HAVERI UNIVERSITY, HAVERI.

B.Sc. (Physics)

SYLLABUS

With Effect from 2024-25

DISCIPLINE SPECIFIC CORE COURSE (DSC) FOR SEM I - VI,

SKILL ENHANCEMENT COURSE (SEC) FOR SEM IV/V/VI

And

ELECTIVE COURSES FOR SEM V AND VI

AS PER N. E. P. (Revised): 2024

Haveri University, Haveri
B.Sc. in PHYSICS
Effective from 2024-25

Sem.	Type of Course	Theory/ Practical	Course Code	CourseTitle	Instruction hour/week	Total hours / sem	Duration Of Exam	Marks			Credits
								Formative	Summative	Total	
I	DSC-1	Theory	C1PHY1T1	Mechanics, Properties of Matter and Sound	04hrs	60	03hrs	20	80	100	04
	DSC-2	Practical	C1PHY1P1	Mechanics, Properties of Matter and Sound	04hrs	56	03hrs	10	40	50	02
II	DSC-3	Theory	C2PHY1T1	Thermal Physics and Fluid Mechanics	04hrs	60	03hrs	20	80	100	04
	DSC-4	Practical	C2PHY1P1	Thermal Physics and Fluid Mechanics	04hrs	56	03hrs	10	40	50	02
III	DSC-5	Theory	C3PHY1T1	Geometrical and Physical Optics, Electricity-I and Basic Electronics	04hrs	60	03hrs	20	80	100	04
	DSC-6	Practical	C3PHY1P1	Geometrical and Physical Optics, Electricity-I and Basic Electronics	04hrs	56	03hrs	10	40	50	02
1V	DSC-7	Theory	C4PHY1T1	Wave Optics, Electricity-II and Electromagnetic Theory	04hrs	60	03hrs	20	80	100	04
	DSC-8	Practical	C4PHY1P1	Wave Optics, Electricity-II and Electromagnetic Theory	04hrs	56	03hrs	10	40	50	02
*V	DSC-9A	Theory	C5PHY2T1	Classical and Quantum mechanics-I, Modern Physics-I	04hrs	60	03hrs	20	80	100	04
	DSC-10A	Practical	C5PHY2P1	Classical and Quantum mechanics-I, Modern Physics-I	04hrs	56	03hrs	10	40	50	02
	DSC-9B	Theory	C5PHY2T2	Classical and Quantum mechanics-I, Modern Physics-II	04hrs	60	03hrs	20	80	100	04
	DSC-10B	Practical	C5PHY2P2	Classical and Quantum mechanics-I, Modern Physics-II	04hrs	56	03hrs	10	40	50	02
*VI	DSC-11A	Theory	C6PHY2T1	Classical and Quantum mechanics-II, Modern Physics-III	04hrs	60	03hrs	20	80	100	04
	DSC-12A	Practical	C6PHY2P1	Classical and Quantum mechanics-II, Modern Physics-III	04hrs	56	03hrs	10	40	50	02
	DSC-11B	Theory	C6PHY2T2	Classical and Quantum mechanics-II, Modern Physics-IV	04hrs	60	03hrs	20	80	100	04
	DSC-12B	Practical	C6PHY2P2	Classical and Quantum mechanics-II, Modern Physics-IV	04hrs	56	03hrs	10	40	50	02
V	EC-1	Theory	C5PHY5T1	Renewable energy Sources and Medical Physics	03hrs	45	03hrs	20	80	100	03
VI	EC-2	Theory	C6PHY5T1	Basic instrumentation, Computational Physics and Nanoscience and Nano-technology	03hrs	45	03hrs	20	80	100	03
IV/V/ VI **	Skill	Practical	C0PHY6T1	Applied Physics	04hrs	56	03hrs	10	40	50	02

*Student shall study either DSC 9A and DSC10A or DSC 9B and DSC10B in 5th semester. Those who have studied DSC 9A and DSC10A during fifth semester shall study DSC 11A and DSC 12A and those who have studied DSC 9B and DSC10B during fifth semester shall study DSC 11B and DSC12B in 6th semester.

** Student shall study Skill of this subject either in 4th / 5th / 6th but not in all the semester.

UG programme: 2024-25

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSC/ EC

(80 marks for semester end Examination with 3 hrs duration)

Part-A

1. Question number 1-10 carries 2 marks each. Answer all the questions : 20 marks

Part-B

2. Question number 11- 18 carries 05 Marks each. Answer any 06 questions : 30 marks

Part-C

3. Question number 19-22 carries 10 Marks each. Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary)

Note: Proportionate weightage shall be given to each unit based on number of hours Prescribed

UG programme: 2024-25

Practical Scheme of Evaluation

(40 marks for semester end Practical Examination with 3 hours duration)

1.	**Basic formula with description, nature of graph and mention of units**	**: 4 Marks**
2.	**Tracing of schematic ray/block/circuit diagram with description**	**: 4 Marks**
3.	**Tabulation**	**: 4 Marks**
4.	**Experimental skill and connection**	**: 4 Marks**
5.	**Recording of observations**	**: 8 Marks**
6.	**Calculations and drawing graph**	**: 6 Marks**
7.	**Accuracy of the result and unit**	**: 2 Marks**
8.	**Journal assessment**	**: 4 Marks**
9.	**Oral performance/Viva-voce**	**: 4 Marks**
	Total	**: 40 Marks**

Haveri University, Haveri
B.Sc. PHYSICS

Programme Specific Outcomes (PSO):

On completion of the 03 years Degree in **PHYSICS** students will be able to:

PSO1: Acquire in-depth knowledge of almost all basic branches of physics such as mechanics, properties of matter, special theory of relativity, electricity and magnetism, wave motion, optics, thermal physics, electronics, classical mechanics, quantum mechanics, spectroscopy, nuclear physics, condensed matter physics and also advanced areas like nanoscience, energy science and basic instrumentation.

PSO2: Ability to correlate the concepts of physics with day-to-day life experiences. Acquire the ability of recognizing and distinguishing various aspects of physics found in real life.

PSO 3: Learn, perform and design experiments in the laboratory to develop the necessary skills and to demonstrate the concepts or principles, laws of physics, and also experimentally verify the theories learnt in the classrooms.

PSO4: Acquire the ability to think critically and reason logically while solving problems.

PSO 5: Able to appreciate the importance of physics concepts and its application for pursuing interdisciplinary and multidisciplinary higher education and research.

PSO6: Understand the vast scope of physics as a branch of science having strong theoretical foundations and experimental tools, with application to solve problems in nature, spanning from the smallest dimension of 10^{-15}m up to the highest dimension of 10^{26}m in space, and covering energy ranges from10^{-10}eV up to 10^{25}eV.

PSO7: Ability to develop algorithms and programs using different techniques to solve real world physics problems.

PSO8: Develop the ability to work independently and to make in-depth study of various aspects of physics.

PSO9: Develop the ability to apply the knowledge and skills acquired through performing experiments in laboratories to solve real life problems.

PSO10: Able to pursue advanced studies and research in different areas of physical science.

B.Sc. Semester–I

Discipline Specific Course (DSC-1)

Course Title: Mechanics, Properties of Matter and Sound

Course Code:C1PHY1T1

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Lectures/Hours /Semester	Duration of exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-1	**Theory**	**04**	**04**	**60 hrs.**	**3 hrs.**	**20**	**80**	**100**

Course Outcome (CO):
At the end of the course, students will be able to:

CO 1: Analyze data (graphical and analytical), through estimation of errors and their sources in the experimental determination of physical quantities. Also able to fit experimental data to straight-line graph and calculate standard deviation, standard error and probable error.

CO 2: Distinguish between inertial, non-inertial and rotational frames of reference. Also able to understand and distinguish real, fictitious and Coriolis force and their importance in real life.

CO 3: Distinguish Galilean, Lorentz transformation and their applications. Understand special theory of relativity by studying variation of length, mass and time with relativistic velocity.

CO 4: Analyze collision problems through laboratory and center of mass frame of reference, also able to relate these two frames.

CO 5: Understand concept of moment of inertia of regular/irregular bodies and its variation with axes through distribution of mass.

CO 6: Find Young's modulus, rigidity modulus and their importance in understanding Materials and applications.

CO 7: Understand concept of sound and their experimental determination.

CO 8: Understand importance of mechanics, properties of matter and sound in real life situations (everyday life).

Unit	Title: Mechanics, Properties of Matter and Sound	60 hrs/sem
Unit I	**Frames of References:** Inertial frames, Galilean transformation equations (derivation), Invariance of Newton's Laws under Galilean Transformations, Invariance of the laws of conservation of momentum and energy under Galilean transformations, non-inertial frames and fictitious force (in brief), rotating frame of reference(quantitative), concept of the Coriolis force and mention of its expression. **Special Theory of Relativity:** Postulates of special theory of relativity. The Lorentz transformation equations (Derivation), Length contraction, Time dilation, Simultaneity, Twin paradox, Addition of velocities. Mass-Energy Equivalence (with derivation). Space -Time diagram: Minkowski's four-dimensional space-time.	15hrs
Unit II	**Collisions**: Two-dimensional elastic and inelastic collisions in center of mass and laboratory frames of reference: i) relation between velocities in center of mass system and laboratory system ii) relation between angle of recoil in laboratory system and angle of scattering in center of mass system. Conservation of linear momentum in case of variable mass. **Gravitation:** Central force, Kepler's laws of Planetary motion(derivation). Newton's Law of Gravitation. Determination of Gravitational constant by Cavendish's method. Density and mass of the Earth. Satellite in circular orbit and Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). Qualitative discussions on applications of artificial satellites.	15hrs
Unit III	**Rotational Dynamics:** Angular momentum of a particle and system of particles. Torque, principle of conservation of angular momentum. Rotation about a fixed axis, moment of inertia, theorem of parallel and perpendicular axes(derivation). M.I. of rectangular lamina and circular disc(derivations), hollow and solid cylinders (mention of expressions). Theory of flywheel and experimental determination of radius of gyration. Theory of compound pendulum, interchangeability of centers of suspension and oscillation, four points collinear with the C.G. about which the time period is same, conditions for maximum and minimum time periods. Bar pendulum, experimental determination of 'g' using bar pendulum. Bifilar suspension with parallel threads (derivation).	15hrs
Unit IV	**Elasticity:** Relation between elastic constants(derivation), Poisson's ratio in terms of elastic constants(derivation). Twisting couple on a solid cylinder (wire), work done in twisting solid cylinder (wire). Determination of coefficient of rigidity by torsional pendulum and Maxwell needle method. Bending of beams- neutral surface, neutral axis, plane of bending, bending moment. Expression for bending moment(derivation), uniform bending (mention formula). Theory of light cantilever(derivation). **Sound:** Free, forced and sustained vibrations, resonance with examples. Analytical treatment of damped and forced vibrations. Theory of Helmholtz resonator, condition for resonance: Expressions for amplitude and phase. Effect of damping on the phase of forced vibration.	15hrs

Recommended books:

1. Mechanics (VI-Edition)-J.C. Upadhyay–Ramprasad & Sons, Agra,2005.
2. Mechanics (XX-Edition)–D.S. Mathur-S. Chand & Company Ltd., New-Delhi,2007.
3. Mechanics & Electrodynamics (XVII-Edition, Course-1&2)– Brijlal, Subramanyam & Jivan Seshan, S. Chand & Company Ltd., New-Delhi,2008.
4. Properties of Matter (XIII-Edition)–Brijlal & Subramanyam, Eurasia Publishing House Pvt.Ltd., New-Delhi,2001.
5. Elements of Properties of Matter (XXVIII-Edition), D.S. Mathur-S. Chand & Company Ltd., New-Delhi,2005.
6. Physics, Vol. No. I(V-Edition)–Resnick, Halliday & Krane–John Wiley & Sons Inc., New-York, Singapore,2005.
7. Berkeley Physics, Vol. No. I–ABC Publications, Bangalore & New-Delhi.
8. University Physics (XI-Edition)-Young & Freedman–PearsonEducation,2004.
9. Introduction to Relativity-R. Resnik.
10. Relativistic Mechanics-Gupta and Kumar.
11. Text book of Sound – Brijlal and Subrahmanyam
12. Refresher Course in B.Sc. Physics Volume 1– C. L. Arora, S. Chand & Company
13. Theoretical Mechanics – Spiegel (Schaum Series).

