| Semester V | | | | | | |
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| **S.No** | **Course Code** | **Course Name** | **L** | **T** | **P** | **C** |
| | PH 201 | Electrodynamics | 2 | 1 | 0 | 6 |
| | PH 202 | Classical Mechanics | 2 | 1 | 0 | 6 |
| | PH 203 | Quantum Mechanics-I | 2 | 1 | 0 | 6 |
| | EE 202 | Introduction to Analog Circuits (Pre Mid Sem) | 3 | 0 | 0 | 3 |
| | EE 212 | Devices and circuits Lab | 0 | 0 | 3 | 3 |
| | | HSS Elective-II | 3 | 0 | 0 | 6 |
| | PH 311 | Advanced Physics Lab | 0 | 0 | 3 | 3 |
| | | Total Credits | | | | 36 |

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| 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.<br><br>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.<br><br>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.<br><br>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.<br><br>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.<br><br>Waveguides, Resonant Cavities and Optical Fibers, Basics of Antennas. |
| 4 | **Texts/References** | (1) D. J. Griffith: Introduction to Electrodynamics, 4th edition, Pearson, 2015.<br>(2) J.D. Jackson: Classical Electrodynamics, Wiley student edition, 3rd edition, 2007.<br>(3) Modern Electrodynamics, Andrew Zangwill, Cambridge University Press, 2012.<br>(4) Foundations of Electromagnetic Theory, J. R. Reitz, F. J. Milford, and R. W. Christy, Addison-Wesley, 4th edition, 2008.<br>(5) W K H Panofsky and M Philips: Classical Electricity and Magnetism Addison Wesley, 2nd edition, 1962.<br>(6) W Greiner: Classical Electrodynamics, Springer, 1998.<br>(7) Hayt, William H., Jr., and John A. Buck, "Engineering Electromagnetics", 7th ed. McGraw-Hill, 2006.<br>(8) M.A. Heald and J.B. Marion, Classical Electromagnetic Radiation, Saunders, 1983. |

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| 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.<br>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.<br>Central Force: Equations of motion Virial Theorem, Kepler's Laws,<br>Scattering in a Central Force Field.<br>Rigid Body: Euler angles, Coriolis Effect, Euler equations, moment of inertia tensor, motion of asymmetric top.<br>Small Oscillations: Eigen value problem, frequencies of free vibrations and normal modes, forced vibration, dissipation.<br>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.<br>Hamiltonian Equation, Gauge transformation, canonical transformation, Infinitesimal transformation, Poisson brackets, Hamilton-Jacobi equations, Separation of variables.<br>Lagrangian and Hamiltonian formulation of continuous systems. |
| 4 | **Texts/References** | **1.** Classical Mechanics: H. Goldstein, C. P. Poole, and J. Safko, Pearson 2011.<br>**2.** Classical Mechanics: N. C. Rana and P. S. Joag, Tata McGraw Hill, 2017.<br>**3.** Introduction to Classical Mechanics: David Morin, Cambridge University Press, 2008.<br>**4.** Mechanics: L.D. Landau and E. M. Lifshitz, Butterworth- Heinemann, 3rd edition, 1982.<br>**5.** Mechanics: From Newton's Laws to Deterministic Chaos, F. Scheck, Springer, 5th edition, 2010.<br>**6.** Introduction to Classical Mechanics, R G Takwale and P S Puranik, Tata McGraw Hill, 2008. |

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| 1 | **Title of the course**<br>(L-T-P-C) | **Quantum Mechanics-II**<br>**(2-1-0-6)** |
| 2 | **Pre-requisite courses(s)** | PH101-Quantum Physics and Applications Quantum Mechanics - I |
| 3 | **Course content** | Time independent Perturbation Theory – Zeeman and Stark effects. Wentzel–Kramers–Brillouin approximation<br>Variational method<br><br>Time dependent perturbation theory,<br><br>Scattering Theory, Born Approximation, Partial Wave analysis, Path Integral approach to Quantum Mechanics,<br>Relativistic Quantum Mechanics<br><br>Introduction to Quantum Field Theory, Quantization of free scalar field.<br>Master equations, open and closed quantum system dynamics. |
| 4 | **Texts/References** | 1. Modern Quantum Mechanics, J J Sakurai, Addison-Wesley, Reading, MA, 1994<br>2. Advanced Quantum Mechanics, J J Sakurai, Pearson, 1967.<br>3. Quantum Mechanics (Vol 1 and 2), C. Cohen-Tannoudji, B. Diu, and F. Laloe, Wiley VH; 2nd edition 2019.<br>4. R. Shankar, Principles of Quantum Mechanics, 2nd Ed. (Plenum Press, New York, 1994)<br>5. Quantum Mechanics and Path Integrals, R. P. Feynman and A. R. Hibbs, McGraw-Hill, New York, 1965.<br>6. An Introduction to Quantum Field Theory, M.E. Peskin, D. V. Schroeder, Westview Press, 1995.<br><br>The theory of open quantum systems, H. P. Breuer and F. Petruccione, Oxford University Press, 2002. |

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| 1 | **Title of the course** (L-T-P-C) | **Introduction to Analog Circuits** **(3-0-0-3)** |
| 2 | **Pre-requisite courses(s)** | Network theory, Electronic Devices |
| 3 | **Course content** | Part 1: Linear circuits<br>• Introduction to feedback control – Integral control and proportional control<br>• Linear circuits using Op-amps (amplifiers, arithmetic circuits, filters and oscillators)<br>Part 2: Need for Non-linearity for amplification<br>Single stage amplifiers, frequency response, Current mirror circuits, Differential amplifier. |
| 4 | **Texts/References** | **1)** J.V.Wait, L.P.Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York, 1992.<br>**2)** J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.<br>**3)** Ramakant Gayakwad, Op-amps and Linear Integrated Circuit, 4th edition, Pearson, 2000.<br>**4)** P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.<br>**5)** Behzad Razavi , “Fundamentals of Microelectronics,” John Wiley, 2013. |

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| 1 | **Title of the course** (L-T-P-C) | **Devices and circuits Lab (0-0-3-3)** |
| 2 | **Pre-requisite courses(s)** | -- |
| 3 | **Course content** | This lab will reinforce concepts thought in Electronic devices and analog circuits. It will have experiments on Device characterization and circuits design and characterization. The following is the tentative list of experiments for this lab:<br><br>1. LED and Photodiode characterization<br>2. BJT biasing and CE amplifier<br>3. Solar cell characterization<br>4. Diode Temperature characteristics<br>5. NMOS characterization and CS amplifier<br>6. MOS differential amplifier<br>7. basic opamp circuits<br>8. Active filters<br>9. Multivibrators<br>10. Audio amplifiers |
| 4 | **Texts/References** | 1. J.V.Wait, L.P.Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York, 1992.<br>2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.<br>3. Behzad Razavi, Fundamentals of microelectronics, Wiley Publications<br>4. A.S.Sedra and K.C. Smith,Microelectronic Circuits, Saunder's College Publishing, Edition IV, 2017.<br>5. Ramakant Gayakwad, Op-amps and Linear Integrated Circuit, 4th edition, Pearson, 2000. |