UNIVERSITY OF KERALA

REVISED OUTCOME BASED SYLLABUS
FOR
FIRST DEGREE PROGRAMME IN
PHYSICS

UNDER

CHOICE BASED-CREDIT & SEMESTER-

SYSTEM (CBCSS)

(2023 admission onwards)

PY1141: BASIC MECHANICS AND PROPERTIES OF MATTER

(36 HOURS-2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO – 1	Correlate the knowledge gathered to the immediate experimental curriculum	Apply	PSO – 1
CO – 2	Distinguish the dynamics of rigid bodies of different shapes	Apply	PSO –1, 2, 4
CO – 3	Explain the implications of conservation laws	Understand	PSO – 1
CO – 4	Interpret the flavor of classical fields from oscillations and waves	Understand	PSO – 1, 2
CO – 5	Handle the known problems in elasticity, surface tension and viscosity in a more mathematically rigorous way	Apply	PSO –1, 2,4

MECHANICS (21 hrs.)

UNIT 1 - DYNAMICS OF RIGID BODIES (7 hrs.) (Book 1 Chapter 8)
Angular momentum and Moment of Inertia, Theorems on MI.- calculation of MI. of bodies of regular shapes: thin uniform rod(revision) - ring(revision), disc(revision), annular ring, solid sphere, solid cylinder and hollow cylinder - torque and angular momentum, KE of rotating and rolling bodies - Motion of rigid bodies on an inclined plane, Determination of MI. of a flywheel (Theory only)

UNIT 2 - CONSERVATION OF ENERGY (3 hrs.) (Book 1 Chapter 5)
Energy Conservation law- Work – power- Kinetic Energy – Work Energy theorem - Conservative Forces - potential energy- Conservation of energy for a particle–energy function.

UNIT 3 - OSCILLATIONS (8 hrs.) (Book 1 Chapter 9)
Simple harmonic motion – Energy of harmonic oscillators-simple pendulum - mass on a spring - oscillation of two particles connected by a spring- compound pendulum - interchange ability of suspension and oscillation points-collinear points-conditions for maximum and minimum periods - Determination of g using symmetric bar pendulum (Discussion only).

UNIT 4 - WAVES (3 hrs.) (Book1 Chapter 2)
Mechanical and electromagnetic wave motion- General equation of a wave motion-expression for a plane progressive harmonic wave- energy density for a plane progressive wave.

PROPERTIES OF MATTER (18 hrs.)

UNIT 5 - ELASTICITY (8 hrs.) (Book1 Chapter 12)

Modulus of elasticity (revision) - Relations connecting the three elastic moduli-Poisson's ratio, bending of beams- bending moment cantilever- Beams supported at its ends and loaded at middle- twisting couple on a cylindrical rod or wire -work done in twisting a wire-torsion pendulum.

UNIT 6 - SURFACE TENSION (3 hrs.) (Book1 Chapter 16)

Surface tension - Explanation of surface tension - Surface energy --angle of contact(revision) shapes of drops - expression for excess of pressure on a curved liquid surface -variation of surface tension with temperature.

UNIT 7 - FLUID DYNAMICS (4 hrs.) (Book3 Chapter 15)

Streamline and turbulent flow - Reynold's Number, Poiseuille's formula, Bernoulli's theorem, viscosity-Newton's law- Stokes' formula.

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya and Ram Prasad, S. Chand Publications, 2017
2. Mechanics: H. S. Hans and S. P. Puri, TMH, 2ndEdn.
3. Elements of Properties of Matter: D.S. Mathur, S. Chand Publications,2014
4. Fundamentals of Physics: Halliday and Resnick, Wiley India Pvt. Ltd.,2006.

BOOKS FOR REFERENCE:

1. Properties of matter: Brijlal and Subramaniam, S. Chand & Co.,2004
2. Principles of Physics: P.V. Naik, PHI, 2010

TOPICS FOR ASSIGNMENTS /DISCUSSION IN THE TUTORIAL SESSION (SAMPLE)

1. Physics-The fundamental science-historical development of mechanics-some implications of the principle of mechanics-The scope of mechanics.
2. Life of eminent physicists- Newton, Einstein, C.V. Raman, Edison.
3. Study of Young's modulus for different types of wood.
4. Study of variation of surface tension for different detergents.
5. Study of viscosity of different types of ink and to arrive at knowledge of its fluidity.
6. Wide applications of Bernoulli's equation.
7. Variation of surface tension with temperature by Jaeger's method

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PY 1241: HEAT AND THERMODYNAMICS

(36 HOURS-2 CREDITS)

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Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO –1	Compare thermal conductivity of various types of conductors and explain the radiation of heat.	Analyse	PSO – 1
CO –2	Differentiate between various thermodynamic processes.	Analyse	PSO – 5
CO –3	Judge the efficiency of engines by comparing the performance of various vehicles	Evaluate	PSO – 1, 5
CO –4	Distinguish entropy and available energy in various thermodynamic processes	Analyse	PSO – 1
CO –5	Differentiate between various phase transitions	Analyse	PSO –1, 5

UNIT 1 - TRANSFERENCE OF HEAT (10 hrs.) (Book 1)

Thermal conductivity – determination by Lee's disc method for bad conductor – radial flow of heat, cylindrical flow, thermal conductivity of rubber – Wiedmann Franz law – Radiation of heat - Plank's law – Black body radiation – discussion of black body radiation curve - Stefan's law, determination of Stefan's constant – Solar constant, determination of solar temperature

UNIT 2 - THERMODYNAMICS (18 hrs.) (Book 2)

Zeroth law and first law of thermodynamics – first law in differential form – Thermodynamic processes – Expression for work done in isothermal and adiabatic process – Application of first law to specific heat and latent heat – reversible and irreversible processes – Second law of thermodynamics – Clausius and Kelvin statements – Carnot's engine – Principle of refrigerator – working and efficiency – Otto engine and Diesel engine – working and efficiency

UNIT 3 - ENTROPY (8 hrs.) (Book 2)

Definition of entropy – change of entropy in reversible and irreversible cycle – Clausius inequality and second law of thermodynamics –Carnot's theorem- entropy and available energy – entropy, probability, and disorder – Nernst theorem and third law of thermodynamics – Phase transition – phase diagram – first and second order phase transitions (qualitative idea) – Clausius – Clapeyron equation

BOOKS FOR STUDY:

1. Heat and Thermodynamics: D. S. Mathur, S. Chand & Sons, New Delhi (1995)
2. Heat and Thermodynamics: Brijlal and Subramaniam, S. Chand &Co.

BOOKS FOR REFERENCE:

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1. Thermal and Statistical Mechanics: S. K. Roy, New Age International publishers, New Delhi (2001)

2. Heat and Thermodynamics: M. Zeemansky, McGraw Hill, New Delhi (2007)

3. Heat and Thermodynamics: Rose C. McCarthy, The Rosen Publishing Group, Inc. NY. (2005)

4. Thermodynamics Kinetic Theory and Statistical Thermodynamics: F. W. Sears and G. L. Salinger, Addison-Wesley Publishing Company, 3rd Edn. (1975)

5. Modern Trends in B Sc Physics: C. J. Babu, S. Chand & Co. Ltd., New Delhi (2010)

PY 1341: INDUSTRY BASED COURSES
(54 HOURS-3 CREDITS FOR EACH COURSE)

PY1341.3: ELECTRONIC & ELECTRICAL INSTRUMENTATION AND CIRCUIT DESIGN

(54 HOURS-3 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish between the passive and active electrical components	Understand	PSO-1
CO – 2	Identify electronic components	Understand	PSO-1,9
CO – 3	Recognize electrical and electronic circuits	Apply	PSO-1
CO – 4	Design and construct simple electrical and electronic circuits	Understand	PSO-1,9

UNIT 1 - MAJOR ELECTRONIC COMPONENTS FOR INSTRUMENTATION (14 hrs.) (Book 1 Chapter 7)

Types of electronic components, passive and active components, Capacitor-types-characteristics and codes- Resistor-types-characteristics and colour codes-P-N Junction diodes-forward and reverse characteristics-Testing diodes using multimeter- Transistor: principle and working. Different types of transistors.

UNIT 2 - FAMILIARIZATION WITH ELECTRICAL CIRCUITS (12 hrs.) (Book 1 Chapters 3,4,5)

Comparison of A.C voltage and D.C voltage– R.M.S and peak value of A.C signal – Ohm's law. Electrical resistance and resistivity- Laws of resistance in series and parallel circuits – Series voltage divider - Electric circuit- Load resistance and load current- Power dissipation in the resistance- Open and short circuits- Kirchhoff's laws.

UNIT 3 - ELECTRICAL AND ELECTRONIC INSTRUMENTS (QUALITITATIVE STUDY ONLY) (12 hrs.) (Book 3 Chapter 11 and Book 2)

Solders, flux and soldering technique - Rheostat – Potentiometer – Galvanometer – Thermocouple – Electric tester – Electric shock and Earthing system- LED and types of LED– Solar cell

UNIT 4 - CIRCUIT DESIGN (16 hrs.) (Hands on training) To be Delivered as contact lecture hours, laboratory practices, seminars etc. Not for End Semester Examination. Only for continuous evaluation through practice tests, assignments viva etc.

Design and construction of variable dc power supply (0-12V) using diodes, capacitors and IC 7812)

Make a two-socket electric extension board. LED circuit design

Carey Foster's bridge – Resistivity, Potentiometer- Resistivity

PY1341.3: ELECTRONIC & ELECTRICAL INSTRUMENTATION AND CIRCUIT DESIGN

(54 HOURS 3 CREDITS)

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO-1	Distinguish between the passive and active electrical components	Understand	PSO- 1
CO-2	Identify electronic components	Understand	PSO- 1,9
CO-3	Recognize electrical and electronic circuits	Apply	PSO- 1
CO-4	Design and construct simple electrical and electronic circuits	Understand	PSO- 1,9

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Experiment to verify

    a) Kirchhoff's voltage law

    b) Kirchhoff's current law

Experiment to study time domain transient response of RC circuit., Transistor characteristics: Common emitter configuration, Transistor characteristics: Common base configuration

Clamper circuits

    a) Positive clamping circuits

    b) Negative clamping circuits

Clipping circuits – to observe the clipping waveform in different clipping configuration.

Design and verification of transistor potential divider bias circuit.

BOOKS FOR STUDY:

1. A text book of Applied Electronics, Dr. R. S. Sedha, S Chand and company Ltd.
2. Basic electrical engineering: I. Anwani, Dhanpat Rai and Co.
3. Principles of Electronics, V.K. Mehta and Rohit Mehta, *S. Chand Publishing*
4. Electronic instrumentation, H.S. Kalsi, *Mc Graw Hill Education, 3rd edn.*
5. Digital Electronics, C. Chinnapu Reddy, *Radiant Publishing Houser, Hyderabad*
6. Practical Electronics: Components and Techniques: Components and Techniques, J. M. Hughes, *O'Reilly Media*
7. Basic Electronics, B. L. Theraja, *S Chand & Co Ltd*
8. A Practical Approach to Analog and Digital Electronics, K G Raval, *Oxford Book Company.*

CO No.	Course Outcomes	Cognitive Level	PSO No.
CO1	Identify the principles of electrostatics and apply it to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density	Apply	PSO – 1 PSO – 6
CO2	Identify the principles of magnetostatics and apply it to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density	Apply	PSO – 1 PSO – 6
CO3	Recognize the concepts related to Faraday 's law, induced emf and Maxwell's equations.	Understand	PSO – 1
CO4	Compare the properties of electromagnetic waves in vacuum, and matter	Apply	PSO – 6
CO5	Analyse the growth and decay of transient currents in different electrical circuits	Understand	PSO – 6
CO6	Compare the properties of different ac circuits	Apply	PSO –3, 6

UNIT 1 – ELECTROSTATIC FIELD (10 hrs.) [Book 1 Chapter 2, 3 and 6]

Electric field: Introduction, Coulomb's law, Electric field, continuous distribution (Revision) Gauss's law, Integral form of Gauss's law, Electric field due to Some Symmetric Charge Distribution, Electric Potential Energy, Relation between E and V, Equipotential Surfaces and Field Lines, Potential Energy of a continuous charge distribution, Boundary conditions satisfied by an Electrostatic Field, Poisson's and Laplace's Equation, Potential at the centre of a sphere in a charge free region.