Formative Assessment for Theory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–I

Discipline Specific Course (DSC-2)

Course Title:Mechanics, Properties of Matter and Sound (Practical)

Course Code: C1PHY1P1

Type of Course	Theory /Practical	Credits	Instruction hours per week	Total No. of Teaching hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-2	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**10**	**40**	**50**

List of first semester Physics Experiments:

1. Estimation of errors (Average deviation, Standard deviation, standard error and Probable error) in the experimental determination of physical quantities like length, diameter, thickness, time, mass, temperature and resistance from the given data. And also fit the given data to a straight-line graph and calculate from the given observations Standard deviation, standard error and Probable error.
2. Moment of Inertia of the Fly-Wheel.
3. Bar pendulum/Kater's Pendulum.
4. Verification of Parallel axes theorem of Moment of Inertia using Bar Pendulum.
5. Y- by bending using Cantilever.
6. Modulus of Rigidity of a wire using disc/ Maxwell's needle.
7. To find Youngs modulus, modulus of rigidity and Poisson's ratio for the material of a wire by Searle's method.
8. Bifilar Suspension.
9. To determine gravitational constant 'G' by Cavendish Method.
10. Volume Resonator.
11. Frequency of AC using Sonometer.
12. Velocity of sound through wire using sonometer.
13. Velocity of sound using Kundt's tube.

Note:

1. **Experiments are of four hours duration each.**
2. **Minimum of Eight experiments are to be performed.**

Books recommended:

1. Physics For Degree Students B. Sc. First Year- C.L. Arora, S. Chand & Company.
2. B.Sc. practical Physics – C.L. Arora.
3. Advanced practical Physics – Samir Kumar Ghosh.
4. Advanced practical Physics – Worsnop and Flint.

B.Sc. Semester– II

Discipline Specific Course (DSC-3)

Course Title: -Thermal Physics and Fluid Mechanics

Course Code: C2PHY1T1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-3	**Theory**	**04**	**04**	**60hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcome (CO):
At the end of the course, students will be able to:

CO 1: Apply the laws of thermodynamics and analyze the thermal system and compare the efficiency and working of steam Otto and Diesel engine.

CO 2: Analyze the temperature entropy-diagram with physical significance.

CO 3: Study the Maxwell's thermodynamical relations with different applications.

CO 4: Analyze the significance of thermodynamic potentials and develop the relation between thermodynamical potential with their variables.

CO 5: Understand concept of surface tension and viscosity of liquids and their experimental determination.

CO 6: Understand importance of surface tension and viscosity of liquids/fluids in real life situation (everyday life).

Unit	Title: Thermal Physics and Fluid Mechanics	60 hrs/ sem
Unit I	**Kinetic theory of gases:** Maxwell's law of distribution of velocities (with derivation). Expressions for Average, R.M.S. and most probable velocities (with derivation). Qualitative discussions on Mean free path, mention of Clausius and Maxwell's expressions for mean free path. Transport phenomena — Brief discussion on Viscosity, Thermal conductivity and Diffusion. Expressions for Coefficient of Viscosity, Coefficient of Thermal conductivity and Coefficient of Diffusion (with derivations) and relation between them. **Radiation:** Concept of Radiation, Stefan's law and its derivation using radiation pressure. Experimental determination of Stefan's constant. Wein's displacement law (with derivation), Rayleigh-Jeans's law (qualitative), Planck's law of radiation and its derivation.	15 hrs
Unit II	**Thermodynamics-I:** Review of basics of thermodynamics. Statement of second law of thermodynamics, Carnot`s theorem: statement and proof. Otto engine (Internal combustion engine) and expression for its efficiency. Diesel engine and expression for its efficiency. **Entropy:** Concept of entropy, change of entropy in reversible cycle, change of entropy in irreversible process with examples. Temperature-entropy diagram, physical significance of entropy, entropy of a perfect gas. Second law of thermodynamics in terms of entropy. Entropy of the Universe. Third law of thermodynamics: Nernst's heat theorem statement.	15 hrs
Unit III	**Thermodynamics-II: Maxwell's Thermodynamic Relations:** Thermodynamic variables: extensive and intensive variables. Derivation of Maxwell's thermodynamical relations and its applications, specific heat equation for Van der Waals gas, Joule-Thomson-cooling and Joule-Thomson coefficient for perfect and real gases. Clausius - Clapeyron's equation (first latent heat equation). **Thermodynamic Potentials:** Internal energy, Enthalpy, Helmholtz free energy, Gibb's free energy. Significance of thermodynamic potentials. Relations of thermodynamical potentials with their variables. First and second order phase transitions.	15 hrs
Unit IV	**Fluid Mechanics:** **Surface Tension:** Basic concepts. Pressure difference across a liquid surface: excess pressure inside a spherical liquid drop and excess pressure inside a soap bubble. Derivation of relation between radius of curvature, pressure and surface tension. Angle of contact: case of two liquids in contact with each other and with air, case of solid, liquid and air in contact. Experimental determination of surface tension by Jaeger's method with relevant theory. Determination of surface tension and angle of contact of mercury by Quincke's method. **Viscosity:** Basic concepts. Expression for critical velocity, significance of Reynolds's number. Derivation of Poiseuille's equation. Experimental determination of co-efficient of viscosity for a liquid by Poiseuille's method. Motion of a spherical body in a viscous medium: expression for co-efficient of viscosity from Stoke`s law (derivation).	15hrs

Recommended books:

1. Kinetic Theory of Gases(I-Edition) – V.N. Kelkar – Ideal Book Service, Pune, 1967.
2. Heat & Thermodynamics and Statistical Physics (XVIII-Edition) – Singhal, Agarwal & Satyaprakash – Pragati Prakashan, Meerut, 2006.
3. Heat & Thermodynamics and Statistical Physics (I-Edition) – Brijlal, Subramanyam & Hemne - S. Chand & Company Ltd., New-Delhi, 2008.
4. Heat and Thermodynamics (I-Edition) – D.S.Mathur - S. Chand & Company Ltd., New-Delhi, 1991.
5. A Treatise on Heat – Saha and Srivatsava.
6. A text book of heat - J.B.Rajam.
7. Properties of Matter (XIII-Edition) – Brijlal & Subramanyam, Eurasia Publishing House Pvt. Ltd., New-Delhi, 2001.
8. Elements of Properties of Matter (XXVIII-Edition), D.S.Mathur - S. Chand & Company Ltd., New-Delhi, 2005.
9. Physics, Vol. No.I (V-Edition)– Resnick, Halliday & Krane – John Wiley & Sons Inc., New-York, Singapore, 2005.
10. Berkely Physics, Vol. No.I – ABC Publications, Bangalore & New-Delhi.
11. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004
12. B.Sc. practical Physics – C.L.Arora.
13. Advanced practical Physics – Samir Kumar Ghosh.
14. Advanced practical Physics – Worsnop and Flint.
15. Thermodynamics and Statistical Physics, J.P.Agarwal and Satya Prakash, Pragati Prakashan, 2024.

Formative Assessment for Theory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–II

Discipline Specific Course (DSC-4)

Course Title: Thermal Physics and Fluid Mechanics (Practical)

Course Code:C2PHY1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-4	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**10**	**40**	**50**

List of second semester Physics Experiments:

1. Verification of Clausius–Clapeyron equation and determination of specific enthalpy.
2. Specific Heat by cooling.
3. Thermal conductivity of a bad conductor by Lee's method/Charlton's method.
4. Thermal conductivity of copper by Searle's apparatus/Angstrom's method.
5. Verification of Stefan's Law (Electrical method).
6. Determination of Stefan's constant.
7. 'J' by continuous flow method.
8. 'J' by electrical method.
9. Mechanical equivalent of heat using Callender and Barnes method.
10. To find the ratio of specific heats at constant pressure and constant volume for air using Clement and Desorme's apparatus.
11. Surface Tension by Jeager's method.
12. Surface Tension by Quincke's method.
13. To determine the Coefficient of Viscosity of water by Capillary Flow method (Poiseuille's method).
14. Stokes method to determine the coefficient of viscosity.
15. Problem based learning in physics: Problems on entropy, heat engines, fluid mechanics and statistical physics.

Note:

1. **Experiments are of four hours duration each.**
2. **Minimum of Eight experiments to be performed.**

Books recommended:

1. Physics For Degree Students B. Sc. First Year, S. Chand & Company.
2. B.Sc. practical Physics – C.L. Arora.
3. Advanced practical Physics – Samir Kumar Ghosh.
4. Advanced practical Physics – Worsnop and Flint.
5. Advanced practical Physics-I, S.P.Singh.

B.Sc. Semester–III

Discipline Specific Course (DSC-5)

Course Title: Geometrical and Physical Optics, Electricity-I and Basic Electronics

Course Code:C3PHY1T1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-5	**Theory**	**04**	**04**	**60 hrs.**	**3 hrs.**	**20**	**80**	**100**

Course Outcome (CO):
At the end of the course, students will be able to:

CO 1: Explain basics of laws of reflection and refraction.

CO 2: Describe different types of aberrations, cardinal points of optical instruments.

CO 3: Demonstrate interference of light due to division of wavefront and amplitude by Fresnel's biprism and Newton's rings experimental setup. Measurement of wavelength of light using experiments like Michelson interferometer.

