Definition, classification, and composition of ice cream and other frozen desserts; Stabilizersand emulsifiers-their classification, properties, and role in the quality of ice cream; Technological aspects of ice cream manufacture; Effect of process treatments on the physio-chemical properties of ice-cream mixes and ice cream, Processing and freezing of ice-cream mix andcontrol of overrun, Packaging, hardening, storage, and shipping of ice-cream, Defects in ice cream; food safety & legal standards

Dairy By-products

- Dairy by-products in India and Abroad; Whey and its related Product like fermented whey beverages, Deproteinized, and demineralized whey; buttermilk and ghee residue, By-products from skim milk like casein, casein hydrolysates, etc.; Lactose; Nutritional characteristics of byproducts

Packaging and sensory of milk and milk products

- Sensory evaluation and judging of milk and milk products, types of packaging materials andtheir properties, Packaging of milk and dairy products; packing forms and operations, problems in food packaging, and recent advances in packaging dairy and food products. Modern Packaging Techniques: Vacuum Packaging, Modified atmosphere packaging (MAP), Eco-friendly packaging, Aseptic Packaging (AP), and Intelligent Food Packaging. Nutritional labelling of food products

Quality assurance of dairy products

- Dairy plant hygiene and sanitation - Microbiology of air, water, equipment, packaging materials, personnel, disposal of dairy waste; quality (ISO 9001:2000) and food safety (HACCP) system and their application during milk production and processing; Microbiological standards for milk and milk products - PFA, BIS, Codex/ ISO standards (ISO 22000:2005).

Syllabus
for
Data Science, Artificial Intelligence, Cyber Security etc. (MTQP04)

Note:

i. There will be one Question Paper which will have 100 questions.

ii. All questions will be complulsory.

iii. The Question Paper will have two Parts i.e. Part A and Part B:

iv. Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.

v. Part B will have 75 questions based on Subject-Specific Knowledge.

Data Science, Artificial Intelligence, Cyber Security etc. (MTQP04)

1. **Engineering Mathematics**: Discrete Mathematics, Linear Algebra, Calculus, Statistics and Probability Set Theory & Algebra**:** Sets; Relations; Functions; Compositions of functions and relations,Group; Partial Orders; Boolean Algebra.
2. **Theory of Computations:** Finite Automata and Regular Expressions, on –determinism and NFA, Properties of Regular Sets, Context free grammar: Chomsky Normal Form (CNF), Griebach Normal Form (GNF), Push-down automata, Moore and mealy Machines, Turing machines.
3. **Digital Logic:** Number representations and computer arithmetic (Fixed and floating point), Logic functions, Minimizations, Design and synthesis of combinational and sequential circuits, A/D AND D/A CONVERTERS.
4. **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.
5. **Microprocessors and interfacing:** Instructions sets, addressing modes, Memory interfacing, interfacing peripheral devices, Interrupts. Microprocessor architecture, Instructions set and Programming (8085), Microprocessor applications, DMA, Interrupt and Timer.
6. **Programming and Data Structures:** Programming in C; Functions, Recursion, Parameter passing, and Definition of data structure. Arrays, Stacks, Queues linked lists, trees, priority queues and heaps, Binary search trees.
7. **Algorithm**: Algorithm concepts, Analyzing and design, asymptotic notations and their properties, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide and conquer; Tree and graph transversals, Spanning trees, shortest paths: Hashing, Sorting Searching.
8. **Operating System**: Main functions of operating systems, Processes, Threads, Interprocess communication, concurrency, Synchronization, Deadlock, CPU scheduling, I/O scheduling, Resource scheduling. Deadlock and scheduling algorithms, banker's algorithm for deadlock handling. Memory management and virtual memory. File Systems, I/O systems, DOS, UNIX and Windows.
9. **Computer Networks**: OSI Model, TCP/IP model, LAN technologies (Ethernet, Token ring), Transmission media – twisted pair, coaxial cables fiber–optic cables, Flow and error control techniques, Routing algorithms, Congestion control, IP (v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Sliding window protocols; Internetworking: Switch /Hub, Bridge, Router, Gateways, Concatenated virtual circuits, Firewalls: Network Security; Cryptography- public key, secret key. Domain Name System (DNS)-Electronic Mail and World Wide Web (WWW).

Data Science, Artificial Intelligence, Cyber Security etc. (MTQP04)

10. **Artificial Intelligence**: Basic concepts of AI; Intelligent agents; solving problems by searching – Uniformed search, Informed search; Logical agents; first order logic; knowledge representations.
11. **Cryptography & Network security:** Computer & network security concepts, Classical encryption techniques: Symmetric cipher model, Caesar Cipher, Playfair Cipher, Hill Cipher.
12. **Data Science**: Basic concepts; data, types of data–structured, unstructured; data representation,machine learning algorithms-supervised, unsupervised, reinforcement, clustering, classification and regression problems, data preprocessing, normalization, smoothing, visualization.

Syllabus
for
Electronics, Communication and Information Engineering (MTQP05)

Note:

i. ***There will be one Question Paper which will have 100 questions.***

ii. ***All questions will be complulsory.***

iii. ***The Question Paper will have two Parts i.e. Part A and Part B:***

iv. ***Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.***

v. ***Part B will have 75 questions based on Subject-Specific Knowledge.***

Electronics, Communication and Information Engineering (MTQP05)

Unit 1: Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.

Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Divergence theorem, Green's theorem.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables.

Complex variables: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis

Numerical Methods: Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression and correlation analysis.

