GENERAL INFORMATION REGARDING ME/MTECH ENTRANCE TEST INCLUDING ENTRANCE TEST SYLLABUS

Duration of test: 90 minutes(75 Questions)
Negative marking: ¼ marks shall be deducted for each wrong answer.

1 ME PROGRAMME (REGULAR/ PART-TIME)

(I) CAD/CAM & ROBOTICS
(II) THERMAL ENGINEERING
(III) PRODUCTION & INDUSTRIAL ENGINEERING

Section-A
Solid Mechanics, Machine Design, Theory of Machines, Mechanical Vibrations, Machine Drawing, CAD, CAM and Robotics, Computer Programming
Section-B
Thermodynamics, Steam Engineering, IC Engines and Gas Turbines, Turbo Machines, Fluid Mechanics and Machinery, Refrigeration and Air Conditioning, Heat and Mass Transfer, Power Plant Engineering, Non-conventional Sources of Energy
Section-C
Industrial Engineering, Plant layout, Production Management, Work Study, Inspection and Quality Control, Manufacturing Processes/Technologies, Machining Science, Measurement Techniques, Industrial Automation, Material Science and Metallurgy.
*Entrance test exam for admission to **ME (CAD/CAM & Robotics)** shall consist of 50 questions from section-A and 25 questions from section B and C.*
*Entrance test exam for admission to **ME (Thermal Engineering)** shall consist of 50 questions from section-B and 25 questions from section A and C.*
*Entrance test exam for admission to **ME (Production & Industrial Engineering)** shall consist of 50 questions from section-C and 25 questions from section A and B.*

CIVIL (STRUCTURES) ENGINEERING

Basic Structural Mechanics: Bending moment and shear force diagrams. Analysis of pinjointed and rigid plane frames. Influence lines, Analysis of axially loaded and eccentrically loaded columns. **Concrete Technology:** Concept of quality control. Concrete making materials. Properties of fresh and hardened concrete. Methods of concrete mix design. **Reinforced Concrete:** Limit state design methods for flexure, shear, bond and torsion. Design of basic elements using IS: 456-2000. **Design of Steel Structures:** Design of tension and compression members. Design of beams and columns (including bases and foundations). Welded and riveted joints. **Introduction to pre-stressed concrete.**

CIVIL INFRASTRUCTURE ENGINEERING

Structures: Free Body Diagrams, bending moments and shear forces in statically determinate beams, analysis of statically determinate and indeterminate structures, influence lines for determinate and indeterminate structures -- basic concepts of matrix methods of structural analysis. Basic working stress and limit states design concepts for design of concrete structures subject to flexure, shear, compression and torsion (beams, columns isolated footings). Analysis and design of steel structures in tension and compression, beams and beam-columns, column

bases -- connections - simple and eccentric, beam-column connections, plastic analysis of beams and frames.

Geotechnical Engineering*:* Origin of soils, soil classification, fundamental definitions, relationship and inter-relationships, permeability and seepage, effective stress principle: consolidation, compaction, shear strength. Sub-surface investigation, earth pressure theories, foundation design requirements, bearing capacity, shallow and deep foundations, load capacity of piles in sands and clays.

Highway and Transportation Engineering*:* Highway planning, Geometric design of Highways, Testing and specifications of paving materials, Design of flexible and rigid pavements

Water Resources and Hydraulics: Fluid Mechanics and Hydraulics: Hydrostatics, applications of Bernoulli equation, laminar and turbulent flow in pipes, critical flow and gradually varied flow in channels, hydraulic jump, dimensional analysis and hydraulic modeling. **Hydrology:** Hydrologic cycle, rainfall, evaporation infiltration, unit hydrographs, flood estimation, reservoir design, reservoir and channel routing, well hydraulics. **Irrigation:** Irrigation methods, Duty, delta, estimation of evapo-transpiration, crop water requirements, design of lined and unlined canals, head works, design of weirs on permeable foundation Gravity dams, Ogee spillways, Earth dams.