CO 4: Understand and distinguish application of Gauss law in vacuum and dielectric medium.

CO 5: Determine dielectric constant of solid/liquid materials by experiments in laboratory.

CO 6: Apply the resonant circuits in the field of communication and signal oscillator building.

CO 7: Apply concepts of AC and DC bridges to determine values of resistance, capacitance of capacitor andself-inductance of a coil.

CO 8: Distinguish the current and voltage source and construct the power supply with different filter circuits and its importance in real life.

CO 9: Use the concept of semiconductor to describe BJT, FET etc. and explain their functions and applications.

Unit	Title: Geometrical and Physical Optics, Electricity-I and Basic Electronics	60 hrs/ sem
Unit I	**Geometrical Optics:** **Fermat principle:** Derivation of laws of reflection and refraction, sign convention, refraction at a spherical surface, derivation of Lagrange's law and Helmholtz relation, Abbe's sine condition derivation, aplanatic points of a spherical surface(qualitative). **Aberrations:** Spherical aberrations**:** methods to reduce spherical aberration (qualitative). Chromatic aberrations: Conditions for achromatism of two thin lenses in contact, two thin lenses separated by finite distance. **Cardinal points**: Cardinal points of an optical system. Equivalent focal length of two thin lenses separated by a distance. Location of cardinal points of a thick lens (derivation). Experimental determination of cardinal points of a lens system using Searle's Goniometer and Turn Table (Nodal slide).	15 hrs
Unit II	**Physical Optics-1:** **Interference due to division of wave front:** Fresnel's biprism. Determination of wavelength of monochromatic light & thickness of a thin film using biprism. **Interference due to division of amplitude:** Interference phenomenon with a plane parallel thin film in reflected and transmitted light (with derivation). Interference using wedge shaped film (air wedge). Theory of Newton's rings. Experimental determination of wavelength of monochromatic light using Newton's rings. Michelson interferometer: Principle, construction and working. Formation of circular and straight fringes(qualitative). Mention of the applications of Michelson's Interferometer. Michelson-Morley experiment and its significance.	15 hrs
Unit III	**Theory of Dielectrics:** Introduction to dielectric materials. Polar and non-polar molecules with examples. Gauss law in a dielectric medium. Dielectric in an electric field, electric polarization (**P**), electric displacement (**D**), electric susceptibility (χ) and atomic polarizability(α), relation between **D**, **E** and **P**. Mechanism of polarization. Boundary condition at a dielectric surface(derivation). Derivation of Clausius–Mosotti equation and its limitations. Dielectric constant and its experimental determination. **Moving coil Galvanometer:** Conditions for a moving coil galvanometer to be ballistic and dead beat. Theory of moving coil ballistic galvanometer (BG). Charge and current sensitivity and their relationship. Measurement of capacitance of a capacitor by absolute method using B.G. Measurement of high resistance by leakage method using B.G.	15 hrs
Unit IV	**DC Power Supply:** Block diagram of regulated power supply, Zener diode characteristics and Zener diode as voltage regulator, Introduction to integrated circuit (IC) and its types, Dual power Supply using 78xx and 79xx ICs. **Bipolar Junction Transistor:** BJT characteristics in CE mode, Operating point. DC *h*-parameters and their determination using low frequency transistor model. Single stage RC coupled CE amplifier, Expression for current gain, voltage gain, input and output impedance, frequency response. Brief explanation of positive and negative feedback. Transistor as an oscillator: Hartley and Phase shift oscillators. **Junction Field Effect Transistor:** Types, characteristics and parameters of JFET. Common source FET amplifier.	15 hrs

Recommended books:

1. Principles of Optics (I-Edition) – B.K. Mathur – New Gopal Printing Press, 1962.
2. Fundamentals of Optics (V-Edition) – Khanna & Bedi – R. Chand & Co., New-Delhi, 1971.
3. A Text book of Optics (I-Edition) – Brijlal& Subramanyam - S. Chand & Company Ltd., New-Delhi, 2006.
4. Fundamentals of optics- Khanna and Gulati.
5. Optics (IV-Edition) – Ajay Ghatak –Tata Mc Graw-Hill, New-Delhi, 2006
6. Fundamentals of Optics (III-Edition) – Jenkins & White - Mc Graw-Hill, 1957.
7. Geometrical Optics (I-Edition) – D.P. Acharya – Oxford & IBH Pub. Co., New-Delhi,1970.
8. Optics & Spectroscopy (VI-Edition) – Murugeshan, Kirutiga & Shivaprasath - S. Chand & Company Ltd., New-Delhi, 2006.
9. Geometrical Optics – A. Verstraeten.
10. Fundamentals of Electricity and Magnetism – Basudev Ghosh – Books & Allied New Central Book Agency, Calcutta, 2009.
11. Electricity and magnetism- D.N. Vasudev- S. Chand Publication, New Delhi.
12. Electricity and Magnetism- B.S. Agarwal- S. Chand Publication, New Delhi.
13. Electricity and magnetism- Brijlal & Subramasnyam.
14. Electronic Devices and Circuits by David A. Bell PHI, NewDelhi2004.
15. Integrated Electronics by Jacob Millman and CC Halkias.
16. Digital Fundamentals by Floyd PHI, New Delhi 2001.
17. Principle of Electronics by V. K. Mehta and Rakshit.
18. Basic electronics and solid-state physics- B. L. Theraja- S. Chand Publication, New Delhi
19. Basic Electronics- B. L. Theraja- S. Chand Publication, New Delhi.
20. Integrated Electronics- Millmans and Halkias-McGraw Hill, New Delhi.
21. Electronic devices and circuits- Allan Mottersed-McGraw Hill, New Delhi.
22. Basic Electronics and Linear Circuits- TTTI- Bhargav & Others. McGraw Hill Education (1983)

Formative Assessment for Theory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester– III

Discipline Specific Course (DSC-6)

Course Title: Geometrical and Physical Optics, Electricity-I and Basic Electronics (Practical)

Course Code:C3PHY1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-6	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**10**	**40**	**50**

List of third semester Physics Experiments:

1. Goniometer
2. Turn table
3. Newton's rings
4. Biprism: Determination of wavelength of monochromatic light.
5. Calibration of a spectrometer.
6. Michelson interferometer.
7. Determination of wavelength of laser light by Young's double slit method.
8. Determination of dielectric constant of a liquid.
9. Calibration of Ballistic Galvanometer (BG): Determination of the constants of B.G.
10. Measurement of capacity by absolute method by using B.G.
11. Determination of high resistance by leakage method, using B.G.
12. Single stage RC coupled CE amplifier.
13. JFET characteristics.
14. Hartley/ Colpitt/crystal Oscillator using BJT.
15. Zener Diode Voltage Regulator/Dual Power Supply using IC 78XX and IC79XX.

Note:

1. **Experiments are of four hours duration each.**
2. **Minimum of Eight experiments to be performed.**

Books recommended:

1. Physics For Degree Students B. Sc. First Year, S. Chand & Company.
2. Electronics Instrumentation by H S Kalasi.
3. B.Sc. practical Physics – C.L. Arora.
4. Advanced practical Physics – Samir Kumar Ghosh.
5. Advanced practical Physics – Worsnop and Flint.

B.Sc. Semester–IV

Discipline Specific Course (DSC-7)

Course Title: -Wave Optics, Electricity-II and Electromagnetic Theory

Course Code:C4PHY1T1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-7	**Theory**	**04**	**04**	**60 hrs.**	**3 hrs.**	**20**	**80**	**100**

Course Outcome (CO):
At the end of the course, students will be able to:

CO 1: Explain diffraction due to different objects like single slit, two slits, diffraction of grating, oblique incidence, circular aperture and give the theory and experimental setup for the same.

CO 2: Explain the polarization of light and obtain how the polarization occurs due to quarter wave plates, half wave plates, and through the optical activity of a medium.

CO 3: **U**nderstand how to produce magnetic field from electric current. Understand magnetic field produced by current in toroid and solenoid.

CO 4: Distinguish Seeback and Peltier effect and their applications to real life. Also able to distinguish different type of thermocouples as temperature sensors.

CO 5: Explain Maxwell's equations to articulate the relationship between varying electric and magnetic field. Also able to explain electromagnetic waves and their characteristics.

Unit	Title: Wave Optics, Electricity-II and Electromagnetic Theory	60 hrs/ sem
Unit I	**Wave optics:** **Fresnel diffraction**: Fresnel's treatment of the wavefront and Fresnel assumptions. Theory of half period zones considering plane wave fronts. Zone plate: construction, theory and expression for focal length. Comparison between zone plate and convex lens. **Fraunhofer diffraction**: Fraunhofer diffraction at a single slit and at a double slit. Diffraction grating. Theory of Plane transmission grating. Dispersive power of grating. Comparison of grating and Prism spectra. **Polarization:** Malus law. Huygen's theory of double refraction. Positive and negative crystals. Wave plates: quarter wave plate and half wave plate. Optical activity, specific rotation. Laurent's Half Shade Polarimeter: Construction and working.	15 hrs
Unit II	**Resonance Circuits, D. C. and AC Bridges:** **Resonance Circuits:** Operator j, Argand diagram. LCR series circuit- Expression for current, impedance and phase (using j–operator method). Condition for resonance, resonant frequency, bandwidth, quality factor and the relation between them. LCR parallel circuit (Series L-R in parallel with C): Expression for admittance and the condition for resonance (using j-operator method). Comparison between series and parallel resonant circuits. **D.C. & A.C. Bridges:** D.C. Wheatstone Bridge and its demerits (qualitative discussion without derivation). Measurement of inductance, Theory of Maxwell's bridge and Anderson's bridge. Comparison of capacities of two condensers by de Sauty's method.	15 hrs
Unit III	**Magnetostatics and Thermoelectricity:** **Magnetostatics:** Overview of basics of Magnetostatics: Statement of Biot-Savart' law, derive the expression for magnetic field due to a straight conductor carrying current, mention the expression for the field along the axis of a circular coil and discuss the special cases. Tangent law, Helmholtz galvanometer-principle, construction and working. Ampere's circuital law-statement, proof and its applications (for D. C.) to derive the magnetic field due to Solenoid and Toroid. **Thermoelectricity:** Seebeck effect, Variation of thermo-emf with temperature. Neutral temperature and temperature of inversion. Thermoelectric series. Peltier effect, Thomson effect. Thermoelectric laws. Derivation of the relations $\pi = T\,(de/dT)$ and $\sigma_a - \sigma_b = T\,(d^2e/dT^2)$. Tait diagram and its uses. Thermoelectric generators (TEG), Peltier-cooling, Thermoelectric cooler (TEC).	15 hrs
Unit IV	**Electromagnetic Induction and Electromagnetic Theory:** Overview of basics of EMI. Determination of self-inductance by Rayleigh's method. Determination of mutual inductance by direct method. **Electromagnetic Theory:** Fields, types of fields, flux and circulation of a vector field, gradient of a scalar field and its significance, vector point function (electric field intensity) and scalar point function (electric potential) and relation between them for an electrostatic charge distribution. Divergence and curl of a vector field and their significance; Gauss divergence theorem (derivation) and Stokes theorem (derivation). Electromotive force (emf) as the circulation of electric field intensity (derivation); continuity equation (proof) and its significance. Concept of displacement current. Setting up of the differential form of Maxwell's equations (derivations). Poynting's theorem (statement and derivation).	15hrs