Unit 2: Networks, Signals and Systems

Circuit analysis: Node and mesh analysis, superposition, Thevenin's theorem, Norton's theorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer. Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform. Linear 2-port network parameters, wye-delta transformation.

Continuous-time signals: Fourier series and Fourier transform, sampling theorem and applications.

Discrete-time signals: DTFT, DFT, z-transform, discrete-time processing of continuous-time signals. LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay, Adaptive Signal Processing

Unit 3: Electronic Devices

Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors.

Carrier transport: diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations.
P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell, DC-biasing of Bipolar Junction Transistors, AC analysis of Bipolar Junction Transistors, Frequency Analysis of BJT and FET, Power Amplifiers

Unit 4: Analog and Digital Electronics

Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers: characteristics and applications; single stage active filters, Active Filters: Sallen Key, Butterwoth, VCOs and timers, combinatorial and sequential logic circuits, multiplexers, demultiplexers, Schmitt triggers, sample and hold circuits, A/D and D/A converters. Machine instructions and addressing modes, ALU, data-path and control unit, instruction pipelining.

Unit 5: Control and Automation

Mathematical modeling and representation of systems, Feedback principles, Block Diagram and signal flow graphs, transient response, steady-state-errors, Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, state-space representation of systems; time-delay systems; mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on-off, P, PI, PID, cascade, feedforward, and ratio controllers, tuning of PID controllers and sizing of control valves, State space model, Solution of state equations of LTI systems**.**

Unit 6: Communications and Information Theory

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems. Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers. Information theory: entropy, mutual information and channel capacity theorem. Digital communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER. Fundamentals of error correction, Hamming codes, CRC.

Shannon's fundamental coding theorems, Differential entropy & mutual information for discrete & continuous ensembles, source coding, Rate distortion theory. Introduction to Algebra:Groups, fields, Binary field arithmatic, Basic properties of Galois field GF(2m) and vector spaces. Channel coding and decoding: Run length limited codes, LBC, cyclic code, BCH code, convolutional code, Trellis coded modulation, Reed-Solomon code.

Unit 7: Electromagnetic Theory and Wave Propagation

Maxwell's equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector. Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth. Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays.

Unit 8: IoT and Applications

Introduction to IoT, IoTECo system, Internet of Things definition evolution, smart IoT, IoT architecture, IoT and the cloud, Embedded prototyping: Embedded systems, Processor embedded in to system, Embedded hardware units and software system.

Electronics, Communication and Information Engineering (MTQP05)

Internet Communications Protocols, IP,TCP,The IP Protocol Suite (TCP/IP), UDP ; IP Addresses:DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses; TCP and UDP Ports :An Example: HTTP Ports, Other Common Ports; Application Layer Protocols :HTTP , HTTPS; Encrypted HTTP, Performance, Libraries, Debugging.

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Electronics, Communication and Information Engineering (MTQP05)

Syllabus
for
Food Engineering and Technology (MTQP06)

Note:

i. ***There will be one Question Paper which will have 100 questions.***
ii. ***All questions will be complulsory.***
iii. ***The Question Paper will have two Parts i.e. Part A and Part B:***
iv. ***Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.***
v. ***Part B will have 75 questions based on Subject-Specific Knowledge.***

Food Engineering and Technology (MTQP06)

Section 1: Food Chemistry and Nutrition

Carbohydrates: structure and functional properties of mono-, oligo-, & poly- saccharides including starch, cellulose, pectic substances and dietary fiber, gelatinization and retro gradation of starch.
Proteins: classification and structure of proteins in food, biochemical changes in postmortem and tenderization of muscles.

Lipids: classification and structure of lipids, rancidity, polymerization and polymorphism.

Pigments: carotenoids, chlorophylls, anthocyanins, tannins and myoglobin.

Food flavors: terpenes, esters, aldehydes, ketones and quinines.

Enzymes: specificity, simple and inhibition kinetics, coenzymes, enzymatic and non- enzymatic browning.

Nutrition: balanced diet, essential amino acids and essential fatty acids, protein efficiency ratio, water soluble and fat-soluble vitamins, role of minerals in nutrition, co-factors, anti-nutrients, nutraceuticals, nutrient deficiency diseases.
Chemical and biochemical changes: changes occur in foods during different processing.

Section 2: Food Microbiology

Characteristics of microorganisms: morphology of bacteria, yeast, mold and actinomycetes, spores and vegetative cells, gram-staining. Microbial growth: growth and death kinetics, serial dilution technique.

Food spoilage: spoilage microorganisms in different food products including milk, fish, meat, egg, cereals and their products.

Toxins from microbes: pathogens and non-pathogens including Staphylococcus, Salmonella, Shigella, Escherichia, Bacillus, Clostridium, and Aspergillus genera. Fermented foods and beverages: curd, yoghurt, cheese, pickles, soya-sauce, sauerkraut, idli, dosa, vinegar, alcoholic beverages and sausage.

Section 3: Food Products Technology

Processing principles: thermal processing, chilling, freezing, dehydration, addition of preservatives and food additives, irradiation, fermentation, hurdle technology, intermediate moisture foods.
Food pack aging and storage: packaging materials, aseptic packaging, controlled and modified atmosphere storage.

Cereal processing and products: milling of rice, wheat, and maize, parboiling of paddy, bread, biscuits, extruded products and ready to eat breakfast cereals.

Oil processing: expelling, solvent extraction, refining and hydrogenation.

Fruits and vegetables processing: extraction, clarification, concentration and packaging of fruit juice, jam, jelly, marmalade, squash, candies, tomato sauce, ketchup, and puree, potato chips, pickles.
Plantation crops processing and products: tea, coffee, cocoa, spice, extraction of essential oils andoleoresins from spices.