UNIT 2 – ELECTRIC FIELDS IN MATTER (10 hrs.) [Book 1 Chapter 8, 9]

Polar and Nonpolar molecules, Polarization P in a Dielectric Material, Bound and Free Charges, Bound Charge Density and Polarization, Electric Field due to a Uniformly Polarized Sphere, long and cylindrical dielectric, Displacement Field, Gauss's law in terms of displacement vector, Boundary conditions, Displacement Vector in a Linear Dielectric.

UNIT 3 – MAGNETOSTATICS AND ELECTROMAGNETIC INDUCTION (10 hrs.) [Book 1 Chapter 12, 13, 15, 17]

The Biot- Savart law, Ampere's force law (revision), Magnetic field due to a straight segment of a wire, force between two current carrying wires, Divergence of B, Ampere's law in integral form, Applications of Ampere's law, Boundary conditions on B, Magnetic Vector Potential Faraday's law, Induced Electric field, Integral form of Faraday's law, Induced emf.

UNIT 4 – ELECTROMAGNETIC WAVES (12 hrs.) [Book 1 Chapter 19, 20, 23, 25]

Maxwell's Equation, The Poynting Vector, The Poynting Theorem (Derivation not required), Electromagnetic waves, General Properties of EM waves, Energy in EM waves, Complex representation of EM Waves, Maxwell's equation in Material Medium, Linear Electric and Magnetic Materials, Displacement Current, Boundary conditions on Fields across a Surface, Reflection and Transmission of EM waves (Normal Incidence only). JC

UNIT 5 – TRANSIENT CURRENTS (6 hrs.) [Book 2 Chapter 12]

Growth and decay of current in LR and CR Circuits-Measurement of high resistance by leakage-Charging and discharging of a capacitor through LCR circuit.

UNIT 6 – ALTERNATING CURRENT (6 hrs.) [Book 2 Chapter 13]

AC through series LCR (acceptor circuit) and parallel LCR circuit (rejecter circuit)- Q- factor, Power in AC-power factor.

BOOKS FOR STUDY:

1. Classical Electromagnetism: H. C. Verma, Bharathi Bhavan Publishers.
2. Electricity and Magnetism: S. Murugesan, Chand & Co.

BOOKS FOR REFERENCE:

1. Electrodynamics: David J Griffith, PHI, 3rd Edn.
2. Electricity and Magnetism: Muneer H. Nayfeh & Norton K. Bressel, John Wiley & Sons
3. Electricity and Magnetism: E. M. Purcell, Berkley Physics course, Vol.2, MGH
4. Classical Electrodynamics: Walter Greiner, Springer International Edn.
5. Electromagnetics: B. B. Laud, Wiley Eastern Ltd., 2ndEdn.
6. Introduction to electrodynamics: Reitz & Milford Addison Wesley
7. Electricity and Magnetism: D. C. Tayal, Himalaya Publishing Co.
8. Electricity and Magnetism: K. K. Tiwari, S. Chand & Co.
9. Principles of electromagnetics: Matthew N.O Sadiku and S. V Kulkarni., Oxford University Press, 6th Edn.

Topics for discussion in Tutorial session/Assignments (sample)

1. Comment on how electrostatic energy is stored in a field

2. Discuss the electrostatic properties of conductors

3. What is meant by electrostatic shielding? In what way it helps us?

4. Discuss the peculiarities of electric displacement D and electric field E. How they are incorporated in Maxwell's Equations

5. Discuss the properties of linear dielectrics. What differentiates a dielectric to be linear or not?

6. Discuss applications of Ampere's circuital law

7. Compare electrostatics and magnetostatics

8. Why magnetic forces cannot do work

9. Discuss about cyclotron motion & cycloid motion

10. Discuss whether there exists any stand-off between ohm's law and Newton's second law

11. A battery has an emf. Can this emf. be a 'force'? How will you interpret electromotive force?

12. Discuss the role of motional emf in power generation

13. Discuss the orthogonality of E, B and propagation vector k

14. A wave function can have a sinusoidal representation. Solve the wave equation for this function and discuss the various terms related to a wave such as amplitude, frequency, phase, wave number.

15. Complex representation of wave function has good advantage. Why? Discuss the linearity of wave function (Use complex notation)

16. Discuss AC through LC, LR and CR circuits

17. Show that sharpness of resonance is equal to Q-factor

18. What is a choke coil? Discuss the advantage of using a choke coil instead of a resistor

PY1541: CLASSICAL, STATISTICAL AND RELATIVISTIC MECHANICS
(72 HOURS- 4 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO – 1	Recognize the mechanics of a single and a system of particles under different force fields	Understand	PSO – 1,8
CO – 2	Solve different mechanical problems in classical mechanics using Lagrangian formalism	Apply	PSO –3, 15
CO – 3	Generalize Hamiltonian mechanics to solve various problems in classical mechanics	Apply	PSO –3, 15
CO – 4	Able to define phase space, microstate, macrostate and ensemble	Understand	PSO – 1, 8
CO – 5	Learn to distinguish different statistical distributions and judge which distribution applies to a given system	Apply	PSO – 1, 3
CO – 6	Distinguish inertial and non- inertial frames of references	Understand	PSO – 1,6, 9
CO – 7	Understand the concept of Galilean and Lorentz Transformations and their applications	Understand	PSO – 1, 6

UNIT 1 - NEWTONIAN MECHANICS (4 hrs.) (Book 1 Chapter 2)

Newtons Laws, The equation of motion of a particle, Conservations theorems, Limitations of Newtonian mechanics

UNIT 2 - MOTION IN CENTRAL FORCE FIELD (12 hrs.) (Book 4 Chapter 5)

Reduction to one-body problem, General properties of central force motion, Motion in central force field, Inverse square law force, Kepler's laws.

UNIT 3 - LAGRANGIAN DYNAMICS (12 hrs.) (Book 2 Chapter 2)

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Constraints-generalized coordinates- principle of virtual Work-D' Alembert's principle, Lagrange's equation from D'Alembert's Principle-Newton's equation of motion from Lagrange's equations, applications of Lagrange's equation in simple pendulum, Atwood's machine and compound pendulum.

UNIT 4 - HAMILTONIAN DYNAMICS (12 hrs.) (Book 2 Chapter 3)

Generalized momentum and cyclic coordinates- Hamiltonian function conservation of energy- Hamilton's equation - examples of Hamiltonian dynamics: Equation of motion of i) one dimensional harmonic oscillator ii) particle in central force field

UNIT 5 - FRAMES OF REFERENCE, GALILEAN TRANSFORMATION AND SPECIAL THEORY OF RELATIVITY (14 hrs.) (Book 2 Chapter 12 and 13)

Inertial and non- inertial frame of reference- Galilean transformations- Ether Hypothesis- The Michelson-Morley experiment- explanation of negative result- postulates of special theory of relativity- Lorentz transformations - Consequences of Lorentz transformations- length contraction, simultaneity, time dilation, twin paradox, Addition of velocities- variation of mass with velocity (Derivation not needed) – mass energy relation.

UNIT 6 - STATISTICAL MECHANICS (18 hrs.) (Book 3)

Macro states and micro states, thermodynamic probability, Bose - Einstein statistics, Fermi - Dirac statistics, Maxwell - Boltzmann statistics, The statistical interpretation of entropy, The Bose - Einstein distribution function, the Fermi - Dirac distribution function, the classical distribution function, comparison of distribution functions for indistinguishable Particles, the Maxwell· Boltzmann distribution function

BOOKS FOR STUDY:

1. Classical dynamics of particles and systems: Thornton & Morion, 2008.
2. Classical Mechanics: J. C. Upadhyaya, Himalaya Publishing
3. Thermodynamics Kinetic Theory and Statistical Thermodynamics: F. W. Sears and G. L. Salinger, Addison-Wesley Publishing Company
4. Classical Mechanics - G. Aruldhas, PHI Learning Private Limited

BOOKS FOR REFERENCE:

1. Classical Mechanics: G. Aruldhas, PHI Learning Pvt Ltd., 2008.
2. Mechanics: H. S. Hans and S. P. Puri, Tata-McGraw HilL
3. Concepts of Modern Physics: Arthur Beiser, McGraw-Hill, 2009.
4. Heat Thermodynamics and Statistical Physics: Brij Lal and N. Subrahmanyam, P. S. Hemne, S. Chand, 2008.
5. Thermal and Statistical Mechanics: S. K. Roy, New Age International- 2001

6. Classical Mechanics: Goldstein.
7. Classical Mechanics Systems of Particles & Hamiltonian Dynamics: Walter Greiner, Springer, 2nd Edn.
8. An Introduction to Mechanics: D. Kleppner, R. J. Kolenkow, McGraw-Hill, 1973.
9. Mechanics, Berkeley Physics: C. Kittel W. Knight, et.al., Tata McGraw-Hill, vol.1, 2007
10. Introduction to Special Relativity: R. Resnick, John Wiley and Sons, 2005.
11. Statistical Mechanics: Kerson Huang
12. Statistical and Thermal Physics: S. Lokanathan and R. S. Gambhir, Prentice Hall, 1991.
13. Classical Mechanics: N. C. Rana & P. S. Joag

PY1542: CLASSICAL AND MODERN OPTICS

(72 HOURS-4 CREDITS)

CO No.	Upon completion of this course students will be able to	Cognitive Level	PSO NO.
CO – 1	Explain the different basic phenomena of light such as Interference, Diffraction, Dispersion and Polarization	Recognize	PSO – 1
CO –2	Differentiate between the two types of diffraction, viz., Fresnel and Fraunhofer diffraction	Identify	PSO – 1
CO –3	Apply diffraction theory in Rayleigh's criterion for resolution and in finding resolving power of diffraction grating	Apply	PSO – 1, 6, 9
CO –4	Distinguish between normal and anomalous types of dispersion and to derive region-specific dispersion formulae from the general dispersion relation	Understand	PSO – 1, 6, 9
CO –5	Understand the different methods for the production of plane polarized light and also the different rules governing polarization.	Understand	PSO – 1, 6, 9
CO –6	Have a good knowledge about the different types of polarizations, its theory and the production/analysis methods	Apply	PSO – 1, 6, 9
CO –7	Apply the concept of polarization in studying Nicol prism, quarter wave and half wave plates	Understand	PSO – 1, 6, 9
CO–8	Explain the basic constituents of a laser, different types and working	Apply	PSO – 1, 6, 9
CO –9	Obtain an idea about non-linear optical processes especially the different harmonic generations	Understand	PSO – 1, 6, 18
C –10	Gain knowledge about the principle and different types of optical fibers	Remember	PSO – 1, 6, 9
C –11	Understand the applications of optical fibers in different fields of science	Understand	PSO – 1, 6, 9

| C –12 | Have knowledge on the principles of holography, its production and different types | Understand | PSO – 1, 6, 9 |

