Curriculum of
B.Sc. in Physics (2026-27)

Hassan University
Hemagangothri
Hassan

Hassan University

Prof. M. S. Chandrashekara
Chairman, BoS in Physics

Mobile: +91 94486 00121
Email:msc@physics.uni-mysore.ac.in

Proceedings of the Annual meeting of the Board of Studies in Physics (UG) held on Date: 10-07- 2026 and 13-07-2026 at Hemagangotri, Hassan University, Hassan.

Sl. No.	Name	Designation	Signature
1	Prof. M. S. Chandrashekara Professor, Department of Studies in Physics, University of Mysore, Manasagangotri, Mysuru.	Chairman	
2	Prof. Sheela M Professor, Department of Physics GFGCW, Holenarasipura.	Member	
3	Dr. Chandrashekara H.D Associate Professor, Department of Physics, HDDGFGC, Paduvalahippe, Holenarasipura.	Member	
4	Sri.Khaleel Ahmed Associate Professor, Department of Physics GFGCW, Holenarasipura.	Member	
5	Dr. Latha .N Assistant Professor, Department of Physics GFGCW, Hassan.	Member	

The meeting started with a welcome by the BoS Chairman.

1. The syllabus for All semesters B.Sc (Physics) UG program was prepared as per the university guidelines and approved.
2. Syllabus of elective papers for 3rd and 4th semesters is prepared and approved.
3. Question paper pattern for semester end examination is prepared.
4. Assessment method and distribution of marks for IA was discussed and approved.
5. Panel of examiners is prepared and approved.

13/7/26

B.Sc. (Physics) course pattern

2026–27

SI. No	Code	Course Title	HC/SC/ OE	No of hours	L	T	P	Credit value
First Semester								
1	PHY101	Mechanics and properties of matter	HC	48	3	0	0	3
2	PHY102	Physics practical 1	HC	64	0	0	2	2
Second Semester								
3	PHY201	Heat and thermodynamics	HC	48	3	0	0	3
4	PHY202	Physics practical 2	HC	64	0	0	2	2
Third Semester								
5	PHY301	Waves, acoustics and optics	HC	48	3	0	0	3
6	PHY302	Laser and fibre optics (Elective)	SC	32	2	0	0	2
7	PHY303	Physics practical 3	HC	64	0	0	2	2
Fourth Semester								
8	PHY401	Electricity and electromagnetism	HC	48	3	0	0	3
9	PHY402	Communication systems (Elective)	SC	32	2	0	0	2
10	PHY403	Physics practical 4	HC	64	0	0	2	2
11	PHY404	Physics practical 5 (Skill)[#]	SC	64	0	0	2	2
Fifth Semester								
12	PHY501	Classical mechanics, quantum mechanics and atomic spectroscopy	HC	48	3	0	0	3
13	PHY502	Nuclear and particle physics	HC	48	3	0	0	3
14	PHY503	Physics practical 6	HC	64	0	0	2	2
Sixth Semester								
15	PHY601	Relativity and solid state physics	HC	48	3	0	0	3
16	PHY602	Astrophysics and molecular spectroscopy	HC	32	2	0	0	2
17	PHY603	Physics practical 7	HC	64	0	0	2	2

[*]L Lecture; T Tutorial; P Practical.

[#] Skill paper may be offered during 4th or 5th or 6th semesters.

Course: B.Sc. Physics, Semester - 1

PHY101: Mechanics and properties of matter

Course category: Hard core (HC)

Number of Credits: 3, Course duration:48 Hours

Unit 1: 16 hours

Frames of Reference: Inertial and Non-inertial reference frames with examples. Uniform rectilinear motion in an inertial frame. Uniformly accelerated rectilinear motion-concept of fictitious force-illustration; plumb line accelerometer and a freely falling elevator. Qualitative discussion of centrifugal force, Coriolis force and earth as a non-inertial frame, Numerical problems. [4 hours]

Motion of a Point Particle: Point mass. The position vector $\vec{r}(t)$ of a moving point particle and its Cartesian components. Velocity and acceleration as the vector derivatives. Derivation of planar vector of a constant magnitude. Radial and transverse components of velocity and acceleration for arbitrary planar motion, deduction of results for uniform circular motion centripetal force, Numerical problems. [4 hours]

Rigid Body Dynamics: Moment of inertia and radius of gyration and statements of the theorems of the parallel and perpendicular Axes. Relation between torque and angular acceleration. Expression for kinetic energy of a rigid body. Calculation of moment of inertia of rectangular lamina (axis passing through the Centre – Perpendicular to length – Perpendicular to Breadth), circular lamina and of a solid cylinder. Theory of compound pendulum. Numerical problems. [8 hours]

Unit 2: 16 hours

Conservation of Linear Momentum: Conservation of the linear momentum for a system of two particles. Rocket motion in a uniform gravitational field (single stage rocket equation with and without gravity). Multistage rocket elementary ideas. Elastic and inelastic collisions – Elastic head-on collision, reduced mass. Numerical problems. [5 hours]

Conservation of Angular Momentum: Review of angular momentum and Torque. Relation between angular momentum and torque. Law of conservation of angular momentum. Areal velocity derivation $^{dA}/_{dt} = {}^{1}/_{2} r^2 \dot{\theta}\hat{n}$. Central force, Kepler's laws of planetary motion-Derivations using Newton's laws. Numerical problems. [6 hours]

Conservation of Energy: Conservative force and non-conservative forces with examples. Conservation of energy in a conservative force field. Applications:(i) Vertical oscillations of a loaded light spiral spring (Derivation) and (ii) Calculation of escape velocity in the gravitational field of the earth (Derivation). Conditions for a geo-stationary satellite. Numerical problems. [5 hours]

Unit 3: 16 hours

Elasticity: Concepts of moduli of elasticity, Hooke's Law, and Poisson's ratio σ. Relation between the elastic constants q, k, η and σ, limiting values for σ. Work done in stretching. Bending moment. Theory of light single cantilever. I-section girders. Torsion – calculation of couple per unit twist. The Torsional pendulum, Static torsion, Searle's double bar experiment. Numerical problems. [8 hours]

Fluid Mechanics: Ideal fluid, equation of continuity, Bernoulli's theorem and applications of Bernoulli's equation-curved flight of a spinning ball -Magnus effect, the lift on an aircraft wing.

