

Centre for Nanoscience and Nanotechnology
Jamia Millia Islamia, New Delhi

M. Tech. (Nanotechnology) Entrance Syllabus

Materials science : Crystal structure , crystal diffraction and reciprocal lattice, Types of bonding, elementary ideas about point defects and dislocations, lattice vibrations, phonons, specific heat of solids, free electron theory-Fermi statistics; heat capacity. Electron motion in periodic potential, energy bands in metals, insulators and semiconductors Electronic transport from classical kinetic theory, electrical and thermal conductivity. Hall Effect and thermo electric power transport in semiconductors. Di-electrics-Polarization mechanisms, Clausius-Mossotti equation, Piezo, Pyro and ferro electricity. Dia and para magnetism; exchange interactions, magnetic order, ferro. Anti-ferro and ferromagnetism. Superconductivity - basic phenomenology. Meissner effect, Type-I and Type-II superconductors, BCS theory London equations Laser: operating principles, semi conducting lasers: structures and properties, Quantum well laser: operating principle and applications Materials synthesis: polymers, composites, liquid crystals, organics conductors, nanomaterials, multiphase materials and deformation, various types of isomorphism, two component phase diagram

Electronics: Operational amplifier and its applications: inverting, non-inverting amplifier, adder and integrator, differentiator, wave form generator, comparator and Schmidt trigger, The 555 timer. Digital integrated circuits- NAND and NOR gates as building blocks, XOR gate, simple combination circuits, half and full adder, Flip-flop, shift registers and counters Basic principles of A/D and D/A converters, simple applications of A/D and D/A converters Bipolar junction transistors and its applications, Field effect transistor: JFET, MOSFET, C-MOS and CCD Discrete Fourier transform, frequency domain sampling of discrete time signals, properties of DFT, DET as a linear transformation, Relationship of DFT to other 2transform, frequency analysis of signals using the DFT computation of DFT and FFT algorithms. CMOS process technology: silicon- semiconductor technology, wafer processing, Oxidation, Epitaxy, Deposition, Ion implantation and diffusion, n-well CMOS process, p-well CMOS process, twin tub CMOS process and silicon on insulator. Software simulation of VLSI design.

Communications: Analog communication: signal and noise in communication, modulation and demodulations, AM, FM, DSB, SSB transition, angle modulation and demodulation circuits

Digital and data communication: Pulse analog modulations (PAM, PWM, PPM) Pulse code modulation and detection, differential pulse code modulation, delta modulation, amplitude shift keying, frequency shift keying, phase shift keying adaptive delta modulation

Computer Architecture: Basics of computer architecture, types of computers, function of basic building blocks. Computer instruction set: introduction, OP-CODE encoding, addressing modes, instruction types, reduced instruction set computer. Fundamentals of parallel processing: introduction, parallelism in conventional computers, general classification of computer architectures, array processors, pipeline processing, multiprocessor: single bus, multiple bus, cross bar, multiple memory.

Mathematical methods : Special functions and their properties, Fourier transform, Laplace transform Calculus, Vector algebra and vector calculus. Linear algebra, matrices. Linear differential equations. Fourier-series, elementary complex analysis. Tensor.

Mechanics: Governing equations for fluid flow and heat transfer, boundary layer theory, Boussinesq approximation, Blasius flow over a flat plate , dynamic behavior of fluid system, computational fluid dynamics, finite element method, Flow measurements, measurement technique for pressure, temperature and power, types of thermo-couples and transducers, Skin friction coefficient for boundary layers on a flat plate.

Quantum Mechanics: Wave-particle duality, Heisenberg's uncertainty principle, The Schrödinger equation, particle in box, harmonic oscillator, tunneling through a barrier. Motion in a central potential, Orbital angular momentum, Addition of angular momentum, Time independent perturbation theory. Fermi's golden rule. Elementary theory of scattering in a central potential. Phase shifts, partial wave analysis. Born approximation, identical particles.