UNIT 1 - INTERFERENCE (12 hrs.) (Book 1 Chapters 14, 15)

The principle of superposition – superposition of coherent and incoherent sources – Young's double slit interference (theory of interference fringes and band width) – conditions for sustained interference-interference by division of wavefront and amplitude –Fresnel's biprism-interference in thin films, classification of fringes-wedge shaped films-testing of optical flatness-colours in thin films- Newton's rings (reflected system)- determination of refractive index of a liquid

UNIT 2 - DIFFRACTION (14 hrs.) (Book 2 Chapter 3)

Diffraction-Huygens-Fresnel theory-Fresnel diffraction: Fresnel's assumptions - explanation of rectilinear propagation of light– zone plate-comparison between a zone plate and a convex lens-diffraction at a circular aperture, straight edge-Fraunhofer diffraction: - diffraction at a single slit, double slits – plane transmission grating (derivation not needed), grating law – prism and grating spectra- Resolving power- Rayleigh's criterion for resolution - resolving power of diffraction grating

UNIT 3 - DISPERSION (5 hrs.) (Book 2 Chapter 11, Book 3 Chapter 1)

Normal and anomalous dispersion – Cauchy, Hartmann, Sellmeier equations – Wood's experiment on anomalous dispersion – general dispersion formula

UNIT 4 - POLARIZATION (12 hrs.) (Book 1 Chapter 20)

Polarization -plane/linearly polarized light -polarization by reflection – Brewster's law - pile of plates-double refraction-Malus' law– optic axis- Huygen's explanation for double refraction in uniaxial crystals - Nicol prism-construction - Nicol prism as a polarizer and analyzer – quarter and half wave plates-Theory, production and analysis of plane, circularly and elliptically polarized light

UNIT 5 - LASER (14 hrs.) (Book 1 Chapter 22, Book 2 Chapter 12)

Laser beam characteristics-spatial and temporal coherence (qualitative ideas)-basic principle of laser operation-spontaneous emission-stimulated emission-Einstein's coefficients-light propagation through medium and condition for light amplification-population inversion-pumping and different pumping schemes-metastable states-optical resonant cavity (qualitative)-types of lasers: Ruby laser, He-Ne laser (construction and working)-applications of lasers-Non-linear optics (qualitative ideas only): non-linear polarization, second harmonic generation, phase matching.

UNIT 6 - FIBER OPTICS (8 hrs.) (Book 1 Chapter 24)

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Optical fiber: types of optical fibers (based on material, refractive index, modes), structure of an optical fiber, working principle-numerical aperture: definition, derivation of expression-acceptance angle-coherent, incoherent and fused bundles-pulse dispersion in step index and graded index fibers- losses in optical fibers (qualitative) - advantages and applications of optical fibers: fiber optic sensors (qualitative), fiber optic communication system (qualitative ideas with block diagram)

UNIT 7- HOLOGRAPHY (7 hrs.) (Book 1 Chapter 23)

Principle of holography- recording of holograms, reconstruction of images (Theory not needed) - comparison of hologram and photograph - application of holography, different types of holograms- transmission, reflection, volume, white light reflection, rainbow holograms.

BOOKS FOR STUDY:

1. Textbook of Optics: Subramaniam, Brijlal, M. N. Avadhanulu
2. Optics and Spectroscopy: R. Murugeshan
3. Basic Optics- Principles and Concept: Avijit Lahiri, Elsevier

BOOKS FOR REFERENCE:

1. Optics: Ajoy Ghatak
2. Lasers- Principles, Types and Applications: K. R. Nambiar
3. Lasers and Non-linear optics: B. B. Laud

PY1543: SEMICONDUCTOR DEVICES AND CIRCUITS

(72 HOURS-4 CREDITS)

Course Outcome:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the network theorems	Understand	PSO – 1
CO – 2	Describe diode characteristics	Understand	PSO – 9, 13
CO – 3	Design power supply circuits by applying junction diodes	Apply	PSO – 2, 13
CO – 4	Design single stage transistor amplifiers, oscillators and operational amplifiers.	Apply	PSO – 2,13
CO – 5	Understand the concept of modulation	Understand	PSO – 9, 14
CO – 6	Explain the working of special devices, FET, MOSFET, UJT	Understand	PSO – 9, 13

UNIT 1 - NETWORK THEOREMS (6 hrs.) (Book 1 Chapter 4)

Kirchhoff's current and voltage laws-ideal current and voltage source-Thevenin's Theorem-Equivalent circuit-Norton's Theorem-Equivalent Circuit-Maximum Power transfer theorem (Proof not required for theorems)

UNIT 2 - DIODES AND DC POWER SUPPLIES (12 hrs.) (Book 1 Chapters 13,15 and 17)

PN Junction-Depletion layer-Barrier Potential-Effect of temperature on barrier voltage-Forward biased PN Junction-Forward VI characteristics-Reverse Biased PN Junction-Reverse Saturation Current-Junction Breakdown-Zener Diode-VI characteristics-Zener diode as voltage stabilizer - Rectifiers: Half wave rectifier, Full wave rectifier and Full wave bridge rectifier (working, average value, form factor, PIV, ripple factor, efficiency)

Filter circuits-Types of filter circuits: series inductor filter, shunt capacitor, LC filter, pi filter (basic working only)

UNIT 3 - TRANSISTORS AND TRANSISTOR AMPLIFIERS (18 hrs.) (Book 2 Chapters 8, 9, 10 &11)

Transistor Fundamentals-transistor action-transistor connections-CB connection and characteristics-CE connection and characteristics-CC connection-Comparison of Transistor Connections-Relations between α, β and Υ

Transistor as an amplifier in CE arrangement-operation-analysis of collector currents-load line analysis-dc load line-operating point- cut off and saturation points-faithful amplification-transistor biasing-stabilization-stability factor-voltage divider bias and stability factor-Single stage CE amplifier circuit-phase reversal-load line analysis-voltage gain-frequency response and bandwidth

UNIT 4 - FEEDBACK AMPLIFIERS AND OSCILLATOR CIRCUITS (9 hrs.) (Book 1 Chapters 25 and 28)

Principle of Feedback Amplifiers-Negative and Positive Feedback-Gain of Negative Feedback- Advantages of Negative Feedback-Gain Stability-Increased Bandwidth-Decreased Distortion- Oscillator criterion- Hartley Oscillator- Colpitts oscillator- Phase shift Principle-Phase Shift Oscillator (Derivations not required)

UNIT 5 - MODULATION (9 hrs.) (Book 2 Chapter 16)

Need for modulation-Types of Modulation-Amplitude Modulation-Modulation Factor-Analysis of AM wave-Side bands and Frequencies in AM wave-Power in AM wave-Limitations of Amplitude Modulation-Frequency Modulation-Theory of Frequency Modulation-Comparison of FM and AM, Demodulation (definition only).

UNIT 6 - FIELD EFFECT TRANSISTORS (9 hrs.) (Book 1 Chapter 26)

Types of FET-JFET: Basic construction (n-channel & p-channel)-Theory of Operation-Static Characteristics -Drain characteristics without external bias and with external bias - Transfer Characteristics-Small Signal JFET Parameters-Advantages of FETs

UNIT 7- OPERATIONAL AMPLIFIERS (IC 741) (9 hrs.) (Book 3 Chapter 7)

Op Amp as a Differential Amplifier (Block Diagram) - Differential gain and common mode gain- common mode rejection ratio-Op Amp-Schematic Symbol and Pin Configuration-Inverting and Non-inverting inputs-Ideal Op Amp-Virtual Ground-Parameters of Op amp-inverting amplifier- non-inverting amplifier-summing amplifier-Difference Amplifier

BOOKS FOR STUDY:

1. Basic Electronics-Solid State: B. L. Theraja, S. Chand Ltd., 2005
2. Principles of Electronics: V. K. Mehta, S. Chand Ltd.,2005
3. Basic Electronics: Devices, circuits and IT fundamentals: Santiram Kal, PHI, 2010

BOOKS FOR REFERENCE:

4. Electronic Devices and Circuits: Theodore F. Bogart Jr., Universal Book Stall
5. Electronic Devices and Circuit theory: Robert Boylestad & Louis Nashelski, PHI,5th Edn.
6. Electronic Fundamentals & Applications: John D Ryder, PHI, 4thEdn.

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PY1544: ATOMIC AND MOLECULAR PHYSICS
(72 HOURS-4 CREDITS)

Course Outcome:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize different atomic models, their significances, properties, merits and demerits	Understand	PSO – 1, 6
CO – 2	Distinguish between atomic and molecular spectra and their relevant uses	Apply	PSO – 6, ,11
CO – 3	Understand the features of X- ray spectra	Understand	PSO – 12
CO – 4	Recognize different spectroscopic techniques	Understand	PSO – 12

UNIT 1 - VECTOR ATOM MODEL (12 hrs.) (Book1 Chapter 6)

Bohr's theory, correspondence principle- Somerfield's atom model and explanation of fine structure of H line in Balmer series of hydrogen atom. Limitation of Sommerfeld atom model Vector atom model-Various quantum numbers associated with vector atom model-, L.S and j.j couplings –application of spatial quantization- Pauli's exclusion principle - magnetic dipole moment of electron due to orbital and spin motion - Stern-Gerlach Experiment - Spin-Orbit coupling.

UNIT 2 - ATOMIC SPECTRA (14 hrs.) (Book1 Chapter 6)

Optical spectra-Spectral terms and notations - selection rules - intensity rule and interval rule - fine structure of sodium D lines – hyperfine structure - Zeeman effect - Larmor's theorem – quantum mechanical explanation of normal Zeeman effect. Anomalous Zeeman effect –Paschen-Back Effect-Stark effect.

