

PROGRAM/COURSE STRUCTURE AND SYLLABUS

Framed according to the National Education Policy (NEP 2020)

for

Bachelor of Science

in

PHYSICS

I & II Semester Physics Papers

w.e.f.

Academic Year 2021-22 and onwards

BOS members 2021-22 (NEP)

| Sl. No. | Name and address of panel members | Designation |
|----------------|--|---|
| 1 | Anupama Assistant Professor HOD, Department of Physics mLAC | Chairman |
| 2 | Dr. N Nagaiah Professor Department of Physics Jnanabharathi campus, Bangalore University, Bangalore-560056 | Bangalore City University Nominee |
| 3 | Dr. Meera B N Associate Professor Department of Physics Jnanabharathi campus, Bangalore University, Bangalore-560056 | Subject Expert |
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| 6 | Ms. Madhuramurthy M N, KAS Commercial Tax Officer Government of Karnataka | Alumnus |
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Introduction

The NEP-2020 offers an opportunity to effect a paradigm shift from a teacher-centric to a student-centric higher education system in India. It is based on Outcome Based Education, where the Graduate Attributes are first kept in mind to reverse-design the Programs, Courses and Supplementary activities to attain the graduate attributes and learning outcomes. The learning outcomes-based curriculum framework for a degree in B.Sc. (Honours) Physics is intended to provide a comprehensive foundation to the subject and to help students develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. The framework is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills in Physics, as well develop scientific orientation, spirit of enquiry problem solving skills and human and professional will values which foster rational and critical thinking in the students.

Graduate attributes in Physics

Some of the characteristic attributes a graduate in Physics should possess are:

- Disciplinary knowledge and skills:
- Skilled communication:
- Critical thinking and problem-solving capacity:
- Sense of inquiry:
- Team player/worker:
- Project Management Skills:
- Digital and ICT efficiency:
- Ethical awareness / reasoning:
- National and international perspective:
- Lifelong learning

Flexibility

- The programmes are flexible enough to allow liberty to students in designing them according to their requirements. Students may choose a single Major, one Major with a Minor, and one Major with two Minors. Teacher Education or Vocational courses may be chosen in place of Minor/s. Below listed are the various options students may choose from.
- One Major subject/discipline, Two Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities.
- One Major and one Minor subject/discipline along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities
- Two Major subject/disciplines along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses, including Extracurricular Activities (subject to fulfilling the requirements as stated in 3. i and 3.ii)
- One Major subject/discipline and one Vocational course along with Languages, Generic Electives, Ability Enhancement and Skill Development and courses including Extracurricular Activities.
- One Major Discipline and One Education Discipline along with Languages, Generic Electives, Ability Enhancement and Skill Development Courses including Extracurricular Activities.

Exit Options

Progressive Certificate, Diploma, Bachelor Degree or Bachelor Degree with Honours Provided at the End of Each Year of Exit of the Four-year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

| EXIT OPTIONS | Credits required |
|--|-------------------------|
| Certificate upon the Successful Completion of the First Year (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme | 44- 48 |
| Diploma upon the Successful Completion of the Second Year (Four Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme | 88- 96 |
| Basic Bachelor Degree at the Successful Completion of the Third Year (Six Semesters) of the multidisciplinary Four- year Undergraduate Programme/Five-year Integrated Master's Degree Programme | 132- 144 |
| Bachelor Degree with Honours in a Discipline at the Successful Completion of the Fourth Years (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme | 176- 192 |
| Master's Degree in a Discipline at the Successful Completion of the Fifth Year (Ten Semesters) of the Five- year Integrated Master's Degree Programme | 224- 240 |

Aims of UG program in Physics

The aims and objectives of our UG educational programs in sciences in general and Physics in particular should be structured to

- Create the facilities and environment in all the educational institutions to consolidate the knowledge acquired at +2 level and to motivate and inspire the students to create deep interest in Physics, to develop broad and balanced knowledge and understanding of physical concepts, principles and theories of Physics.
- Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learned in the classrooms.
- Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics.
- Expose the student to the vast scope of Physics as a theoretical and experimental science with applications in solving most of the problems in nature spanning from 10^{-15} m to 10^{26} m in space and 10^{-10} eV to 10^{25} eV in energy dimensions.
- Emphasize the discipline of Physics to be the most important branch of science for pursuing the interdisciplinary and multidisciplinary higher education and/or research in interdisciplinary and multidisciplinary areas.
- To emphasize the importance of Physics as the most important discipline for sustaining the existing industries and establishing new ones to create job opportunities at all levels of employment.

