

# M. Tech in Internet of Things

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## Topics for Entrance Exam

### 1. Engineering Mathematics

Linear Algebra: matrices and determinants, rank of a matrix, system of linear equations, eigenvalues and eigenvectors, vector spaces and linear transformations.

Calculus: limits and continuity, differentiation and its applications, partial derivatives, maxima and minima, integration and applications, multiple integrals.

Differential Equations: first-order differential equations, higher-order linear differential equations and basic partial differential equations.

Probability and Statistics: basic probability, conditional probability, Bayes' theorem, random variables, probability distributions, mean, variance and standard deviation, and basic statistical measures.

Complex Variables and Transforms: complex numbers and functions, Laplace transform, Fourier series and basic Fourier transform concepts.

Numerical Methods: errors and approximations, roots of equations, numerical integration and numerical solution of differential equations.

### 2. Digital Electronics

Number Systems and Codes: binary, octal, decimal and hexadecimal number systems, number-system conversions, signed number representation, 1's and 2's complement, binary arithmetic, BCD, Gray and ASCII codes.

Boolean Algebra and Logic Gates: basic and universal logic gates, Boolean algebra, De Morgan's theorems, Boolean functions, SOP and POS forms, and Karnaugh maps.

Combinational Circuits: half and full adders, subtractors, multiplexers, demultiplexers, encoders, decoders, comparators and code converters.

Sequential Circuits: latches, SR, JK, D and T flip-flops, registers, shift registers, synchronous and asynchronous counters, ring and Johnson counters.

Digital Memory: ROM, PROM, EPROM, EEPROM, RAM, SRAM, DRAM and memory organization.

Data Converters: basic principles of ADC and DAC, ADC architectures, resolution and quantization.

### **3. Circuit Theory**

Basic Circuit Concepts: voltage, current, power, Ohm's law, Kirchhoff's current and voltage laws, series and parallel circuits, voltage and current division.

Network Theorems: Superposition, Thevenin, Norton, Maximum Power Transfer and Reciprocity theorems.

AC Circuits: sinusoidal signals, phasors, impedance, admittance, series and parallel RLC circuits, resonance, power factor, real, reactive and apparent power.

Transient Analysis: first-order RC and RL circuits and basic second-order RLC response.

Network Analysis: mesh analysis, nodal analysis, star-delta transformation, two-port networks and network functions.

Frequency Response: basic frequency response, low-pass, high-pass, band-pass and band-stop circuits, filters, bandwidth and quality factor.

### **4. Electronic Devices and Circuits (EDC)**

Diodes and Applications: rectifiers, clippers, clampers, Zener diode and voltage regulation, LED, photodiode and basic optoelectronic devices.

Bipolar Junction Transistors: BJT construction and operation, transistor configurations and characteristics, biasing, small-signal model and transistor as a switch.

Field Effect Transistors: JFET, MOSFET, enhancement and depletion MOSFET, characteristics and switching applications.

Amplifiers: single-stage and multistage amplifiers, voltage gain, current gain, input and output impedance and frequency response.

Operational Amplifiers: ideal characteristics, inverting and non-inverting amplifiers, voltage follower, summing and difference amplifiers, integrator, differentiator, comparator and basic active filters.

Basic power semiconductor concepts including SCR and switching principles.

### **5. Computer Architecture and Organization**

Computer Fundamentals: basic computer organization, CPU, memory and I/O organization, instruction execution cycle, registers and bus organization.

Processor Organization: ALU, control unit, registers, datapath and instruction cycle.

Instruction Set Architecture: instruction formats, addressing modes, instruction types and basic RISC and CISC concepts.

Memory Organization: semiconductor memory, cache memory, main memory, memory hierarchy, memory mapping and basic concepts of virtual memory.

Input/Output Organization: programmed I/O, interrupt-driven I/O and Direct Memory Access (DMA).

Computer Performance: CPU performance, clock frequency, instruction execution time and basic pipelining concepts.

Data Representation: integer, floating-point and character representation.

## **6. Microprocessors and Microcontrollers**

8085 Microprocessor: 8085 architecture and functional blocks, registers, ALU, flags, program counter, stack pointer, address and data buses, instruction set, addressing modes, data transfer, arithmetic, logical, branching and machine control instructions. Basic 8085 assembly language programming including arithmetic and logical operations, loops, branching and stack operations. Hardware and software interrupts, interrupt structure, memory interfacing, I/O interfacing and basic peripheral interfacing.

8051 Microcontroller: 8051 architecture, CPU and registers, program and data memory, Special Function Registers (SFRs) and I/O ports. Instruction set and addressing modes covering data transfer, arithmetic, logical, Boolean and branching operations. Basic 8051 programming, timers and counters, interrupts and serial communication. GPIO, timer, UART and basic peripheral interfacing.

## **7. Data Communications and Protocols**

Communication Fundamentals: analog and digital signals, bandwidth, data rate, noise and signal-to-noise ratio, transmission media and basic communication concepts.

Data Transmission: serial and parallel transmission, synchronous and asynchronous transmission, simplex, half-duplex and full-duplex communication.

Basic Digital Modulation: ASK, FSK, PSK, QAM and pulse modulation concepts. Data Link Concepts: framing, error detection, parity, checksum, CRC, flow control and basic ARQ mechanisms.

Computer Networking: LAN, WAN and PAN, network topologies, OSI reference model, TCP/IP model, switching and routing concepts.

Internet Protocols: IPv4, IPv6, IP addressing, basic subnetting, ARP, ICMP, TCP, UDP, ports and sockets. Application and IoT-Relevant Protocols: HTTP/HTTPS, DNS, DHCP, FTP/SFTP, MQTT, CoAP and basic WebSocket concepts.

## **8. Measurement Principles and Instrumentation**

Measurement Fundamentals: measurement systems, standards and units, accuracy, precision, sensitivity, resolution, range, linearity, repeatability and calibration. Measurement Errors: systematic and random errors, absolute and relative errors, error propagation and basic measurement uncertainty.

Electrical Measurements: measurement of voltage, current, resistance, power and energy, AC and DC measurements, RMS and average measurements.

Electronic Measuring Instruments: analog and digital multimeters, oscilloscopes, digital storage oscilloscopes, signal/function generators, and frequency and phase measurement.

Sensors and Transducers: sensor and transducer principles, classification of sensors, resistive, capacitive, inductive and piezoelectric sensors, thermocouples, RTDs, thermistors, LVDT, strain gauges, pressure sensors, proximity sensors and optical sensors.

Signal Conditioning: amplification, filtering, isolation, linearization, bridge circuits, instrumentation amplifiers and basic ADC/DAC interfacing.

Data Acquisition: sampling, sampling theorem, quantization, multiplexing, ADC, DAC and basic data acquisition systems.

Basic Instrumentation and Control: open-loop and closed-loop systems, feedback, basic block diagrams and measurement of temperature, pressure, flow and level.

## **9. C Programming**

Programming fundamentals, algorithms and flowcharts, variables, data types, operators and expressions. Control structures including conditional statements, loops, switch, break and continue. Functions, parameter passing, scope, storage classes and recursion. Arrays, multidimensional arrays and strings. Pointers, pointer arithmetic, pointers with arrays and functions. Structures, unions and enumerations. Dynamic memory allocation and basic file handling. Preprocessor directives and macros. Bitwise operations, bit manipulation and masking.