UNIT 3 - X-RAYS (6 hrs.) (Book2 Chapter 7)

X-ray spectra - Characteristic X-ray spectrum - Moseley's law - Absorption of X-rays - X-ray absorption edges

UNIT 4 - MOLECULAR SPECTRA (28 hrs.) (Book2 Chapter 9)

Electromagnetic spectra-molecular energies-classification of molecules-rotational spectra of diatomic molecules-rotational energy levels-selection rules-rotational spectrum-isotope effect-bond length and atomic mass. Diatomic vibrational spectra-vibrational energy levels-selection rule-vibrational transitions-Rotation-Vibration transitions-IR spectrometer - Raman scattering-classical description of Raman scattering, quantum theory of Raman scattering-vibrational Raman

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spectra-diatomic molecules-polyatomic molecules-rotational Raman spectra Raman spectra - Electronic spectra sequences and progressions-Frank-Condon principle

UNIT 5 - RESONANCE SPECTROSCOPY (12 hrs.) (Book2 Chapter 9)

NMR principle-Resonance condition-NMR spectrometer-chemical shift-indirect spin Interaction- applications of NMR spectroscopy- ESR principle- Resonance condition spectrometer- hyperfine interaction – applications of ESR spectroscopy, Mossbauer spectroscopy principle -isomer shift

BOOKS FOR STUDY:

1. Modern Physics: R. Murugesan, S. Chand& Co., Reprint, 2008
2. Modern Physics: G. Aruldhas and P. Rajagopal, PHI, New Delhi, 2005

BOOKS FOR REFERENCE:

1. Atomic and Nuclear Physics: N. Subramaniam & Brijlal, S. Chand& Co.
2. Atomic Physics: J. B. Rajam, S. Chand& Co.
3. Concepts of Modern Physics: A. Beiser, TMH, New Delhi, 6thEdn.
4. Fundamentals of Molecular Spectroscopy: Banwell, TMH
5. Spectroscopy: Walker & Straw, Chapman & Hill.
6. Molecular Spectroscopy: G. Aruldhas, PHI, 2004
7. Atomic and Nuclear Physics: Dr. V. W. Kulkarni-Himalaya Publishing House

PY 1551 OPEN COURSE

(54 HOURS-2CREDITS FOR EACH COURSE)

PY1551.5: ENERGY PHYSICS

(54 HOURS, 2 CREDITS)

Course outcomes:

CO. No	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed.
CO – 1	Explain the principle of conversion of energy	Understand	PSO – 1, 9
CO – 2	Understand energy conservation policies	Understand	PSO – 1, 9
CO – 3	To obtain knowledge about non-conventional energy sources	Understand	PSO – 1, 9
CO – 4	Distinguish reliable and clean energy sources	Apply	PSO – 1, 9
CO – 5	Gain knowledge about energy storage	Apply	PSO – 1, 9

UNIT 1 - INTRODUCTION (7 hrs.) (Book 1 section 1.4 - 1.14)

Units and scales of energy - various forms of energy – renewable and conventional energy systems – comparison – coal, oil and natural gas – availability– applications – merits and demerits. Impact due to non-conventional energy sources – global warming, Approaches to Energy conservation - energy conservation policies of different Governmental bodies.

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UNIT 2 - SOLAR ENERGY (10 hrs.) (Book 1 section 2.6, 3.1-3.4, 3.7,3.8, 4.1-4.3, 4.2, 5.10-5.12)

Solar radiation measurements (qualitative only), solar energy collector, principle of the conversion of solar radiation in to heat, classification of different types of solar energy collectors (qualitative ideas only)- merits and demerits, Solar energy storage, solar heaters, solar cookers, solar water houses, merits and demerits of solar energy, Solar cell technology (basic principle only)

UNIT 3 - WIND ENERGY (9 hrs.) (Book 1 section 6.2, 6.5-6.8, 6.13)

Basic principle of wind energy conversion, basic components of wind energy conversion system (WECS), wind energy collectors. Applications of wind energy.

UNIT 4 - BIOMASS ENERGY (9 hrs.) (Book 1 section 7.1-7.5)

Biomass conversion process, photosynthesis, biogas generation and influencing factors, Gobar gas plants, wood gasification, ethanol from wood, merits and demerits of biomass as energy source.

UNIT 5 - ALTERNATIVE ENERGY SOURCES (9 hrs.) (Book 1 Section - 1.7 - 1.8, 8.1, 8.4, 8.13)

Geothermal energy sources, Applications of Geothermal energy, Energy from Oceans and Chemical energy resources: Ocean thermal energy Conversion, energy from waves and tides - basic ideas, nature, applications, merits and demerits.

UNIT 6 - CLEAN ENERGY AND STORAGE (10 hrs.) (Book 1 Section - 16.2-16.9 & 17.3)

Nuclear energy-nuclear fission and fusion (definition only)-nuclear reactors-nuclear energy policy of our nation.

Mechanical, Electrical, Chemical, Thermal and Biological storage. Primary and secondary cells-fuel cells (basics). Distribution of Energy.

BOOKS FOR STUDY:

1. Non – Conventional Energy Resources: G. D. Rai, Khanna Publishers, 2008.

2. Solar energy: G. D. Rai, 5th edition, 1995.

3. Solar Energy Fundamentals and application: H.P. Garg and J. Prakash,

Tata McGraw - Hill Publishing company Ltd., 1997.

BOOKS FOR REFERENCE:

1. Energy Technology: S. Rao and Dr. B. B. Parulekar., 2ndEdn, 1997.

2. Power Plant Technology: A. K. Wahil. 1993.

3. Solar energy: S. P. Sukhatme, Tata McGraw- Hill Publishing company Ltd., 1992.

PY 1641 SOLID STATE PHYSICS
(72 HOURS -4 CREDITS)

Course Outcomes:

CO No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO–1	Able to distinguish types of crystals according to their structure	Understand	PSO – 1, 6, 9
CO–2	Able to illustrate the concepts of unit cell and lattice of crystals	Apply	PSO – 1,6
CO–3	Able to discuss diffraction of X rays by crystals and to demonstrate its experimental techniques	Apply	PSO – 1, 2, 9
CO–4	Able to describe and evaluate mechanical, electrical and magnetic properties of metals	Understand	PSO – 1, 6, 9
CO–5	Learn to discuss and evaluate dielectric properties of materials	Apply	PSO – 1,9
CO–6	Able to discuss types of magnetic properties of materials	Understand	PSO – 1, 6,9
CO–7	Learn to explain different physical characteristics of superconductors	Understand	PSO – 1, 6, 9
CO–8	Able to illustrate theoretical formulation of superconductors	Apply	PSO – 1, 9

UNIT 1 - CRYSTAL STRUCTURE (18 hrs.) (Book 1 Chapter 1, 8)

Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors Lattice with a Basis – Unit Cell-Elements of symmetry Revision topics qualitative ideas only-Bravais Lattice -two and three dimensional- Miller Indices- X-ray Diffraction Bragg's Law- The Reciprocal Lattice- (Qualitative Ideas only) X- ray diffraction Experiment- Powder method- Laue Method (Experimental Techniques only)

UNIT 2 - CONDUCTION IN METALS- FREE ELECTRON MODEL (18 hrs.) (Book 1 Chapter 10)

Introduction-conduction electrons-Fermi Dirac Statistics-Electrical conductivity of metals-Relaxation time and mean free path- electrical conductivity and Ohm's Law Electrical resistivity of metals-Hall effect - failure of free electron model.

UNIT 3 - DIELECTRIC AND MAGNETIC PROPERTIES OF MATERIALS (20 hrs.) (Book 1 Chapter 14, 16)

Polarization- Local Electric Field at an Atom- Depolarization Field- Electric Susceptibility-Polarizability- Clausius-Mossotti Equation- Classical Theory of Electric Polarizability
Response of a substance to magnetic field- Classification of magnetic materials- Atomic Theory

of Magnetism- The origin of permanent magnetic moment-Classical Langevin Theory Diamagnetism - Sources of Para magnetism- Langevin Classical Theory of Para magnetism Ferromagnetism- The Weiss molecular Exchange field Curie temperature - Ferromagnetic Domains- Discussion of B-H Curve. Hysteresis and Energy Loss (qualitative ideas only)

UNIT 4 - SUPERCONDUCTIVITY (16 hrs.) (Book 1 Chapter 17)

Introduction- Sources of Superconductivity- Response of magnetic field- Critical Temperature Critical magnetic field-Meissner effect- Origin of Energy gap- Isotope effect- London's Equation London Penetration Depth-Coherence length-BCS theory- Normal Tunnelling-dc and ac Josephson Effect -high temperature super conductivity

BOOKS FOR STUDY:

1. Solid State Physics: M. A. Wahab, Narosa Publication, 2011
2. Elementary Solid-State Physics: M. Ali Omar, Pearson India, 1999
3. Elements of Solid-State Physics: J. P. Srivastava, Prentice-Hall of India, 2nd Edn., 2006

BOOKS FOR REFERENCE:

1. Introduction to Solid State Physics: Charles Kittel, Wiley India Pvt. Ltd., 8th Edn., 2004
2. Introduction to Solids: Leonid V. Azaroff, Tata Mc-Graw Hill, 2004
3. Solid State Physics: Neil W. Ashcroft and N. David Mermin, Cengage Learning, 1976
4. Solid State Physics: Rita John, McGraw Hill, 2014
5. Solid-State Physics: H. Ibach and H. Luth, Springer, 2009

PY 1642: NUCLEAR AND PARTICLE PHYSICS

(72 HOURS-4 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO Addressed
CO – 1	Identify nuclear constituents and general properties of nuclei	Understand	PSO – 1
CO – 2	Describe nuclear forces, phenomena of radioactivity & radiation Hazards	Understand	PSO – 1 ,6. 9
CO – 3	Distinguish different nuclear models	Understand	PSO –1. 6. 3

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CO – 4	Understand different types of nuclear reactions, fission & fusion energies and applications	Apply	PSO – 1,6
CO – 5	Recognize different particle detectors and accelerators	Understand	PSO – 1, 9
CO – 6	Classify elementary particles and relate their properties	Understand	PSO – 1, 9

UNIT 1 - GENERAL PROPERTIES OF NUCLEI (10 hrs.) (Book 1 Chapter 11, Book 2 Chapter 27)

Nuclear composition-Some nuclear properties-quantitative facts about size, mass, charge, density, spin and magnetic moment, electric quadrupole moments - nuclear stability-Segre chart, binding energy- average binding energy and its variation with mass number, main features of binding energy versus mass number curve, nuclear forces-properties, meson theory.

UNIT 2 - NUCLEAR MODELS (11 hrs.) (Book 1 Chapter 11, Book 2 Chapter 27)

Liquid drop model -comparison of nucleus with liquid drop-semi empirical mass formula and significance of various terms. Shell model-evidence for nuclear shell structure, nuclear magic numbers, basic assumptions of shell model, Collective model.

UNIT 3 - RADIOACTIVITY (12 hrs.) (Book 1 Chapter 12, Book 2 Chapter 31)

Basics of radioactivity-Law of Radioactive Disintegration, Unit of activity, half-life, mean life, properties of alpha, beta and gamma rays, Law of Successive Disintegration- Ideal equilibrium, transient and secular equilibrium, radioactive series, Radioactive Dating : The Age of the Earth, Alpha decay-basics of α-decay processes, α-ray spectra, Geiger Nuttall law, β -decay- βray spectra, positron emission, electron capture, neutrino hypothesis, Gamma decay- Gamma ray spectra, internal conversion.

UNIT 4 - NUCLEAR REACTIONS (6 hrs.) (Book 1 Chapter 12, Book 2 Chapter 34)

Types of Reactions, Conservation Laws, Q-value- reaction rate- reaction cross section- reaction mechanism-Concept of compound nucleus.

UNIT 5 - PARTICLE DETECTORS & ACCELERATORS (10 hrs.) (Book 1-Chapter 15, Book 2- Chapter 29 &30, Book 4- Chapter 13 (section 13.4))

Particle Detectors –GM counter, scintillation counter, Micro-pattern Gas Detectors: Gas Electron Multiplier (GEM) - Particle Accelerators- Linear accelerator, Cyclotron, Betatron, Synchrotron, Synchrocyclotron, LHC

UNIT 6 - NUCLEAR FISSION AND FUSION (13 hrs.) (Book 1 Chapter 12, Book 2 Chapter 32, 35 & 36)

Nuclear fission-energy released in fission-Bohr and Wheeler's theory-chain reaction - multiplication factor-critical size-atom bomb-nuclear reactors-breeder reactors-uses of nuclear

reactors. Nuclear fusion-sources of stellar energy-thermonuclear reactions-hydrogen bomb-controlled thermonuclear reactions-magnetic bottle-Tokamak- inertial confinement-nuclear power in India, Radiation Hazards-Radiation Levels for Safety, Radiation Protection Methods, Nuclear Disasters, Nuclear Waste Disposal.