ELECTRONICS & COMMUNICATION ENGINEERING

Networks : Network graphs; ,matrices associated with graphs, incidence, fundamental cut set and fundamental circuit matrices. Solution methods: nodal and mesh analysis. Network theorems: superposition, Thevenin and Norton's Maximum Power Transfer, Wye-Delta Transformation Steady state sinusoidal analysis using phasors. Fourier series. Linear constant coefficient differential and difference equations; time domain analysis of simple RLC circuits. Laplace and Z transforms; frequency domain analysis of RLC circuits. Convolution 2 port network parameters driving point and transfer functions. State equations for networks. **Analog Circuits:** Characteristics and equivalent circuits (large and small signal) of diodes, BJTs, JFETs and MOSFETs Simple diode circuits : clipping, clamping, rectifier Biasing and bias stability of transistor and FET amplifiers. Amplifiers : single and multistage, differential, operational; feedback and power. Analysis of amplifiers; frequency response of amplifiers. Simple op-amp circuits. Filters Sinusoidal oscillators: criterian for oscillation; single-transistor and op-amp configurations. Function generators and wave-shaping circuits Power supplies. **Digital Circuits:** Boolean algebra; minimization of Boolean functions; logic gates, Digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits; arithmetic circuits, code converters, multiplexers and decoders. Sequential circuits; latches and flip-flops, counters and shift registers. Comparators, timer, multivibrators. Sample and hold circuits, ADCs and DACs. Semiconductor memories Microprocessor :8085/8086; architecture, AL programming, memory and I/O interfacing. **Communication System:** Fourier analysis of signals amplitude, phase and power spectrum, Autocorrelation and cross-correlation and their Fourier transforms. Signal transmission through linear time-invariant (LTI) system, impulse response and frequency response, group delay and phase delay. Analog modulation systems-amplitude and angle modulation and demodulation systems, spectral, analysis of operations, superheterodyne receivers, elements of hardware realizations of analog communication systems. Basic sampling theorem. Pulse code modulation (PCM), differential pulse code modulation (DPCM), delta modulation (DM). **Digital Modulation**

Scheme : amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK). Multiplexing time division and frequency division, Additive Gaussian noise characterization using correlation. Probability density function (PDF), power spectral density (PSD). Signal to noise ratio (SNR) calculation for amplitude modulation (AM) and frequency (FM) for low noise conditions. **Electromagnetism :** Elements of vector calculus : gradient, divergence and curl; Gauss' and Strokes' theorems, Maxwell's equations : differential and integral forms. Wave equation. Pointing vector Plane waves : propagation through various media; reflection; phase and group velocity; Skin depth Transmission lines : Characteristics impedance; impedance transformation, Smith Chart, Impedance matching pulse excitation. **Waveguides :** Modes in rectangular waveguides; Boundary conditions; Cut-Off frequencies; Dispersion relations. **Antennas:** Dipole antennas; antenna arrays; radiation pattern; reciprocity theorem; antenna gain.

SOFTWARE ENGINEERING/COMPUTER SCIENCE & ENGG

Section-I: Logical Reasoning & Analytical Ability

Section-II: Mathematical Foundations of Computer Science

Mathematical Logic: Propositional logic, first-order logic, **Probability:** Random variables and expectation, conditional probability, independent random variables, frequency distributions; **Discrete Mathematics:** Sets, relations, functions, groups, lattices, boolean algebra, induction, recurrence relations; **Combinatorics:** Permutations, combinations, counting, summation; **Elementary Graph Theory:** Basic properties, graph traversals, topological sort, spanning tree, shortest paths; **Computational Techniques:** Solution of non-linear equations, elementary concepts of linear and matrix algebra, solution of system of linear equations, curve fitting and interpolation, numerical differentiation and integration, regression and correlation analysis; **Theory of Computation:** Regular languages and finite automata, context free languages and pushdown automata, Turing machines.

