First Year 1st Semester Curriculum Structure for B.Tech. Course

Physics (BSC101)	
Department: **Program:** **Course Code:** **Title of Course:** **Year of Study:** **Semester:**	Basic Science and Humanities B. Tech. **BSC101** **Physics** First Year First
Contact Hours: **Credits:** **Type of course:** **Total Lecture Hours:**	L-T-P: 3-1-0 4 Theory 40
Pre-requisites Courses:	Basic knowledge of differential and integral calculus, vector calculus. Basic knowledge of classical mechanics at XI, XII level. Basic knowledge of wave theory of light
Course Outcome (CO):	Upon successful completion of this course, students should be able to: **CO1:**Develop knowledge of classical mechanics and oscillatory motion for applications in engineering. **CO2:**Develop basic concepts of quantum mechanics, concept of light as a wave and the phenomenon of interference. **CO3:**:Develop concept of different phenomenon of light as a wave for applications in optical instruments, optical softwares, communications etc. **CO4:**:Formulate and solve the engineering problems on quantum physics, statistical mechanics and their applications in engineering.**(Note: CO must be in multiple of 4 only)**

Detailed Syllabus

Module 1: Classical Mechanics and Oscillations (8 L)

Problems including constraints & friction, Constraints- Holonomic and Non-Holonomic Constraints, Degrees of Freedom;Potential energy function F = -grad V, Equipotential surfaces and meaning of gradient. Conservative and non-conservative forces. Curl of a force field, Conservation laws of energy & momentum; Concept of Central forces, Kepler's problem;Non-inertial frames of reference, Rotating coordinate system, Centripetal and Coriolis accelerations;Motion of a rigid body, Moment of inertia tensor, Principal moment of inertia.

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly damped oscillators; Examples of mechanical and electrical simple harmonic oscillators, energy decay in a damped harmonic oscillator, Logarithmic decrement, Forced oscillations and resonance, quality factor, power absorbed by oscillator.

Module 2: Optics (8L)

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Fraunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Spontaneous and Stimulated emission,Einstein's theory of A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers, solid-state lasers, dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers.

Introduction to Polarization, Circular and Elliptical polarization, Polarisation by Reflection, Brewster's Law, Polarisation by Double Reflection, E-ray, O-Ray, Nicol Prism, Wave plates - Half wave plate and Quarter wave plate.

Module 3:Introduction to Electromagnetic Theory (8 L)

Electrostatics in a linear dielectric medium, Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric Displacement current;magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials,Faraday's law in terms of EMF produced by

changing magnetic flux,Differential form ofFaraday's law expressing curl of electric field in terms of time-derivative of magnetic field, energy stored in a magnetic field.

Displacement current, Magnetic field due to time-dependent electric field and
Maxwell's equations, Continuity equation for current densities, Modifying equation for the curl of magnetic field to satisfy continuity equation.

Maxwell's equation in vacuum and non-conducting medium, Energy in an electromagnetic field, Flow of energy and Poynting vector with examples, The wave equation, Plane electromagnetic waves in vacuum, their transverse nature and polarization, relation between electric and magnetic fields of an electromagnetic wave, energy carried by electromagnetic waves and examples, EM waves in conducting medium, skin depth.

Module 4:Electronic Materials and Semiconductors(5 L)

Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Bloch's Theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands, Metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p–n junction.

Module 5:Introduction to Quantum Mechanics for Engineers (8 L)

Introduction to Quantum Mechanics, Wave nature of particles, Time-dependent and time-independent Schrödinger equation for wavefunction, Born interpretation, Probability current density, Expectation values, Free-particle wavefunction and wave-packets, Uncertainty principle and de-Broglie hypothesis, Concept of Operator.

Applications of Schrödinger equation: One-dimensional problems - particle in one dimensional potential box, step potential, concept of tunnel effect, linear harmonic oscillator; Three-dimensional problems - particle in three dimensional potential box, hydrogen atom problem.

Module 6: Statistical Mechanics (3 L)

Statistical Distributions (Three different kinds) , Maxwell Boltzmann Statistics (Classical particles such as gas molecules obey them), Molecular energies in an ideal gas(Average molecular energy),Equipartition of Energy, Distribution of Molecular speeds , Quantum Statistics (Bosons and Fermions have different distribution function), Names of the functions, Bose-Einstein Condensate, Comparison of the three statistical distribution functions, Free Electrons in a Metal.

(Extra added portion over the given AICTE syllabus must be highlighted in yellow)

Book list:

Module No.	Module Name	Text Books
1	Classical Mechanics Oscillations	Theory and problems of Theoretical Mechanics by Murray R. Spiegel SI(Metric) edition Advanced Acoustics – Dr. D. P. Raychaudhuri, The new book stall, Revised Ninth Edition, 2009
2	Optics	A textbook on Optics, B. Ghosh and K. G. Majumder, Sreedhar Publishers, fifth edition
3	Introduction to Electromagnetic Theory	Introduction to Electrodynamics by David J. Griffiths 3rd Edition
4	Electronic Materials and Semiconductors	Introduction to Solid State Physics (January 2019) by Charles Kittel (Published by Wiley)
5	Quantum Mechanics	Concepts of Modern Physics (Sixth Edition) by Arthur Beiser (Published by McGraw-Hill)
6	Statistical Mechanics	Concepts of Modern Physics (Sixth Edition) by Arthur Beiser (Published by McGraw-Hill)