UNIT 7 - PARTICLE PHYSICS (10 hrs.) (Book 1 Chapter 13, Book 2 Chapter 38 & 39)

Particle interactions- basic features- types of particles and its families-Symmetries and Conservation Laws-baryon number, Lepton number- Isospin- Strangeness - concepts of quark model & Standard model

BOOKS FOR STUDY:

1. Concepts of Modern Physics: A. Beiser, Tata McGraw-Hill, New Delhi, 6th Edn.
2. Modern Physics: R. Murugesan, S. Chand & Co., Reprint.2008
3. Modern Physics: G. Aruldhas and P. Rajagopal, PHI, New Delhi, 2005.
4. Gaseous Radiation Detectors: Fundamentals and Applications, Fabio Sauli, Cambridge University Press

BOOKS FOR REFERENCE:

1. Atomic and Nuclear Physics: N. Subramaniam and Brijlal, S. Chand & Co.
2. Nuclear Physics: S. N. Ghoshal, S. Chand & Co.
3. Introduction to Elementary Particles: D. Griffith, John Wiley & Sons
4. Nuclear Physics: Kaplan, Narosa publications
5. Introductory nuclear Physics: Kenneth S. Krane, Wiley India Pvt Ltd., 2008
6. Nuclear Physics an Introduction: S. B. Patel, New Age International (P) Ltd., 2nd Edn.
7. Nuclear Physics: D. C. Tayal, Himalaya Publishing House, 4thEdn.
8. Pattern Recognition, Tracking and Vertex Reconstruction in Particle Detectors: Rudolf Frühwirth, Are Strandlie, Particle Acceleration and Detection book series, Springer. Published with the support of the Austrian Science Fund (FWF): PUB 733-Z, https://doi.org/10.1007/978-3-030-65771-0
9. Radiation Detection and Measurement, G. Knoll Publisher: John Wiley, New York, ISBN: 0-471-07338-53rd Edn., 2000.

PY1643: QUANTUM MECHANICS
(72 HOURS-4 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the limitations of Classical Physics to explain certain physical phenomena	Understand	PSO –1,6, 9
CO – 2	Identify the quantum mechanical concepts applicable to Physical systems	Apply	PSO –1,6, 9
CO – 3	Apply the concepts of Quantum Mechanics to solve problems	Apply	PSO – 1, 9
CO – 4	Derive Equations of motion of Physical systems using quantum concepts	Apply	PSO – 1, 9

UNIT 1 - LIMITS OF CLASSICAL PHYSICS (20 hrs.) (Book 1, Sections A-E, Chapter 1, Book 2 Chapter 2)

Blackbody Radiation, Photoelectric Effect, Compton Effect, Electron Diffraction, Bohr Atom, Correspondence Principle.

UNIT 2 - WAVE PACKETS AND UNCERTAINTY RELATIONS (12 hrs.) (Book 2 Sections 3.1-3.4, 3.7-3.8, Book 4 Section 2.2,2.3,2.4)

De Broglie Waves, Wave Packets, Group and Phase Velocities, Uncertainty Principle and its applications

UNIT 3 - WAVEFUNCTION AND SCHRODINGER EQUATION (14 hrs.) (Book 3 Chapter 1.1-1.5, Book 1, Book 4 Chapter 3)
Schrodinger Equation, Statistical Interpretation, Expectation Values, Normalization of Wavefunction, Position and Momentum Operators.

UNIT 4 - SOME ONE-DIMENSIONAL SYSTEMS (26 hrs.) (Book 3 Sections 2.1, 2.2, 2.3 (only 2.3.2), 2.4, 2.6, Book 2 Section5.8)
Stationary States, Time-Independent Schrodinger Equation, Free Particle, Particle in (i) Infinite Square Well Potential and (ii) Finite Potential Well, Quantum Tunnelling, Harmonic Oscillator (by solving the differential equation)

BOOKS FOR STUDY:

1. Quantum Physics: Stephen Gasiorowicz, John Wiley and Sons.

2. Concepts of Modern Physics: Arthur Beiser, McGraw Hill. 6th Edn

3. Introduction to Quantum Mechanics: David J. Griffiths, Prentice Hall, 1995.

4. Quantum Mechanics: G. Aruldhas, PHI, 2nd Edn., 2002

BOOKS FOR REFERENCE:

1. Quantum mechanics: Concepts & Applications, N. Zettilli, Second Edition, Wiley
2. A Text book of Quantum Mechanics: P.M. Mathews & K. Venkatesan- McGraw Hill, 2nd Edn., 2010
3. Quantum Mechanics: Robert Eisberg and Robert Resnick, Wiley, 2nd Edn. 2002
4. Quantum Mechanics: Leonard I. Schiff, TMH, 3rd Edn., 2010
5. Quantum Mechanics: Eugen Merzbacher, John Wiley and Sons Inc.,2004
6. Quantum Mechanics: Walter Greiner, Springer,4th Edn., 2001
7. Quantum Mechanics: Bruce Cameron Reed, Jones and Bartlett, 2008.
8. Quantum Mechanics for Scientists & Engineers: D.A. B. Miller, Cambridge University Press, 2008
9. Shaum's outline series

PY1644: DIGITAL CIRCUITS AND COMPUTATIONAL PHYSICS

(72 HOURS- 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Explain different number systems and their mathematical operations.	Understand, Apply	PSO – 1
CO – 2	Differentiate different logic gates.	Understand	PSO -1, 9
CO – 3	Summarize digital circuits and their functions.	Analyse	PSO -1, 9
CO – 4	Develop and compile programs in Python.	Apply	PSO -2, 9, 19
CO – 5	Apply numerical methods to solve physical problems.	Apply, Evaluate	PSO –1, 2, 9

UNIT 1 - (18 hrs.) (Book 1 Chapter 2)

NUMBER SYSTEMS :-Decimal number system-binary number system-conversion of binary number to decimal and decimal number to binary-binary addition and subtraction-1's complement-2's complement-binary subtraction using 2's complement-signed arithmetic operation-conversion of real numbers-conversion of decimal fraction to binary fraction-binary coded decimal hexadecimal number system-conversion of hexadecimal number to decimal, decimal to hexadecimal, binary to hexadecimal and hexadecimal to binary-real or floating point representation of numbers-ASCII code.

UNIT 2 - (18 hrs.) (Book 2 Chapters 2, 6, and 8)

BOOLEAN ALGEBRA AND LOGIC GATES: - Logic gates AND, OR, NOT, NAND, NOR And Ex-OR gate-realization of other logic functions using NAND / NOR gates-tri state logic gate-Boolean laws- De-Morgan's Theorems-Simplification of Boolean equations using Boolean laws.
ARITHMETIC CIRCUITS: - Half adder-full adder-controlled inverter.
FLIP-FLOPS: - Flip-Flop, S-R Flip Flop, J-K Flip-flop, Master slave JK Flip- Flop.

UNIT 3 - COMPUTATIONAL PHYSICS (18 hrs.) (Book 3 Chapters 2,3,4 and 5)

About Python – Statements and Lines: one statement per line; multiple statements per line – Comments –Basic Data types (Literals and Operations): int type; float type; complex type; str type; bool type-Identifiers – Keywords – Variables – Print ( ), input ( ) and format ( ) functions – Control flow statements: Decision statements (if , if-else and nested if); Loops (while, for) – Terminating control – Lists: Definition; creating lists; accessing and counting list elements; searching elements within Lists (checking for existence, counting occurrences and locating elements; adding and deleting elements (appending elements, inserting elements, deleting elements using del, remove( ), pop( ) and clear( ); adding, multiplying and copying lists; operations on Lists [min( ), max( ), list reverse ( ), list .sort ( )] – Tuples: Definition; creating Tuples, accessing and counting Tuple elements; searching elements within Tuples (checking for existence, counting occurrences and locating elements); adding, multiplying and copying Tuples, operations on Tuples [min( ), max( ), sorted( )] – Comparison of Lists and Tuples.

UNIT 4 - COMPUTER ORIENTED NUMERICAL METHODS (18 hrs.) (Book 5 Chapters 3,5,6,8. Book 7 Chapter 4)

Solution to Numeric, Algebraic and Transcendental equations:-method of successive bisection to find the roots of an equation (include algorithm also)- Newton – Raphson iterative method-Forward and backward differences-Interpolation-Lagrange interpolation-Newton - Gregory forward interpolation-least square approximation of functions-linear regression-regression coefficients (Include algorithm also for linear regression) - Numerical differentiation using Newton's forward difference formulae- Numerical integration; Simpson's 1/3 rule; Trapezoidal rule.

BOOKS FOR STUDY:

1. Fundamentals of Microprocessors and Microcomputers: B. Ram, Dhanpat Rai Publications
2. Digital principles and Applications: Donald P. Leach, Albert Paul Malvino and Goutam Saha, TMH, New Delhi, 7th Edn.
3. Learning Python, B. Nagesh Rao, Cyber Plus Infotech Pvt Ltd., Bengaluru, India.
4. Fundamentals of Python -First Programs: Kenneth Lambert, Cengage Learning India Pvt Ltd, Delhi, India.
5. Numerical methods: Dr. V. N. Vedamurthy and Dr. N. Ch. S. N. Iyengar, Vikas Publishing House, Pvt Ltd, New Delhi, India.

6. Computer oriented numerical methods: V. Rajaraman, PHI Learning Pvt Ltd., Delhi, India.

7. Introductory methods of numerical analysis: S.S Sastry, PHI Learning Pvt Ltd., Delhi, India.

BOOKS FOR REFERENCE:

1. Python for Programmers: Paul Deitel and Harvey Deitel, Pearson India Education Services Pvt Ltd, Uttar Pradesh, India.

2. Introduction to Computing and Problem- Solving Using Python: E. Balaguruswamy, Mc Graw Hill India.

PY1661: ELECTIVE COURSES

(54 HOURS-2 CREDITS FOR EACH COURSE)

PY 1661.2: SPACE SCIENCE AND RESEARCH METHODOLOGY
(54 HOURS - 2 CREDITS)

Course outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addresse
CO – 1	Understand the structure of universe	Understand	PSO – 1,
CO – 2	Knowledge about evolution of stars	Understand	PSO – 1,
CO – 3	Gain knowledge about Earth's atmosphere	Understand	PSO – 1,
CO – 4	Understand research methodology, ethics in research, report writing and plagiarism	Understand Apply	PSO – 1, 9, 20

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UNIT 1 - UNIVERSE (8 hrs.) (Book 3)

Large Scale Structure of the Universe: Astronomy and Cosmology, Our Galaxy, Galaxy types, Radio sources, Quasars, Structures on the largest scale, Coordinates and catalogues of astronomical objects, Expansion of the Universe.

