Semester V						
S.No	Course Code	Course Name	L	T	P	C
1	PH301T	Electrodynamics	2	1	0	6
2	PH302T	Classical Mechanics	2	1	0	6
3	PH303T	Quantum Mechanics - I	2	1	0	6
4	PH420T	Electronics	2	1	0	6
5	PH501T	Mathematical Physics-II	2	1	0	6
6	PH402L	Electronics Laboratory	0	0	3	3
		Total Credits				**33**

1	**Title of the course** (L-T-P-C)	**Electrodynamics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Successful completion of PH102
3	**Course content**	Review of electrostatics and magnetostatics. Electrodynamics: Differential and integral forms of Maxwell's equations, Scalar and vector potentials, gauge transformations, Coulomb and Lorentz Gauge; Maxwell's equations in terms of potentials. Energy and momentum in electrodynamics. Electromagnetic waves: Electromagnetic waves in non-conducting media: Monochromatic plane waves in vacuum, propagation through linear media; Boundary conditions; Reflection and transmission at interfaces. Fresnel's laws; Electromagnetic waves in conductors: Modified wave equation, monochromatic plane waves in conducting media, Dispersion: Dispersion in non-conductors, free electrons in conductors and plasmas. Guided waves. Retarded potentials, Electric dipole radiation, magnetic dipole radiation. Radiation from a point charge: Lienard-Wiechart potentials, fields of a point charge in motion, power radiated by a point charge. Electrodynamics and Relativity: Review of special theory of relativity, Lorentz transformations, Minkowski four vectors, energy-momentum four vector, covariant formulation of mechanics; Transformation of electric and magnetic fields under Lorentz transformations, field tensor, invariants of electromagnetic field, Covariant formulation of electrodynamics, Lorentz force on a relativistic charged particle. Waveguides, Resonant Cavities and Optical Fibers, Basics of Antennas.
4	**Texts/References**	(1) D. J. Griffith: Introduction to Electrodynamics, 4th edition, Pearson, 2015. (2) J.D. Jackson: Classical Electrodynamics, Wiley student edition, 3rd edition, 2007. (3) Modern Electrodynamics, Andrew Zangwill, Cambridge University Press, 2012. (4) Foundations of Electromagnetic Theory, J. R. Reitz, F. J. Milford, and R. W. Christy, Addison-Wesley, 4th edition, 2008. (5) W K H Panofsky and M Philips: Classical Electricity and Magnetism Addison Wesley, 2nd edition, 1962. (6) W Greiner: Classical Electrodynamics, Springer, 1998. (7) Hayt, William H., Jr., and John A. Buck, "Engineering Electromagnetics", 7th ed. McGraw-Hill, 2006. (8) M.A. Heald and J.B. Marion, Classical Electromagnetic Radiation, Saunders, 1983.

1	**Title of the course** (L-T-P-C)	**Quantum Mechanics - I** **(3-1-0-8)**
2	**Pre-requisite courses(s)**	PH101 MA101
3	**Course content**	Review of Wave mechanics, Schrodinger equation, Uncertainty principle, wave packets, group velocity and phase velocity. Postulates of quantum mechanics, probability and probability current density, operators, eigenvalues and eigenfunctions. Bound states, delta-function potential, and harmonic oscillator. Formalism: Hilbert space, Observables, Eigenfunctions of Hermitian operator, Dirac's notation, matrix representations of vectors and operators, parity operation, matrix theory of harmonic oscillator. Theory of Angular Momentum: Spherical harmonics, eigenvalues of L^2 and L_z, addition of angular momentum, commutation relations, degeneracies. Hydrogen atom, quantum numbers, two particle systems.
4	**Texts/References**	1. Introduction to Quantum Mechanics, D. J. Griffiths and D. F. Schroeter, Cambridge University Press, 3rd edition, 2019. 2. Modern Quantum Mechanics, J. J. Sakurai, Cambridge University Press, 2017. 3. Principles of Quantum Mechanics, R. Shankar, Springer, 2014. 4. Quantum Physics, S. Gasiorowicz, John Wiley, 2000. 5. Quantum Mechanics, L. D. Landau and E.M. Lifshitz, Pergamon press, 1965