Milk and milk products processing: pasteurization and sterilization, cream, butter, ghee, ice- cream, cheese and milk powder.

Processing of animal products: drying, canning, and freezing of fish and meat; production of egg powder.

Waste utilization: pectin from fruit wastes, uses of by-products from rice milling.

Food standards and quality maintenance: FPO, PFA, Agmark, ISI, HACCP, food plant sanitation andcleaning in place (CIP)

Section 4: Food Engineering

Mass and energy balance; Momentum transfer: Flow rate and pressure drop relationships for Newtonian fluids flowing through pipe, Reynolds number.
Heat transfer: heat transfer by conduction, convection, radiation, heat exchangers. Mass transfer: molecular diffusion and Fick's law, conduction and convective mass transfer, permeability through singleand multilayer films.

Mechanical operations: size reduction of solids, high pressure homogenization, filtration, centrifugation, settling, sieving, mixing & agitation of liquid.

Thermal operations: thermal sterilization, evaporation of liquid foods, hot air drying of solids, spray and freeze-drying, freezing and crystallization.
Mass transfer operations: Psychometry, humidification and dehumidification operations.

Syllabus
for
Mechanical Engineering
(MTQP07)

Note:

i. ***There will be one Question Paper which will have 100 questions.***
ii. ***All questions will be complulsory.***
iii. ***The Question Paper will have two Parts i.e. Part A and Part B:***
iv. ***Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.***
v. ***Part B will have 75 questions based on Subject-Specific Knowledge.***

Mechanical Engineering (MTQP07)

Unit 1: Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.

Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Divergence theorem, Green's theorem.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables.

Complex variables: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis

Numerical Methods: Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression and correlation analysis.

Unit 2: Applied Mechanics and Design

Engineering Mechanics: Free-body diagrams and equilibrium; friction and its applications including rolling friction, belt-pulley, brakes, clutches, screw jack, wedge, vehicles, etc.; trusses and frames; virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations; Lagrange's equation.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; concept of shear centre; deflection of beams; torsion of circular shafts; Euler's theory of

columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

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

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

Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the SN diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs

Unit 3: Fluid Mechanics and Thermal Sciences

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

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

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

Applications: *Power Engineering*: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. *I.C. Engines*: Air-standard Otto, Diesel and dual cycles. *Refrigeration and air-conditioning*: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. *Turbomachinery*: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines; steam and gas turbines.

Unit 4: Materials, Manufacturing and Industrial Engineering

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

Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. 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. Principles of welding, brazing, soldering and adhesive bonding.

Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; 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, jigs and fixtures; abrasive machining processes; NC/CNC machines and CNC programming.

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly; concepts of coordinate-measuring machine (CMM).

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

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

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

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

Unit 5: Mechatronics and Industrial Robotics

Sensors and Drives: Sensor characteristics, different types of sensors and transducers, micro sensors, electrical contacts, actuators, and switches, signal processing devices; relays, output devices. Drives: Electrical, Mechanical, Hydraulic & Pneumatic. Automatic Production and Assembly Machines: Transfer lines, Production and throughput, Buffer Storage

Robot Kinematics & Gripper Mechanism : Role of robotics in automated manufacturing system, Robot anatomy. Robot classifications and specifications, Manipulation and Control. Robot kinematics, forward and reverse transformation, homogeneous transformations. Fundamental Rotation matrices, Kinematic modeling of the manipulator, Denavit-Hartenberg Notation.

Robot Manipulators, Actuators and Drives : Robot vision and their interfaces, Machine Vision Applications. Welding, spray painting and finish coating, Parts Mating & Parts Joining Operations. Types of Robot Manipulators, Application of Robot Manipulators, Construction of a Robot Manipulatotor.

Robot Sensors and Robot Safety: Sensors in Robotics, classification of Robotic sensors, Acoustic sensors Optical Sensors, Pneumatic Sensors. Touch Sensors, Force Sensors, Force Sensing Wrist and its applications. Robot Planning and Installation, Robot Safety, Need of Robot Safety

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Syllabus
for
Nanoscience (MTQP08)

Note:

i. There will be one Question Paper which will have 100 questions.

ii. All questions will be complulsory.

iii. The Question Paper will have two Parts i.e. Part A and Part B:

iv. Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.

v. Part B will have 75 questions based on Subject-Specific Knowledge.

Nanoscience (MTQP08)

CHEMICAL SCIENCES:

Periodic Table and periodicity in properties: Chemical bonding and shapes of compounds, VSEPR theory, lattice energy. Main group elements (s and p blocks). Transition metals and innertransition metals (d and f block). Allotropes. Coordination compounds. Organometallic compounds. Stoichiometry. Acids and bases. Oxidation reduction and precipitation reactions.

Radioactivity. Nuclear reactions: fission and fusion.

Quantum mechanics: Chemical bonding. Chemical thermodynamics. Kinetic theory of gases. Electrochemistry & Chemical kinetics: Conductance, EMF, Free energy, Nernst equation, redox systems, electrochemical cells, Reactions of various order, Arrhenius equation, Enzyme kinetics,Catalysis. Solutions. Ionic equilibria in solutions, pH and buffer solutions, Hydrolysis, Solubility product, Phase equilibria–Phase rule. Vapour pressure and Osmotic pressure. Molecular weightdetermination.

IUPAC nomenclature. Stereochemistry. Organic reactive intermediates: Generation, stabilityand reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Common named reactions and rearrangements –applications in organic synthesis. Polymers.