Section III: Computer Hardware

Digital Logic: Logic functions, minimization, design and synthesis of combinational and sequential circuits; **Number Representation and Computer Arithmetic**; **Computer Organization:** Machine instructions and addressing modes, ALU and data-paths, hardwired and micro-programmed control, memory interface, I/O interfaces, serial communication interface, instruction pipelining, cache, main and secondary storage.

Section IV: Software Systems

Programming Methodology: C programming, program control, functions, recursion, scope, binding, parameter passing, pointers, array handling, structures and unions, file handling, elementary concepts of Object Oriented, Functional and Logic Programming; **Data Structures:** Notion of abstract data types, stacks, queues, linked lists, trees, heap, graphs; **Algorithms for Problem Solving:** Tree and graph traversals, connected components spanning trees, shortest

paths, hashing, sorting, searching; design techniques; **Complier Design:** Lexical analysis, parsing, syntax directed translation, runtime environment, code generation, linking; **Operating Systems:** Classical concepts (concurrency, synchronization, deadlock), processes, threads and inter-process communication, CPU scheduling, memory management, file systems, I/O systems, protection and security; **Database Systems:** Relational model, ER diagram, relational algebra, database design, normalization, SQL, file structures, transactions management and concurrency control; **Computer Networks:** ISO/OSI stack, sliding window protocol, LAN technologies (Ethernet, Token ring), TCP/UDP, IP, Basic concepts of switches, gateways and routers.

ELECTRONIC INSTRUMENTATION & CONTROL ENGINEERING

Mathematical Principles: Laplace and Fourier transform, Theory of maxima & minima. **Electrical Principles:** Kirchoff's laws, Norton/Thevenin theorem, Current- voltage transformation, Ideal current source, Ideal voltage source. **Electronic Principles:** Zener/Avalanche breakdown, Basic Transistor Operation, Biasing Circuits, SCR, MOSFET, Oscillator & Amplifier Principles, Op-Amps, their applications, Logic gates, Flip flops, Timers, Counters & Registers. **Microprocessor :** 8085 & 8086 architecture, Addressing modes of 8085 & 8086, Mnemonics, Basic programming, RS-232 protocol. **Electrical Measurements:** PMMC, moving iron Galvanometer, Electro dynamometer, Wattmeter, Wheat-stone Bridge, Maxwelll Bridge, De-saute's, Bridge, Current & Voltage transformer, Q-meter, Distortion meter, digital Voltmeter, CRO-analog & digital. **Generalized Measurement Systems:** Generalized impedance & stiffness concepts, Static-response of step & ramp signals to 1^{st} & 2^{nd} order systems, Loading effects, Analogies. **Signal Conditioning & Display :** Filters-active & passive, Dead time elements, LED/LCD. **Process Modelling & Control :** Lumped & Distributed parameters, interacting & non interacting systems, Concept of feedback & fed forward control, Actuators like Relay, Stepper motor, Servo motor, Pneumatic valves. **Industrial Measurements:** Principles of Level, Flow, Pressure, Temperature and Vibration measurements. **Analytical & Biomedical Instrumentation:** Principles of UV, Visual Spectroscopy, chromatographic techniques, Thermography & ultrasonography Cardiovasular Measurements.

POWER SYSTEMS & ELECTRIC DRIVES

Power Systems : Transmission line - performance, models, Cables, Electrical & mechanical design of transmission line, Load flow and solution techniques, Symmetrical and unsymmetrical faults, Insulators, Circuit breakers, Electromechanical relays, Static relays, Protection schemes for feeders, generators, motors and transformers. High Voltage AC, DC and Impulse voltages generation and measurement; breakdown in solid, liquid and gases, Transient phenomenon in power systems.

Electrical Machines & Drives : Electromechanical energy conversion principals; construction, operation and performance of Transformer and rotating electrical machines, Drives – Basics, starting, speed control, braking through conventional and static drives.

Networks : Network Topology, Network Theorems, Circuit transients, Laplace transforms, Single and Three phase system, Fourier analysis, Magnetic circuits, Two port Network, Network Synthesis.