Streamline flow and turbulent flow. Critical velocity and Reynolds number. Viscosity-Variation of viscosity of liquids with temperature and pressure. Numerical problems.

[4 hours]

Surface Tension: Surface Energy and Surface Tension-examples. Pressure inside curved liquid surface, excess of pressure inside a soap bubble. Angle of contact. Surface tension and interfacial tension by drop-weight method. Numerical problems.

[4 hours]

Learning resources:

1. Halliday D, Resnick R, and Walker J, Principles of Physics, 9th Edition, Wiley India Pvt. Ltd. (2013).
2. Upadhyaya J C, Classical Mechanics, 2nd Edition, Himalaya Publishing House (2017).
3. Arora C L, and Hemne P S, Physics for Degree Students, Revised Edition, S Chand and Company (2012).
4. Charles Kittel, and Walter Knight, Berkeley Physics Course, Mechanics Vol. 1, 2nd Edition, Tata McGraw Hill (2011).
5. Arora C L, Refresher Course in B.Sc. Physics Vol. 1, Revised Edition, S Chand and Company (2008).
6. Mathur D S, Elements of Properties of Matter, S Chand and Company (2007).
7. Mathur D S, Mechanics, S Chand and Company (2007).
8. BrijLal, and Subrahmanyam N, Properties of Matter, 6th Edition, S Chand and Company (2002).
9. Shankara Narayana S R, Mechanics and Properties of Matter, 2nd Revised Edition, Sultan Chand and Sons (1998).
10. Tewari K K, Electricity and Magnetism, S Chand and Company (2007).
11. BrijLal, and Subrahmanyam N, A Text Book of Electricity and Magnetism, 19th Edition, Ratan Prakashan Mandir (2016).
12. Gaur R.K and S.L Gupta, Engineering Physics, Dhanpant Rai Publications, 8th Edition (2001).

Course: B.Sc. Physics, Semester - 1

PHY102: Physics Practical 1

Course category: Hard core (HC)

Number of Credits: 2; Course duration: 64 Hours

Any EIGHT of the following experiments:

1. Bar pendulum: Determination of the acceleration due to gravity and radius of gyration (graphical method).
2. Fly wheel: Determination of moment of inertia, mass and density.
3. Drop weight method: Determination of surface tension of liquid and interfacial tension between two liquids.
4. Young's modulus: Single cantilever method using travelling microscope
5. Searle's double bar: Determination of Young's modulus, rigidity modulus and Poisson's ratio.
6. Torsional pendulum: Determination of the rigidity modulus.
7. Determination of the Young's modulus by dynamic method (using graph).
8. Spiral spring: Determination of the acceleration due to gravity and unknown mass (graphical method).
9. Determination of radius of gyration and moment of inertia of a rectangular body in three different axes.
10. Stokes' method: Determination of coefficient of viscosity of viscous liquids.
11. Determination of rigidity modulus by the static-torsion method.
12. Determination of Young's modulus by the method of uniform bending.

Course: B.Sc. Physics, Semester - 2

PHY201: Heat and thermodynamics

Course category: Hard core (HC)

Number of Credits: 3; Course duration: 48 Hours

Unit 1: 16 hours

Kinetic theory of gases: Maxwell's law of distribution of molecular velocity (no derivation); its interpretation. Degrees of freedom. Principle of equipartition of energy based on Kinetic theory of gases. Derivation of U = 3/2 RT. Mean free path, expression for mean free path. Real gases, Andrew's isothermals, Van der Waals equations – expression for critical constants, calculation of mean velocity, most probable velocity and RMS velocity. Numerical problems. [8 hours]

Thermal conductivity: Equation for the flow of heat through a solid bar. Determination of thermal conductivity of a bad conductor by Lee and Charlton method. Numerical problems. [2 hours]

Statistical physics: The Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac energy distribution formulae (no derivation). A qualitative comparison of the MB, BE and FD statistics and their applications. [2 hours]

Radiation: Planck's quantum theory of radiation. Induced and spontaneous emission of radiation. Derivation of Planck's law of radiation using Einstein's A and B coefficients. Deduction of Rayleigh-Jeans law, Stefan's law and Wein's displacement law from Planck's law. Numerical problems. [4 hours]

Unit 2: 16 hours

Thermodynamics: Review of basic concepts of heat and temperature - the zeroth law of thermodynamics. Differential form of the first law of thermodynamics, work done in an isothermal and adiabatic process for an ideal gas (Derivations). Second law of thermodynamics (Kelvin's & Clausius' statements and their equivalence), Reversible and irreversible processes with examples.

Carnot theorem (statement and proof). Carnot cycle and its efficiency (derivation).Carnot Engine. Refrigerator-Coefficient of performance. First order Phase Transitions with examples. Clausius-Clapeyron first latent heat equation. Numerical problems. [10 hours]

Entropy: The concept of entropy. Change of entropy in reversible and irreversible cycles. Second law of thermodynamics in terms of entropy. Entropy of ideal gas, entropy of steam and mixtures. T-S diagram. Third law of thermodynamics - statement, significance and unattainability of absolute zero. Microscopic interpretation of entropy (Boltzmann relation). Numerical problems. [6 hours]

Unit 3: 16 hours

Thermodynamic potentials and maxwell's thermodynamic relations: Internal Energy, Enthalpy, Helmholtz function, Gibbs function, relations among these functions, Gibbs-Helmholtz Equations. Derivation of Maxwell's thermodynamic Relations (using Thermodynamic Potentials). TdS equations for C_p and C_v. Derivation of C_p-C_v=R using Maxwell's Relations. Numerical problems.