PHYSICAL SCIENCES:

Interference. Diffraction. Polarization. Quantum mechanics: Postulates; Wave-particle duality. Commutators and Heisenberg uncertainty principle. Schrödinger equation (time-dependent and time-independent). Exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom. Tunneling through a barrier. Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magneto statics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Scalar and Vector potentials, Maxwell equations. First and second laws of thermodynamics, Thermodynamic functions, Heat capacity enthalpy, entropy. Bonding in solids, Crystal structures. Bravais lattices. Miller indices.

Reciprocal lattice. Bragg's law and applications; Diffraction and the structure factor. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Drude model of electrical and thermal conductivity. Hall Effect and thermoelectric power. Electron motion in a periodic potential, Band theory of solids: metals, insulators and semiconductors. Dielectrics. Ferroelectrics. Magnetic materials. Superconductivity: type-I andtype-II superconductors.

BIOLOGICAL SCIENCES:

Biomolecules: Biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins). Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties). Bioenergetics, glycolysis, oxidative phosphorylation. Catalysis, enzymesand enzyme kinetics.

Cell Biology: Membrane structure and function; Cell organelles; Cell division and cell cycle.
Microbes, infectious disease biology, cancer and microbial diseases.

Fundamental Processes: DNA replication, repair and recombination, RNA synthesis andprocessing and Protein synthesis

Immunology: Innate and adaptive immunity, antigens, antibody, antigen-antibody interactions,immune responses, congenital and acquired immune deficiencies, vaccines.

Genetics: Mendelian principles, Gene: Allele, multiple alleles, mutation types and cause.
Human Physiology: Blood, coagulation, blood groups, Heart, Endocrine glands, Hormones anddiseases.

Syllabus
for
Nanoelectronics (MTQP09)

Nanoelectronics (MTQP09)

Note:

i. ***There will be one Question Paper which will have 100 questions.***

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iii. ***The Question Paper will have two Parts i.e. Part A and Part B:***

iv. ***Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.***

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Nanoelectronics (MTQP09)

Unit-I

Electronic Transport in semiconductor, PN Junction, Diode equation and diode equivalent circuit. Breakdown in diodes, Zener diodes, Tunnel diode, Semiconductor diodes, characteristics and equivalent circuits of BJT, JFET, MOSFET, IC fabrication-crystal growth, doping, bonding, Thin film active and passive devices. Rectifiers, Voltage regulated ICs and regulated power supply, Biasing of Bipolar junction transistors and JFET. Single stage amplifiers, Multi stage amplifiers, Feedback in amplifiers, oscillators, function generators, multi vibrators, Operational Amplifiers (OP AMP): Characteristics and Applications, Computational Applications, Integrator, Differentiator.

Unit-II

Network theorems, Network graphs, Nodal and Mesh analysis. Time and frequency domain responses. Image impedance and passive filters. Two-port Network Parameters. Transfer functions, Signal representation. State variable method of circuit analysis, AC circuit analysis, Transient analysis. Logic families, flip-flops, Gates, Boolean algebra and minimization techniques, Multi vibrators and clock circuits, Counters-Ring, Ripple. Synchronous, Asynchronous, Up and down shift registers, multiplexers and demultiplexers, Arithmetic circuits, Memories, A/D and D/A converters. Modulation index, frequency spectrum, generation of AM (balanced modulator, collector modulator), Amplitude Demodulation (diode detector Other forms of AM: Double side band suppressed carrier, DSBSC generation (balanced modulator), Single side band suppressed carrier, SSBSC generation and Phase modulation, modulation index.

Unit-III

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magneto statics: Biot-Savart law, Ampere's theorem. Electromagnetic induction.
Maxwell equations. Reflection and refraction, polarization.

Unit-IV

Microprocessor: Introduction to 8085, Basic Concepts of Microprocessors, Central Processing Unit: CPU, I/O devices, clock, memory, bussed architecture, tristate logic, address bus, data bus and control bus. Development of semiconductor memory, internal structure and decoding, memory read

and write timing diagrams, MROM, ROM, EPROM, EEPROM, DRAM: Intel 8085 microprocessor.

Unit V:

Introduction to nanotechnology, Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence, Schrodinger's Equation, wave function, Low dimensional structures Quantum wells, Basic properties of two dimensional semiconductor nanostructures, Quantum wires and quantum dots, carbon nano tube, grapheme, Introduction to methods of fabrication of nano-layers, Introduction to characterization of nanostructures, Principle of operation of Scanning Tunnelling Microscope, X-Ray Diffraction analysis, MOSFET structures, Quantum wells, modulation doped quantum wells, multiple quantum wells, The concept of super lattices, Transport of charge in Nanostructures under Electric field, Transport of charge in magnetic field, Nanoelectonic devices, principle of NEMS

Unit VI:

Nanotechnology Enabled Se nsors, Sensor Characteristics and Terminology, Potentiometric Sensors, Selectivity of Potentiometric Sensor, the IonSelective Field Effect Transistor (ISFET), Measurement with Potentiometric Sensors, Amperometric Sen sors Selectivity of Amperometric Sensors, Electrode Design and Examples, Measurement with Amperom etric Sensors, Sensors Based on Other Electrochemical Methods, Electrochemical Biosensors, Classes of Electrochemical Biosensors.Sensors with Thermistors and Pellistors, Pyroelectric Sensors, Sensors Based on Other Thermal Effects, Optical Fibres as a Basis for Optical Sensors.

