(Applicable to the batch of students admitted in the academic year 2025-26 onwards)

B.Sc. Physics (CBCS) :: DEPARTMENT OF PHYSICS :: FACULTY OF SCIENCE, SU

B.Sc. (PHYSICS)

Syllabus (CBCS)

R-25 Regulations (w.e.f. 2025-2026)

FACULTY OF SCIENCE
DEPARTMENT OF PHYSICS
SATAVAHANA UNIVERSITY
KARIMNAGAR – 505002

2025-2026

B.Sc. (Physics) - I Year
Semester – I
Paper – I: Mechanics and Oscillations

Unit – I

Vector Analysis (5)
Scalar and Vector fields, Gradient of a Scalar field, Divergence and Curl of a Vector field and their physical significance and related problems. Vector integration, line, surface and volume integrals. Applications of Stokes', Gauss's and Green's theorems.

Mechanics of Particles and Rigid Bodies(7)
Laws of motion, motion of variable mass system, motion of a rocket, multi-stage rocket, parts of a rocket and their functions. Definition of Rigid body, rotational kinematic relations, equation of motion for a rotating body, angular momentum and inertial tensor. Euler's equation, precession of a top, Gyroscope.

Unit – II

Central Forces (7)
Central forces – definition and examples, conservative nature of central forces, conservative force as a negative gradient of potential energy, equation of motion under a central force, gravitational potential and gravitational field, motion under inverse square law, derivation of Kepler's laws.

Special theory of Relativity (7)
Galilean relativity, absolute frames, Michelson-Morley experiment, Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation. Concept of four vector formalism.

Unit – III

Oscillations(10)
Simple harmonic oscillator, and solution of the differential equation– Physical characteristics of SHM, torsion pendulum measurements of rigidity modulus, compound pendulum, measurement of g. Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance, velocity resonance.

Unit – IV

Waves(12)
Fundamentals of Waves -Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones, energy transport, transverse impedance.
Longitudinal vibrations in bars- wave equation and its general solution. Special cases (i) bar fixed at both ends ii) bar fixed at the mid point iii) bar free at both ends iv) bar fixed at one end. Transverse vibrations in a bar - wave equation and its general solution.

Note: *Problems should be solved at the end of every chapter of all units.*

Suggested Books for Reference:

1. Berkeley Physics Course. Vol.1, **Mechanics** by C. Kittel, W. Knight, M.A. Ruderman - *Tata-McGraw hill Company Edition 2008*.
2. **Fundamentals of Physics**. Halliday/Resnick/Walker *Wiley India Edition 2007*.
3. **First Year Physics** - *Telugu Academy*.
4. **Introduction to Physics for Scientists and Engineers**. F.J. Ruche. *McGraw Hill*.
5. **Sears and Zemansky's University Physics** by Hugh D. Young, Roger A. Freedman *Pearson Education Eleventh Edition*.
6. **Theory of relativity - Resnick**

7. **Fundamentals of Physics** by Alan Giambattista et al *Tata-McGraw Hill Company* Edition, 2008.
8. **University Physics** by Young and Freeman, *Pearson Education, Edition 2005*.
9. **An introduction to Mechanics** by Daniel Kleppner& Robert Kolenkow. *The McGraw Hill Companies*.
10. **Mechanics**. Hans &Puri. *TMH Publications*.

B.Sc. (Physics)- I Year
Semester – I
Paper – I: Mechanics and Oscillations practicals

1. Measurement of errors –simple Pendulum.
2. Calculation of slope and intercept of a Y= mX +C graph by theoretical method (simple pendulum experiment)
3. Study of a compound pendulum- determination of 'g' and 'k'.
4. Moment of Inertia of a fly wheel.
5. Rigidity moduli by torsion Pendulum.
6. Determine surface tension of a liquid through capillary rise method.
7. Determination of Surface Tension of a liquid by any other method.
8. Determine of Viscosity of a fluid.
9. Study of oscillations of a mass under different combination of springs-Series and parallel
10. Study of Oscillations under Bifilar suspension-Verification of axis theorems.
11. Verification of Laws of a stretched string (Three Laws).
12. Velocity of Transverse wave along a stretched string
13. Determination of frequency of a bar-Melde's experiment
14. Verification of Stokes, Gauss-Divergence and Green's theorem using simulation.
15. Experimental analysis of gyroscope using simulation.

