DEPARTMENT OF PHYSICS

Course Structure & Syllabi for MINOR programme in Engineering Physics
(To be applicable from BTech 2010-batch onwards)

Semester	Course Code	Course Title	L-T-P-C
3rd	PH 281M	Quantum Physics	2- 1- 0- 6
4th	PH 282M	Engineering Optics	3- 0- 0- 6
5th	PH 381M	Computational Physics	2- 0- 2- 6
6th	PH 382M	Laser Physics and Technology	3- 0- 0- 6
7th	PH 481M	Materials Science & Engineering	3- 0- 0- 6
		Total credits	**13-1-2-30**

PH 281M Quantum Physics (2-1-0-6)

Overview of basics: Basic postulates, Schroedinger equation; eigenvalues and eigenfunctions; Simple applications: particle in a box; potential well; quantum dots; potential barrier, linear harmonic oscillator; Angular momentum: spherical harmonics, commutation relations, Stern-Gerlach experiment and concept of spin;Three-dimensional problems: harmonic oscillator, Central Potential, Hydrogen atom; Approximate methods: non-degenerate and degenerate perturbation theory, variational methods, applications to Stark effect and Helium atom.

Texts:

1. D.J. Griffiths, *Introduction to Quantum Mechanics*, 2nd Ed., Pearson Education, 2000.
2. P. M. Mathews and K. Venkatesan, *A Textbook of Quantum Mechanics,* Tata McGraw Hill, 1995.

References:

1. S. Gasierowicz, *Quantum Physics*, John Wiley, 2000.
2. E. Merzbacher, *Quantum Mechanics*, 3rd Ed., John Wiley and Sons, 1998.
3. W. Greiner, *Quantum Mechanics: an Introduction*, Springer, 2004.
4. B.H. Bransden and C.J. Joachain, *Quantum Mechanics*, 2nd Ed., Pearson Education, 2007.
5. J. J. Sakurai, *Modern Quantum Mechanics*, Pearson Education, 2002.

PH 282M Engineering Optics (3-0-0-6)

Fermat's principle, laws of reflection and refraction from Fermat's principle; Electromagnetic waves at the interface of two dielectrics; Reflection and refraction by a single spherical surface, thin lens; Chromatic and monochromatic aberrations; Hygen's principle and its applications; Interference by divison of wave front and amplitude, Thin film interference and related

applications; Multiple beam interferometry; Coherence; Fraunhofer and Fresnel diffraction, diffraction grating, Zone plate; Polarization and double reflection, optical activity; Fibre Optics: basic characteristics of a step index optical fibre, attenuation and dispersion in optical fibres, principles of a fibre optic communication system; Holography: basic principles and applications; Nonlinear Optics: Nonlinear optical susceptibilities, second harmonic generation, self-focussing phenomenon. Optical Instruments: various kinds of optical microscopes, telescopes, binoculars, spectrometer; Cameras, Zoom lenses.

Texts:

1. A. Ghatak, *Optics*, 4th Ed., Tata McGraw Hill, 2009.
2. E. Hecht, *Optics*, 4th Ed., Pearson Education, 2002.

References:

1. F. Pedrotti, L. Pedrotti and L. Pedrotti, *Introduction to Optics*, Benjamin Cummings, 3rd Ed., 2007.
2. R. D. Guenther, *Modern Optics*, Wiley & Sons, 1990.
3. M. Born and E. Wolf, *Principles of Optics*, 7th Ed., Cambridge University Press, 2005.

PH 381M Computational Physics (2-0-2-6)

Review of error analysis and roots finding method; Solution of linear algebraic equations: LU decomposition, Jacobi method, and Gauss–Seidel method, eigen value problems and applications to physical problems; Interpolation: interpolating functions, spline interpolation, cubic spline method, linear and nonlinear least squares fitting; Numerical integration: equidistant example points, Newton–Cotes formulae, Romberg integration, Gaussian integration.Numerical differentiation: simple forward difference, extrapolation Methods; Ordinary differential equations: Euler Method , Runge-Kutta Method;Partial differential equations: finite difference method, polynomial expansions method, split step exponential methods, applications to physical problems; Monte Carlo methods and simulation: random number generators; Monte-Carlo integration; the Metropolis algorithm-the Ising model.

Texts:

1. P. O. J. Scherer, *Computational Physics: Simulation of Classical and Quantum Systems*, 1st Ed., Springer; 2010.
2. R. H. Landau, M. J. Paez and C. C. Bordeianu, *Computational Physics: Problem Solving with Computer*, Wiley Vch Verlag Gmbh & Co. KGaA, 2007.

References:

1. W. H. Press, S. A. Teukolsky, W. T. Verlling and B. P. Flannery, *Numerical Recipes in C*, Cambridge, 1998.
2. Tao Pang, *An Introduction to Computational Physics*, Cambridge University Press, 2006.

PH 382M Laser Physics and Technology (3-0-0-6)

Laser basics: Spontaneous and stimulated emission, Einstein A and B coefficients, line broadening mechanism, properties of laser, laser rate equations, population inversion, pumping mechanism, optical resonators, laser cavity modes, Gaussian beam, Q-switching, mode-locking and pulse compression; Laser systems: gas, solid state, semiconductor and dye lasers; Laser technology: ultrafast lasers, pulse width measurement, microchip lasers, fiber lasers, frequency up and down conversion; Laser applications: holography, laser interferometry, laser spectroscopy, light detection and ranging, biomedical applications, laser lithography.

Texts:

1. W. T. Silfvast, *Laser and Fundamentals,* Cambridge University Press, 2004.
2. J Wilson and JFB Hawkes, *Optoelectronics: An Introduction*, Prentice Hall, 1996.
3.

Reference:

1. B. E. Saleh and M.C. Teich, *Photonics*, John Wiley & Sons, 2007.

PH 481M Materials Science and Engineering (3-0-0-6)

Classification of engineering materials; structure of solids: unit cells and crystal systems, crystallographic directions and planes, Miller indices; X-ray diffraction: the crystalline and the non-crystalline states, structure determination; covalent solids, metals and alloys, ionic solids, polymers; Imperfections in solids: point defects, line defects; diffusion in solids: diffusion process and mechanisms; Phase Diagrams; solubility limits, phases, phase equilibria, binary isomorphic systems, binary eutectic systems, non-equilibrium cooling; phase transformation process, nucleation and growth, precipitation, solidification and crystallization, re-crystallization and grain growth; Mechanical properties of metals and alloys; visco-elastic behaviour; structure-property correlations; Selected properties of ceramic, ferroelectric, ferromagnetic, polymeric and composite materials.

Texts/References:

1. W. D. Callister Jr., *Materials Science and Engineering: An introduction*, 6th Ed., John Wiley India, 2006.
2. V. Raghavan, *Materials science and engineering: a first course*, Prentice Hall of India, 2005.