Syllabus
for
Electrical, Power and Energy Engineering (MTQP10)

Note:

i. ***There will be one Question Paper which will have 100 questions.***
ii. ***All questions will be complulsory.***
iii. ***This Question Paper will have two Parts i.e. Part A and Part B:***
iv. ***Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.***
v. ***Part B will have 75 questions based on Domain Knowledge.***

Electrical, Power and Energy Engineering (MTQP10)

Unit 1: Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.

Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Divergence theorem, Green's theorem.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables.

Complex variables: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis

Numerical Methods: Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression and correlation analysis.

Unit 2: Instrumentation, Control, and Automation

Measurements and Instrumentation: SI units, standards (R,L,C, voltage, current and frequency), systematic and random errors in measurement, expression of uncertainty - accuracy and precision, propagation of errors, linear and weighted regression. Bridges: Wheatstone, Kelvin, Megohm, Maxwell, Anderson, Schering and Wien for measurement of R, L, C and frequency, Q-meter. Measurement of voltage, current and power in single and three phase circuits; ac and dc current probes; true rms meters, voltage and current scaling, instrument transformers, timer/counter, time, phase and frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding and grounding.

Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (variable head, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement. 4-20 mA two-wire transmitter.

Control and Automation: Mathematical modeling and representation of systems, Feedback principles, Block Diagram and signal flow graphs, transient response, steady-state-errors, Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, state-space representation of systems; time-delay systems; mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on-off, P, PI, PID, cascade, feedforward, and ratio controllers, tuning of PID controllers and sizing of control valves, State space model, Solution of state equations of LTI systems**.**

Unit 3: Electrical Circuits and Electrical Machines

Voltage and current sources: independent, dependent, ideal and practical; v-i relationships of resistor, inductor, mutual inductance and capacitor; transient analysis of RLC circuits with dc excitation. Kirchoff's laws, mesh and nodal analysis, superposition, Thevenin, Norton, maximum power transfer and reciprocity theorems.

Peak-, average- and rms values of ac quantities; apparent-, active- and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance, locus diagrams, realization of basic filters with R, L and C elements. transient analysis of RLC circuits with ac excitation. One-port and two-port networks, driving point impedance and admittance, open-, and short circuit parameters.

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Types of losses and efficiency calculations of electric machines.
Operating principle of single-phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors; Types of losses and efficiency calculations of electric machines.

Unit 4: Analog and Digital Electronics

Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers: characteristics and applications; single stage active filters, Active Filters: Sallen Key, Butterwoth, VCOs and timers, combinatorial and sequential logic circuits, multiplexers, demultiplexers, Schmitt triggers, sample and hold circuits, A/D and D/A converters.

Unit 5: Power System and Power Electronics

Power System: Basic concepts of electrical power generation, ac and dc transmission concepts, Models and performance of transmission lines and cables, Economic Load Dispatch (with and without considering transmission losses), Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss- Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential, directional and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Power Electronics: Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost Converters; Single and three-phase configuration of uncontrolled rectifiers; Voltage and Current commutated Thyristor based converters; Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; Power factor and Distortion Factor of ac to dc converters; Single-phase and three-phase voltage and current source inverters, sinusoidal pulse width modulation

Unit 6: Non-conventional Energy Sources

Energy Alternatives: The Solar Option, The Nuclear Option, Tar sands and Oil Shale, Tidal Energy, Geothermal Energy Solar Energy: Solar Radiation, availability, measurement and estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic conversion, Wave Energy and Ocean Thermal Energy Conversion, Wind Energy Conversion, Biomass Energy Conversion Energy from Waste, Mini/Micro-hydel.

Measurement of solar radiation and sunshine hours, Measurement of albedo, UV & IR radiation, Measurement of emissivity, reflectivity, transmittivity, Performance testing of solar flat plate water heater – forced flow & thermosyphon systems, Performance testing solar air heater & dryer & desalination unit, Performance testing of solar thermal concentrators, Characteristics of photovoltaic devices & testing of solar PV operated pump, Energy consumption & lumen measurement of lights & ballasts

Unit 7: Energy Resources, Economics & Environment

3-0-0-6 Overview of World Energy Scenario – Dis-aggregation by end-use, by supply Fossil Fuel Reserves - Estimates, Duration Overview of India's Energy Scenario - Dis-aggregation by end-use, by supply, reserves Country Energy Balance Construction - Examples Trends in energy use patterns, energy and development linkage. Energy Economics - Simple Payback Period, Time Value of Money, IRR, NPV, Life Cycle Costing, Cost of Saved Energy, Cost of Energy generated, Examples from energy generation and conservation, Energy Chain, Primary energy analysis Life Cycle Assessment, Net Energy Analysis Environmental Impacts of energy use - Air Pollution - SOx, NOx, CO, particulates Solid and Water Pollution, Formation of pollutants, measurement and controls; sources of emissions, effect of operating and design parameters on emission, control methods, Exhaust emission test, procedures, standards and legislation; environmental audits; Emission factors and inventories Global Warming, CO2 Emissions, Impacts, Mitigation Sustainability, Externalities, Future Energy Systems.

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Syllabus
for
Water Engineering and Management (MTQP11)

Note:

i. ***There will be one Question Paper which will have 100 questions.***
ii. ***All questions will be complulsory.***
iii. ***The Question Paper will have two Parts i.e. Part A and Part B:***
iv. ***Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.***
v. ***Part B will have 75 questions based on Subject-Specific Knowledge.***

Water Engineering & Management (MTQP11)

Fluid Mechanics:

Types of fluids, Properties of Fluids, Equation of state, Coefficient of compressibility, Bluk modulus of elasticity, Newtonian and non- Newtonian fluid, Coefficient of thermal expansion, Surface tension, capillarity, concept of viscosity, Effect of temperature on viscosity. Fluid Static, Fluid Kinematics, Fluid Rotation, Fluid dynamics.