UNIT 2 - THE EVOLUTION OF STARS (12 hrs.) (Book 4)

Introduction, Classification of Stars: The Harvard classification, Hertzsprung – Russel diagram, Stellar evolution, White dwarfs, Electrons in a white dwarf star, Chandrasekhar limit, Neutron stars, Black holes, Supernova explosion, Photon diffusion time, Gravitational potential energy of a star, Internal temperature of a star, Internal pressure of a star

UNIT 3 - THE EARTH'S ATMOSPHERE AND MAGNETOSPHERE (16 hrs.) (Book 1, Book 2)

Nomenclature and temperature profile, Temperature distribution in the troposphere, Temperature of stratosphere, temperature of mesosphere and thermosphere, Temperature variability, The pressure profile, Scale height, Density variation. The Ionosphere: Effect on scale height, Ionospheric electric fields. The magnetic field of Earth, Earth's variable magnetic field, Solar activity and Earth's magnetic weather, solar wind interaction, Structure of the magnetosphere: Magneto tail and Plasma sheet, Plasma sphere.

UNIT 4 - RESEARCH METHODOLOGY (18 hrs.) (Book 5 Chapter1, 2, Book 6 Chapter 16, Book 7 Chapter 5)

Research - Objectives and motivation in research – different types of research – Various steps in a research process- criteria of good research.

Research Problem, selecting the problem, technique involved in defining a problem -

Thesis/ Report writing - preliminary section (Title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface acknowledgement), Main Text (abstract, introduction, experimental section, results and discussion), Conclusions, references, scope for future study.

Undesirable authorships - General responsibilities of authors.

BOOKS FOR STUDY:

1. Introduction to Space Science: Robert C Hymes, John Wiley & Sons Inc,. 1971.
2. Earth's Proximal Space: Chanchal Uberoi, Universities Press (India) 2000.
3. Introduction to Cosmology: J. V. Narlikar, Cambridge University Press, 1993.
4. Modern Physics: R. Murugeshan, KiruthikaSivaprasath, S.Chand& Company Ltd., 2007.
5. Research Methodology, methods and techniques: C R Kothari, New Age Publications
6. Fundamentals of Research Methodology and statistics: Yogesh Kumar Singh, New Age international Publications

7. Ethics in science education, research and governance: Edited by Kambadur Muralidhar, Amit Ghosh, Ashok Kumar Singhvi, Indian National Science Academy

BOOKS FOR REFERENCE:

8. Space Physics and Space Astronomy: Michael D Pappagiannis, Gordon and Breach Science Publishers Ltd, 1972.
9. Introduction to Ionosphere and magnetosphere: Ratcliffe CUP, 1972.
10. The Physics of Atmospheres: Houghton, Cambridge University Press
11. Introduction to Ionospheric Physics: Henry Rishbeth& Owen K. Garriot, Academic Press, 1969
12. Space Science: Louise K. Harra& Keith O. Mason, Imperial College Press, London, 2004.
13. Introduction to Space Physics: Kivelson and Russel
14. Introduction to Astrophysics: Baidyanadh Basu
15. Astrophysics: K. D. Abhayankar, University Press.

PRACTICAL
(Semester 4, External Examination)
PY1442- Basic Physics Lab
(Minimum 14 experiments to be done)

CO.NO.	Upon completion of this course, students will be able to	Cognitive Level
CO1	Familiarize with the precautions and steps of systematic recording of an experiment.	Understand, Apply
CO2	Understand multiple experimental techniques for determining physical quantities.	Understand, Apply
CO3	Develop skill in setting up of apparatus for accurate measurement of physical quantities.	Understand, Apply
CO4	Apply and illustrate the concepts of mechanics, heat and acoustic experiments	Understand, Apply

1. Fly Wheel - Moment of Inertia
2. Compound Bar Pendulum – Symmetric
3. Compound Bar Pendulum – Asymmetric
4. Uniform Bending---Y---Pin and Microscope
5. Uniform bending—Y- optic lever method
6. Non-uniform bending-Y-Optic lever& telescope
7. Rigidity modulus –Static torsion
8. Torsion pendulum I- By Torsional oscillations
9. Torsion pendulum I- By Equal masses
11. Kater's pendulum-Acceleration due to gravity
12. Melde's string-----Frequency of fork
13. Phase transition-determination of M.P of wax.
14. Determination of thermal conductivity of rubber
15. Lee's disc-determination of thermal conductivity of a bad conductor
16. Viscosity-Continuous flow method using constant pressure head.
17. Viscosity-Variable pressure head arrangement
18. Surface tension-Capillary rise
19. Sonometer-frequency of A.C
20. Kundt's tube-determination of velocity of sound.
21. Determination of m and Bh using deflection and vibration magneto meters.
22. Potentiometer-Resistivity.
23. Comparison of least counts of measuring instruments.
24. Evaluation of errors in simple experiments.

BOOKS FOR REFERENCE:

1. Yarwood and Wittle; Experimental Physics for Students, Chapman & Hall Publishers.
2. An advanced course in practical physics, Chathopadhyaya, Rakshit and Saha, New central agency, Kolkata.
3. A text book of practical physics, S. Viswanathan & Co., Chennai.
4. Advanced Practical Physics, B. L. Worsnop and H. T. Flint, Khosla Publishers, Delhi.

PY 1442.1: INDUSTRY BASED LAB
(Semester 4, Internal Examination)
(Minimum 6 experiments should be done)

Electronic & Electrical instrumentation and circuit design

CO. No	Upon completion of this course, students will be able to	Cognitive Level
CO –1	Design and construct variable dc power supply	Understand
CO – 2	Design and construct electrical circuits	Understand
CO – 3	Understand different transistor configurations and their Characteristics	Understand
CO – 4	Understand the working of clamper circuits	Understand, Apply

1. Design and construction of variable dc power supply (0-12V) using diodes, capacitors and IC 7812)
2. Make a two-socket electric extension board.
3. LED circuit design
4. Carey Foster's bridge – Resistivity
5. Potentiometer- Resistivity
6. Experiment to verify
    c) Kirchhoff's voltage law
    d) Kirchhoff's current law
9. Experiment to study time domain transient response of RC circuit.
10. Transistor characteristics: Common emitter configuration
11. Transistor characteristics: Common base configuration
12. Clamper circuits
    c) Positive clamping circuits
    d) Negative clamping circuits
13. Clipping circuits – to observe the clipping waveform in different clipping configuration.
14. Design and verification of transistor potential divider bias circuit.

6. OTDR Test (i) Setting up of OTDR (ii) Measuring Cable Span (iii) Measuring Attenuation Coefficient (iv) Connector/Splice Loss Measurement (v) Distance to Fault.
7. OTDR Trace Analysis and Optical Loss Budget in long distance optical links and FTTH networks.

PY1645: Advanced Physics Lab I
(Minimum 18 experiments to be done)

CO No	Upon completion of the course, students will be able to	Cognitive Level
CO 1	Understand how to use a spectrometer	Understand
CO 2	Obtain a practical understanding of the refraction of light by a prism	Understand, Apply
CO 3	Use basic laws to study the spectral and optical properties of the given prism and grating	Understand, Apply
CO 4	Understand the working of different electrical circuits and use it to determine different physical quantities	Understand, Apply

1. Spectrometer-A, D and n of a solid prism.
2. Spectrometer –Dispersive power and Cauchy's constants
3. Spectrometer Grating—Normal incidence- N & wavelength
4. Spectrometer-i-d curve
5. Spectrometer- Hollow prism
6. Liquid lens-refractive index of liquid and lens
7. Newton's Rings—Reflected system
8. Air wedge-diameter of a wire
9. Potentiometer-Calibration of ammeter
10. Potentiometer –Reduction factor of T.G
11. Potentiometer –Calibration of low range voltmeter
12. Potentiometer – Calibration of high range voltmeter
13. Thermo emf-measurement of emf using digital multimeter.
14. Carey Foster's Bridge-Resistivity
15. Carey Foster's Bridge-Temperature coefficient of resistance.
16. Mirror galvanometer-figure of merit.
17. BG- Absolute capacity of a condenser
18. Conversion of galvanometer into ammeter and calibration using digital Multimeter
19. Conversion of galvanometer into voltmeter and calibration using digital Voltmeter.

20. Circular coil-Calibration of ammeter.
21. Study of network theorems-Thevenin's & Norton's theorems and maximum power transfer theorem.
22. Circular coil-Study of earth's magnetic field using compass box.
23. Absolute determination of m and B_h using box type and Searle's type vibration magnetometers.
24. Searle's vibration magnetometer-comparison of magnetic moments.

BOOKS FOR REFERENCE:

1. Yarwood and Wittle; Experimental Physics for Students, Chapman &Hall Publishers
2. An advanced course in practical physics, Chathopadhyaya, Rakshit and Saha, New central agency, Kolkata.
3. A text book of practical physics, S. Viswanathan& Co., Chennai.
4. Advanced Practical Physics, B. L. Worsnop and H. T. Flint, Khosla Publishers, Delhi

PY1646: Advanced Physics Lab II

(Minimum 18 experiments to be done – 4 from Computational programming)

CO No	Upon completion of the course, students will be able to	Cognitive Level
CO 1	Understand the working of PN junction diodes, Zener diodes and their applications	Understand, Apply
CO 2	Understand the working of transistors and their applications	Understand, Apply
CO 3	Understand the working of operational amplifiers and their circuits	Understand, Apply
CO 4	Understand computational programming using Python and apply it to find the solution to different physical problems	Understand, Apply

ELECTRONICS

1. PN junction Diode (Ge & Si) characteristics-To draw the characteristic curves of a PN junction diode and to determine its ac and dc forward resistances.

2. Full wave (centre tapped) rectifier-To construct a full wave rectifier using junction diode and

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to calculate the ripple factor with and without shunt filter (10 readings for R_L 100 to 5000).

3. Full wave (centre tapped) rectifier-To construct a full wave rectifier using junction diode and to study effect of L, C, and LC filters on the ripple factor (for different R_L).

4. Bridge rectifier-To construct a bridge rectifier using junction diodes and to calculate the ripple factor with and without shunt filter (10 readings for R_L 100 to 5000).

5. Bridge rectifier- Dual power supply-To construct a dual power supply using bridge rectifier and measure the output voltages for different pair of identical load resistors.

6. Zener diode characteristics-To draw the I-V characteristic of a Zener diode and to find the break down voltage and the dynamic resistance of the diode.

7. Zener diode as a voltage regulator-To construct a voltage regulator using Zener diode and to study the output voltage variation (i) for different RL and (ii) for different input voltage with same R_L.

8. Transistor characteristics-CE-To draw the characteristic curves of a transistor in the CE configuration and determine the current gain, input impedance and output impedance.

9. Transistor characteristics-CB-To draw the characteristic curves of a transistor in the CB configuration and determine the current gain, input impedance and output impedance.

10. Single stage CE amplifier-To construct a single stage CE transistor amplifier and study its frequency response.

11. OP amp. IC741- Inverting amplifier-To construct an inverting amplifier using IC741 and determine its voltage gain.

12. OP amp. IC741- Non-inverting amplifier

To construct a non-inverting amplifier using IC741 and determine its voltage gain

13. OP amp. IC741- Differentiator-To construct an OP amp. Differentiator, determine its voltage gain and study the output response to pulse and square wave.

14. OP amp. IC741- Integrator-To construct an OP amp. Integrator, determine its voltage gain and study the output response to pulse and square wave.

15. Phase shift oscillator-To construct a phase shift oscillator using transistor and measure the frequency of the output waveform.