[6 hours]

Low temperature physics: Ideal gas and real gas. Van der Waals equation of state. Porous plug experiment and its theory. Joule-Thomson expansion, expression for the temperature of inversion, inversion curve. Relation between Boyle temperature, temperature of inversion and critical temperature of a gas. Principle of regenerative cooling. Adiabatic demagnetization. Cryogenics and its applications (qualitative). Numerical problems. [6 hours]

Vacuum technology: Introduction with basic definitions and units, Exhaust pump and their characteristics, Measurement of low pressure, Pirani gauge. Numerical problems.

[4 hours]

Learning resources:

1. Halliday and Resnick: Fundamentals of Physics, 9th Edition, Wiley India, 2011.
2. Dittaman R H. and Zemansky M. W.: Heat and Thermodynamics, 7th Edition, The McGraw-Hill companies, 2007.
3. Blundell S. J. and Blundell K. M: Concepts in Thermal Physics, 2nd Edition, Oxford University Press, 2006.
4. Brijlal,N. Subramanyam P.S. Hemne: Heat Thermodynamics and Statistical Physics, 1st Edition. S Chand Publishing, 2007.
5. Gupta S C: Thermodynamics, 1st Edition, Pearson, 2005.
6. Satya Prakash: Optics and Atomic Physics, 11th Edition, Ratan Prakashan Mandir, 1994.
7. Arora C. L.: Refresher Course in Physics Vol I, S Chand publishing, 2011.
8. Shankara Narayana S. R.: Heat and Thermodynamics, 2nd Edition, Sulthan Chand and Sons, 1990.
9. Gaur R.K and S.L Gupta, Engineering Physics, DhanpantRai Publications, 8th Edition (2001).

Mark W. Zemansky, Heat and Thermodynamics, Tata McGraw Hill, 7th Edition (1997)..

Course: B.Sc. Physics, Semester - 2

PHY202: Physics practical 2

Course category: Hard core (HC)

Number of Credits: 2; Course duration: 64 Hours

Any EIGHT of the following experiments:

1. Verification of Gaussian distribution and calculation of standard deviation-Monte Carlo experiment.
2. Specific heat by Newton's law of cooling-graphical method.
3. Determination of thermal conductivity of a bad conductor by Lee-Charlton method.
4. Coefficient of thermal conductivity of copper by Searle's apparatus.
5. Verification of Clausius–Clapeyron equation and determination of specific enthalpy.
6. Verification of Stefan-Boltzmann law using a meter bridge or a potentiometer.
7. Determination of Solar constant.
8. Determination of the value of the mechanical equivalent of heat(J) by electrical method
9. Determination of boiling point of a liquid by using a platinum resistance thermometer.
10. Dice experiment - Randomocity verification.
11. Determination of temperature coefficient of resistance of a platinum resistance thermometer.
12. Mechanical Equivalent of Heat by Callender and Barne's method.

Course: B.Sc. Physics, Semester - 3

PHY301: Waves, acoustics and optics

Course category: Hard core (HC)

Number of Credits: 3; Course duration: 48 Hours

Unit 1:16 hours

Waves: Plane and spherical Waves. Longitudinal and transverse waves. Characteristics of wave motion. Differential equation of wave motion. Relation between amplitude and intensity. Group and phase velocity, relation between group and phase velocity. Expression for velocity of progressive waves in a medium -Newton's formula, Laplace's correction. Expression for frequency of vibration of a stretched string – harmonics, longitudinal vibrations in a rod. Numerical problems. [8 hours]

Simple harmonic motion: Superposition of two perpendicular simple harmonic motions of equal frequency- Lissajous' figures. Equation for damped vibrations. Forced vibration-solution in exponential form. Resonance-expression for amplitude and phase at resonance. Numerical problems. [5 hours]

Analysis of complex waves: Fourier theorem. Evaluation of Fourier co-efficient. Analysis of square wave and saw tooth wave. [3hours]

Unit 2:16 hours

Acoustics: Noise and music, limits of human audibility, intensity and loudness, bel and decibel, the acoustics of halls, absorption coefficient, Reverberation and reverberation time, Sabine's reverberation formula (derivation), Factors affecting acoustics in buildings, requisites for good acoustics. Ultrasonics: properties, production of ultrasonic waves-piezoelectric method, detection of ultrasonic waves. Determination of velocity of ultrasonic waves in liquids-acoustic grating. Applications of ultrasonics. Numerical problems. [8 hours]

Velocity of light: Kerr cell, Kerr effect. Determination of velocity of light by Kerr cell method. Numerical problems. [2 hours]

Interference: Review of basic concepts, coherent sources. Interference by division of wave front – theory of Fresnel's biprism, Interference by division of amplitude-thin films of uniform thickness. Newton's rings. Interference at a wedge. Michelson's interferometer - Measurement of λ and $d\lambda$. Numerical problems. [6 hours]

Unit 3:16 hours

Diffraction: Fresnel and Fraunhofer diffraction. Explanation of rectilinear propagation of light. Theory of the zone plate. Comparison with a convex lens. Fresnel diffraction at a straight edge. Fraunhofer diffraction at a single slit. Transmission grating-theory for the case of normal incidence, Resolving power and dispersive power of plane grating. Numerical problems. [8 hours]

Polarization: Double refraction in uniaxial crystals. Huygen's theory. Positive and negative crystal. Principal refractive indices. Huygen's constructions of O and E wave fronts in a uniaxial crystal – (i) optic axis in the plane of incidence and parallel to the crystal surface at normal incidence, (ii) optic axis in the plane of incidence and perpendicular to the crystal surface at normal incidence. Retarding plates. Production and analysis of linearly, Circularly and elliptically polarized light. Optical activity, Fresnel's theory of rotatory polarization. Numerical problems. [8 hours]

Learning resources:

1. Halliday, D., Resnick, R., & Walker, J. (2014). *Fundamentals of physics* (10th ed.). Wiley. United States.
2. Subrahmanyam, N., & Lal, B. (2018). *Waves and oscillations* (2nd ed.). Vikas Publishing House. India.
3. Mittal, P. K., & Anand, J. D. (2007). *A textbook of sound*. Har-Anand Publications. India.
4. Kalsi, H. S. (2012). *Electronic instrumentation* (3rd ed.). McGraw-Hill Education India. India.
5. Bhattacharya, A. B., & Bhattacharya, R. (2020). *Undergraduate physics: Volume I*. The Info Library. India.
6. Subrahmanyam, N., Lal, B., & Avadhanulu, M. N. (2006). *A textbook of optics* (24th rev. ed.). S. Chand & Company Ltd. India.
7. Khanna, D. R., Gulati, H. R., & Kumar, A. (2021). *Fundamentals of optics* (15th ed.). R. Chand & Co. India.
8. Murugeshan, R., & Sivaprasath, K. (2010). *Optics and spectroscopy* (17^{th} rev. ed.). S. Chand & Company Ltd. India.