Dimensional and Model Analysis, Laminar flow, Turbulent Flow. Cement, Concrete, Special Concrete, Properties of bricks and stones, forms of bricks, tests on bricks and stones, relevant codes, Timber.

Physical properties of Rock forming Minerals, introduction of Rocks, mode of formation and classification of sedimentary and igneous rocks, agents of metamorphism and zone of metamorphism, physical and engineering properties of some important rocks, Weathering; mechanical and chemical weathering: Erosion.

Surveying and Levelling:

Plane and geodetic surveying; classification of surveying; basic principles; measurement of horizontal distance by conventional methods; taping on sloping ground, offsets, errors and sources of errors, field book. Levelling: definition of terms; levelling principle; levelling, instruments; types of spirit levelling; methods of booking and reduction of levels; sensitiveness of level tube; errors in levelling; curvature and refraction correction. Compass Survey, Plane Table Surveying, Area and Volume Computation: computation of area by different methods.

Mechanics of Solids:

Theories of Elastic Failure: Introduction; Comparison and Significance of Various Theories, Distribution of Bending and Shear Stresses across cross-section of Beams; Shear Centre; Theory of Shear Flow; Shear Flow Diagrams; Shear Centre for Thin-Walled Symmetrical Sections, Basic Elastic Theorems and Energy Methods; Theorem of Complementary Energy; Principle of Minimum Strain Energy; Concepts of Stiffness and Flexibility.
Functions of Project Management, Project Life Cycle, the Project Environment, Project Selection, Project Proposal, Project Scope, Work Breakdown Structure. Network Scheduling, Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of cc

Water Engineering & Management (MTQP11)

Hydrology:

Hydrological cycle, storage, water balance. Atmospheric Circulation: Atmospheric circulation patterns, cyclones, typhoons, water vapor, precipitable water. Hydrologic Elements: Precipitation types, measurements, analysis, mean precipitation, depth-area- duration relation, maximum intensity duration-frequency relation. Evapotranspiration: Evaporation processes, influencing factors, measurement, potential and actual evapotranspiration. Infiltration: Infiltration processes, influencing factors, measurement, and infiltration models, infiltration capacity.

Geotechnical Engineering:

Nature of Soil, Phase Representation and Relationships, Structure of soil; soil texture; Size and range of soil particles; shapes of individual sand and clay particles; field identification of soils; Introduction to particulate behaviour. Three-phase system : representation by Phase diagram – soil solids, water and air; Basic definitions and relationships : Specific gravity; Void ratio; Porosity;water content; Unit Weights : bulk, dry, saturated, submerged and natural; Degree of saturationand Density index. Nature of Soil, Phase Representation and Relationships, Structure of soil; soiltexture; Size and range of soil particles; shapes of individual sand and clay particles; field identification of soils; Introduction to particulate behaviour. Three-phase system: representationby Phase diagram Soil solids, water and air; Basic definitions and relationships : Specific gravity; Void ratio; Porosity; water content; Unit Weights : bulk, dry, saturated, submerged and natural; Degree of saturation and Density index. Compaction, Consolidation and Shear Strength of Soil. Bearing Capacity of Shallow and Deep Foundations.

Irrigation Engineering and Hydraulic Structures:

Irrigation Development Planning, Irrigation Network and Hydraulics, Planning and Design of Irrigation Systems, Kenneady and Lacey's theory, Wastewater Quantity Estimation, Wastewater Quality Enhancement, Physical Unit Processes: Screening, Introduction to Microbiology, Basic Features of Open Channel Flow, Uniform Flow, Critical flow, Specific Energy, Hydraulic Jump. Fundamentals of Groundwater Flow and Groundwater Wells, Groundwater Resources Assessment, Introduction to watershed hydrology.

Farm Machinery

Machine Design: Design and selection of machine elements – gears, pulleys, chains and sprockets and belts; overload safety devices used in farm machinery; measurement of force, torque, speed, displacement and acceleration on machine elements.

Farm Machinery: Soil tillage; forces acting on a tillage tool; hitch systems and hitching of tillage implements; functional requirements, principles of working, construction and operation of manual, animal and power operated equipment for tillage, sowing, planting, fertilizer application, inter-cultivation, spraying, mowing, chaff cutting, harvesting, threshing and transport; testing of agricultural machinery and equipment; calculation of performance parameters - field capacity, efficiency, application rate and losses; cost analysis of implements and tractors.

Farm Power

Sources of Power: Sources of power on the farm - human, animal, mechanical, electrical, wind,

solar and biomass; bio-fuels.

Farm Power: Thermodynamic principles of I.C. engines; I.C. engine cycles; engine components; fuels and combustion; lubricants and their properties; I.C. engine systems – fuel, cooling, lubrication, ignition, electrical, intake and exhaust; selection, operation, maintenance and repairof I.C. engines; power efficiencies and measurement; calculation of power, torque, fuel consumption, heat load and power losses.

Tractors and Power tillers: Type, selection, maintenance and repair of tractors and power tillers; tractor clutches and brakes; power transmission systems – gear trains, differential, final drives and power take-off; mechanics of tractor chassis; traction theory; three point hitches- free link and restrained link operations; mechanical steering and hydraulic control systems used intractors; tractor tests and performance.Human engineering and safety in design of tractor and agricultural implements.