Electronics : Diode and Transistor, Operational Amplifiers, Oscillators: Boolean algebra; logic and sequential circuits : registers, counters, flip flops, Semiconductor memories, Microprocessor (8085), architecture, programming, memory and 1/0 Interfacing; Thyristors and power converter.

2 MTech PROGRAMMES (REGULAR)

MATERIALS & METALLURGICAL ENGINEERING

Bonding in solids, electronic configurations, ionic, covalent, metallic and secondary bonds. Space lattice and unit cells; crystal systems; indices for planes and directions; effect of radius ratio on coordination; structures of common metallic, semiconducting, polymeric, ceramic, amorphous/glassy materials. X-ray diffraction, Bragg's law, use of x-ray diffraction for the determination of simple crystal structures; Point, line and surface defects; geometry of edge and screw dislocations; Burger's vector; energy of dislocations; First and second Fick's laws of diffusion and their solutions under simple boundary conditions; Solid solutions; intermediate phases and intermetallic compounds; Gibbs' phase rule; unary and binary phase diagrams; iron-iron carbide phase diagram; Phase transformations; nucleation and growth; solidification; crystal growth and zone refining; precipitation hardening; recrycstallization and grain growth; martensitic transformations; Elastic behaviour of materials including composite, atomic models of elasticity, rubber-like elasticity; Plastic deformation; slip systems in crystals; critical resolved shear stress; strengthening mechanisms; ductile and brittle fracture; Griffith's criterion, mechanisms of creep; fatigue; Polymeric materials; polymerization, cross-linking; glass transition; composites; Absorption, oxidation and corrosion; Thermal properties of materials, specific heat, thermal conductivity, thermoelectricity; Electrical/electronic behaviour of materials; electrical conductivity; free electron and band theory of solids; intrinsic and extrinsic semiconductors; p-n junctions; solar cells; superconductivity; type I and II superconductors and their applications; Dielectric behaviour of materials; polarization phenomena; spontaneous polarization; dielectric constant and loss; piezo - and Ferro electricity; Magnetic behaviour of materials; dia-, para-, ferro and ferrimagnetism; soft and hard magnetic materials and their applications; Optical properties of materials; refractive index, absorption and emission of light; optical fibres, lasers and optoelectronic materials.

ENVIRONMENTAL SCIENCE & TECHNOLOGY

Interactions between humans and environment; The physical environment- land water, and climate; Resources and their management- Natural, Technological and Human; Concept of sustainability- Natural ecosystems and sustainability; Agricultural and Industrial systems from the angles of environment protection; Environmental Chemistry- Analytical Techniques and instrumentation; Atmospheric Chemistry; Basic Microbiology- nature and extent of microbial world; growth and energetics, Microbiology of water and wastewater; Microbial Corrosion and biofouling; Quantity of Water- per capita demand, factor affecting the demand; Quality of water- physical, chemicals and biological characteristics, Treatment of water- Sedimentation, Coagulation; filtration; Chlorination; absorption; adsorption, and Miscellaneous methods; Sewage and sewerage systems; Primary and Secondary treatment of sewage- aerobic and anaerobic processes and their applications in the wastewater treatment.

VLSI DESIGN & CAD

Logical and Analytical Ability; Fundamentals of Computer and C programming: Basics of Computers; Operators, Data types, Expression, Control Flow statement, Functions, Arrays, Strings, pointers, structures, and unions. **Data Structures and Algorithms:** Data types, structures, stacks, queues, and linked lists. Sorting and Searching, B-trees, B+ trees and hashing. **Networks :** Network graphs; ,matrices associated with graphs, incidence, fundamental cut set and fundamental circuit matrices. Solution methods: nodal and mesh analysis. Network