***Note**: Minimum of eight experiments should be performed. Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.*

Suggested Books for Reference:

1. D.P. Khandelwal, "A laboratory manual for undergraduate classes" (Vani Publishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
4. "Practical Physics" R.K Shukla, Anchal Srivastava.

B.Sc. (Physics)- 1 Year
Semester - II
Paper - II: Thermal Physics

Unit - I

Kinetic theory of gases: (3)

Introduction - Deduction of Maxwell's law of distribution of molecular speeds, Transport Phenomena -Viscosity of gases - thermal conductivity - diffusion of gases.

Thermodynamics: (7)

Basics of Thermodynamics- Carnot's engine (qualitative)-Carnot's theorem -Kelvin's and Clausius statements - Thermodynamic scale of temperature - Entropy, physical significance - Change in entropy in reversible and irreversible processes - Entropy and disorder - Entropy of universe - Temperature- Entropy (T-S) diagram - Change of entropy of a perfect gas-change of entropy when ice changes into steam. Application of entropy in waste management.

Unit - II

Thermodynamic potentials and Maxwell's equations: (6)

Thermodynamic potentials - Derivation of Maxwell's thermodynamic relations - Clausius-Clapeyron's equation - Derivation for ratio of specific heats - Derivation for difference of two specific heats for perfect gas.

Low temperature Physics: (8)

Joule Kelvin effect - liquefaction of gas using porous plug experiment. Joule expansion - Distinction between adiabatic and Joule Thomson expansion - Expression for Joule Thomson cooling - Liquefaction of helium, Kapitza's method - Adiabatic demagnetization - Production of low temperatures - Principle of refrigeration, vapour compression type, Thermocouple- seebeck effect, Peltier effect and Thomson's effect.

Unit - III

Quantum theory of radiation: (12)

Black body-Ferry's black body - distribution of energy in the spectrum of Black body - Wein's displacement law, Wein's law, Rayleigh-Jean's law - Quantum theory of radiation - Planck's law - deduction of Wein's law, Rayleigh-Jeans law, Stefan's law from Planck's law. Measurement of radiation using pyrometers - Disappearing filament optical pyrometer - experimental determination - Angstrom pyro heliometer - determination of solar constant, effective temperature of sun.

Unit - IV

Statistical Mechanics: (12)

Introduction, postulates of statistical mechanics. Phase space, concept of ensembles and some known ensembles, classical and quantum statistics and their differences, concept of probability, Maxwell-Boltzmann's distribution law -Molecular energies in an ideal gas- Maxwell-Boltzmann's velocity distribution law (qualitative), Bose-Einstein Distribution law- application to Photon energy, Fermi-Dirac Distribution law- free electron gas, comparison of three distribution laws.

NOTE: Problems should be solved at the end of every chapter of all units.

Suggested Books for Reference:

1. Fundamentals of Physics. Halliday / Resnick/Walker.C. Wiley India Edition 2007
2. Second Year Physics- Telugu Academy.
3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath (For statistical Mechanics) S. Chand & co.
4. Modern Physics by G. Aruldas and P. Rajagopal, Eastern Economy Education.
5. Berkeley Physics Course. Volume-5. Statistical Physics by F. Reif. The McGraw-Hill companies.
6. An Introduction to Thermal Physics by Daniel V. Schroeder. Pearson Education Low Price Edition.
7. Thermodynamics by R. C. Srivastava, Subit K. Saha & Abhay K. Jain Eastern Economy Edition.
8. Modern Engineering Physics by A.S. Vasudeva. S. Chand & Co. Publications.
9. B.B. Laud "Introduction to statistical Mechanics" (Macmillan 1981).