The progressive curriculum shall position knowledge and skills required on the transformation of novice problem solvers (at entry level of the program) to expert problem solvers (by the time of graduation) as given below:

- i. At the end of first year – Ability to solve well defined problems
- ii. At the end of second year – Ability to solve broadly defined problems
- iii. At the end of third year – Ability to solve complex problems that are ill-structure that require multi-disciplinary skills to solve them
- iv. During fourth year – Experience of workplace problem solving in the form of internship or Research Experience preparing for higher education or Entrepreneurship and employment.

Curriculum Framework for Multidisciplinary Four- year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

| Integrated Master's Degree Programme | | | | |
|---|-------------------------------|---|---|---------------------|
| Year | Objectives | Nature of courses | Outcome | Number of courses |
| 1 st Year I & II Semester | Understanding and Exploration | 1. Major Core Courses | Understanding of Disciplines | 1 + 1 |
| | | 2. Minor/Related Discipline | Language Competency | 1 + 1 |
| | | 3. Languages, | Gaining perspective of context | 2 + 2 |
| | | 4. Ability Enhancement Compulsory Courses | Generic skills | 1 + 1 |
| | | 5. Skill Enhancement/ | Basic skills set to pursue any vocation | 1 + 1 |
| Exit option with Certification | | | | |
| 2 nd Year III & IV semester | Focus and immersion | 1.Major Core Courses | Understanding of disciplines | 2 + 2 |
| | | 2. Minor/ Related Discipline | Gaining perspective of context | 1 + 1 |
| | | 3. Ability Enhancement | Skill sets to pursue vocation | 1 + 1 |
| | | 4. Skill based Vocational | Development of various | 1 + 1 |
| | | 5. Extra Curricular Activities | Domains of mind &Personality | 1 + 1 |
| Exit Option with Diploma | | | | |
| 3 rd Year V & VI semester | Real time learning | 1.Major Discipline Core and Elective Courses | In depth learning of major and minor disciplines, Skill sets for employability. | 2 + 2 |
| | | 2. Minor Discipline / Generic or Vocational Electives/Field based Learning/ Research Project | Exposure to discipline beyond the chosen Subject Experiential learning/ Research. | 1 + 1 1 + 1 |
| Exit option with Bachelor Degree | | | | |
| 4 th Year VII & VIII semester | Deeper Concentration | Major Discipline Core and Elective courses Research/ Project Work with Dissertation | Deeper and Advanced Learning of Major Discipline Foundation to pursue Doctoral Studies & Developing Research competencies | 4 + 4 |
| Bachelor Degree with Honours | | | | |
| 5 th Year IX & X Semester | Master of the subject | Major Discipline Core and Elective courses/ Research/Project Work with Dissertation | Deeper and Advanced Learning of the Major Discipline towards gaining proficiency over the subject | 4 + 4/ 6 + 6 |
| Master's Degree | | | | |

