SCHEME FOR WRITTEN TEST FOR SCIENTIST – B

PART	EVALUATION FOCUS	MARKS	NO. OF QUESTIONS	TYPE OF QUESTIONS	OBJECTIVES AND SYLLABUS (FOR ALL SCIENTIST-B POSITIONS, PART A, B, C AND D WILL HAVE COMMON SYLLABUS)
A	General Aptitude	10	10	MCQ	It is to test an individual's innate, learned and acquired ability to assess a candidate's abilities towards resolving problems and reasoning-related calculations. It helps assess an individual's capacity to learn and understand, in general, regardless of any particular skill. Questions will be related to logical reasoning, verbal ability questions at UG level.
B	Engineering Mathematics	10	10	MCQ	**Linear Algebra:** Matrix algebra, systems of linear equations, eigenvalues and eigenvectors. **Calculus:** Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; Differential Equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; **Probability and Statistics**: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions. **Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations
C	Engineering Physics & Chemistry	10	10	MCQ	**Physics:** Classical Mechanics, Signals, Semiconductor Devices, Computational Physics, Electro-magnetics, Measurement Techniques, Solid State Physics. **Chemistry:** physical chemistry, electro chemistry, analytical chemistry, surface chemistry, polymer chemistry, materials chemistry.
D	General Engineering Basics	10	10	MCQ	This is to test candidates understanding engineering basics. The syllabus would the subjects studied at BE/B.Tech related to basics of mechanical engineering, electrical & electronics engineering and computer science & programing, engineering drawing (engineering subjects taught in 1 st and 2nd semester BE/B.Tech degree program.
E	Core Engineering Knowledge	20	20	MCQ	Applicants can choose any one of the following core subjects for Part-E 1. Scientist-B: Mechanical Sciences : Mechanical /Manufacturing-Production /Aerospace 2. Scientist-B: Electrical& Electronic Science: Electrical / ECE/Instrumentation 3. Scientist-B: Computer Science: Computer Science and Instrumentation The candidates will be tested for their understanding and abilities of recall, comprehensive, application, analysis and synthesis skills. Questions will be of the GATE standard. Please refer the syllabus for the respective core subjects.
		20	10	Numerical Answer Type	

SYLLABUS FOR PART – E: CORE ENGINEERING KNOWLEDGE

CORE SUBJECTS	OBJECTIVES AND SYLLABUS THE SYLLABUS COVERED IN THE RESPECTIVE SUBJECT AREAS AT UG DEGREE LEVEL . SYLLABUS OF RESPECTIVE PAPERS COVERED IN GATE 2023 MAY BE CONSIDERED FOR THE PREPARATION
Mechanical Engineering	**Applied Mechanics and Design:** Engineering Mechanics, Mechanics of Materials, Theory of Machines, Vibration, and Machine Design. **Basics of Fluid Mechanics and Thermal Sciences**: Fluid Mechanics, Thermodynamics and Heat Transfer. **Materials and Manufacturing:** Engineering materials, Advanced manufacturing processes, CAD/CAM/CIM, Machining and Machine tool operations, Measurement and Quality control, Industrial engineering techniques (Operation Research, PPC, Time and method study).
Manufacturing and Production Engineering	**Mechanical Engineering Fundamentals:** Engineering Mechanics, Engineering Materials, Theory of Machines, and Machine Design, Basics of Fluids and Thermodynamics. **Fundamentals of Manufacturing Processes:** Mechanics of machining, Casting and molding, Forming and Joining, advanced material processing like Powder processing, Polymers and composites. **Advanced Manufacturing Technology**: Advanced machining techniques, Micro-Nano manufacturing, Additive manufacturing, Energy assisted manufacturing processes, Machine Tool development Science, CAD/CAM/CIM. **Manufacturing Quality & Factory operation**: Measurement Tools & techniques, Factory layout design, PPC, Operation Research, Time & Method study, Factory automation Quality control and assurance etc.
Aerospace Engineering	**Mechanical Engineering Fundamentals:** Engineering Mechanics, Engineering Materials, Basics of Fluids and Thermodynamics, Engineering systems design. **Design of Aerospace Structures & Aerodynamics** : Strength of materials, Flight vehicle structures, Structural Dynamics, Aerodynamics Theory of elasticity and plasticity, Theory of elasticity: Equilibrium and compatibility equations, vibration of beams. **Testing and qualification of Aerospace components:** Wind Tunnel Testing: Measurement and visualization techniques. Shock -boundary layer interaction, Aerothermodynamics of rotating parts and non-rotating propulsion components such as intakes, combustor and nozzle. Environmental testing procedures, Testing and Qualification standards for Aerospace LRUs. **Materials and Manufacturing Basics:** Aerospace materials, Basics manufacturing processes, measurement techniques, processes, Quality controls and international standards**.**