Recommended books:

1. Principles of Optics (I-Edition) – B.K. Mathur – New Gopal Printing Press, 1962.
2. Fundamentals of Optics (V-Edition) – Khanna & Bedi – R. Chand & Co., New-Delhi, 1971.
3. A Text book of Optics (I-Edition) – Brijlal& Subramanyam - S. Chand & Company Ltd., New-Delhi, 2006.
4. Fundamentals of optics- Khanna and Gulati.
5. Optics (IV-Edition) – Ajay Ghatak –Tata Mc Graw-Hill, New-Delhi, 2006
6. Fundamentals of Optics (III-Edition) – Jenkins & White - Mc Graw-Hill, 1957.
7. Geometrical Optics (I-Edition) – D.P. Acharya – Oxford & IBH Pub. Co., New-Delhi,1970.
8. Optics & Spectroscopy (VI-Edition) – Murugeshan, Kirutiga & Shivaprasath - S. Chand & Company Ltd., New-Delhi, 2006.
9. Geometrical Optics – A. Verstraeten.
10. Fundamentals of Electricity and Magnetism – Basudev Ghosh – Books & Allied New Central Book Agency, Calcutta, 2009.
11. Electricity and magnetism- D.N. Vasudev- S. Chand Publication, New Delhi.
12. Electricity and Magnetism- B.S. Agarwal- S. Chand Publication, New Delhi.
13. Electricity and magnetism- Brijlal & Subramasnyam.
14. Vector Analysis- Hague
15. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004.

FormativeAssessmentforTheory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–IV

Discipline Specific Course (DSC-8)

Course Title: Wave Optics, Electricity-II and Electromagnetic Theory (Practical)

Course Code:C4PHY1P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-8	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**10**	**40**	**50**

List of fourth semester Physics Experiments:

1. R.P. of grating.
2. RP of Prism.
3. Determination of wavelength of laser light by diffraction: single slit method.
4. Polarimeter: Determination of specific rotation of sugar solution.
5. Study of elliptically polarized light/Verification of Malus law.
6. Study of elliptically polarized light using polarizer - analyzer setup and sodium vapor source.
7. Helmholtz galvanometer.
8. Determination of magnetic field along the axis of a coil
9. Series /parallel resonance circuit.
10. Determination of coefficient of self-inductance (L) by Rayleigh's method
11. Determination of coefficient of self-inductance (L) using Anderson's bridge .
12. Determination of coefficient of mutual inductance by direct method/Carey-Foster's method.
13. Measurement of emf of a thermocouple at various temperatures and verification of any one law of thermoelectric effect.
14. Study of Seeback effect.
15. Study of Peltier Effect (Thermoelectric Cooler-TEC).

Note:

1. **Experiments of four hours duration each.**
2. **Minimum of Eight experiments to be performed.**

Books recommended:

1. Physics For Degree Students B. Sc. First Year, S. Chand & Company.
2. Electronics Instrumentation by H S Kalasi.
3. B.Sc. practical Physics – C.L. Arora.
4. Advanced practical Physics – Samir Kumar Ghosh.
5. Advanced practical Physics – Worsnop and Flint.
6. Advanced practical Physics-I & II, S.P.Singh.

B.Sc. Semester–V

Discipline Specific Course (DSC-9A)

Course Title: - Classical and Modern Physics-I

Course Code:C5PHY2T1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-9A	**Theory**	**04**	**04**	**60 hrs.**	**3 hrs.**	**20**	**80**	**100**

Course Outcome (CO):
At the end of the course, students will be able to:

CO 1: Identify the failure of classical physics at the microscopic level.

CO 2**:** Alternate approach towards the study of classical mechanics by Lagrangian, Variational and Hamiltonian formulations.

CO 3: Find the relationship between the normalization of a wave function and the ability to calculate expectation values or probability densities.

CO 4: Explain the minimum uncertainty of measuring both observables on any quantum state.

CO 5: Describe the time-dependent and time-independent Schrödinger equation for simple potentials like forinstance one-dimensional potential well and Harmonic oscillator.

CO 6: Describe the processes of alpha, beta and gamma decays based on well-established theories.

CO 7: Explain the basic aspects of interaction of gamma radiation with matter by photoelectric effect,Compton scattering and pair production.

CO 8**:** Explain the different nuclear radiation detectors such as ionization chamber, Geiger-Mueller counter etc.

CO 9: Explain the basic concept of scintillation detectors, photo multiplier tube and semiconductor detectors.

CO 10: Get hands on training in wiring a circuit, soldering, making a measurement using an electronic circuit used in instrumentation.

CO 11: Have an understanding of the basic electronic components viz., resistors, capacitors, inductors, discrete and integrated circuits, colour codes, values and pin diagram, their practical use**.**

CO 12: Understanding of the measurement of voltage, current, resistance value, identification of the terminals of a transistor and ICs.

CO 13: Understand and give a mathematical treatment of the working of rectifiers, filter, data converters and different types of transducers.

CO 14: Connect the concepts learnt in the course to their practical use in daily life.

CO 15: Develop basic hands-on skills in the usage of oscilloscopes, multi meters, rectifiers, amplifiers, oscillators and high voltage probes, generators and digital meters.

CO 16: Servicing of simple faults of domestic appliances: Iron box, immersion heater, fan, hot plate, battery charger, emergency lamp and the like.

Unit	Title: Classical and Modern Physics-I	60 hrs/ sem
Unit I	**Classical Mechanics-I:** Constraints (Holonomic, Non-holonomic,Scleronomic, and Rheonomic constraints with examples), Degrees of freedom, space point and configuration space, virtual displacement and principle of virtual work, Generalized co-ordinates, generalized displacement, generalized velocity and generalized force, D'Alembert's Principle, Derivation of Lagrange's equation of motion using D'Alembert's Principle (For holonomic case), Applications of the Lagrangian formulation: Simple pendulum, Atwood's machine and Linear Harmonic Oscillator(one dimension).	15 hrs
Unit II	**Quantum Mechanics-I:** Brief discussion on failure of classical physics to explain black body radiation, Photoelectric effect, Compton effect, stability of atoms and spectra of atoms. **Compton Scattering:** Expression for energy of the scattered photon, kinetic energy of the recoil electron and Compton shift (with derivation). **Matter Waves:** de Broglie hypothesis. Expression for group velocity and Phase velocity of matter waves. Davisson and Germer experiment and its significance. **Uncertainty principle:** Statement and illustration by Gamma ray microscope and diffraction of electrons at a single slit. **Wave Mechanics**: Setting up of time independent Schrodinger's equation. Physical interpretation of wave function. Eigen function and Eigen values. Expression for energy of a Particle in a one-dimensional infinite potential well(derivation), One-dimensional simple harmonic oscillator (qualitative)- concept of zero-point energy.	15 hrs
Unit III	**Nuclear Physics:** **Radioactivity:** Half-life, activity and decay constant. **Alpha decay:** Gamow's theory of Alpha decay (Without derivation). Derivation of expression for alpha disintegration energy. Range of Alpha particles. Experimental determination of range of alpha particles. Geiger-Nuttal relation and its significance (qualitative). **Beta decay:** Types of beta decay with examples. The neutrino theory of beta decay (qualitative). Decay scheme of Tl-204. **Gamma decay:** Origin of Gamma rays**.** Decay schemes of Cs-137 and Na-22. **Nuclear forces:** Meson theory of nuclear forces. **Nuclear models:** Liquid-drop model: Semi-empirical mass formula and explanation of the terms, nuclear fission on the basis of liquid-drop model. Shell model (qualitative), Magic numbers. **Nuclear Reactions:** Energy balance in nuclear reactions and the Q-value. **Detectors:** Geiger-Muller counter: Characteristics, dead time, working and applications. **Accelerators:** Theory, construction and working of Cyclotron. **Elementary Particles:** Types of elementary particles and their classifications, briefly give quarks models.	15 hrs

Unit IV	**Electronics:** **Integrated Circuits (ICs):** IC741 and its characteristics (both ideal and practical). Voltage transfer characteristics of op-amp and its significance. Inverting and non-inverting amplifier, Wein bridge and Phase shift oscillators using op-amp. IC555 timer: internal configuration; operation of IC555 as Astable multivibrator (qualitative). **Digital Electronics:** Basic theorems of Boolean algebra, Basic and Universal gates. Demorgan's theorems. IC7400: Pin configuration and applications. Digital to Analog (D/A) and Analog toDigital (A/D) converters, Ladder type (R-2R) D/A converter using Op-amp. **Communication**: Mention the types of radio wave propagation. Radio wave propagation through ionosphere: Critical frequency, critical angle, MUF, virtual height, secant law. **Amplitude modulation (AM):** Modulation index, frequency spectrum of AM, AM modulator using BJT. **Frequency Modulation (FM):** Modulation index, FM spectrum, Comparison between FM and AM**.** **Demodulation:**AM detection using PIN diode (qualitative).	15hrs

Recommended books:

1. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer Physics Vol. No.I (V Edition)
3. Classical Mechanics, G. Aruldhas, 2008, Prentice-Hall of India Private limited, New Delhi.
4. Classical Mechanics, Takwale and Puranik-1989, Tata McGraw Hill, New Delhi.
5. Resnick, Halliday & Krane – John Wiley & Son's Inc., New-York, Singapore, 2005.
6. Berkely Physics, Vol. No. I – ABC Publications, Bangalore & New-Delhi.
7. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004.
8. Classical Mechanics (XVII ed)- Goldstein-Narosa Publishing New Dhli,1998.
9. Quantum Mechanics vol 1 and vol 2(I ed)- Shrivatsav-Pragati Prakashan, Meerat,1977
10. Quantum Mechanics- Gupta,Kumar & Sharma- Jayprakashnath &Co,Meerat,2004
11. Quantum Mechanics (I ed)- Powell-Oxford& IBH Publishing, New Dehli, Bombay, Kolkata,1961
12. Quantum Mechanics – Pauling & Wilson.
13. Modern physics- R. Murugeshan-- S. Chand Publication,New Dehli.
14. Introduction to modern physics- Ritchmeyer, Kennerd & Lauritser-TMH Publishing New Dehli
15. Perspective of modern physics (VI ed)- A.Baiser- Tata McGraw Hill, New Dehli.2002
16. Solid State Physics-R. K. Puri and V.K. Babber., S. Chand publications,1st Edition (2004).
17. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
18. Nuclear Physics, Irving Kaplan, Narosa Publishing House.
19. Concepts of nuclear physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
20. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
21. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press

22. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (Institute of Physics (IOP) Publishing, 2004).
23. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
24. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier,2007).
25. Basic electronics and solid-state physics- B.L. Theraja- S. Chand Publication, New Delhi
26. Basic Electronics- B.L. Theraja- S. Chand Publication, New Delhi
27. Integrated Electronics- Millmans Ans Halkias-McGraw Hill, New Delhi
28. Electronic devices and circuits- Allan Mottersed- McGraw Hill, New Delhi
29. Basic Electronics linear circuits, TTTI- Bhargav & et. al.
30. Electronics communication system- Kennedy & Davis.
31. Quantum Mechanics, Satya Prakash, Pragati Publications.
32. Nuclear Physics, Satya Prakash, Pragati Publications.