16. Logic gates- OR and AND-To verify the truth tables of OR and AND gates using diodes.

17. Logic gate- NOT-To verify the truth tables of NOT gate using a transistor.

18. Network theorems (Superposition, Thevenin's & Norton's theorems)

To verify the (i) Superposition, (ii) Thevenin's & (iii) Norton's theorems

19. RC-Filter circuits (Low pass)

To construct an RC –low pass filter circuit and to find the upper cut off frequency

20. RC-Filter circuits (High pass)-To construct an RC –high pass filter circuit and to find the lower cut off frequency.

COMPUTATIONAL PROGRAMMING (PYTHON)

21. Program to find square, cube, square root and factorial.

22. Program to find logarithm and anti-logarithm of a number.

23. Program to find the roots of a quadratic equation.

24. Program to find sin (x), cos (x), tan (x), cosec (x), sec (x), cot (x)

25. Program that classifies a given pair of coordinates as (a) the point is on the origin, (b) the point is on the x-axis, (c) the point is on the y-axis, (d) the point lies in which quadrant.

26. Program to print the sum of digits of a given number

27. Program to classify a given number as prime or not.

28. Program to generate all prime numbers till a given number.

29. Program to determine whether a number is a palindrome or not.

30. Program for implementation of least square fitting.

31. Program for implementation of Bisection method for solving equations

REFERENCES:

1. Basic electronics and linear circuits; N.N. Bhargava, D.C. Kulshreshtha, S.C.Gupta
2. OP- Amps and linear integrated circuits; Ramakant A. Gayakwad
3. Basic electronics; Santiram Kal
4. Basic electronics; B. L. Theraja
5. Principles of electronics; V. K. Mehta
6. A first course in Electronics; Anwar A. Khan, Kanchan K. Dey

II COMPLEMENTARY COURSES

SEMESTER 1
(MATHEMATICS MAIN)

PY1131.1 MECHANICS AND PROPERTIES OF MATTER
(36 HOURS- 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the dynamics of rigid bodies of different shapes and their applications	Understand, Apply	PSO – 1
CO – 2	Understand the basics of simple harmonic motion and mechanical waves and their applications	Understand	PSO – 1,9
CO – 3	Understand the concepts of moduli of elasticity and applications	Understand Apply	PSO – 1,9
CO – 4	Explain the properties of fluids such as surface tension and viscosity and their applications with examples	Understand Apply	PSO – 1,9

UNIT I - (28 hrs.)

DYNAMICS OF RIGID BODIES (7 hrs.) (Book 1 Chapter 8)

Theorems of MI with proof-Calculation of MI of bodies of regular shapes rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid sphere-Kinetic energy of a rotating body. Determination of MI of a fly wheel (theory only).

OSCILLATIONS AND WAVES (13 hrs.) (Book 1 Chapter 9, 11)

Examples of SHM oscillator-compound pendulum-determination of g -torsion pendulum-oscillations of two particles connected by a spring-vibration state of a diatomic molecule
Wave motion-general equation of wave motion-plane progressive harmonic wave - energy density of a plane progressive wave -intensity of wave and spherical waves-

MECHANICS OF SOLIDS (8 hrs.) (Book1 Chapter 12)

Bending of beams-bending moment-cantilever-beam supported at its ends and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity.

UNIT 2 - (8 hrs.)

SURFACE TENSION (5 hrs.) (Book1 Chapter 16)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger' method-equilibrium of a liquid drop over solid and liquid surfaces

VISCOSITY (3 hrs.) (Book2 Chapter 15)

Flow of liquid through a capillary tube-derivation of Poiseuille's formula -limitations-Ostwald's viscometer-variation of viscosity with temperature

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya, Ram Prasad & Sons
2. Elements of Properties of Matter: D.S. Mathur, S. Chand Publications,2014
3. Oscillations & Waves: K. Rama Reddy, S. Badami& V. Balasubramaniam (University Press)

SEMESTER 2
(MATHEMATICS MAIN)

PY1231.1: THERMAL PHYSICS AND STATISTICAL MECHANICS
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish the various process of heat transmission	Understand, Apply	PSO –1,9
CO – 2	Recognize the different thermodynamic processes	Understand	PSO – 1,9
CO – 3	Recognize the difference of petrol and diesel engines	Understand	PSO – 1,9
CO – 4	Obtain the concept of entropy and apply it to physical situations	Understand Apply	PSO – 1,9
CO – 5	Identify different statistical distribution	Understand Apply	PSO – 1,8

UNIT I - TRANSMISSION OF HEAT (14 hrs.) (Book 2)
Thermal conductivity and thermometric conductivity-Lee's disc experiment-Weidman and Franz law (statement only)-energy distribution in the spectrum of black body and results-Wien's displacement law-Rayleigh-Jeans law-their failure and Planck's hypothesis-Planck's law-comparison-solar constant-its determination-temperature of sun.

UNIT 2 - THERMODYNAMICS (9 hrs.) (Book 2)

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity Heat engines-Carnot's cycle -derivation of efficiency-petrol and diesel engine cycles-efficiency in these two cases-second laws of thermodynamics-Kelvin and Clausius statements.

UNIT 3 - ENTROPY (9 hrs.) Book 2

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second law in terms of entropy-calculation of entropy when ice is converted into steam.

UNIT 4 - STATISTICAL MECHANICS (4 hrs.) Book 5

Statistical probability-Macro and Microstates- Phase space-statistical ensemble-postulates of equal probability-Maxwell Boltzmann Distribution- velocity distribution

BOOKS FOR STUDY:

1. Heat and Thermodynamics: D. S. Mathur, S. Chand &Co.
2. Heat & Thermodynamics: N. Subramaniam & Brijlal, S. Chand & Co
3. Heat & Thermodynamics: W. Zemansky, McGraw Hill
4. Heat & Thermodynamics: C. L. Arora
5. Statistical Mechanics: Sinha (TMH).

SEMESTER 3
(MATHEMATICS MAIN)

PY1331.1: OPTICS, MAGNETISM AND ELECTRICITY
(54 HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Differentiate the optical phenomena - interference and diffraction	Understand, Apply	PSO – 1,9
CO – 2	Explain the principle behind the experiments -Newton's rings, air wedge and diffraction grating	Understand Apply	PSO – 1,9
CO – 3	Understand the working and application of laser in the field of Fiber Optics	Understand	PSO – 1,9
CO – 4	Distinguish different magnetic materials	Understand Apply	PSO – 1,6 9

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CO – 5	Attain knowledge about the theory of magnetism	Understand Apply	PSO – 1,6, 9
CO –6	Explain the production of ac and its characteristics and also about ac circuits	Understand	PSO – 1, 9

UNIT 1 - (36 hrs.) (Book 1)

INTERFERENCE (12 hrs.)

Analytical treatment of interference-theory of interference fringes and bandwidth. Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness . Newton's rings-reflected system-measurement of wavelength and refractive index of liquid.

DIFFRACTION (16 hrs.)

Phenomenon of diffraction-classification-Fresnel and Fraunhofer. Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge and circular aperture. Fraunhofer diffraction at a single slit, two slits and N slits (Derivation required only for single slit). Plane transmission grating-determination of wavelength.

LASER AND FIBRE OPTICS (8 hrs.)

Principle of operation of laser-population inversion-optical pumping-ruby laser applications of lasers. Light propagation in optical fibres-step index fibre-graded index fibre-applications. Fibre optic communication system.

UNIT 2 - (18 hrs.) (Book 2)

MAGNETISM (8 hrs.)

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability. Magnetic properties-diamagnetism, para magnetism, ferromagnetism-ant ferromagnetism. Electron theory of diamagnetism- ferromagnet domains.

ELECTRICITY (10 hrs.)

EMF induced in a coil rotating in a magnetic field-peak, mean, rms and effective values of A.C. Ac circuits-AC through RC, LC, LR and LCR series circuits-resonance-sharpness of resonance-power factor and choke coil-transformers.

BOOKS FOR STUDY:

1. A text book of optics – Brijlal & Subramaniam
2. Electricity and Magnetism – R. Murugeshan, S. Chand & Co Ltd.

SEMESTER 4

(MATHEMATICS MAIN)

PY1431.1: MODERN PHYSICS AND SEMICONDUCTOR PHYSICS
(54HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize different atomic models	Understand	PSO – 1,
CO – 2	Identify radioactive process and its applications	Understand Apply	PSO – 1,9
CO – 3	Understand the concepts Quantum Mechanics, Planck's hypothesis and applications	Understand Apply	PSO – 1, 9
CO – 4	Obtain the theoretical concept of working of various electronic circuits	Understand Apply	PSO – 1,9 13
CO – 5	Obtain the knowledge about basics of Digital electronics and its applications	Understand Apply	PSO – 1,9 13

UNIT 1 - (30 hrs.) Book 1

MODERN PHYSICS (20hrs)

Basic features of Bohr atom model-Bohr's correspondence principle -vector atom model-various quantum numbers-magnetic moment of orbital electrons -electron spin-Spin-Orbit coupling-Pauli's exclusion principle-

Atomic nucleus-basic properties of nucleus-charge, mass, spin, magnetic moment-binding energy and packing fraction-nuclear forces-salient features-radioactivity-radioactive decay-decay laws-decay constant-half life and mean life-radioactive equilibrium-secular and transient equilibrium-measurement of radioactivity.

QUANTUM MECHANICS (10 hrs.)

Inadequacies of classical physics-experimental evidences- quantum theory-Planck's hypothesis-foundation of quantum mechanics-wave function and probability density-Schrödinger equation-time dependent and time independent-particle in a potential box

UNIT 2 - (24 hrs.) Book 2

SEMICONDUCTOR DEVICCES (16 hrs.)

Current-voltage characteristics of a diode-forward and reverse bias-breakdown mechanism of p - n junction diode-Zener diode and its characteristics-half wave and full wave rectifiers-bridge rectifier-ripple factor, efficiency.

Construction and operation of a bipolar junction transistor-transistor configurations current

components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits- voltage divider bias. amplifier-basic features of an amplifier-gain, -frequency response and band width

NUMBER SYSTEMS AND LOGIC GATES (8 hrs.)

Number systems and codes-decimal numbers-binary arithmetic -1's and 2's compliment-decimal to binary conversion-octal numbers-hexadecimal numbers-binary coded decimal-digital codes- logic gates-NOT, OR, AND, NOR and NAND gates. Boolean algebra-Boolean operations -logic expressions-laws of Boolean algebra-de Morgan's theorem-Boolean expression for gate network- simplification of Boolean expression

BOOKS FOR STUDY:

1. Modern Physics – Murugesan, S. Chand& Co. Ltd.
2. Principles of Electronics – V. K. Mehta.

SEMESTER 1
(CHEMISTRY MAIN)

PY1131.2: ROTATIONAL DYNAMICS AND PROPERTIES OF MATTER
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Recognize the Rotational dynamics of rigid bodies of different shapes and their applications	Understand Apply	PSO – 1,9
CO – 2	Understand the basics of simple harmonic motion and mechanical waves and their applications	Understand	PSO – 1,9
CO – 3	Understand the concepts of moduli of elasticity and their applications	Understand Apply	PSO – 1,9
CO – 4	Explain the properties of fluids such as surface tension and viscosity and their applications with examples	Understand Apply	PSO – 1,9

UNIT 1 - (28 hrs.)

