Engineering Physics

Semester III						
Sr. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	PH 201	Electrodynamics	2	1	0	6
2	EE 221	Introduction to Probability	3	0	0	3
3	EE 229	Electronic Devices	3	0	0	3
4	EE 202	Introduction to Analog Circuits	3	0	0	3
5	EE 210	Signals and Systems	2	1	0	6
6	ME 201	Engineering Mechanics	2	1	0	6
7	ME 207	Thermodynamics	2	1	0	6
8	PH 211	Introductory Physics Laboratory	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. 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.

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1	**Title of the course (L-T-P-C)**	**Introduction to Probability (3-0-0-3)**
2	**Pre-requisite courses(s)**	Basic calculus
3	**Course content**	**Introduction**: Motivation for studying the course, revision of basic math required, connection between probability and length on subsets of the real line, probability-formal definition, events and σ-algebra, independence of events, and conditional probability, sequence of events, and *Borel-Cantell* Lemma. **Random Variables**: Definition of random variables, and types of random variables, CDF, PDF and its properties, random vectors and independence, brief introduction to transformation of random variables, introduction to Gaussian random vectors. **Mathematical Expectations**: Importance of averages through examples, definition of expectation, moments and conditional expectation, use of MGF, PGF and characteristic functions, variance and k-th moment, MMSE estimation. **Inequalities and Notions of convergence**: Markov, Chebychev, Chernoff and Mcdiarmid inequalities, convergence in probability, mean, and almost sure, law of large numbers and central limit theorem. **A short introduction to Random Process:** Example and formal definition, stationarity, autocorrelation, and cross correlation function, definition of ergodicity.
4	**Texts/References**	**1. Robert B. Ash**, ``Basic Probability Theory," Reprint of the John Wiley & Sons, Inc., New York, 1970 edition. **2. Sheldon Ross**, ``A first course in probability," Pearson Education India, 2002. **3. Bruce Hayek**, ``An Exploration of Random Processes for Engineers," Lecture notes, 2012. **4.** D. P. Bertsekas and J. Tsitisklis, "Introduction to Probability" MIT Lecture notes, 2000 (*link*: https://www.vfu.bg/en/e-Learning/Math-- Bertsekas_Tsitsiklis_Introduction_to_probability.pdf)

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1	**Title of the course (L-T-P-C)**	**Electronic Devices (3-0-0-3)**
2	**Pre-requisite courses(s)**	EE 102
3	**Course content**	• Introduction of Semiconductor Equations: Fermi-Dirac Distribution, Boltzmann's approximation • Semiconductor Diodes: Barrier formation in metal- semiconductor junctions, PN homo- and hetero- junctions; CV characteristics and dopant profiling; IV characteristics; Small signal models of diodes; Some Applications of diodes. • Field Effect Devices: JFET/HFET, MIS structures and MOSFET operation; JFET characteristics and small signal models; MOS capacitor CV and concept of accumulation, depletion, and inversion; MOSFET characteristics and small signal models. Bipolar transistors: IV characteristics and Elers-Moll model; small signal models; Charge storage and transient response
4	**Texts/References**	**1.** D. A. Neamen, Semiconductor Physics and Devices, 4e Edition, McgrawHill, 13th reprint, 2016. **2.** E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988. **3.** B.G. Streetman, Solid State Electronic Devices, 7th Edition, Pearson, 2016. **4.** J. Millman and A. Grabel, Microelectronics, II edition 34th reprint McGraw Hill, International, 2017. **5.** A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991. **6.** R.T. Howe and C.G. Sodini, Microelectronics: An integrated Approach, Prentice Hall International, 1997.

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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** **1.** Introduction to feedback control – Integral control and proportional control **2.** Linear circuits using Op-amps (amplifiers, arithmetic circuits, filters and oscillators) **Part 2: Need for non-linearity for amplification.** 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. **2.** J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988. **3.** Ramakant Gayakwad, Op-amps and Linear Integrated Circuit, 4th edition, Pearson, 2000. **4.** P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989. **5.** Behzad Razavi, “Fundamentals of Microelectronics,” John Wiley, 2013.

Engineering Physics

1	**Title of the course (L-T-P-C)**	**Signals and Systems (2-1-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	• Continuous-time and Discrete-time signal (and system) classification and properties. • Impulse response, LTI / LSI system and properties; Continuous-time and Discrete-time convolution. • Linear constant coefficient differential (and difference) equations. • Continuous – time Fourier series and Continuous – time Fourier Transform. Their properties. • Discrete – time Fourier series and Discrete – time Fourier Transform. Their properties. • Sampling and Aliasing in time and frequency. Discrete Fourier Transform. • Laplace Transform and its Properties. Z-Transform and its Properties.
4	**Texts/References**	**1.** Signals and Systems, Authors: Alan V. Oppenheim, Alan S. Willsky, Edition: 2, illustrated, Publisher: Pearson, 2013. **2.** Signal Processing and Linear Systems, Author: Bhagawandas P. Lathi, Edition: 2, illustrated, Publisher: Oxford University Press, 2009. **3.** Signals and Systems, Authors: Simon S. Haykin, Barry Van Veen, Edition: 2, illustrated, Publisher: Wiley, 2003.