Formative Assessment for Theory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–V

Discipline Specific Course (DSC-10A)

Course Title: Classical and Modern Physics-I (Practical)

Course Code:C5PHY2P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-10A	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**10**	**40**	**50**

List of fifth semester (DSC-10A) Physics Experiments:

1. To study the effect of amplitude of oscillation on the time period of a simple pendulum.
2. Determine the acceleration due to gravity by using Atwood's machine.
3. To study the spectral characteristics of a photo-voltaic cell (solar cell) by using different filters.
4. To study the I-V characteristics of a solar cell and determination of its fill factor.
5. To study the tunneling phenomenon in a tunnel diode by using I-V characteristics.
6. Determination of quantum efficiency of a photodiode.
7. Study of op-amp as an inverting and non-inverting amplifier (DC / AC)
8. Determination of modulation index (amplitude modulation)
9. Astable multivibrator using IC 555.
10. Voltage Transfer Characteristics of op-amp (in negative feedback/ amplifier mode, for two different gains after feedback (A_f)).
11. Digital to Analog Converter using Ladder (R-2R) network
12. Basic gates using IC 7400.
13. Verification of Boolean expressions using IC 7400.
14. Study of GM counter characteristics and dead time of a GM Counter/ Determination of mass attenuation coefficient of aluminum for beta rays from Tl-204.
15. Phase Shift/ Wein bridge oscillator using op-amp.

Note:

1. **Experiments of four hours duration.**
2. **Minimum of Eight experiments to be performed.**

Books recommended:

1. Physics For Degree Students B. Sc. First Year, S. Chand & Company.
2. Electronics Instrumentation by H S Kalasi.
3. B.Sc. practical Physics – C.L. Arora.
4. Advanced practical Physics – Samir Kumar Ghosh.
5. Advanced practical Physics – Worsnop and Flint.

B.Sc. Semester–V

Discipline Specific Course (DSC-9B)

Course Title: - Classical and Modern Physics-II

Course Code:C5PHY2T2

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-9B	**Theory**	**04**	**04**	**60 hrs.**	**3 hrs.**	**20**	**80**	**100**

Course Outcome (CO):
At the end of the course, students will be able to:

CO 1: Identify the failure of classical physics at the microscopic level.

CO 2: Alternate approach towards the study of classical mechanics by Lagrangian, Variational andHamiltonian formulations.

CO 3: Find the relationship between the normalization of a wave function and the ability to calculate expectation values or probability densities.

CO 4: Explain the minimum uncertainty of measuring both observables on any quantum state.

CO 5: Describe the time-dependent and time-independent Schrödinger equation for simple potentials like for instance one-dimensional potential well and Harmonic oscillator.

CO 6: Apply Hermitian operators, their eigen values and eigen vectors to find various commutation and uncertainty relations.

CO 7: Study crystal systems and X-ray spectra and Braggs X-ray spectrometer.

CO 8: Understand the concepts of free electron theory of metals, specific heat of solids, semiconductors and magnetic properties of matter.

CO 9: Understand the theory and applications of Hall Effect.

CO 10: Learn origin of spectral lines and spectral series of hydrogen like atom.

CO 11: Interpret vector atomic model optical spectra.

CO 12: Interpretation of molecular Spectra of compounds using basics of molecular physics.

CO 13: Explain laser systems and their applications in various fields.

Unit	Title: Classical and Modern Physics-II	60 hrs/ sem
Unit I	**Classical Mechanics-I:** Constraints (Holonomic, Non-holonomic, Scleronomic, and Rheonomic constraints with examples), Degrees of freedom, space point and configuration space, virtual displacement and principle of virtual work, Generalized co-ordinates, generalized displacement, generalized velocity and generalized force, D'Alembert's Principle, Derivation of Lagrange's equation of motion using D'Alembert's Principle (For holonomic case), Applications of the Lagrangian formulation: Simple pendulum, Atwood's machine and Linear Harmonic Oscillator(one dimension).	15 hrs
Unit II	**Quantum Mechanics-I:** Brief discussion on failure of classical physics to explain black body radiation, Photoelectric effect, Compton effect, stability of atoms and spectra of atoms. **Compton Scattering:** Expression for energy of the scattered photon, kinetic energy of the recoil electron and Compton shift (with derivation). **Matter Waves:** de Broglie hypothesis. Expression for group velocity and Phase velocity of matter waves. Davisson and Germer experiment and its significance. **Uncertainty principle:** Statement and illustration by Gamma ray microscope and diffraction of electrons at a single slit. **Wave Mechanics**: Setting up of time independent Schrodinger's equation. Physical interpretation of wave function. Eigen function and Eigen values. Expression for energy of a Particle in a one-dimensional infinite potential well (derivation), One-dimensional simple harmonic oscillator (qualitative)-concept of zero-point energy.	15 hrs
Unit III	**Condensed matter physics:** **Crystal structure:** Lattice, lattice translational vectors, basis of crystal structure, Types of unit cells, Co-ordination numbers, Bravais lattices, Miller indices, expression for inter-planar spacing, crystal structure of NaCl. Bragg`s law of X-ray diffraction(derivation). **Free electron theory of metals:** Classical free electron model, expressions for electrical and thermal conductivity, Wiedemann-Franz law. **Semiconductors:** Expression for electrical conductivity in case of intrinsic semiconductors. Hall effect and expressions for Hall co-efficient. Applications of Hall effect. **Magnetic materials:** Classification of Magnetic materials. Classical Langevin's theory of diamagnetism (with derivation). Ferromagnetism and Weiss Theory of Ferromagnetism(qualitative). **Superconductivity:** Zero resistivity and Critical temperature. Meissner effect and Isotope effect. **Nanoscience:** Nanomaterials: Synthesis, Characterization, Properties and applications.	15 hrs
Unit IV	**Spectroscopy:** **Atomic Spectra:** Vector-Atom model, LS and jj Coupling schemes in case of one valence electron and two valence electron atoms. Spectral terms. Selection rules for transitions. Magnetic moment due to orbital and spin motion. Stern-Gerlach Experiment. Larmor precession. Normal and Anomalous Zeeman effect. Expression for Zeeman shift (using quantum theory). **Molecular spectra:** Different types of motions (electronic, vibration and rotation) in a molecule. The diatomic molecule as a rigid rotator: Energy, energy levels and spectra (with derivation). Diatomic molecule as a non-rigid rotator(qualitative). **Lasers:** Einstein's theory of spontaneous emission, stimulated absorption and stimulated	15hrs

	emission. Conditions for lasing action. Theory, construction and working of He-Ne laser. Applications of Lasers. **Raman effect:** Rayleighs Scattering and Raman Scattering. Quantum theory of Raman effect. Applications of Raman effect.	

Recommended books:

1. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer Physics Vol. No.I (V Edition)
3. Classical Mechanics, G. Aruldhas, 2008, Prentice-Hall of India Private limited, New Delhi.
4. Classical Mechanics, Takwale and Puranik-1989, Tata McGraw Hill, New Delhi.
5. Resnick, Halliday & Krane – John Wiley & Son's Inc., New-York, Singapore, 2005.
6. Berkely Physics, Vol. No. I – ABC Publications, Bangalore & New-Delhi.
7. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004.
8. Classical Mechanics (XVII ed)- Goldstein-Narosa Publishing New Dhli,1998.
9. Quantum Mechanics vol 1 and vol 2(I ed)- Shrivatsav-Pragati Prakashan, Meerat,1977.
10. Quantum Mechanics- Gupta, Kumar & Sharma- Jayprakashnath & Co, Meerat,2004.
11. Quantum Mechanics (I ed)- Powell-Oxford& IBH Publishing, New Delhi, Bombay, Kolkata,1961.
12. Quantum Mechanics – Pauling & Wilson.
13. Solid State Physics- C. Kittel-Wishey Publishing.
14. Solid state physics (I ed)- A.J. Dekker-McMillan, New Dehli,2003
15. Solid state physics (I ed)- Keer-New age international Pvt. Limited.2002
16. Solid state physics- Kumar and Gupta.
17. Solid state physics- Kumar and Gupta and Saxena.
18. Solid state physics – S.O. Pillai.
19. Elements of Solid-State Physics, J.P. Srivastava, 2nd Ed., 2006
20. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-GrawHill
21. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976.
22. Solid State Physics, Rita John, 2014, McGrawHill
23. Solid-state Physics, H. Ibach and H Luth, 2009, Springer
24. Elementary Solid-State Physics, 1/e M. Ali Omar, 1999, Pearson India
25. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
26. Moden Physics- Duggal and Chabra.
27. Modern physics- R. Murugeshan-- S. Chand Publication, New Delhi.
28. Introduction to modern physics- Ritchmeyer, Kennerd & Lauritser-TMH Publishing New Delhi.
29. Perspective of modern physics (VI ed)- A.Baiser- Tata McGraw Hill,Newdehli.2002
30. Modern physics- J.B.Rajam.
31. Introduction to atomic spectra (IV ed)- H.E.White- McGraw Hill,Newdehli,2004.
32. Molecular spectra and molecular structure– G.Herzberg.
33. Modern spectroscopy – J.Michael Hollas.

34. LASERs and Nonlinear Optics- B.B.Laud.
35. Nano science and Nanotechnology, Sunder Singh, Pragati Publications, 2024.
36. Classical Mechanics, B.A.Kagali and T. Shivalingaswamy, Himalaya Publishing House, 2018.