1	**Title of the course** (L-T-P-C)	**Classical Mechanics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nil
3	**Course content**	Review of Newtonian Mechanics - Newton’s Laws of Motion and Conservation Laws. Principles of Canonical Mechanics - Constraints and generalized coordinates, Alembert’s principle, Lagrange's equation, Hamilton’s variational principle, canonical systems, symmetries and conservation laws, Noether’s theorem, Liouville’s Theorem. Central Force: Equations of motion Virial Theorem, Kepler’s Laws, Scattering in a Central Force Field. Rigid Body: Euler angles, Coriolis Effect, Euler equations, moment of inertia tensor, motion of asymmetric top. Small Oscillations: Eigen value problem, frequencies of free vibrations and normal modes, forced vibration, dissipation. Special Theory of Relativity: Newtonian relativity, Michelson-Morley experiment, Special theory of relativity, Lorentz transformations and its consequences, addition of velocities, variation of mass with velocity, mass-energy relation, Minkowski four-dimensional continuum, four vectors. Hamiltonian Equation, Gauge transformation, canonical transformation, Infinitesimal transformation, Poisson brackets, Hamilton-Jacobi equations, Separation of variables Lagrangian and Hamiltonian formulation of continuous systems.
4	**Texts/References**	1. Classical Mechanics: H. Goldstein, C. P. Poole, and J. Safko, Pearson 2011. 2. Classical Mechanics: N. C. Rana and P. S. Joag, Tata McGraw Hill, 2017. 3. Introduction to Classical Mechanics: David Morin, Cambridge University Press, 2008. 4. Mechanics: L.D. Landau and E. M. Lifshitz, Butterworth- Heinemann, 3rd edition, 1982. 5. Mechanics: From Newton's Laws to Deterministic Chaos, F. Scheck, Springer, 5th edition, 2010. 6. Introduction to Classical Mechanics, R G Takwale and P S Puranik, Tata McGraw Hill, 2008.

1	**Title of the course** (L-T-P-C)	**Electronics** **2-1-0-6**
2	**Pre-requisite courses(s)**	--
3	**Course content**	Network theorems; application to simple circuits. Semiconductor basics, diodes, p-n junction devices, transistors; biasing schemes; small signal amplifiers; feed-back theory; oscillators; power supply; wave shaping circuits. Bipolar junction transistor: configurations, small signal amplifier, oscillators; JFET and MOSFET: characteristics, small signal amplifier. OP-AMP: Differential amplifiers; Op-Amp (741) circuits (amplifiers; scalar; adder; subtractors; comparator; logarithmic amplifiers; etc.) Digital electronics : Logic gates, Boolean algebra, Karnaugh maps, flip flops, shift registers, adders, counters, ADC and DAC.
4	**Texts/References**	• J. Millman, C. C. Halkias, C. D. Parikh, Integrated Electronics, 2nd edition, McGraw Hill Education (2017). • A. P. Malvino, Electronic Principles, 7th edition, McGraw Hill Education (2017). • R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 11th edition, Prentice Hall (2013). • D. P. Leach, A. P. Malvino and G. Saha, Digital Principles and Applications, 8th edition, McGraw Hill Education (2014). • R. Gaekwad, Op-Amps and Linear Integrated Circuits, 4th edition, Prentice Hall of India (2015).

1	**Title of the course** (L-T-P-C)	**Electronics Laboratory** **0-0-3-3**
2	**Pre-requisite courses(s)**	--
3	**Course content**	The following is the proposed list of experiments/topics for this lab: ● Diode properties of transistor junctions ● Transistor as function generator ● Characteristics of field-effect transistor ● Half and full-wave rectifier ● RC-coupled amplifier ● Differential amplifier circuits ● Unregulated and regulated power supply ● Wein bridge oscillator using OP-Amp ● Op-Amp as adder/subtractor/integrator/differentiator ● MOSFET characteristics ● Universality of NOR/NAND gates ● Verification of De Morgan's theorem ● RC/ LR/ LCR circuit
4	**Texts/References**	• J. Millman, C. C. Halkias, C. D. Parikh, Integrated Electronics, 2nd edition, McGraw Hill Education (2017). • A. P. Malvino, Electronic Principles 7th edition, McGraw Hill Education (2017). • R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory 11th edition, Prentice Hall (2013). • D. P. Leach, A. P. Malvino and G. Saha, Digital Principles and Applications 8 th edition, McGraw Hill Education (2014). • R. Gaekwad, Op-Amps and Linear Integrated Circuits, 4th edition, Prentice Hall of India (2015).