theorems: superposition, Thevenin and Norton's Maximum Power Transfer, Wye-Delta Transformation Steady state sinusoidal analysis using phasors. Fourier series. Linear constant coefficient differential and difference equations; time domain analysis of simple RLC circuits. Laplace and Z transforms; frequency domain analysis of RLC circuits. Convolution 2 port network parameters driving point and transfer functions. State equations for networks. **Semiconductor Devices and Analog Circuits :** Characteristics and0020equivalent circuits (large and small signal) of diodes, BJTs, FETs, JFETs, MOSFETs, UJT, SCR, photodiode, phototransistor, etc. Simple diode circuits; clipping, champing, rectifier, biasing and bias stability of transistor and FET amplifiers. Amplifiers : single and multistage, differential, operational, feedback and power, Analysis of amplifiers. Amplifiers : frequency response of amplifiers, simple op-amp circuits. Sinusoidal Oscillators: criterion for oscillation; op-amp configurations. Function generators and wave shaping circuits. Regulated power supplies. **Digital Circuits :** Number Systems, Fixed-point and floating number representations, Boolean Algebra, Demorgan's therorems, minimization of Boolean functions, logic gates, digital logic families (DTL, TTL, ECL, MOS, CMOS), Combinational circuits, arithmetic circuits, code converter, multiplexers and decoders; sequential circuits : latches and flipflops, Registers, Counters, Comparators, timers, multivibrators; Sample and hold circuits, ADCs and DACs; Semiconductor memories. **Microprocessors :** Evolution, microcomputer architecture; Intel 8085: architecture, addressing mode, Instruction set, programming technique, Interrupt Structure; Intel 8086: architecture, concept of segmented memory, addressing modes, Instruction set, programming techniques, Interrupt Structure; Interfacing devices i.e. 8255,8279,8257,8253,8259etc.: memory and I/O interfacing, read/write timing diagrams. **Computer Architecture :** Basic computer organization and Design, memory organization, I/O organization, I/O Devices, Data transfer techniques, Register transfer Language Microprogrammed control, CPU, Concept and CISC and RISC architecture.

CHEMICAL ENGINEERING

Process Calculations and Thermodynamics: Laws of conservation of mass and energy; degree of freedom analysis, first and second laws of thermodynamics and their applications; phase equilibria; chemical reaction equilibria. **Fluid Mechanics and Mechanical Operations**. Fluid statistics, Bernoulli equation, macroscopic friction factors, dimensional analysis, flow through pipeline systems, flow meters pumps and compressors, packed and fluidized beds, size reduction and size separation free and hindered settings; centrifuge and cyclones; thickening and classification, filtration, mixing and agitation, conveying. **Heat Transfer**: conduction, convection, radiation, heat exchangers, evaporators. **Mass Transfer**: Ficks' law, molecular diffusion in fluids, distillation, absorption, drying, etc. **Chemical Reaction Engineering**: Kinetics of homogeneous reactions, interpretation of kinetic data, residence time, kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis. **Instrumentation and Process Control**: Dynamics of simple systems, controller modes (P, PI and PID). **Plant Design and Economics**: Design and sizing of chemical engineering equipment, principles of process economics an cost estimation. **Chemical Technology**: Inorganic chemical industries; sulfuric acid, NaOH, fertilizers (Ammonia, Urea, SSP and TSP); organic chemical industries (Pulp and Paper, Sugar, Oil and Fats); petroleum refining and petrochemicals: polymerization industries; polypropylene, PVC and polyester synthetic fibers., **Process modeling and simulation:** Equation of continuity, momentum, energy, CSTR, exchangers, distillation**,** etc. **Computational methods**

in chemical engineering: PDE, ODE, use of excel sheet, MATLAB etc., **Differential Equations**: First order (Linear and nonlinear), Laplace transforms, **Numerical Methods**: Numerical solutions of linear and non linear algebraic equations, integration by trapezoidal and Simpson's rule, single and multi-step methods of differential equations **Probability and Statistics**: Mena median moxe and standard deviation, random variables, Poisson, normal and binominal distributions.

COMPUTER SCIENCE AND APPLICATIONS

Section-I: Analytical Ability (20 Marks)

The questions in this section will cover logical reasoning, quantitative reasoning, and visual-spatial reasoning.