Course: B.Sc. Physics, Semester - 3

PHY302: Laser and fiber optics

Course category: Soft core (SC) (Elective)

Number of Credits: 2; Course duration: 32 Hours

Unit 1:16 hours

Laser basics: Coherence properties of laser light, temporal coherence, monochromaticity, spatial coherence, directionality, line width, divergence, line shape broadening, laser modes, axial and transverse, mode selection, single mode operation, selection of laser emission line, Numerical problems.

Laser oscillator: Pumping schemes, gain, threshold conditions; optical resonators. Numerical problems.

Types of lasers: Construction and principles of working of Ruby Laser, CO_2 and semiconductor laser.

Laser diodes: Lasing conditions and gain in a semiconductor, selective amplification and coherence, materials for laser diodes, quantum well lasers, surface emitting lasers, characterization and modulation of lasers. Numerical problems. **16 Hours**

Unit 2:16 hours

Fiber optics and dielectric wave guides: Waveguide – slab wave guide, modes, V number, modal material and waveguide dispersions, Numerical problems.

Optical fiber: Types, functions, light propagation, optical power, velocity of propagation, critical angle, acceptance angle, numerical aperture, mode of propagation. Numerical problems.

Index profile: Single mode step-index optical fiber, multimode step-index fiber, graded index fiber; advantages and disadvantages. Numerical problems.

Energy losses in optical fiber: Bit rate, dispersion optical fiber communication, and optical bandwidth, absorption, bending and scattering, **16 Hours**

Learning resources:

1. Kinsler, L. E., Frey, A. R., Coppens, A. B., & Sanders, J. V. (2000). Fundamentals of acoustics (4th ed.). Wiley. United States.
2. Wilson, J., & Hawkes, J. F. B. (1998). Optoelectronics: An introduction (3rd ed.). Prentice Hall. United Kingdom.
3. Singh, J. (1996). Optoelectronics: An introduction to materials and devices. McGraw-Hill. United States.
4. Bhattacharya, P. (1997). Semiconductor optoelectronic devices (2nd ed.). Prentice Hall. United States.
5. Nambiar, K. R. (2004). Lasers: Principles, types and applications. New Age International. India.
6. Ghatak, A. K., & Thyagarajan, K. (2017). An introduction to fiber optics (Reprint ed.). Cambridge University Press. India.

Course: B.Sc. Physics, Semester - 3

PHY303: Physics practical 3

Course category: Hard core (HC)

Number of Credits: 2; Course duration: 64 Hours

Any EIGHT of the following experiments:

1. Kundt's tube experiment – velocity of sound in air at room temperature.
2. Study of stationary wave on a stretched string – Determination of speed of the transverse waves over the sonometer wire.
3. Newton's rings – Determination of radius of curvature of a plano convex lens.
4. Air wedge – Determination of thickness of a thin paper/diameter of a thin wire.
5. Helmholtz resonator – Determination of frequency of a tuning fork.
6. Diffraction grating – Determination of grating constant and wave length (minimum deviation method).
7. Diffraction at a straight wire –Determination of diameter of a wire.
8. Cauchy's constants using pectrometer.
9. Polarization – Determination of unknown concentration of sugar solution by graphical method using a polarimeter.
10. Determination of refractive indices of calcite and quartz crystal using spectrometer and sodium light.
11. To determine dispersive power and resolving power of a plane diffraction grating.
12. To determine wavelength of sodium light using Fresnel bi prism.

Course: B.Sc. Physics, Semester - 4

PHY401: Electricity and Electromagnetism

Course category: Hard core (HC)

Number of Credits: 3; Course duration:48 Hours

Unit 1:16 hours

Electrostatics: Mechanical force and electric pressure on a charged surface. The path traced by a charged particle in an electric field. The attracted disc electrometer-construction, theory and applications. Numerical problems. [4 hours]

Galvanometers: Moving coil galvanometer-construction, theory, damping correction, current sensitivity and charge sensitivity. Helmholtz galvanometer – Theory. Numerical Problems. [4 hours]

Thermo-electricity: Seebeck, Peltier and Thomson effects. Thermodynamic theory of thermoelectric effect. The law of intermediate metals and the law of intermediate temperatures. Thermocouple. Numerical Problems. [4 hours]

Network Theorems: Mesh analysis circuits using Kirchoff's voltage law and Kirchoff's current law. Statement and proof of Thevenin's theorem and Maximum power transfer theorem. Numerical problems. [4 hours]

Unit 2:16 hours

Alternating current: R.M.S. values. Response of LR, CR and LCR circuits to sinusoidal voltages (discussion using the 'j' symbols). Series and parallel resonance-half-power frequencies, band-width and Q-factor. Power in electrical circuits- power factor. Numerical problems. [8 hours]

Applications of ac circuits: AC bridges – Anderson's bridge, Maxwell's bridge, desauty bridge, Robinson's bridge. Numerical problems. [4 hours]

Electrical measurement: CRO–construction & working. Measurement of voltage, frequency and phase using a CRO. [2 hours]

Filters: High-pass and low-pass filters with RC combination. Expression for cut-off frequency. Numerical problems. [2 hours]

Unit 3:16 hours

Electromagnetism: Scalar and vector fields. The gradient of a scalar field. The divergence and curl of a vector field. The physical significance of gradient, divergence and curl. statement and physical significance of Gauss and Stokes theorems. Numerical Problems. [4 hours]

Electromagnetic theory: Review of basic concepts. Equation of continuity, Maxwell's modification of Ampere circuital law- displacement current. Setting up of Maxwell's field equations. Maxwell's field equations in free space, Poynting vector (definition). Wave equation for the field vectors in free space and in isotropic dielectric. Energy density of electromagnetic wave (qualitative) and Poynting Theorem (Proof). Plane monochromatic electromagnetic waves – transverse nature. Numerical Problems.