Soil and Water Conservation Engineering

Fluid Mechanics:
Ideal and real fluids, properties of fluids; hydrostatic pressure and its measurement; hydrostatic forces on plane and curved surface; continuity equation; Bernoulli's theorem; laminar and turbulent flow in pipes, Darcy- Weisbach and Hazen- Williams equations, Moody's diagram; flowthrough orifices and notches; flow in open channels.

Soil Mechanics:
Engineering properties of soils; fundamental definitions and relationships; index properties of soils; permeability and seepage analysis; shear strength, Mohr's circle of stress, active and passive earth pressures; stability of slopes.

Hydrology:
Hydrological cycle and components; meteorological parameters, their measurement and analysis of precipitation data; runoff estimation; hydrograph analysis, unit hydrograph theory and application; stream flow measurement; flood routing, hydrological reservoir and channel routing.

Surveying and Leveling:
Measurement of distance and area; instruments for surveying and leveling; chain surveying, methods of traversing; measurement of angles and bearings, plane table surveying; types of leveling; theodolite traversing; contouring; computation of areas and volume.

Soil and Water Erosion:
Mechanics of soil erosion, soil erosion types, wind and water erosion, factors affecting erosion; soil loss estimation; biological and engineering measures to control erosion; terraces and bunds; vegetative waterways; gully control structures, drop, drop inlet and chute spillways; earthen dams.

Watershed Management:
Watershed characterization; land use capability classification; rainwater harvesting structures, check dams and farm ponds.

Irrigation and Drainage Engineering

Soil-Water-Plant Relationship:
Water requirement of crops; consumptive use and evapotranspiration; measurement of infiltration, soil moisture and irrigation water Irrigation.

Water Engineering & Management (MTQP11)

Water Conveyance and Application Methods:

Design of irrigation channels and underground pipelines; irrigation scheduling; surface, sprinkler and micro irrigation methods, design and evaluation of irrigation methods; irrigation efficiencies.

Agricultural Drainage:

Drainage coefficient; planning, design and layout of surface and sub- surface drainage systems; leaching requirement and salinity control; irrigation and drainage water quality and reuse.

Groundwater Hydrology:

Groundwater occurrence; Darcy's Law, steady flow in confined and unconfined aquifers, evaluation of aquifer properties; groundwater recharge.

Wells and Pumps:

Types of wells, steady flow through wells; classification of pumps; pump characteristics; pump selection and installation.

Agricultural Processing Engineering

Drying: Psychrometry – properties of air-vapors mixture; concentration and drying of liquid foods – evaporators, tray, drum and spray dryers; hydrothermal treatment; drying and milling ofcereals, pulses and oilseeds.

Size Reduction and Conveying: Mechanics and energy requirement in size reduction of granularsolids; particle size analysis for comminuted solids; size separation by screening; fluidization of granular solids-pneumatic, bucket, screw and belt conveying; cleaning and grading; effectivenessof grain cleaners; centrifugal separation of solids, liquids and gases.

Processing and By-product Utilization: Processing of seeds, spices, fruits and vegetables; By-product utilization from processing industries.

Storage Systems: Controlled and modified atmosphere storage; perishable food storage, godowns, bins and grain silos.

Dairy and Food Engineering

Heat and Mass Transfer: Steady state heat transfer in conduction, convection and radiation; transient heat transfer in simple geometry; working principles of heat exchangers; diffusive and convective mass transfer; simultaneous heat and mass transfer in agricultural processing operations; material and energy balances in food processing systems; water activity, sorption and desorption isotherms.

Preservation of Food: Kinetics of microbial death – pasteurization and sterilization of milk and other liquid foods; preservation of food by cooling and freezing; refrigeration and cold storage basics and applications.

Syllabus
for
Textile Engineering (MTQP12)

Note:

i. ***There will be one Question Paper which will have 100 questions.***
ii. ***All questions will be complulsory.***
iii. ***The Question Paper will have two Parts i.e. Part A and Part B:***
iv. ***Part A will have 25 questions based on Language Comprehension/Verbal Ability, General Awareness, Mathematical/Quantitative ability and Analytical Skills.***
v. ***Part B will have 75 questions based on Subject-Specific Knowledge.***

Textile Engineering (MTQP12)

Section 1: Textile Fibres

Classification of textile fibres; Essential features of fibre forming polymers; fine structures of natural fibres like cotton, silk, wool, ; Introduction to bast fibres; Properties and applications of natural and man-made fibres including aramid, carbon, glass and ultra-high molecular weight polyethylene 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 glass transition and melting temperature; Polymerization of nylon-6, nylon-66, poly (ethylene terephthalate), polyacrylonitrile and polypropylene fibre forming polymers; Melt spinning processes for PET, polyamide and polypropylene; Principles of wet spinning, Preparation of spinning dope; dry spinning, dry-jet-wet spinning and gel spinning; Spinning of acrylic, viscose and other regenerated cellulosic fibres such as polynosic and lyocell; Post spinning operations such as drawing, heat setting, tow-to-top conversion; Spin finish composition and applications; Different texturing techniques. Fibres characterization techniques such as density, x-ray diffraction, birefringence, optical and electron microscopy such as SEM and TEM, Infrared spectroscopy, thermal characterization by differential scanning calorimetry (DSC), Dynamic mechanical analyser (DMA), TMA and thermogravimetric analysis (TGA); Structure and morphology of man-made fibres; Mechanical behaviour of textile fibres; Concept of moisture sorption of fibres; Influence of fibre structure on fibre properties.