Section-II: Mathematical Aspects of Computer Science (40 Marks)

Combinatorics : Permutations, combinations, counting, summation;

Theory of Probability : Axiomatic definition of Probability, conditional probability, Baye's Theorem : random variables, Functions of random variables. Expectation, Probability distributions: Binomial Poisson, Exponential and Nomial distribution and their moment generating functions.

Discrete Mathematics : Sets, relations, functions, lattices, Boolean algebra, induction, recurrence relations.

Groups, Subgroups, Homomorphisms, Normal and subnormal subgroups.

Linear Algebra:

Review of matrices, Consistency of system of Linear equations. Vector spaces and subspace, linear independence and dependence of vectors, Basis and dimensions. Rank and nullity of a linear transformation, Eigen values and eigenvectors of a Matrix, diagonalization.

Optimization Techniques

Linear Programming : Graphical method, Simplex method, Duality Theory and Sensitivity Analysis.

Transportation and Assignment Problem: Initial Basic Feasible Solutions of Balanced and Unbalanced Problems, Optimal Solutions.

Network Analysis : Shortest Path problem. Minimum Spanning Tree Problem. Maximum Flow Problem. Minimum Cost Flow Problem.

Numerical Techniques : Number systems, Solution of non-linear equations, solution of system of linear equations, curve fitting, interpolation, numerical differentiation and integration, solutions of IVP.

Section III: Concepts of Computer Science (40 Marks)

Number Representation and Computer Arithmetic

Computer Organization : Machine instructions and addressing modes, ALU and data-paths, hardwired and micro-programmed control pipelining , memory interface, I/O interfaces, serial communication interface, parallel processing**,** memory management

Structured and object oriented programming concepts (with reference to "C/ C++"):

Program control, functions, recursion, scope, binding, parameter passing, pointers, array handling, structures and unions, file handling, concepts of Object Oriented Programming.

Data Structures : Notion of abstract data types, stacks, queues, linked lists, trees,

heap,graphs, Tree and graph traversals, hashing, sorting, searching.

Theory of Computation : Regular languages and finite automata, context free languages and pushdown automata, Turing machines.

Complier Design : Lexical analysis, parsing, syntax directed translation, runtime environment, code generation, linking.

Operating Systems: Definition and significance of OS, OS as resource manager, Classical concepts processes, concurrency, synchronization, deadlock, threads and inter-process communication, CPU scheduling, memory management, file systems, I/O systems, protection and security, DOS, UNIX and windows.

Database Management Systems: Relational model, ER diagram, relational algebra, database design, normalization, SQL, transactions management and concurrency control.

Computer Networks: OSI reference model, sliding window protocols, LAN technologies (Ethernet, Token ring), TCP/UDP, IP, , Networking addresses, transmission medias, Networking devices-Hub, switches. gateways and routers.

Software Engineering: Basics of s/w engineering, Software Process models, software project planning and management.

INDUSTRIAL POLLUTION AND ABATEMENT

Mathematics: Algebra, calculus, and differential equations: first order (linear and nonlinear), numerical solutions of linear and non linear algebraic equations, integration by trapezoidal and Simpson's rule, single and multi-step methods of differential equations.

Probability and Statistics: Mean, median, mode and standard deviation, random variables, Poisson, normal and binominal distributions.

Thermodynamics: Laws of conservation of mass and energy; degree of freedom, first and second laws of thermodynamics and their applications,

Fluid Mechanics: Fluid statistics, Bernoulli equation, friction factors, flow through pipeline systems, flow meters, pumps and compressors.

Energy Technology: Primary and secondary fuels, non-conventional energy resources.

Fundamentals of Environmental Chemistry: Stochiometry, Gibb's energy, chemical potential, chemical equilibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons and reaction kinetics.

Pollution: Definition, causes, effects and control measures of the pollution – air, soil, noise, water, marine and thermal and nuclear pollution, solid waste management, role of Individual in prevention of pollution, disaster management.

Social Issues: Sustainable development, water conservation, environmental ethics, climatic change, wasteland reclamation, environmental protection acts and issues.

Biotechnology: Biochemical kinetics, bioreactors, transport phenomena in bioprocess systems.