B.Sc. (Physics) – I year
Semester - II
Paper – II: Thermal Physics Practicals

1. Co-efficient of thermal conductivity of a bad conductor by Lee's method.
2. Measurement of Stefan's constant.
3. Specific heat of a liquid by applying Newton's law of cooling correction.
4. Heating efficiency of electrical kettle with varying voltages.
5. Calibration of thermo couple
6. Cooling Curve of a metallic body
7. Resistance thermometer
8. Thermal expansion of solids
9. Study of conversion of mechanical energy to heat.
10. Determine the Specific heat of a solid (graphite rod)
11. Simulations for T-S doiagram

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2. S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
4. "Practical Physics" R.K Shukla, Anchal Srivastava

B.Sc. (Physics)- II year
Semester – III
Paper- III: Electromagnetic Theory

Unit 1: Electrostatics and Dielectrics (14hrs)

Electrostatics

Electric field:-Concept of electric field lines and electric flux, Gauss law (integral and differential forms), applications to linear, plane and spherical charge distributions. Conservative nature of electric field 'E', irrotational field. Electric potential: - concept of electric potential, relation between electric potential and electric field, potential energy of a system of charges. Energy density in an electric field. Calculation of potential from electric field for a spherical charge distribution.

Dielectrics

Dielectric properties of matter, Electric field in matter, polarization, polarization charge, electric susceptibility & dielectric constant, capacitors (Parallel, Spherical, Cylindrical plates) filled with dielectrics, Displacement vector D, Gauss Law in dielectrics, Relation of E, P & D.

Unit 2: Magnetostatics (12hrs)

Concept of magnetic field 'B' and magnetic flux, Biot-Savart's law, B due to straight current carrying conductor. Force on a point charge in a magnetic field. Properties of B, curl and divergence of B, solenoidal field. Integral form of Ampere's law, Applications of Ampere's law: field due to straight, circular and solenoidal currents. Energy stored in magnetic field. Magnetic energy in terms of current and inductance. Magnetic force between two current carrying conductors. Magnetic field intensity. Ballistic Galvanometer:Torque on a current loop in a uniform magnetic field, working principle of B.G., current and charge sensitivity, electromagnetic damping, critical damping resistance.

Unit 3:-Electromagnetic induction and Electromagnetic waves (10hrs)

Faraday's law of induction (differential and integral form), Lenz's law, self and mutual induction, Continuity equation, modification of Ampere's law, displacement current.

Maxwell's equations.Maxwell's equations in vacuum and dielectric medium, boundary conditions, plane wave equation. Transverse nature of EM waves, velocity of light in vacuum and in medium. Poynting's theorem.

Unit 4:-

Varying and Alternating currents (7)

Growth and decay of currents in LR, CR and LCR circuits- Critical damping, Alternating current, relation between current and voltage in pure R, C and L- vector diagrams- Power in ac circuits. LCR series and parallel resonant circuit- Q-factor. AC and DC motors- single, three phase (basics only). RC low pass, High pass filters.

Network Theorems (7)

Passive elements, power sources, Active elements, Network models: T and π Transformations, Superposition theorem, Thevenin's theorem, Norton's theorem. Reciprocity theorem and Maximum power transfer theorem (problems).

<u>Suggested Books for Reference:</u>

1. Fundamentals of electricity and magnetism By Arthur F. Kip (McGraw-Hill, 1968).
2. Telugu Academy.
3. Electricity and magnetism by J.H. Fewkes and John Yarwood, Vol.1 (Oxford Univ. Press, 1991).
4. Introduction to Electrodynamics, 3rd edition, by David J. Griffiths, (Benjamin cummings, 1998).
5. Electricity and magnetism by Edward M. Purcell (McGraw-Hill Education, 1986).
6. Electricity and magnetism by D.C. Tayal (Himalaya Publishing House, 1988).
7. Electromagnetics by Joseph A. Edminister 2nd edition (New Delhi: Tata McGraw Hill, 2006).

B.Sc. (Physics) – II year
Semester - III
Paper – III: Electromagnetic Theory Practicals

1. To verify the Thevenin's Theorem
2. To verify Norton's Theorem
3. To verify Superposition Theorem
4. To verify maximum power transfer theorem.
5. To determine a small resistance by Carey Foster's bridge.
6. To determine the (a) current sensitivity, (b) charge sensitivity, and (c) CDR of a B.G.
7. To determine high resistance by leakage method.
8. To determine the ratio of two capacitances by De Sauty's bridge.
9. To determine self-inductance of a coil by Anderson's bridge using AC.
10. To determine self-inductance of a coil by Rayleigh's method.
11. To determine coefficient of Mutual inductance by absolute method.
12. LR circuit
13. RC circuit
14. LCR series circuit
15. LCR parallel circuit