Section 2: Yarn Manufacture

Concept of yarn manufacturing and Yarn Properties, Principles of ginning; Principles of opening, cleaning and blending of fibres; Concept and description of modern blow room machines; Fundamentals of carding; Comparision between conventional and modern carding machine; Card setting; Card clothing; Carding defects and remedies, Card auto leveller; Principles of roller drawing; Roller arrangements in drafting systems; Periodic mass variation in drawn sliver; Draw frame auto leveller; Principles of cotton combing; Combing cycle and mechanisms; Recent developments in combing machine; Principles of drafting, twisting, and bobbin building in roving forming machine ; Modern developments in simplex machine; Principles of drafting, twisting and cop building in ring spinning; Causes of end breakages in Ring Frame during yarn formation; Modern developments in ring spinning machine; Working principles of ring doubler and two-for-one twister; Concept of yarn twist, Relationship between single yarn twist and folded yarn twist; Principles of compact, rotor, air-jet, air-vortex, friction, core, wrap and twistless spinning processes. Influence of fibre geometry, fibre configuration and fibre orientation in yarn; Fibre packing density of yarn; Yarn diameter; Yarn twist and its relation to yarn strength; Helical arrangement of fibres in yarns; Fibre migration in yarns;

Stress-strain relation in yarn; Mass irregularity of yarn; Comparison among ring, compact, rotor, air-jet and friction spun yarns

Section 3: Fabric Manufacture

Principles of yarn winding processes; Classification of winding methods; Patterning mechanism; Yarn clearers and tensioners; Different systems of yarn splicing; Warping objectives and classification; Different types of warping creels; Features of beam and sectional warping machines; Different sizing systems; Sizing of spun and filament yarns; Quality control during sizing process: different sized yarn drying systems, different techniques of warp yarn sizing: Sizing ingredients: Drawing-in process; Principles of pirn winding. Primary and secondary motions of loom; Shedding motion; Positive and negative shedding mechanisms; Type of sheds; Tappet, dobby and jacquard shedding; Weft insertion; Mechanics of weft insertion with shuttle; Shuttle picking and checking; Beat-up; Kinematics of sley; Loom timing diagram; Cam designing; Take-up and Let-off motions; Warp and weft stop motions; Warp protection; Weft replenishment; Principles of weft insertion systems of shuttle-less weaving machines such as projectile, rapier, water-jet and air-jet; Principles of functioning of multiphase and circular looms; Different types of rapier systems: Types of selvedges. Basic woven fabric constructions and their derivatives; Crepe, cord, terry, gauze, leno and double cloth constructions; Drawing and lifting plans. Fundamentals of weft knitting; Classification of weft knitting technologies; Weft knitted constructions such as plain, rib, interlock and purl; Different knit stitches such as loop, tuck and float. Principle of warp knitting; Classification of warp knitting technologies; Swinging and shogging motion of guide bar; Basic warp knit construction such as pillar, tricot, atlas, inlay and nets. Fibre preparation processes for nonwovens; Web formation and bonding processes; Spun-bonding and melt-blowing technologies; Applications of nonwoven fabrics. Principles of braiding; Type of braids; Maypole braiding technology. Peirce's equations for plain woven fabric geometry, basic calculation of production, efficiency, yarn requirement, machine requirement.

Section 4: Textile Testing

Sampling techniques for fibres, yarns and fabrics; Sample size and sampling errors. Moisture in textiles; Fibre length, fineness, crimp, maturity and trash content measurement; Tensile testing of fibres; High volume fibre testing. Linear density of sliver, roving and yarn; Twist and hairiness of yarn; Tensile testing of yarns; Evenness testing; Fault measurement and analysis of yarns by Classimat and Classifault system . Fabric thickness, compressibility, stiffness, shear, drape, crease recovery, tear strength, bursting strength, pilling and abrasion resistance; Tensile testing of fabrics; Objective evaluation of low stress mechanical characteristics; Air permeability; Wetting and wicking; Water-vapour transmission through fabrics; Thermal resistance of fabrics. Contact angle measurement for water proofness and water repellence.

Section 5: Chemical Processing

Impurities in natural fibre; Singeing; Chemistry and practice of preparatory processes for cotton; Preparatory processing of wool and silk; Mercerization of cotton; Preparatory processes for manmade fibres and their blends; Optical brightening agent.

Classification of dyes; Dyeing of cotton, wool, silk, polyester, nylon and acrylic with appropriate classes of dyes; Dyeing of polyester/cotton and polyester/wool blends; Dyeing machines; Dyeing processes and machines for cotton knitted fabrics; Dye-fibre interaction; Introduction to thermodynamics and kinetics of dyeing; Brief idea about the relation between colour and chemical constitution; Beer-Lambert's law; Kubelka-Munk theory and its application in colour measurement; Methods for determination of wash, light and rubbing fastness. Methods of printing such as roller printing and screen printing; Preparation of printing paste; Various types of thickeners; Printing

auxiliaries; Direct styles of printing of (i) cotton with reactive dyes, (ii) wool, silk, nylon with acid and metal complex dyes, (iii) polyester with disperse dyes; Resist and discharge printing of cotton, silk and polyester; Pigment printing; Transfer printing of polyester; Inkjet printing; Printing faults. Mechanical finishing of cotton; Stiff, soft, wrinkle resistant, water repellent, flame retardant and enzyme (bio-polishing) finishing of cotton; antimicrobial, soil resistance and nanofinish: Milling, decatizing and shrink resistant finishing of wool; Antistatic and soil release finishing; Heat setting of synthetic fabrics; Minimum application techniques. Pollution control and treatment of effluents