[10 hours]

Production of electromagnetic waves: Accelerated charges and oscillating dipole. Hertz's experiment. Radiation loss - synchrotron radiation (qualitative). [2 hours]

Learning resources:

1. Halliday, D., Resnick, R., & Walker, J. (2014). *Fundamentals of physics* (10th ed.). Wiley. United States.
2. Laud, B. B. (2010). *Electromagnetics* (2nd ed.). New Age International. India.
3. Griffiths, D. J. (2023). *Introduction to electrodynamics* (5th ed.). Cambridge University Press. United Kingdom.
4. Hayt, W. H., & Buck, J. A. (2018). *Engineering electromagnetics* (9th ed.). McGraw-Hill Education. United States.
5. Mehta, V. K., & Mehta, R. (2020). *Principles of electronics* (12th ed., Low Priced Student Edition). S. Chand & Company Pvt. Ltd. India.
6. Subrahmanyam, N., & Lal, B. (1999). *Electricity and magnetism* (9th ed.). Ratan Prakashan Mandir. India.
7. Bhattacharya, A. B., & Bhattacharya, R. (2008). *Undergraduate physics: Volume II*. New Central Book Agency, India.
8. Vasudeva, D. N. (2022). *Fundamentals of magnetism and electricity*. S. Chand & Company, India.
9. Tewari, K. K. (2007). *Electricity and magnetism* (Rev. ed.). S. Chand and Company, India.
10. Brij Lal, & Subrahmanyam, N. (2016). *A textbook of electricity and magnetism* (19th ed.). Ratan Prakashan Mandir, India.

Course: B Sc. Physics, Semester - 4

PHY402: Communication systems

Course category: Soft core (SC) (Elective)

Number of Credits: 2; Course duration: 32 Hours

Unit 1: 16 hours

Signal & noise: Distinction between signal and noise. Signal to noise ratio and its importance in communication.

Electro-acoustic transducers: Microphone types- Carbon, Moving coil, condenser and ribbon microphones, sensitivity, directivity, phasing and testing.

Loudspeakers: Direct radiator dynamic type, expression for efficiency, radiated output power, horn loudspeaker, cutoff frequency, measurement of acoustic power and pressure response of a speaker. numerical problems. **16 Hours**

Unit 2: 16 hours

Radio communication: Role of ionosphere in radio communication, need for modulation, amplitude modulation, modulation index, side bands, band width and the power of AM wave, frequency modulation (definition), difference between AM and FM, block diagram of super heterodyne AM receiver.

Demodulation: Detection and demodulation of FM signal using foster seely discrimination.

Amplifiersused in communication: Classes and types of amplifiers, AF, IF and RF amplifier

Other Communication Systems: Principles of Microwave and satellite communication, wire telephone, simplex and duplex systems. **16 Hours**

Learning resources:

1. Dennis Roddy and John Coolen, J. (2008). Electronic communications (4th ed.). Pearson Education. New Delhi, India.
2. Wayne Tomaal, (2004). Electronic communications systems: Fundamentals through advanced (5th ed.). Pearson Education. New Delhi, India.
3. Kennedy, G., Davis, B., & Prasanna, S. R. M. (2011). Kennedy's electronic communication systems (5th ed.). McGraw-Hill Education. India.
4. Desphande Etal. Communication electronics Tata Mc graw Hill, New Delhi, India.

Course: B.Sc. Physics, Semester - 4

PHY403: Physics Practical 4

Course category: Hard core (HC)

Number of Credits: 2; Course duration: 64 Hours

Any EIGHT of the following experiments:

1. Anderson's Bridge – Determination of the self-inductance of the coil.
2. De-Sauty bridge – Verification of laws of combination of capacitances.
3. Variation of thermo-emf across two junctions of a thermocouple with temperature.
4. Verification of Maximum Power Transfer Theorem.
5. B_H using Helmholtz double coil galvanometer and potentiometer.
6. Capacity of a condenser using a BG.
7. LCR series circuit – Determination of L & Q factor.
8. Voltage triangle – Measurement of phase difference.
9. RC Low and High pass filters – Determination of the cut-off frequency.
10. LCR parallel circuit – Determination of L & Q factor.
11. To study the variation of X_C with f and determination of C.
12. CRO- determination of voltage and frequency.

Course: B.Sc. Physics, Semester - 4

PHY404: Physics practical 5

Course category: Soft core (SC), Skill

Number of Credits: 2; Course duration: 64 Hours

Note: This paper may be offered during 4th or 5th or 6th semester.

Any EIGHT of the following experiments:

1. To determine the Wavelength of LASER light using plane diffraction grating
2. Diffraction of LASER by thin wire
3. Divergence of LASER beam
4. Diffraction hallows experiment to determine the size the particle
5. Measurement of Numerical Aperture of optical fiber
6. To determine refractive index of the material of a prism
7. Optocoupler experiment
8. Attenuation coefficient of optical fiber
9. PN junction diode characteristics.
10. Zener diode characteristics
11. Zener diode as voltage regulator.
12. Young's Modulus by Cornu's method
13. LED Characteristics
14. Solar Cell characteristics

Course: B.Sc. Physics, Semester - 5

PHY501: Classical Mechanics, Quantum Mechanics and Atomic Spectroscopy

Course category: Hard core(HC)

Number of Credits: 3; Course duration:48 Hours

Unit 1: 16 hours

Lagrangian formulation: Constraints, Holonomic constraints, non-holonomic constraints, Scleronomic and Rheonomic constraints. Generalized coordinates, degrees of freedom, Principle of virtual work, D'Alembert's principle, Lagrange equations. Newton's equation of motion from Lagrange equations, simple pendulum, Atwood's machine, numerical problems.

