Engineering Physics – CSE Cluster

Course Code:26ENXXXX
Semester: 1/2
Programs Offered: B. Tech, Department of Physics
Course Type: Basic Science

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Course Modules

Module 1: (09 Hours)

Failure of Classical Mechanics, Planck's hypothesis, Wave-Particle Duality, Uncertainty Principle, Wave function, Eigen functions and Eigen values, Schrodinger Time-Independent Wave Equation in 1D (Derivation), Particle in a Potential Well (Derivation), Numericals.

Module 2: (09 Hours)

Introduction to Quantum Information, Qubit, Bloch Sphere, Superposition, Entanglement, Quantum Gates, Quantum Measurement, Quantum Parallelism, Quantum Supremacy. Applications: Quantum Key Distribution (QKD), Quantum Sensors.

Module 3: (09 Hours)

Quantum Optics: Absorption, spontaneous and stimulated emission, Einstein coefficients, pumping, population inversion, resonators, laser characteristics, Nd:YAG and semiconductor lasers, engineering applications.

Fibre Communication: Optical fibre basics, numerical aperture, acceptance angle, step-index and graded-index fibres, fibre losses, applications.

Module 4: (10 Hours)

Semiconductor and Device Physics: Classification of solids, band structure, Fermi level (intrinsic and extrinsic), Fermi-Dirac distribution, electron concentration in conduction band (Derivation), intrinsic carrier concentration, conductivity, Numericals.
Semiconductor Devices: Zener diode, BJT and LED.
Nano Science & Technology: Nanomaterials, classification, size-dependent properties, quantum confinement, top-down and bottom-up approaches (ball milling, photolithography), applications in medicine and engineering.

Module 5: (08 Hours)

Physics for AI and ML (Statistical Mechanics and Distribution Functions): Microscopic and Macroscopic Descriptions, Microstates and Macrostates, Probability and entropy, Equal A Priori Probability Postulate, Boltzmann Entropy Relation, Probability Distribution, Boltzmann Distribution, Partition Function, Ensembles, Average Values, Maxwell–Boltzmann distribution (Softmax function) and Bose–Einstein distribution (Occupancy constraints, Resource allocation models, Quantum-inspired algorithms)

List of Experiments

No.	Experiment	Module Link
1	I-V Characteristics of Zener Diode	Module IV
2	Four Probe Technique — Resistivity	Module IV
3	Dielectric Constant Determination	Module IV
4	Fibre Optic System — NA, Acceptance Angle & Losses	Module III
5	Band Gap Energy of Intrinsic Semiconductor	Module IV
6	Diffraction Grating — Wavelength of Laser Light	Module III
7	Planck's Constant using LED	Module IV
8	LCR Series & Parallel Resonance	Module IV
9	Transistor Characteristics (NPN-CE)	Module IV
10	Hall Effect — Concentration, Mobility & Conductivity	Module IV
11	Realization of the hadamard gate and its geometric representation on the bloch sphere via quantum-circuit computing platform	Module II
12	Realization of the c-not gate and its bloch sphere visualization using	Module II