Course Structure
Major Discipline: PHYSICS
Semester I to X

| Semester | Discipline Core Theory (DSCT) | Core Papers |
|---------------|-------------------------------------|---|
| Semester I | Phy.DSCT1 | Mechanics & Properties of Matter (<i>Select one Open Elective from the Pool A</i>) |
| Semester II | Phy.DSCT2 | Electricity and Magnetism (<i>Select one Open Elective from the Pool A</i>) |
| Semester III | Phy.DSCT3 | Wave motion and optics (<i>Select one Open Elective from the Pool A</i>) |
| Semester IV | Phy.DSCT4 | Thermal Physics & Electronics (<i>Select one Open Elective from the Pool A</i>) |
| Semester V | Phy.DSCT5 | Classical Mechanics and Quantum Mechanics- I |
| | Phy.DSCT6 | Elements of Atomic, Molecular Physics |
| Semester VI | Phy.DSCT7 | 1. Elements of Nuclear Physics and Nuclear Instruments |
| | Phy.DSCT8 | 2. Elements of Condensed Matter Physics |
| Semester VII | Phy.DSCT9 | 1. Mathematical Methods of Physics – I |
| | Phy.DSCT10 | 2. Classical Electrodynamics. |
| | Phy.DSCT11 | 3. Experimental methods of Physics |
| | | 4. Research Methodology |
| Semester VIII | Phy.DSCT12 | 1. Classical Mechanics and Quantum Mechanics-II |
| | Phy.DSCT13 | 2. Statistical Mechanics |
| | Phy.DSCT14 | 3. Astrophysics & Astronomy |
| | | 4. Research Project* (<i>Select Two DSE subjects from the Pool B-II shown below</i>) *In lieu of the research Project, two additional elective papers/ Internship may be offered. |
| Semester IX | Phy.DSCT15 | Mathematical Methods of Physics – II (<i>Select One DSE subjects from the Pool B-III shown below</i>) |
| | Phy.DSCT16 | Research Project |
| Semester X | Phy.DSCT17 | 1. Quantum Mechanics – III (<i>Select One DSE subjects from the Pool B-IV shown below</i>) |
| | | 2. Research Project |

Open Electives

| Sl. No. | I To IV Semester Pool A |
|---------|---------------------------------|
| 1 | Phy-OE1: Energy Sources |
| 2 | Phy-OE2: Climate Science |
| 3 | Phy-OE3: Astronomy |
| 4 | Phy-OE4: Medical Physics |
| 5 | Phy-OE5: Optical Instruments |
| 6 | Phy-OE6: Sports Science |
| 7 | Phy-OE7: Nanotechnology |
| 8 | Phy-OE8: Electrical Instruments |
| 9 | Phy-OE9: Physics for All |

Discipline Specific Electives for VII to X Semesters

| VII Semester | | VIII Semester | |
|---------------------------|---|----------------------------|------------------------------------|
| Pool B-I (Select any TWO) | | Pool B-II (Select any TWO) | |
| A | Condensed Matter Physics-1 | A | Atomic & Molecular Physics-1 |
| B | Nuclear and Particle Physics | B | Materials Physics & Nano materials |
| C | Theoretical and Computational Physics-I | C | Lasers and non-linear optics |
| D | Biophysics | D | Plasma Physics |
| E | Astronomy and Astrophysics | E | Physics of Semiconductor devices |

| IX Semester | | X Semester | |
|-------------|---|------------|---|
| Pool B-III | | Pool B-IV | |
| A | Condensed Matter Physics-2 | A | Condensed Matter Physics-3 |
| B | Nuclear and Particle Physics-2 | B | Nuclear and Particle Physics-3 |
| C | Atomic & Molecular spectroscopy-1 | C | Atomic & Molecular spectroscopy-2 |
| D | Materials Physics & Nanophysics –1 | D | Materials Physics & Nanophysics -2 |
| E | Theoretical and Computational Physics-I | E | Theoretical and Computational Physics-2 |
| F | Astronomy and Astrophysics-1 | F | Astronomy and Astrophysics-2 |

Course Content: Semester – I

| | |
|---|---------------------------------|
| Phy-DSCT1: Mechanics and Properties of Matter | Course Credits (L+T+P): 4+0+2=6 |
| Total Contact Hours: 52 | Duration of ESA: 3 hours |

Course Outcomes (COs):