Variational principle: Hamilton's principle, Deduction of Hamilton's principle, Lagrange's equation of motion from Hamilton's principle.

Hamiltonian Mechanics: The Hamiltonian of a system, Hamilton's equations of motion, Hamilton's equations from variational principle, Canonical transformations, Poison Brackets, fundamental properties and equations of motion in Poison Brackets.

[16 Hours]

Unit 2: 16 hours

Introduction to Quantum Mechanics: Matter waves, de Broglie hypothesis of matter waves, Group and Phase velocities and relation between them, Experimental evidence for matter waves: Davisson- Germer experiment, G.P Thomson's experiment and its significance, numerical problems.

Elementary proof of Heisenberg's relation between momentum and position, energy and time, angular momentum and angular position, illustration of uncertainty principle by Gamma ray microscope thought experiment. Consequence of the uncertainty relation (electron cannot exist in nucleus).

Wave function and its admissibility, Born's interpretation of the wave function, Normalization and orthogonality of wave functions, Schrödinger time dependent and independent equations. Eigen values and Eigen functions, Application of Schrödinger equation for i) Free particle in one dimensional box of infinite height, ii) Simple harmonic oscillator (Qualitative), Concept of zero - point energy, numerical problems.

[16 Hours]

Unit 3: 16 hours

Electron: Properties of electron, determination of e/m of an electron by Thomson method, determination of the charge of the electron by Millikan's oil-drop method, numerical problems.

Atomic spectra: A qualitative account of Summerfield relativistic atomic model, excitation and ionization potentials – Frank - Hertz experiment, vector model of an atom - electron spin and space quantisation, quantum numbers associated with vector atom model. Magnetic moment of an electron due to its orbital motion, evaluation of Bohr magneton,

Stern-Gerlach experiment with necessary theory. Spin-orbit interaction and the fine structure of spectral lines. Pauli's exclusion principle, electronic configuration of atoms, LS and JJ coupling for multi electron system, numerical problems.

Zeeman effect: Zeeman effect and its types, experimental study of normal Zeeman effect, classical theory of normal Zeeman effect (expression for Zeeman effect). Stark effect and Paschen back effect (qualitative), numerical problems.

[16 Hours]

Learning resources:

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics, G. Aruldhas, 2008, Prentice-Hall of India Private limited, New Delhi.
3. Classical Mechanics, Takwale and Puranik-1989, Tata Mcgraw Hill, new Delhi
4. Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, 2009.9
5. Quantum Physics, Berkeley Physics Course Vol. 4. E.H. Wichman, Tata McGraw-Hill Co., 2008.
6. P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill publication, ISBN: 9780070146174.
7. Ajoy Ghatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer Publication, ISBN 978-1-4020-2130-5.
8. Modern Physics; R. Murugeshan & K. Sivaprasath; S. Chand Publishing.
9. G Aruldhas, Quantum Mechanics, Phi Learning Private Ltd., ISBN: 97881203363.
10. Gupta, Kumar & Sharma, Quantum Mechanics, Jai Prakash Nath Publications.
11. Physics for Degree Students B.Sc., Third Year, C.L. Arora and P.S. Hemne, 1st edition, S. Chand & Company Pvt. Ltd., 2014.
12. Modern Physics, R. Murugeshan, Kiruthiga Sivaprakash, Revised Edition, 2009, S. Chand & Company Ltd.
13. Atomic & Molecular spectra: Laser, Raj Kumar, Revised Edition, 2008, Kedar Nath Ram Nath Publishers, Meerut.
14. Atomic Physics, S.N. Ghoshal, Revised Edition, 2013, S. Chand & Company Ltd.
15. Concepts of Atomic Physics, S.P. Kuila, First Edition, 2018, New Central Book Agency (P) Ltd.
16. Classical Mechanics, Dr. J.C. Upadhyaya, Himalaya publishing house.
17. Concepts of Modern Physics, Arthur Beiser, Seventh Edition, 2015, Shobhit Mahajan, S. Rai Choudhury, 2002, McGraw-Hill.

Course: B.Sc. Physics, Semester - 5

PHY502: Nuclear and particle physics

Course category: Hard core (HC)

Number of Credits: 3; Course duration: 48 Hours

Unit 1: 16 hours

Properties of nuclei: Constituents of nucleus and their intrinsic properties, Nuclear mass, density, charge and size. Binding energy curve and its significance. Nuclear force and its characteristics, numerical problems.

Radioactivity decay: Radioactivity, half-life, mean life, relation between half-life and mean life, theory of successive disintegration, (condition for secular and transient equilibrium), Alpha decay, expression for alpha disintegration energy, experimental determination of range and energy of alpha particle, Geiger-Nutt all law, β-decay (β^+ and β^-decay), electron capture, neutrino hypothesis, Gamma decay, internal conversion, nuclear isomerism and auger transition, numerical problems.

Detectors: GM Counter (construction, working and its characteristics), Basic principle of Scintillation detector, construction and working of photo-multiplier tube (PMT), Principle of semiconductor detector, numerical problems.

[16 Hours]

Unit 2: 16 hours

Accelerators: Construction, Working and Theory of LINAC, Cyclotron, Numerical problems.

Interaction of nuclear radiation with matter: γ-ray interaction through matter, photoelectric effect, Compton scattering, pair-production, energy loss due to ionization (qualitative description of Bethe Bloch formula), energy loss of electrons introduction of Cerenkov radiation.

Mass spectrographs: Construction, Working and Theory of Dempster's and Aston's mass spectrograph, Numerical problems.

Nuclear Models: Liquid-drop model, Semi-empirical mass formula, Shell model (qualitative) and magic numbers, Numerical problems.

[16Hours]

Unit 3: 16 hours

Nuclear reactions: Q-values Threshold energy of an endoergic reaction. Reactions induced by proton, deuteron and α-particles, numerical problems.