Formative Assessment for Theory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester– V

Discipline Specific Course (DSC-10B)

Course Title: Classical and Modern Physics-II(Practical)

Course Code:C5PHY2P2

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-10B	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**10**	**40**	**50**

List of fifth semester (DSC-10B) Physics Experiments:

1. Hall Effect: Determination of Hall Coefficient.
2. Temperature variation of Resistivity of a semiconductor by four probe method.
3. Energy gap of a thermistor.
4. X-ray analysis of crystal structure.
5. Determination of average crystallite size and d-spacing from intensity versus 2 θ XRD patterns.
6. Determination of Fermi energy of copper.
7. B-H Curve.
8. Determination of paramagnetic susceptibility of a solid/ liquid (solution).
9. Ionization potential (Frank-Hertz Experiment).
10. Study of rotational spectra (rigid rotator case).
11. Study of rotational spectra (non-rigid rotator case).
12. Study of Rotational Raman Spectra of diatomic molecules.
13. Determination of Rydberg's constant using hydrogen source.
14. Energy Eigen-values and Eigen-states of particle (an electron or a proton) in a finite square well potential.
15. e/K_B using BJT
16. Determination of Planck's constant using LEDs of different colors.

Note:

1. **Experiments of four hours duration each.**
2. **Minimum of Eight experiments to be performed.**

Books recommended:

1. Physics For Degree Students B. Sc. First Year, S. Chand & Company.
2. Electronics Instrumentation by H S Kalasi.
3. B.Sc. practical Physics – C.L. Arora.
4. Advanced practical Physics – Samir Kumar Ghosh.
5. Advanced practical Physics – Worsnop and Flint.

B.Sc. Semester–VI

Imp. Note: Those who have studied DSC 9A and DSC 10A during fifth semester shall study DSC 11A and DSC 12A and those who have studied DSC 9B and DSC 10B during fifth semester shall study DSC 11B and DSC12B in 6th semester.

Discipline Specific Course (DSC-11A)

Course Title: - Classical and Modern Physics-III

Course Code:C6PHY2T1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Durationof Exam	FormativeAssessmentMarks	Summative assessment Marks	TotalMarks
DSC-11A	**Theory**	**04**	**04**	**60 hrs.**	**3 hrs.**	**20**	**80**	**100**

Course Outcome (CO):
At the end of the course, students will be able to:

CO 1: Identify the failure of classical physics.

CO 2: Alternate approach towards the study of classical mechanics by Lagrangian, Variational and Hamiltonian formulations.

CO 3: Find the relationship between the normalization of a wave function and the ability to calculate expectation values or probability densities.

CO 4: Explain the minimum uncertainty of measuring both observables on any quantum state.

CO 5: Describe the time-dependent and time-independent Schrödinger equation for simple potentials like for instance one-dimensional potential well and Harmonic oscillator.

CO 6: Apply Hermitian operators, their eigen values and eigen vectors to find various commutationand uncertainty relations.

CO 7: Study crystal systems and X-ray spectra and Braggs X-ray spectrometer.

CO 8: Understand the concepts of free electron theory of metals, specific heat of solids, semiconductors and magnetic properties of matter.

CO 9: Understand the theory and applications of Hall Effect.

CO 10: Learn origin of spectral lines and spectral series of hydrogen like atom.

CO 11: Interpret vector atomic model optical spectra.

CO 12: Interpretation of molecular Spectra of compounds using basics of molecular physics.

CO 13: Explain laser systems and their applications in various fields.

Unit	Title: Classical and Modern Physics-III	60 hrs/ sem
Unit I	**CLASSICAL MECHANICS -II** Review of Lagrangian formulation and its advantages. Hamilton's variational principle, Deduction of Hamilton's principle, Lagrange's equation of motion from Hamilton's principle (with derivation). **Hamiltonian Mechanics:** The Hamiltonian of a system, Hamilton's equations of motion, Hamilton's equations from variational principle (with derivation), Integrals of Hamilton's equations: energy integrals, Canonical Transformations (qualitative discussion with mention of four different forms), Poisson Brackets: fundamental properties of Poisson brackets and equations of motion in Poisson Brackets form.	15 hrs
Unit II	**Quantum Mechanics-II:** Probabilistic interpretation of the wave function - normalization and orthogonality of wave functions, Probability current density, equation of continuity and its physical significance, Postulates of Quantum mechanics. **Applications of Wave Mechanics**: Particle in a three-dimensional infinite potential well (derivation for energy Eigen value and Eigen function), degeneracy, particle in a finite potential well (qualitative), Transmission across a potential barrier: discussion with mention of expression for Transmission and Reflection coefficients, the tunnel effect(qualitative) and its applications. **Nano-physics:** Introduction, size effect - correlation with quantum mechanical 'particle in a box' problem, quantum structures: quantum wells, wires and dots.	15 hrs
Unit III	**Condensed matter physics:** **Crystal structure:** Lattice, lattice translational vectors, basis of crystal structure, Types of unit cells, Co-ordination numbers, Bravais lattices, Miller indices, expression for inter-planar spacing, crystal structure of NaCl. Bragg`s law of X-ray diffraction(derivation). **Free electron theory of metals:** Classical free electron model, expressions for electrical and thermal conductivity, Wiedemann-Franz law. **Semiconductors:** Expression for electrical conductivity in case of intrinsic semiconductors. Hall effect and expression for Hall co-efficient. Applications of Hall effect. **Magnetic materials:** Classification of Magnetic materials. Classical Langevin's theory of diamagnetism (with derivation). Ferromagnetism and Weiss Theory of Ferromagnetism(qualitative). **Superconductivity:** Zero resistivity and Critical temperature. Meissner effect and Isotope effect. **Nanoscience:** Nanomaterials: Synthesis, characterization, properties and applications.	15 hrs
Unit IV	**Atomic Spectra:** Vector-Atom model, LS and jj Coupling schemes in case of one valence electron and two valence electron atoms. Spectral terms. Selection rules for transitions. Magnetic moment due to orbital and spin motion. Stern-Gerlach Experiment. Larmor precession. Normal and Anomalous Zeeman effect. Expression for Zeeman shift (using	15hrs

	quantum theory). **Molecular spectra:** Different types of motions (electronic, vibration and rotation) in a molecule. The diatomic molecule as a rigid rotator: Energy, energy levels and spectra (with derivation). Diatomic molecule as a non-rigid rotator(qualitative). **Lasers:** Einstein's theory of spontaneous emission, stimulated absorption and stimulated emission. Conditions for lasing action. Theory, construction and working of He-Ne laser. Applications of Lasers. **Raman effect:** Rayleighs Scattering and Raman Scattering. Quantum theory of Raman effect. Applications of Raman effect.	

Recommended books:

1. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer Physics Vol. No.I (V Edition)
3. Classical Mechanics, G. Aruldhas, 2008, Prentice-Hall of India Private limited, New Delhi.
4. Classical Mechanics, Takwale and Puranik-1989, Tata McGraw Hill, New Delhi.
5. Resnick, Halliday & Krane – John Wiley & Son's Inc., New-York, Singapore, 2005.
6. Berkely Physics, Vol. No. I – ABC Publications, Bangalore & New-Delhi.
7. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004.
8. Classical Mechanics (XVII ed)- Goldstein-Narosa Publishing New Dhli,1998.
9. Quantum Mechanics vol 1 and vol 2(I ed)- Shrivatsav-Pragati Prakashan, Meerat,1977.
10. Quantum Mechanics- Gupta, Kumar & Sharma- Jayprakashnath & Co, Meerat,2004.
11. Quantum Mechanics (I ed)- Powell-Oxford& IBH Publishing, New Delhi, Bombay, Kolkata,1961.
12. Quantum Mechanics – Pauling & Wilson.
13. Solid State Physics- C. Kittel-Wishey Publishing.
14. Solid state physics (I ed)- A.J. Dekker-McMillan, NewDehli,2003
15. Solid state physics (I ed)- Keer-New age international Pvt. Limited.2002
16. Solid state physics- Kumar and Gupta.
17. Solid state physics- Kumar and Gupta and Saxena.
18. Solid state physics – S.O. Pillai.
19. Elements of Solid-State Physics, J.P. Srivastava, 2nd Ed., 2006
20. Introduction to Solids, Leonid V. Azar off, 2004, Tata Mc-Graw Hill
21. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976.
22. Solid State Physics, Rita John, 2014, McGraw Hill
23. Solid-state Physics, H. Ibach and H Luth, 2009, Springer
24. Elementary Solid-State Physics, 1/e M. Ali Omar, 1999, Pearson India
25. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
26. Moden Physics- Duggal and Chabra.
27. Modern physics- R. Murugeshan-- S. Chand Publication, New Delhi.

28. Introduction to modern physics- Ritchmeyer, Kennerd & Lauritser-TMH Publishing New Delhi.
29. Perspective of modern physics (VI ed)- A. Baiser- Tata McGraw Hill, New dehli.2002
30. Modern physics- J.B. Rajam.
31. Introduction to atomic spectra (IV ed)- H.E. White- McGraw Hill, New dehli,2004.
32. Molecular spectra and molecular structure– G. Herzberg.
33. Modern spectroscopy – J. Michael Hollas.
34. LASERs and Nonlinear Optics- B.B. Laud.
35. Advanced quantum Mechanics, B.S.Rajput, 2019, Pragati Publications.

Formative Assessment for Theory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–VI

Discipline Specific Course (DSC-12A)

Course Title: Classical and Modern Physics-III(Practical)

Course Code:C6PHY2P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-12A	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**10**	**40**	**50**

List of sixth semester (DSC-12A) Physics Experiments:

1. Hall Effect: Determination of Hall Coefficient.
2. Temperature variation of Resistivity of a semiconductor by four probe method.
3. Energy gap of a thermistor.
4. X-ray analysis of crystal structure.
5. Determination of average crystallite size and d-spacing from intensity versus 2θ XRD patterns.
6. Determination of Fermi energy of copper.
7. B-H Curve.
8. Determination of paramagnetic susceptibility of a solid/ liquid (solution).
9. Ionization potential (Frank-Hertz Experiment).
10. Study of rotational spectra (rigid rotator case).
11. Study of rotational spectra (non-rigid rotator case).
12. Study of Rotational Raman Spectra of diatomic molecules.
13. Determination of Rydberg's constant using hydrogen source.
14. Energy Eigen-values and Eigen-states of particle (an electron or a proton) in a finite square well potential.
15. e/K_B using BJT
16. Determination of Planck's constant using LED's of different colors.

Note:

1. **Experiments of four hours duration.**
2. **Minimum of Eight experiments to be performed.**

Books recommended:

1. Physics For Degree Students B. Sc. First Year, S. Chand & Company.
2. Electronics Instrumentation by H S Kalasi.
3. B.Sc. practical Physics – C.L. Arora.
4. Advanced practical Physics – Samir Kumar Ghosh.
5. Advanced practical Physics – Worsnop and Flint.

B.Sc. Semester–VI

Discipline Specific Course (DSC-11B)

Course Title: - Classical and Modern Physics-IV

Course Code:C6PHY2T2

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-11B	**Theory**	**04**	**04**	**60 hrs.**	**3 hrs.**	**20**	**80**	**100**

Course Outcome (CO):

At the end of the course, students will be able to:

CO1: Identify the failure of classical physics at the microscopic level.