Note: Minimum of eight experiments should be performed.
Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

Suggested Books for Reference:

1. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
2. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal

B.Sc. (Physics) - II Year
Semester - IV
Paper - IV: Optics

Unit l: Interference: (11)

Principle of superposition - coherence - temporal coherence and spatial coherence - conditions for Interference of light.
Interference by division of wave front: Fresnel's biprism- determination of wavelength of light. Determination of thickness of a transparent material using Fresnel's biprism- Change of phase on reflection- Lloyd's mirror experiment.
Interference by division of amplitude: Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (Cosine law) - Colors of thin films - Non-reflecting films - interference by a plane parallel film illuminated by a point source - Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film) - Determination of diameter of wire-Newton's rings in reflected light with and without contact between lens and glass plate, Newton's rings in transmitted light (Haidinger Fringes) - Determination of wave length of monochromatic light .

Unit II: Diffraction: (11)

Introduction - Distinction between Fresnel and Fraunhofer diffraction, Fraunhofer diffraction: - Diffraction due to single slit and circular aperture - Limit of resolution - Fraunhofer diffraction due to double slit - Fraunhofer diffraction pattern with N slits (diffraction grating).
Resolving Power of grating - Determination of wavelength of light in normal and oblique incidence methods using diffraction grating.
Fresnel diffraction-Fresnel's half period zones - area of the half period zones -zone plate - Comparison of zone plate with convex lens - Phase reversal zone plate - diffraction at a straight edge - difference between interference and diffraction.

Unit III: Polarization (12)
Polarized light: Methods of Polarization, Polarization by reflection, refraction, Double refraction, selective absorption, scattering of light - Brewster's law - Malus law - Nicol prism polarizer and analyzer - Refraction of plane wave incident on negative and positive crystals (Huygens's explanation) - Quarter wave plate, Half wave plate - Babinet's compensator - Optical activity, analysis of light by Laurent's half shade polarimeter.

Unit-lV: LASERS and Holography (11)

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Construction and working of Semiconductor laser. Applications of Lasers.
Holography: Basic Principles of Holography- Recording of amplitude and phase- The recording medium- Reconstruction of original wave front- Image formation by wave front reconstruction. Gaber Hologram- Limitations of Gaber Hologram-Off axis Hologram- Fourier transforms Holograms- Volume Holograms, Applications of Holograms.

NOTE: Problems should be solved at the end of every chapter of all units.

Suggested Books for Reference:

1. Optics by Ajoy Ghatak. The McGraw- Hill companies.
2. Optics by Subramaniyam and Brijlak. S. Chand & Co.
3. Second Year Physics- Telugu Academy.
4. Modern Engineering Physics by A.S. Vasudeva. S. Chand & Co. Publications.
5. Fundamentals of Optics by Jenkin's A. Francis and White E. Harvey, McGraw Hill Inc.
6. K. Ghatak, Physical Optics
7. D.P. Khandelwal, Optical and Atomic Physics' (Himalaya Publishing House, Bombay, 1988).
8. Jenkin and White, 'Fundamental of Optics' (McGraw Hill).
9. Smith and Thomson, 'Optics' (John Wiley and sons).

B.Sc. (Physics) – II year
Semester - IV
Paper – IV: Optics Practicals

1. Thickness of a wire using wedge method.
2. Determination of wavelength of light using Biprism.
3. Determination of Radius of curvature of a given convex lens by forming Newton's rings.
4. Resolving power of grating.
5. Study of optical rotation-polarimeter.
6. Dispersive power of a prism
7. Determination of wavelength of light using diffraction grating minimum deviation method.
8. Wavelength of light using diffraction grating – normal incidence method.
9. Resolving power of a telescope.
10. Refractive index of a liquid and glass (Boys Method).
11. Pulfrich refractometer – determination of refractive index of liquid.
12. Wavelength of Laser light using diffraction grating.
13. To determine the wavelength of laser source using diffraction of single slit.
14. To determine the wavelength of laser source using diffraction of double slits.

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2. S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
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