Nuclear Fission & Fusion: Estimation of the fission energy on the basis of the liquid-drop model, four-factor formula, nuclear reactors - Pressurized Heavy Water Reactor, Thermo-nuclear reactions-sources of stellar energy (C-N cycle and P-P cycle), Tokamak. Numerical problems.

Cosmic Rays: Discovery, Primary and secondary cosmic rays- their composition, Cosmic ray showers, Origin of cosmic rays, elements of Cascade theory, Geomagnetic, Latitude and Altitude effects.

Elementary particles: Particles and anti- particles. Classification of particles Mention of the basic interactions in nature and conservation laws a qualitative introduction to quarks (quark model). **[16 Hours]**

Learning resources:

1. Concepts of nuclear physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
2. Introduction to the physics of nuclei & particles, R.A. Dunlap. Thomson Asia, 2004.
3. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
4. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (Institute of Physics (IOP) Publishing, 2004).
5. Radiation detection and measurement, G.F. Knoll, John Wiley & Sons, 2000.
6. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
7. Atomic and molecular spectra and lasers: Saxena A K, 1stEdn.,CBS publishers and distributors (2009)
8. Nuclear Physics: Kaplan I,2ndEdn., Narosa Publishing House(2002)'
9. Fundamentals of modern physics: Duggal and chabra, 8th edition S. Chand Publishing. 1997
10. Nuclear physics: D C Tayal, 5th edition Himalaya Publishing house 2008
11. Modern Physics, R. Murugeshan and K. Shivaprasath S; Chand Publishing, 2025.

Course: B.Sc. Physics, Semester - 5

PHY503: Physics Practical 6

Course category: Hard core (HC)

Number of Credits: 2; Course duration:64 Hours

Any EIGHT of the following experimentsPractical Content

1. Determination of 'g', the acceleration due to gravity, at a given place, by simple pendulum (L v/s T^2).
2. Determination of acceleration of gravity by Flywheel.
3. Determination of acceleration due to gravity by Stoke's method
4. To study the characteristics of solar cell.
5. Determination of wavelength of laser using diffraction grating.
6. To determine the diameter of the given wire by LASER diffraction.
7. To determine the ionization potential of Xenon.
8. Study the characteristics of Geiger-Muller Tube.
9. Verification of inverse square law for gamma rays using GM counter.
10. Determination of range of electrons in aluminium using GM Counter.
11. Absorption coefficient of beta rays inaluminium foil using GM counter.
12. Attenuation of gamma rays in lead foilusing Cs-137 source and G M counter.
13. Analysis of Stellar Spectra.
14. Analysis of HBr Spectra.

Course: B.Sc. Physics, Semester - 6

PHY601: Relativity and solid state physics

Course category: Hard core(HC)

Number of Credits: 3

Course duration: 48 Hours

Unit 1: 16 hours

Special theory of relativity: Michelson–Morley experiment and discussion of negative results, basic postulates of relativity, Lorentz transformation, Lorentz–Fitz Gerald length contraction, Einstein time dilation, velocity addition theorem, relativity of simultaneity, variation of mass with velocity, Einstein mass–energy relation, energy–momentum relation, Numerical problems.

Superconductivity: Elementary Ideas, Isotopic Effect, Meissner Effect, Persistent Current, Critical Magnetic Field, Type I and Type II Superconductors, BCS Theory (Qualitative), applications, Numerical problems.

[16 Hours]

Unit 2: 16 hours

Free electron theory of metals: Classical free electron model (Drude–Lorentz model), expression for electrical and thermal conductivity, Wiedemann–Franz law, failure of classical free electron theory. Quantum free electron theory (Assumptions), statement of number of available energy states between E and E+dE, Fermi energy and Fermi level, expression for Fermi energy at absolute zero and $\langle E \rangle = 3/5\ E_{F_0}$, numerical problems.

Dielectrics: Dielectric material and its properties, static dielectric constant, polarizability (electronic, ionic and orientational polarizability – qualitative), calculation of Lorentz field (derivation), dielectric loss, Methods of determining dielectric constant of solids. Numerical problems.

[16Hours]

Unit 3: 16 hours

Crystal structure and X-rays: Crystal, space lattice, translational vectors, basis of crystal structure (definition only), primitive and non-primitive cells, a brief mention of crystal systems, Miller indices, expression for inter planar spacing, continuous X-ray spectra, Duane–Hunt limit, characteristic X-ray spectra, Moseley's law and its significance, Bragg's law, Bragg's spectrometer (construction and working), Compton effect – expression for Compton shift, numerical problems.

Magnetism: Magnetic intensity (H), magnetic induction (B), magnetization (M), permeability (μ), susceptibility (χ), classification of magnetic materials, classical theory of paramagnetism (Langevin theory), Curie's Law, Curie–Weiss Law, ferromagnetic domain (qualitative), hysteresis curve (B–H curve) and its significance, hard and soft magnetic materials, numerical problems.

Specific heat of solids: Dulong and Petit's Law (statement only) and its limitations, Einstein's theory of specific heat, Debye's theory of specific heat, numerical problems.

[16 Hours]

Learning resources:

1. Modern Physics, R. Murugeshan and K. Shivaprasath S; Chand Publishing
2. Gravity: An Introduction to Einstein's General Relativity; James B. Hartle; Cambridge University Press
3. A First Course in General Relativity; Bernard Schutz; Cambridge University Press
4. Introduction to General Relativity: A Course for Undergraduate Students of Physics ;James B. Hartle; Cambridge University Press
5. Feynman LecturesVolume 1 – Chapters on Special Relativity ;Addison-Wesley
6. Solid State Physics; S. O. Pillai; New Age International Publishers
7. Solid State Physics (Theory, Applications and Problems); S. L. Kakani & C. Hemarajani; Sultan Chand & Sons
8. Solid State Physics; Adrianus J. Dekker; Macmillan Publishers / Red Globe Press (Palgrave Macmillan)
9. Introduction to Solid State Physics; Charles Kittel; John Wiley & Sons;
10. Solid State Physics; Vijay Kumar & Bhupinder K. Gupta; S. Chand Publishing
11. Solid State Physics; P. K. Palanisamy; Scitech Publications
12. Solid State Physics; S. L. Kakani & C. Hemarajani; Sultan Chand & Sons

Course: B.Sc. Physics, Semester - 6

PHY602: Astrophysics and molecular spectroscopy

Course category: Hard core (HC)

Number of Credits: 2

Course duration: 48 Hours

Unit 1: 16 hours

Stellar Properties: Introduction, Stellar parallax, Units of stellar distance, Definition of absolute magnitude, Apparent brightness, Apparent magnitude, Absolute magnitude, Bolometric magnitude, Expression for radius of a star, Numerical problems.