Engineering Physics

1	**Title of the course (L-T-P-C)**	**Engineering Mechanics (2-1-0-6)**
2	**Pre-requisite courses(s)**	--
3	**Course content**	**Module 1:** Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy **Module 2:** Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack. **Module 3:** Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines. **Module 4:** Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook. **Module 5:** Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability-of-equilibrium. . **Module 6:** Particles dynamics- Kinematics of Particles: Rectilinear motion, Plane curvilinear motion - rectangular coordinates, normal and tangential coordinates, polar coordinates, Space curvilinear - cylindrical, spherical (coordinates), Relative and Constrained motion. Kinetics of Particles: Force, mass and acceleration – rectilinear and curvilinear motion, work and energy, impulse and momentum – linear and angular; Impact – Direct and Oblique. Kinetics of System of Particles: Generalized Newton's Second Law, Work-Energy, Impulse-Momentum, Conservation of Energy and Momentum **Module 7:** Introduction to Rigid body dynamics Kinematics of Planar Rigid Bodies: Equations for rotation of a rigid body about a fixed axis, General plane motion, Instantaneous Center of Rotation in Plane Motion Plane Motion of a Particle Relative to a Rotating Frame. Coriolis Acceleration Kinetics of Planar Rigid Bodies: Equations of Motion for a Rigid Body, Angular Momentum of a Rigid Body in Plane Motion,

		Plane Motion of a Rigid Body and D'Alembert's Principle, Systems of Rigid Bodies, Constrained Plane Motion; Energy and Work of Forces Acting on a Rigid Body, Kinetic Energy of a Rigid Body in Plane Motion, Systems of Rigid Bodies, Conservation of Energy, Plane Motion of a Rigid Body - Impulse and Momentum, Systems of Rigid Bodies, Conservation of Angular Momentum. **Module 8:** Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulums, use of simple, compound and torsion pendulums
4	**Texts/References**	**Textbooks:** **1.** J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II – Dynamics, 6th Ed, John Wiley, 2008. **2.** F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, Tata McGraw Hill, 2011. **3.** R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press, 2006. **References:** **1.** S. P. Timoshenko and D. H. Young, Engineering Mechanics. Fourth Edition. McGraw-Hill, New York, 1956. **2.** I. H. Shames, Engineering Mechanics: Statics and dynamics, 4th Ed, PHI, 2002. **3.** Robert W. Soutas-Little; Daniel J. Inman; Daniel Balint, Engineering Mechanics: Dynamics – Computational Edition, 1st Ed., Cengage Learning, 2007 **4.** Robert W. Soutas-Little; Daniel J. Inman; Daniel Balint, Engineering Mechanics: Statics-Computational Edition, 1st Ed., ,Cengage Learning, 2007

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1	**Title of the course (L-T-P-C)**	**Thermodynamics** **(2-1-0-6)**
2	**Pre-requisite courses(s)**	Nill
3	**Course content**	Thermodynamic Systems, properties & state, process &cycle **Heat & Work**: Definition of work and its identification, work done at the moving boundary, Zeroth law, **Properties of pure substance**: Phase equilibrium, independent properties, and equations of state, compressibility factor, Tables of thermodynamic properties & their use, Mollier Diagram **First law**: First law for control mass & control volume for a cycle as well as for a change of state, internal energy & enthalpy, Specific heats; internal energy, enthalpy & specific heat of ideal gases. SS process, Transient processes. **Second Law of Thermodynamics**: Reversible process; heat engine, heat pump, refrigerator; Kelvin- Planck & Clausius statements ,Carnot cycle for pure substance & ideal gas, Concept of entropy; the Need of entropy definition of entropy; entropy of a pure substance; entropy change of a reversible & irreversible processes; principle of increase of entropy, thermodynamic property relation, corollaries of second law, Second law for control volume; SS & Transient processes; Reversible SSSF process; principle of increase of entropy, Understanding efficiency. **Irreversibility and availability**: Available energy, reversible work & irreversibility for control mass and control volume processes; second law efficiency. **Thermodynamic relations**: Clapeyron equation, Maxwell relations, Thermodynamic relation for enthalpy, internal energy, and entropy, expansively and compressibility factor, equation of state, generalized chart for enthalpy. **Thermodynamic Cycles**: Otto, Diesel, Duel and Joule Third Law of Thermodynamics
4	**Texts/Reference**	**1.** Sonntag R., Claus B. & V. Wylen G, Fundamentals of Thermodynamics, John Wiley, 2000. **2.** G Rogers, YR Mayhew, Engineering Thermodynamics Work and Heat Transfer, Pearson 2003 **3.** J.P Howell, P.O. Bulkins, Fundamentals of Engineering Thermodynamics, McGraw Hill,1987 **4.** Y Cengal, M A Boles, Thermodynamics: An Engineering Approach, Tata McGraw Hill, 2003. **5.** Michael J. & H.N. Shapiro, Fundaments of Engineering Thermodynamics, John Wiley, 2004.