CO2**:** Alternate approach towards the study of classical mechanics by Lagrangian, Variational and Hamiltonian formulations.

CO3: Find the relationship between the normalization of a wave function and the ability to calculate expectation values or probability densities.

CO4: Explain the minimum uncertainty of measuring both observables on any quantum state.

CO5: Describe the time-dependent and time-independent Schrödinger equation for simple potentials like for instance one-dimensional potential well and Harmonic oscillator.

CO 6: Describe the processes of alpha, beta and gamma decays based on well-established theories.

CO 7: Explain the basic aspects of interaction of gamma radiation with matter by photoelectric effect, Compton scattering and pair production.

CO 8**:** Explain the different nuclear radiation detectors such as ionization chamber, Geiger-Mueller counter etc.

CO 9: Explain the basic concept of scintillation detectors, photo - multiplier tube and semiconductor detectors.

CO 10: Get hands on training in wiring a circuit, soldering, making a measurement using an electronic circuit used in instrumentation.

CO11: Have an understanding of the basic electronic components viz., resistors, capacitors, inductors, discrete and integrated circuits, colour codes, values and pin diagram, their practical use**.**

CO12: Understanding of the measurement of voltage, current, resistance value, identification of the terminals of a transistor and ICs.

CO13: Understand and give a mathematical treatment of the working of rectifiers, filter, data converters and different types of transducers.

CO14: Connect the concepts learnt in the course to their practical use in daily life.

CO15: Develop basic hands-on skills in the usage of oscilloscopes, multi meters, rectifiers, amplifiers, oscillators and high voltage probes, generators and digital meters.

CO16: Servicing of simple faults of domestic appliances: Iron box, immersion heater, fan, hot plate, battery charger, emergency lamp and the like.

Unit	Title: Classical and Modern Physics-IV	60 hrs/ sem
Unit I	**CLASSICAL MECHANICS -II** Review of Lagrangian formulation and its advantages. Hamilton's variational principle, Deduction of Hamilton's principle, Lagrange's equation of motion from Hamilton's principle (with derivation). **Hamiltonian Mechanics:** The Hamiltonian of a system, Hamilton's equations of motion, Hamilton's equations from variational principle (with derivation), Integrals of Hamilton's equations: energy integrals, Canonical Transformations (qualitative discussion with mention of four different forms), Poisson Brackets: fundamental properties of Poisson brackets and equations of motion in Poisson Brackets form.	15 hrs
Unit II	**Quantum Mechanics-II:** Probabilistic interpretation of the wave function - normalization and orthogonality of wave functions, Probability current density, equation of continuity and its physical significance, Postulates of Quantum mechanics. **Applications of Wave Mechanics**: Particle in a three-dimensional infinite potential well (derivation for energy Eigen value and Eigen function), degeneracy, particle in a finite potential well (qualitative), Transmission across a potential barrier: discussion with mention of expression for Transmission and Reflection coefficients, the tunnel effect(qualitative) and its applications. **Nano-physics:** Introduction, size effect - correlation with quantum mechanical 'particle in a box' problem, quantum structures: quantum wells, wires and dots.	15 hrs
Unit III	**Nuclear Physics:** **Radioactivity:** Half-life, activity and decay constant. **Alpha decay:** Gamow's theory of Alpha decay (Without derivation). Derivation of expression for alpha disintegration energy. Range of Alpha particles. Experimental determination of range of alpha particles. Geiger-Nuttal relation and its significance(qualitative). **Beta decay:** Types of beta decay with examples. The neutrino theory of beta decay(qualitative). Decay scheme of Tl-204. **Gamma decay:** Origin of Gamma rays**.** Decay schemes of Cs-137 and Na-22. **Nuclear forces:** Meson theory of nuclear forces. **Nuclear models:** Liquid-drop model: Semi-empirical mass formula and explanation of the terms, nuclear fission on the basis of liquid-drop model. Shell model(qualitative), Magic numbers. **Nuclear Reactions:** Energy balance in nuclear reactions and the Q-value. **Detectors:** Geiger-Muller counter: Characteristics, dead time, working and applications. **Accelerators:** Theory, construction and working of Cyclotron. **Elementary Particles:** Types of elementary particles and their classifications, briefly give quarks models.	15 hrs

Unit IV	**Electronics:** **Integrated Circuits (ICs):** IC 741 and its characteristics (both ideal and practical). Voltage transfer characteristics of op-amp and its significance. Inverting and non-inverting amplifier, Wein bridge and Phase shift oscillators using op-amp. IC555 timer: internal configuration; operation of IC555 as Astable multivibrator (qualitative). **Digital Electronics:** Basic theorems of Boolean algebra, Basic and Universal gates. Demorgan's theorems. IC7400: Pin configuration and applications. Digital to Analog (D/A) and Analog toDigital (A/D) converters, Ladder type (R-2R) D/A converter using Op-amp. **Communication**: Mention the types of radio wave propagation. Radio wave propagation through ionosphere: Critical frequency, critical angle, MUF, virtual height, secant law. **Amplitude modulation (AM):** Modulation index, frequency spectrum of AM, AM modulator using BJT. **Frequency Modulation (FM):** Modulation index, FM spectrum, Comparison between FM and AM**.** **Demodulation:** AM detection using PIN diode (qualitative).	15hrs

Recommended books:

1. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.
2. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer Physics Vol. No.I (V Edition)
3. Classical Mechanics, G. Aruldhas, 2008, Prentice-Hall of India Private limited, New Delhi.
4. Classical Mechanics, Takwale and Puranik-1989, Tata McGraw Hill, New Delhi.
5. Resnick, Halliday & Krane – John Wiley & Son's Inc., New-York, Singapore, 2005.
6. Berkely Physics, Vol. No. I – ABC Publications, Bangalore & New-Delhi.
7. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004.
8. Classical Mechanics (XVII ed)- Goldstein-Narosa Publishing New Dhli,1998.
9. Quantum Mechanics vol 1 and vol 2(I ed)- Shrivatsav-Pragati Prakashan, Meerat,1977
10. Quantum Mechanics- Gupta, Kumar & Sharma- Jayprakashnath & Co, Meerat,2004
11. Quantum Mechanics (I ed)- Powell-Oxford& IBH Publishing, New Delhi, Bombay, Kolkata,1961
12. Quantum Mechanics – Pauling & Wilson.
13. Modern physics- R. Murugeshan-- S. Chand Publication, New Delhi.
14. Introduction to modern physics- Ritchmeyer, Kennerd & Lauritser-TMH Publishing New Delhi
15. Perspective of modern physics (VI ed)- A. Baiser- Tata McGraw Hill, New Dehli.2002
16. Solid State Physics-R. K. Puri and V.K. Babber., S. Chand publications,1st Edition (2004).
17. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
18. Nuclear Physics, Irving Kaplan, Narosa Publishing House.
19. Concepts of nuclear physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
20. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
21. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
22. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (Institute of

Physics (IOP) Publishing, 2004).
23. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
24. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier,2007).
25. Basic electronics and solid-state physics- B.L. Theraja- S. Chand Publication, New Delhi
26. Basic Electronics- B.L. Theraja- S. Chand Publication, New Delhi
27. Integrated Electronics- Millmans Ans Halkias-McGraw Hill, New Delhi
28. Electronic devices and circuits- Allan Mottersed- McGraw Hill, New Delhi
29. Basic Electronics linear circuits, TTTI- Bhargav & etal.
30. Electronics communication system- Kennedy & Davis.
31. Handbook of electronics, Vol.1 & 2, S.L.Gupta and V.Kumar, Pragati Publications.
32.

Formative Assessment for Theory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–VI

Discipline Specific Course (DSC-12B)

Course Title: Classical and Modern Physics-IV (Practical)

Course Code:C6PHY2P2

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSC-12B	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**10**	**40**	**50**

List of sixth semester (DSC-12B) Physics Experiments:

1. To study the effect of amplitude of oscillation on the time period of a simple pendulum.
2. Determine the acceleration due to gravity by using Atwood's machine.
3. To study the spectral characteristics of a photo-voltaic cell (solar cell) by using different filters.
4. To study the I-V characteristics of a solar cell and determination of its fill factor.
5. To study the tunneling phenomenon in a tunnel diode by using I-V characteristics.
6. Determination of quantum efficiency of a photodiode.
7. Study of op-amp as an inverting and non-inverting amplifier (DC / AC).
8. Determination of modulation index (amplitude modulation).
9. Astable multivibrator using IC 555.
10. Voltage Transfer Characteristics of op-amp (in negative feedback/ amplifier mode, for two different gains after feedback (A_f)).
11. Digital to Analog Converter using Ladder (R-2R) network.
12. Basic gates using IC 7400.
13. Verification of Boolean expressions using IC 7400.
14. Study of GM counter characteristics and dead time of a GM Counter/ Determination of mass attenuation coefficient of aluminum for beta rays from Tl-204.
15. Phase Shift/ Wein bridge oscillator using op-amp.

Note:

1. **Experiments of four hours duration each.**
2. **Minimum of Eight experiments to be performed.**

Books recommended:

1. Physics For Degree Students B. Sc. First Year, S. Chand & Company.
2. Electronics Instrumentation by H S Kalasi.
3. B.Sc. practical Physics – C.L. Arora.
4. Advanced practical Physics – Samir Kumar Ghosh.
5. Advanced practical Physics – Worsnop and Flint.

B.Sc. Semester– V

Elective Course (EC-1)
(for other combination students)

Course Title: -Renewable energy Sources and Medical Physics
Course Code:C5PHY5T1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
EC-1	**Theory**	**03**	**03**	**45 hrs.**	**3 hrs.**	**20**	**80**	**100**

Course Outcome (CO):
At the end of the course, students will be able to:

CO 1: Able to communicate effectively regarding energy conservation and utilization.

CO 2: Become capable of designing equipment's for energy utilization like for example, solar energy.

CO 3: Appreciate the importance of exploiting renewable sources of energy.