1. Fixing units, tabulation of observations, analysis of data (graphical/analytical).
2. Accuracy of measurement and sources of errors, importance of significant figures.
3. Knowledge of how g can be determined experimentally and derive satisfaction.
4. Understanding the difference between simple and torsional pendulum and their use in the determination of various physical parameters.
5. Knowledge of how various elastic moduli can be determined.
6. Measuring surface tension and viscosity and appreciate the methods adopted.
7. Hands on experience of different equipment's.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

| Course Outcomes (COs) / Program Outcomes (POs) | 1 | 2 | 3 | 4 | 5 | 6 |
|--|---|---|---|---|---|---|
| Fixing units, tabulation of observations, analysis of data (graphical/analytical) | X | | | | | |
| Accuracy of measurement and sources of errors, importance of significant figures | | X | | | | |
| Knowledge of how g can be determined experimentally and derive satisfaction. | X | | | | | |
| Understanding the difference between simple and torsional pendulum and their use in the determination of various physical parameters | | | | | X | |
| Knowledge of how various elastic moduli can be determined | X | | | | | |
| Measuring surface tension and viscosity and appreciate the methods adopted | X | | | | | |
| Hands on experience of different equipment's. | X | | | | | |

Note: Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

| Course Content Phy.DSCT1: Mechanics & Properties of Matter (13 hours of teaching includes 3 hours of activities for each unit) | | Number of Teaching hours |
|---|---|---------------------------------|
| Unit- 1 | | |
| Chapter No.1 | Units and measurements: System of units (CGS and SI), measurement of length, mass and time, dimensions of physical quantities, dimensional formulae, errors, Mean deviation. | 4 |
| Chapter No.2 | Momentum and Energy: Work and energy, Conservation of linear momentum, Conservation of energy with examples, Motion of rockets. | 4 |
| Chapter No.3 | Special Theory of Relativity: Constancy of speed of light, Postulates of the Special Theory of Relativity. Length contraction and Time dilation. Relativistic addition of velocities. | 5 |
| Topics for Self-study | Variable mass problem & Rocket motion, Twin paradox | |
| Suggested Activities | | |
| Activity No.1 | a) Measure diameters of small balls of different size and estimate their volumes. b) Measure lengths of nails of different size. c) Measure volume of a liquid. d) Measure distances and put the result both in CGS and SI units in 2, 3 and 4 significant figures. Mention the precession of the measurement. e) Estimate standard deviations wherever possible. | |
| Activity No.2 | Understand conservation of energy in every day examples like a) What happens in solar energy conversion panels b) Pushing an object on the table it moves c) Moving car hits a parked car causes parked car to move. In these cases, it is known that energy is conserved. How? Understand and verify if possible. | |
| Unit- 2 | | |
| Chapter No.4 | Laws of Motion: Newton's Laws of motion, Dynamics of single particle and a system of particles, Centre of mass. | 3 |
| Chapter No.5 | Dynamics of Rigid bodies: Rotational motion about an axis, Relation between torque and angular momentum, Rotational energy Moment of inertia (MI): Laws of MI, MI of a rectangular lamina and solid cylinder, Flywheel. | 6 |
| Chapter No.6 | Gravitation: Law of Gravitation, Motion of a particle in a central force field (motion in a plane, conservation of angular momentum, constancy of a real velocity is constant). Kepler's laws (statements). Satellite in a circular orbit. | 4 |

| | | |
|------------------------------|--|--|
| Topics for Self-study | Geosynchronous orbits and basic idea of global positioning system (GPS) | |
| Suggested Activities | | |
| Activity No.3 | <p>Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius, r of the body and its mass, m.</p> <p>Refer to different websites to construct and perform simple experiments to verify MI of different objects.</p> <p>Reference: www.khanacademy.org, www.pinterest.com, www.serc.cerleton.edu</p> | |
| Activity No.4 | <p>Prepare suitable charts and give seminar talks in the class.</p> <p>Reference: Weblink/YouTube/Book</p> | |