Stellar Classification and Evolution: Hertzsprung–Russell (H–R) diagram, Gravitational P.E. of a star, Virial theorem (statement), Birth of stars, Source of stellar energy (P–P cycle, C–N cycle), Red giant phase, White dwarf, Chandrasekhar mass limit, Supernova, Neutron star, Maximum mass of neutron star, Pulsars, Black holes, numerical problems.

Stellar temperature: Core temperature of a star, Average temperature of a star, Surface temperature and colour of a star, Photon diffusion time, Mass–luminosity relation, Shift for main sequence of stars, Expression for lifetime of a star, numerical problems.

[16 hours]

Unit 2: 16 hours

Molecular Spectroscopy: Types of molecules based on their moment of inertia, types of molecular motions and energies, Salient features of molecular spectra, theory of pure rotational spectra, theory of vibrating molecule as simple harmonic oscillator (energy levels and spectra), theory of rotational-vibrational spectra of molecule, Fluorescence and Phosphorescence,

Raman Effect, Stokes and anti-stokes lines, quantum theory of Raman Effect, experimental study of Raman effect, applications of Raman effect, numerical problems.

[16 hours]

Learning resources:

1. An Introduction to Astrophysics; Baidyanath Basu, Tanuka Chattopadhyay, Sudhindra Nath Biswas; PHI Learning
2. The Structure of the Universe; Jayant Vishnu Narlikar; Oxford University Press
3. Astrophysics: A New Approach; S. K. Saha; Narosa Publishing House
4. What Are the Stars?;Ganesan Srinivasan; Universities Press
5. Introduction to Cosmology; Jayant Vishnu Narlikar; Jones and Bartlett Publishers
6. An Introduction to Modern Astrophysics; Bradley W. Carroll & Dale A. Ostlie; Cambridge University Press
7. Molecular Structure and Spectroscopy; G. Aruldhas; Prentice Hall of India
8. Spectroscopy (Atomic and Molecular); Gurdeep R. Chatwal & Sham K. Anand; Himalaya Publishing House
9. Molecular Spectroscopy; V. K. Jain; Narosa Publishing House
10. Fundamentals of Molecular Spectroscopy; C. N. Banwell & E. M. Mc Cash; Mc Graw Hill Education

Course: B.Sc. Physics, Semester - 6

PHY603: Physics Practical 7

Course category: Hard core (HC)

Number of Credits: 2

Course duration: 64 Hours

Practical Content

Any **Eight** of following Experiments

1. To determine Planck's constant using Photocell.
2. To determine Planck's constant using LED.
3. Hall Effect in semiconductor: determination of mobility, hall coefficient.
4. Energy gap of semiconductor.
5. Temperature coefficient of resistance of a Thermistor.
6. Fermi Energy of Copper.
7. Analysis of powder X-ray diffraction spectra(calculation of lattice parameter).
8. Specific Heat of Solid by Electrical Method
9. Determination of Dielectric Constant of polar liquid.
10. Determination of particle size from XRD pattern using Debye-Scherrer formula.
11. Determination of particle size from XRD pattern using Williamson Hall Plot.
12. Analysis of single crystal X-ray diffraction spectra(I v/s 2θ).

I, II III, IV , V & VI Semester Physics (Major – DSC)
Question Paper Pattern

Max Marks : 80 Time :3 Hours

Part –A

Answer any TWO of the following 2 X 10 =20

(3 Long answer questions with Two/ three sub questions. Each questions carrying 10 marks)

Part –B

Answer any TWO of the following 2 X 10 =20

(3 Long answer questions with Two/ three sub questions. Each questions carrying 10 marks)

Part –C

Answer any TWO of the following 2 X 10 =20

(3 Long answer questions with Two/ three sub questions. Each questions carrying 10 marks)

Part –D

Answer any FOUR of the following 4 X 5 =20

(6 Numerical Problems of 5 marks each, Two from each part to be asked)

IV, V & VI Semester Physics (For 2 Credit Paper)
Question Paper Pattern

Max Marks : 40 Time : 2 Hours

Part –A

Answer any TWO of the following 2 X 8 =16

(3 Long answer questions with two sub questions. Each questions carrying 8 marks)

Part –B

Answer any TWO of the following 2 X 8 =16

(3 Long answer questions with two sub questions. Each questions carrying 8 marks)

Part –C

Answer any TWO of the following 4 X 2 = 8

(3 Numerical Problems of 4 marks at least one from each part)

Scheme of valuation for practical (Major & compulsory practical/skill paper)

C1 and C2 are internal tests to be conducted during 8th and 16th Weeks respectively of the semester. C3 is the semester-end examination conducted for 3 hours. The student will be evaluated on the basis of skill, comprehension and recording the results.

The student has to compulsorily submit the practical record for evaluation during C1 and C2. For C3, the record has to be certified by the Head of the Department.

The student is evaluated for 40 marks in C1, C2 and C3 as per the following scheme:

Component	Marks (C1)	Marks (C2)	Marks (C3)
Formula with proper units and explanation	5	5	5
Setting up the apparatus / circuit connections	5	5	5
Observations and data recording	5	5	10
Graph / diagrams	5	5	5
Calculations and results	10	10	10
Record book	5	5	--
Viva	5	5	5
Total	**40**	**40**	**40**
Reduced to	**5**	**5**	

Note: While evaluating the practical examination strict accuracy of the results should not be the sole criterion, as the experimental observations are subject to inherent errors and uncertainties. Greater emphasis should be given to the procedure, understanding and method of analysis.