CO 5: Understand the utility of various tools available for the diagnosis of diseases

CO 6: Understand the working of some tools used for medical diagnosis and treatment

CO 7: Use the terminology and units in radiology

CO 8: Appreciate the importance of using radiation treatment safely and effectively

CO 9: Employ caution while using radio-isotopes

CO 10: Appreciate the availability of different tools to aid the modern physician

Unit	Title: Renewable energy Sources and Medical Physics	45 hrs/ sem
Unit I	**Renewable energy Sources:** Need of renewable energy sources. Conventional (commercial) energy sources, non-conventional energy sources (Renewable energy). Potential of solar energy, solar radiation and measurements, different types of solar energy collectors, advantages and disadvantages of different collectors, solar energy storage. Solar hot water supply systems. Solar air heating and cooling systems. Solar thermal electric power generation. Solar pumping, distillation, furnace and green houses. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	15 hrs
Unit II	**Physics of Medical Diagnostics and Treatment** Principle of production of X-rays. Use of X-rays in medical diagnosis, X-ray imaging systems. Computed Tomography (CT): principle and generation of CT. Magnetic Resonance Imaging (MRI): basic principle and image characteristics. Ultrasound Imaging: production of ultrasound, transducers, Interaction of sound waves with body tissues, acoustic coupling, image formation, modes of image display and color Doppler.	15 hrs
Unit III	**Radiation therapy:** Radioactivity and Radio isotopes, Activity and half-life of a radio nuclide, radiation exposure time, effect of absorbed dose, Radiation units: Rad, gray. Relative biological electiveness, effective dose, inverse square law. Rem and Sievert. Radiation therapy: Gamma irradiation for cancer treatment, Proton therapy and Brachytherapy using beta radio-isotopes. Radioactive tracers. Use of radio-tracers in Positron Emission Tomography (PET). Dosimeters.	15 hrs

Recommended books:

1. G. D. Rai, “Non-conventional energy sources”, Khanna Publishers, New Delhi, 2009.
2. M. P. Agarwal “Solar energy” S. Chand and Co. Ltd., 1983.
3. S P Sukhatme, J K Nayak “Solar energy” McGraw Hill Education, 2017.
4. S Pugalendi, J Gitanjali, R Shalini and P Subramanyam “Handbook of renewable energy and green technology” CRC Press, 2024\
5. Arun K Ghosh “Introduction to transducers” PHI, 2015
6. .C Amarnath, “Radiological Physics: Essentials and Applications” CBS Publishers and Distributors Pvt. Ltd., 2024
7. Charles M Washington and Dennis Leaver “Principles and practice of radiation therapy: Practical applications” 3rd Edition, Mosby, 1997
8. Jerrold T. Bushberg “The Essential Physics for Medical Imaging”, 2nd Ed., Lippincott Williams & Wilkins, 2002.
9. Jean A. Pope. “Medical Physics: Imaging”, Heinemann Publishers, 2012.
10. Faiz M. Khan and Roger A. Potish. “Treatment Planning in Radiation Oncology”, Williams and Wilkins, USA, 2003.
11. D. Baltas. “The physics of modern brachytherapy for oncology”. Taylor and Francis, 2007.
12. G. S. Pant. “Advances in Diagnostic Medical Physics”, Himalaya Publishing House,2006.
13. Faiz M Khan. “The Physics of Radiation Therapy” 3rd Ed., Lippincott Williams & Wilkins, USA, 2003.

FormativeAssessmentforTheory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester– VI

Elective Course (EC-2)

Course Title: -Basic instrumentation, Computational Physics and Nanoscience and Nano-technology

Course Code:C6PHY5T1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
EC-2	**Theory**	**03**	**04**	**45hrs.**	**3hrs.**	**20**	**80**	**100**

Course Outcome (CO):
At the end of the course students will be able to:

CO 1: Use the different types of instruments used to characterizing and experimentally determine the properties of substances.

CO 2: Develop an ability to independently select the appropriate instrumental technique as per their requirements.

CO 3: Acquire confidence to use instruments for characterization of samples.

CO 4: Acquire an ability to analyze data in order to draw conclusions.

CO 5: Become comfortable with use of different terms related to instrumentation, NANO Physics, and Energy sources.

CO 6: Use computers for simple programming tasks.

CO 7: Use computer software for data processing comfortably.

CO 8: use Artificial Intelligence tools to enhance their work output and efficiency.

CO 9: prepare simple nano-materials.

CO 10: Use the experimental techniques for the characterization of nanomaterials.

CO 11: Appreciate the importance of nanotechnology in modern life.

Unit	Title: Basic instrumentation, Computational Physics and Nanoscience and Nano-technology	45 hrs/ sem
Unit I	**Basic instrumentation**: Design and construction of Voltmeter, Ammeter, and Ohmmeter; Use of multimeters (Analog/digital) and cathode ray oscilloscopes (Analog/ Digital Storage Oscilloscopes). Thermometers: Basic concepts, different types of thermometers and their temperature ranges (including low and high temperature measurement). Optical instruments: Microscopes: Simple and Compound microscopes, electron microscope. Optical spectrometer (UV-Visible Spectrometer) and its applications. Electrical heaters: Construction of temperature-controlled heaters (furnaces) and their applications	15 hrs
Unit II	**Computers and Computational Physics:** Parts of a computer, output and input devices, data processing software, operating systems, Internet of things (world wide web), Search engines, basic concepts of artificial intelligence (AI) and applications of AI. Algorithm, Flow-chart and Codes (using either Basic/ Fortran/ C-language programming) for solving simple problems (Example: Mathematical operations like addition, subtraction, multiplication and division). Applications of computer programming to solve problems in Physics.	15 hrs
Unit III	**Nanoscience and Nano-technology**: Introduction. Nanomaterials: Preparation and characterization techniques. Quantum structures. Nano-medicine: its advantages and disadvantages. Nano-chemistry and materials science, including nano-composites, carbon nano-structures and their applications. Nano-electronics and biomedical nanotechnology. Nano-engineering. Application of nanotechnology in optoelectronics.	15 hrs

Recommended books:

1. Douglas A Skoog, J. James Holler. Stanley R Couch "Instrumental Analysis" Cengage Learning, 2007.
2. Albert D Helfrick, William D Cooper "Modern Electronic Instrumentation and Measurement Techniques" PHI, 1996.
3. A. K. Sawhney "A Course in Electrical and Electronic Instrumentation" Dhanpat Rai & Sons, 1991.
4. Steve Money "Electronic Test Equipment Handbook" PC Publications (England), 1991.
5. David A Bell "Electronic Instrumentation and Measurements" PHI, 2003.
6. J B Gupta "A course in electronic and electrical measurements and instrumentation" S K Kataria and Sons.
7. H. S. Kalsi "Electronic Instrumentation and Methods" 4th Edition, McGraw Hill Education (India) Pvt. Ltd., 2019.
8. V. Rajaraman "Computer oriented numerical methods", Prentice Hall of India Pvt. Ltd, New Delhi,2003.
9. R.C. Verma, P.K. Ahluwalia and K.C. Sharma "Computational Physics", New Age Int.(P) Ltd publishers, New Delhi,1999.
10. V. Rajaraman "Principles of Computer Programming (Fortran 77 for IBM PC), 3rd Ed., Jay print palace Pvt Ltd., New Delhi, 1990.
11. Donald D Givone, Robert P Roesser "Microprocessor/ microcomputers: An introduction" McGraw Hill – Kogakusha Ltd.

12. T Pradeep “Nano: the essentials – Understanding nanoscience and nanotechnology” 1st Ed., McGraw Hill, 2007.
13. T Pradeep “Textbook of nanoscience and nanotechnology”, McGraw Hill Education (India) Pvt. Ltd., 2012.
14. “Audio and video systems: Principles, maintenance and troubleshooting”, R.G.Gupts, Tata-Mc Graw Hill, New-Delhi, 1995.
15. “Opto electronic circuits manual”, R.M.Marston, BPB publications, New-Delhi, 1988.
16. “Radio and Electronics for technician engineers”, D.A. Jacobs, Mc-Graw hill, 1979.
17. “Electronic testing and fault diagnosis” G.C. Loveday, A.H. Wheeler and Co. Pvt. Ltd., New-Delhi, 1980.
18. “Everyday electronics Data book” Michael Tooley, PC publishing/BPB publications, New-Delhi, 1990.

Formative Assessment for Theory	
Assessment type	**Marks**
Internal Assessment Test1	05
Internal Assessment Test2	05
Assignment	10
Total	**20 Marks**
Formative Assessment as per guidelines.	

B.Sc. Semester–IV/ V/VI

Skill Enhancement Course (SEC)

Student shall study SEC in any one of the Semesters either in IV or V or VI semester

College shall decide to allot the students

Course Title: Applied Physics (Practical)

Course Code: COPHY6P1

Type of Course	Theory /Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours /Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
SEC	**Practical**	**02**	**04**	**56 hrs.**	**3 hrs.**	**10**	**40**	**50**

Course Outcome (CO):
At the end of the course students will be able to:

CO1: Design and repair various devices used in daily life
CO2: Appreciate the physics behind various tools and devices
CO3: Use different devices with care, taking into account the precautions
CO4: Do basic chores in the house and outside, especially with regard to troubleshooting problems in domestic electric wiring
CO5: Design small equipment required for research projects and laboratory use
CO6: Scientifically evaluate the condition of rechargeable batteries

List of Experiments for skill enhancement course:

1. Design and construction of a Mobile Charger.
2. Identification and Correction of long and short sightedness.
3. Trouble shooting of rechargeable batteries.
4. Electrical wiring and its trouble shooting.
5. Design and construction of local AM/FM transmission station.
6. Design and construction of temperature controlling device (using thermistor).
7. Thermometers using thermocouples.
8. Design and construction of transformers.
9. Design and construction of fan regulators using thyristors.
10. Construction and troubleshooting of voltage stabilizers.
11. Digital multimeter: Repair and trouble shooting.
12. Design and construction of automation circuits for electrical/electronic appliances.
13. Radio isotopes: For medical diagnosis and treatment, dose calculations.
14. Design/Construction of speaker decks.
15. Design and construction of solar lamp.
16. Construction of different electrical circuits on a PCB using Soldering/ de-soldering techniques.

Note:

1. **Experiments of four hours duration.**
2. **Minimum of Eight experiments to be performed.**

Books recommended:

1. K Sudeep Singh “Troubleshooting and maintenance of electronic equipment’s”, S K Kataria and Sons, 2013
2. R. M. Marston “Power control circuits manual” BPB publications, New Delhi
3. M Ramamoorthy “Thyristors and their applications” 2nd Ed., Affiliated East West Press Pvt. Ltd., New Delhi, 1991
4. Arun K Ghosh “Introduction to transducers” PHI 2015
5. Samir K Datta “Power electronics and controls” PHI 1991
6. S P Sharma “Basic radio and television” Tata McGraw Hill 2001
7. Rajesh Verma “ABC of Amateur Radio and Citizen band” EFY Enterprises Pvt. Ltd.
8. A K Lal “Troubleshooting and maintenance of electronics experiments” Vayu Eduation of India, Patparganj
9. Micheal Jay Geier “How to diagnose and fix everything electronic” 2nd Ed., MacGraw Hill, 2013
10. M A Chaudhari “Maintenance of electrical equipments” Nirali Prakashan, Pune, 2020.
11. David B Weems “Designing, building and testing your own speaker system” 4th Ed., McGraw Hill Professional, 1996
12. John L Murphy “Introduction to loudspeaker design” 2nd Ed., True Audio, 2014.