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Electrical Engineering	**Electric circuits:** Network Elements, Network solution methods, Network Theorems, Transient response of DC and AC networks, sinusoidal steady-state analysis, resonance, two port networks. **Electricity and Magnetism:** Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential, Dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law ,Curl, Faraday's law, Lorentz force, Inductance, Magneto motive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations. **Signals and Systems:** Linear time invariant systems, Fourier series representation of continuous and discrete time periodic signals, sampling theorem, Applications of Fourier Transform for continuous and discrete time signals, Laplace Transform and Z transform. **Electrical Machines:** Single phase transformer, Three-phase induction machines, AC machines, DC machines, Synchronous machines, Types of losses and efficiency calculations of electric machines. **Control Systems:** Feedback principle, transfer function, Transient and Steady-state analysis of linear time invariant systems, Stability analysis, Types of (P, PI and PID) controllers. **Electrical and Electronic Measurements:** Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multi-meters, Phase, Time and Frequency measurement; Oscilloscopes. **Analog and Digital Electronics:** Simple diode circuits, Biasing, equivalent circuit and frequency response, Oscillators and feedback amplifiers, Operational amplifiers, Active Filters and timers, combinatorial and sequential logic circuits, multiplexers and demultiplexers,, A/D and D/A converters.
Electronics and Communication Engineering	**Networks, Signals and Systems**: Circuit analysis, Continuous-time Signals, Discreet-time signals, Solution of network equations, Applications of Laplace transformation, Fourier transformation and Sampling theory. **Electronic Devices:** Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors, Carrier transport, P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode, solar cell. **Control Systems:** Feedback principle, transfer function, Transient and Steady-state analysis of linear time invariant systems, Stability analysis, Types of (P, PI and PID) controllers. **Electrical and Electronic Measurements:** Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multi-meters, Phase, Time and Frequency measurement; Oscilloscopes. Cont…

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	Analog and Digital Electronics: Simple diode circuits, Biasing, equivalent circuit and frequency response, Oscillators and feedback amplifiers, Operational amplifiers, Active Filters and timers, combinatorial and sequential logic circuits, multiplexers and demultiplexers,, A/D and D/A converters Semiconductor memories, Computer organization . **Communications:** Random processes, Analogue communications, Digital communication, Information theory, Fundamentals of error correction, Hamming codes, CRC. Local networks, cloud computing, security protocols.
Instrumentation Engineering	**Electric circuits and machines :** Network Elements, Network solution methods, Network Theorems, Transient response of DC and AC networks, sinusoidal steady-state analysis, resonance, two port networks, Single phase transformers, Three phase induction motors. **Electricity and Magnetism:** Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential, Dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law ,Curl, Faraday's law, Lorentz force, Inductance, Magneto motive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations. **Signals and Systems:** Linear time invariant systems, Fourier series representation of continuous and discrete time periodic signals, sampling theorem, Applications of Fourier Transform for continuous and discrete time signals, Laplace Transform and Z transform. Impulse response of systems, DFT and FFT, basics of IIR and FIR filters. **Control Systems:** Feedback principle, transfer function, Transient and Steady-state analysis of linear time invariant systems, Stability analysis, Types of (P, PI and PID) controllers. **Electrical and Electronic Measurements:** Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multi-meters, Phase, Time and Frequency measurement; Oscilloscopes. **Analog and Digital Electronics:** Simple diode circuits, Biasing, equivalent circuit and frequency response, Oscillators and feedback amplifiers, Operational amplifiers, Active Filters and timers, combinatorial and sequential logic circuits, multiplexers and demultiplexers,, A/D and D/A converters. Embedded Systems: **Embedded Systems:** Microprocessor and microcontroller applications, Memory and input-output interfacing; basics of data acquisition systems, basics of distributed control systems (DCS) and programmable logic controllers (PLC). **Sensors and Industrial Instrumentation**: Resistive, capacitive, inductive, piezoelectric sensors , Hall effect sensors and associated signal conditioning circuits, transducers for industrial instrumentation. Measurement of pressure, displacement, temperature. Optical instrumentation: LED, Laser, photodiode, interferometer, fiber optic sensing , UV-VIS Spectro-photometers, Mass spectrometer.

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Computer Science and Information Technology	**Digital Logic**: Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point). **Computer Organization and Architecture:** Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage; I/O interface **Algorithms:** Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design, techniques: greedy, dynamic programming and divide-and-conquer. Graph traversals, minimum spanning trees, shortest paths **Data Structures:** Stack, Queue, Hash Tables, Graphs, Bloom Filters, Trees, Sets, Dictionary, Dynamic Graphs, Huffman encoding, Map Reduce (map, fork, join etc), Complexity analysis. **Computation Theories:** Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability. **Compiler Design**: Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation. Local optimization, Data flow analyses: constant propagation, liveness analysis, common subexpression elimination. **Operating Systems:** System calls, processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU and I/O scheduling. Memory management and virtual memory. File systems **Databases:** ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control, Data processing, Data analytics **Computer Networks:** Concept of layering, Data link layer, Routing protocols, Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols, Network Address Translation (NAT), Transport layer, Application layer protocols: DNS, SMTP, HTTP, FTP, Email, LAN, WAN, Cloud computing, **Programing and Application Software Development Skills:** System Requirements Specification, Data flow diagrams, Programing Skills (C, C+, Java, Python, Applications like Web development, image processing, machine control software, etc. **AI/ ML:** Maximum Likelihood Estimation, Bias and Variance, Regression, Regularization, K-Means Clustering, Decision Trees, Gradient Descent Parameter Learning, Logistic Discrimination, Multilayer Perceptrons, Kernel Methods – SVM, Hidden Markov Models.

Note: **The Date, Time, Venue for Written Test will be communicated later.**