DYNAMICS OF RIGID BODIES (7 hrs.) (Book 1 Chapter 8)

Theorems of MI with proof -Calculation of MI of bodies of regular shapes- rectangular lamina, uniform bar of rectangular cross section, annular disc, circular disc, solid cylinder, solid sphere- KE of a rotating body-Determination of MI of a flywheel (Theory only)

OSCILLATIONS AND WAVES (13 hrs.) (Book 1 Chapter 9, 11)

Examples of S.H oscillator-compound pendulum-determination of g-torsion pendulum-oscillations of two particles connected by a spring-vibration state of a diatomic molecule-Wave motion-general equation of wave motion-plane progressive harmonic wave - energy density of a plane progressive wave -intensity of wave and spherical waves

MECHANICS OF SOLIDS (8 hrs.) (Book1 Chapter 12)

Bending of beams-bending moment-cantilever-beam supported at its ends-and loaded in the middle-uniform bending-experimental determination of Y using the above principles with pin and microscope-twisting couple on a cylinder-angle of twist and angle of shear-torsional rigidity.

UNIT 2 - (8 hrs.)

SURFACE TENSION (5 hrs.) (Book1 Chapter 16)

Excess of pressure on a curved surface-force between two plates separated by a thin layer of liquid-experiment with theory to find surface tension and its temperature dependence by Jaeger' method-equilibrium of a liquid drop over solid and liquid surfaces

VISCOSITY (3 hrs.) (Book2 Chapter 15)

Flow of liquid through a capillary tube-derivation of Poiseuille's formula -limitations-Ostwald's viscometer-variation of viscosity with temperature

BOOKS FOR STUDY:

1. Mechanics: J. C. Upadhyaya, Ram Prasad & Sons
2. Elements of Properties of Matter: D.S. Mathur, S. Chand Publications,2014
3. Oscillations &Waves: K. Rama Reddy, S.B. Badami & V. Balasubramaniam
   (University Press)

SEMESTER 2
(CHEMISTRY MAIN)

PY1231.2: THERMAL PHYSICS
(36 HOURS – 2 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Identify the process of diffusion	Understand	PSO – 1,9
CO – 2	Distinguish the various process of heat transmission	Understand Apply	PSO –1, 9
CO – 3	Recognize the different thermodynamic processes	Understand	PSO – 1,9
CO – 4	Recognize the difference of petrol and diesel engines	Understand	PSO – 1,9
CO – 5	Obtain the concept of entropy and apply it to physical situations	Understand Apply	PSO – 1,9

UNIT 1 – DIFFUSION (4 hrs.) (Book1 chapter 10)

Graham's law of diffusion in liquids-Fick's law-analogy between liquid diffusion and heat conduction-methods of estimating concentrations-determination of coefficient of diffusivity

UNIT 2 – TRANSMISSION OF HEAT (14 hrs.)

Thermal conductivity and thermometric conductivity – Lee's Disc experiment- Weidman and Franz law (statement only) -Radiation of heat-black body radiation-Kirchhoff's laws of heat radiation-absorptive power-emissive power-Stefan's law (no derivation) -energy distribution in the spectrum of black body and results-Wien's displacement law - Rayleigh-Jeans law-their failure and Planck's hypothesis -Planck's law-comparison-solar constant-temperature of sun

UNIT 3 – THERMODYNAMICS (9 hrs.)

Isothermal and adiabatic processes-work done-isothermal and adiabatic elasticity Heat engines-Carnot's cycle -derivation of efficiency-petrol and diesel engine cycles-efficiency in these two cases-second laws of thermodynamics-Kelvin and Clausius statements.

UNIT 4 – ENTROPY (9 hrs.)

Concept of entropy-change of entropy in reversible and irreversible cycles-principle of increase of entropy-entropy and disorder-entropy and available energy-T-S diagram for Carnot's cycle-second

in terms of entropy-calculation of entropy when ice is converted into steam.

BOOKS FOR STUDY:

1. The general Properties of matter: F. H. Newman & V. H. L. Searle
2. Heat & Thermodynamics: N. Subramaniam & Brijlal, S. Chand & Co
3. Heat & Thermodynamics: W. Zemansky, McGraw Hill
4. Heat & Thermodynamics: C. L. Arora.
5. https://archive.org/details/dli.ernet.16965/page/11/mode/2up

SEMESTER 3
(CHEMISTRY MAIN)

PY1331.2: OPTICS, MAGNETISM AND ELECTRICITY
(54 HOURS – 3 CREDITS)

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Differentiate the optical phenomena - interference diffraction and Polarization	Understand Apply	PSO – 1,9
CO – 2	Explain the principle behind the experiments -Newton's rings, air wedge and diffraction grating	Understand Apply	PSO – 1,9
CO – 3	Identify the phenomenon of polarization	Understand	PSO – 1,9
CO – 4	Understand the working and application of laser in the field of Fiber Optics	Understand	PSO – 1,9
CO – 5	Distinguish different magnetic materials	Understand Apply	PSO – 1,6 9
CO –6	Attain knowledge about the theory of magnetism	Understand Apply	PSO – 1,6, 9
	Explain the production of ac and its characteristics and also about ac circuits	Understand	PSO – 1, 9

UNIT 1 - (38 hrs.) (Book 1)

INTERFERENCE (11hrs)

Analytical treatment of interference-theory of interference fringes and bandwidth. Interference in thin films-reflected system-colour of thin films-fringes of equal inclination and equal thickness.

DIFFRACTION (13 hrs.)

Phenomenon of diffraction-classification-Fresnel and Fraunhofer. Fresnel's theory of approximate rectilinear propagation of light-Fresnel diffraction at a straight edge. Fraunhofer diffraction at a single slit- two slits and N slits (Derivation is required only for single slit). Plane transmission grating-determination of wavelength.

POLARISATION (8 hrs.)

Experiments showing the transverse nature of light-plane polarized light-polarization by reflection-Brewster's law-double refraction-Nicol prism-propagation of light in uni-axial crystals-positive and negative crystals-principal refractive indices, optical activity.

LASER AND FIBRE OPTICS (6 hrs.)
Principle of operation of laser-population inversion-optical pumping-ruby laser-applications of lasers. Light propagation in optical fibres-step index fibre-graded index fibre-applications.

UNIT 2 - (16 hrs.) (Book 2)

MAGNETISM (6 hrs.)

Magnetic properties of matter-definition and relation between magnetic vectors B, H and M. Magnetic susceptibility and permeability. Magnetic properties-diamagnetism-para magnetism, ferromagnetism-anti ferromagnetism. Electron theory of diamagnetism- ferromagnetic domains.

ELECTRICITY (10 hrs.)
EMF induced in a coil rotating in a magnetic field-peak, mean, rms and effective values of A.C. Ac circuits-AC through RC, LC, LR and LCR series circuits-resonance-sharpness of resonance-power factor and choke coil-transformers.

BOOKS FOR STUDY:

1. A text book of optics – Brijlal & Subramaniam
2. Electricity and Magnetism – R. Murugeshan, S. Chand & Co Ltd.

SEMESTER 4
(CHEMISTRY MAIN)

PY1431.2: ATOMIC PHYSICS, QUANTUM MECHANICS AND SEMICONDUCTOR PHYSICS
(54 HOURS – 3 CREDITS)
Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	Cognitive Level	PSO addressed
CO – 1	Distinguish different atom models	Understand	PSO – 1,
CO – 2	Obtain the theoretical aspects of different types of superconductors and its applications	Understand	PSO – 1,9

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CO-3	Understand the concepts Quantum Mechanics, Planck's hypothesis and applications	Understand Apply	PSO – 1,9
CO-4	Understand different Spectroscopic techniques	Understand	PSO – 1,9
CO-5	Obtain the theoretical concept of working of various electronic circuits	Understand Apply	PSO – 1,9
CO-6	Obtain the knowledge about basics of Digital electronics and its applications	Understand Apply	PSO – 1,9 13

UNIT 1 - ATOMIC PHYSICS (12 hrs.) Book 1

Basic features of Bohr atom model-Bohr's correspondence principle -vector atom model-various quantum numbers-magnetic moment of orbital electrons -electron spin-Spin-Orbit coupling-Pauli's exclusion principle-periodic table

UNIT 2 - SUPERCONDUCTIVITY (8 hrs.) Book 1

Properties of superconductors-zero electrical resistance- Meissner effect- electrical magnetic field-Type I and Type II superconductors-isotope effect-high temperature ceramic superconductors-applications of superconductors.

UNIT 3 - QUANTUM MECHANICS (14 hrs.) Book 1

Inadequacies of classical physics-experimental evidences-evidences for quantum theory-Planck's hypothesis-foundation of quantum mechanics-wave function and probability density-Schrodinger equation-time dependent and time independent-particle in a potential box

UNIT 4 - SPECTROSCOPIC TECHNIQUES (4 hrs.) Book 1

EM Spectrum- UV, Visible, IR, Radio and microwave regions-principle of various spectrometers used in specific regions of EM spectrum-absorption spectroscopy, emission spectroscopy

UNIT 5 – SEMICONDUCTOR DEVICES (12 hrs.) Book 2

Current-voltage characteristics of a diode -forward and reverse bias-breakdown mechanism of p -n junction diode-Zener diode and its characteristics-half wave and full wave rectifiers-bridge rectifier-ripple factor, efficiency.
Construction and operation of a bipolar junction transistor-transistor configurations current components-transistor characteristics-DC load line-Q point-AC load line transistor biasing-need for biasing-bias stabilization-biasing circuits-fixed bias, emitter feedback bias, voltage divider bias (qualitative study only). Transistor amplifier-basic features of an amplifier-gain, input and output resistances-frequency response and band width

UNIT 6 - NUMBER SYSTEMS AND LOGIC GATES (4 hrs.) Book 2

Number systems and codes-decimal numbers-binary arithmetic -1's and 2's compliment-decimal to binary conversion-octal numbers-hexadecimal numbers-binary coded decimal-digital codes. logic gates-NOT, OR, AND, NOR and NAND gates.

BOOKS FOR STUDY:

1. Modern Physics: R. Murugesan, S. Chand& Co. Ltd.
2. Principles of Electronics: V. K. Mehta.

COMPLEMENTARY PRACTICAL (PHYSICS)
(Common for all complementary subjects)

PY1432: Practical
List of Experiments (Minimum 18 experiments to be done)

1. Torsion Pendulum- n by torsional oscillations
2. Torsion Pendulum- n and I using equal masses
3. Fly Wheel
4. Cantilever- Y by pin and microscope method
5. Uniform bending- Y by pin and microscope
6. Symmetric bar pendulum - g and radius of gyration
7. Surface tension- capillary rise method
8. Coefficient of viscosity- capillary flow method
9. Specific heat-method of mixtures applying Barton's correction
10. Lee's disc- Thermal conductivity of cardboard
11. Melde's string- frequency of tuning fork
12. Method of parallax- optical constants of convex lens using
    i) mirror and mercury ii) mirror and water
13. 13.Method of parallax- refractive index of liquid.
14. Spectrometer- A, D and n
15. Spectrometer- dispersive power of a prism
16. Spectrometer- Grating-normal incidence
17. Deflection and vibration magnetometer- M and Bh
18. Circular coil- magnetization of a magnet
19. Carey Foster's bridge - Resistivity
20. Potentiometer- Resistivity
21. Potentiometer- Calibration of ammeter
22. Mirror galvanometer- Current and Voltage sensitivity
23. Diode Characteristics (for Ge and Si diodes)
24. Half wave rectifier-Measurement of ripple factor with and without filter capacitor
25. Full wave rectifier- Measurement of ripple factor with and without filter capacitor