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|------------------------------|--|-----------|
| Unit- 3 | | |
| Chapter No.7 | <p>Elasticity: Hooke's law, Stress-strain diagram, elastic moduli, relation between elastic constants, Poisson's ratio, expression for Poisson's ratio in terms of elastic constants. Work done in stretching and work done in twisting a wire, twisting couple on a cylinder. Beams, bending of beams, expression for bending moment, theory of single cantilever.</p> <p>Torsional pendulum, expression for time-period of torsional oscillations, determination of rigidity modulus (static and dynamic methods) and moment of inertia, determination of q, η and σ by Searle's double bar with necessary theory.</p> | 13 |
| Topics for Self-study | Time period of oscillations of a spring-mass system with non-negligible mass of the spring. | |
| Suggested Activities | | |
| Activity No.5 | <p>Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale alongside. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material.</p> | |
| Activity No.6 | <p>Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.</p> <p>Reference: Weblink/YouTube/Book</p> | |
| Unit- 4 | | |
| Chapter No.8 | <p>Surface tension: Definition of surface, angle of contact, surface energy, relation between surface tension and surface energy, pressure difference across a curved surface (with example), excess pressure inside a spherical liquid drop.</p> | 7 |
| Chapter No.9 | <p>Viscosity: Streamline flow, turbulent flow, equation of</p> | 6 |

| | | |
|--|--|--|
| | continuity, determination of coefficient of viscosity by Poiseuille's method, Stoke's method. | |
| Topics for Self-study | Capillarity determination of surface tension by drop weight method. | |
| Suggested Activities | | |
| Activity No.7 | Measure surface tension of water and other common liquids and compare and learn a) Why water has high surface temperature? think of reasons. b) Check whether surface tension is a function of temperature? You can do it by heating water to different temperatures and measure surface tension. c) Plot surface temperature vs T and learn how it behaves. | |
| Activity No.8 | Collect a set of different liquids and measure their viscosity. a) Find out whether sticky or non-sticky liquids are most viscous. <i>Think of reasons.</i> b) Mix non sticky liquid to a sticky liquid in definite quantities and measure viscosity. Find out viscosity is increasing or decreasing with increase of non-sticky liquid concentration c) Do the above experiment by mixing sticky liquid to the non-sticky liquid. Find out change in viscosity with increase of concentration of sticky liquid. <i>Think why anyone should know viscosity of a liquid.</i> | |
| Reference: Weblink/YouTube/Book | | |

• **Reference Books**

| Sl. No | Title of the book | Author(s) | Publisher | Year of Publication |
|--------|---|---|------------------------|---------------------|
| 1 | Mechanics | D S Mathur | S. Chand &Co | 2000 |
| 2 | Mechanics and Relativity (3 rd Edition) | Vidwan Singh Soni | PHI Learning Pvt. Ltd. | 2013 |
| 3 | Mechanics (Berkeley Physics Course Vol 1 in SI Units) | Charles Kittel, Walter Knight, et al., | Tata McGraw-Hill | 2007 |
| 4 | Properties of Matter | Brij Lal & Subrahmanyam | S. Chand &Co | 2002 |
| 5 | Principles of Physics | David Halliday, Jearl Walker & Robert Resnick | Wiley India Pvt Ltd | 2010 |
| 6 | Physics (8 th edition) | David Halliday & Robert Resnick | Wiley India Pvt Ltd | 2008 |

Paper Code: Phy-DSCP1 - Lab I

List of Experiments

| | |
|---|--|
| 1 | Determination of g using bar pendulum (L versus T and L versus LT^2 graphs) |
| 2 | Determination of moment of inertia of a Fly Wheel. |
| 3 | Determination of rigidity modulus using torsional pendulum |
| 4 | Verification of parallel and perpendicular axis theorems. |
| 5 | Determine the Young's Modulus of a bar by uniform bending method. |
| 6 | Determination of elastic constants of a wire by Searle's double bar method. |
| 7 | Young's modulus by Koenig's method. |
| 8 | Modulus of rigidity of a rod –Static torsion method. |
| 9 | Viscosity by Stoke's method. |
| 10 | Verification of Hooke's law. |
| 11 | Determination of surface tension of a liquid and the interfacial tension between two liquids using drop weight method. |
| 12 | Critical pressure for stream line flow. |
| 13 | Determine the Young's Modulus a bar by single cantilever method. |
| 14 | Study of motion of a spring and to calculate spring constant, g and mass of the spring. |
| Note: A minimum of EIGHT experiments must be performed | |

Reference Books for Laboratory Experiments

| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
|-------|--|-------------------------------------|----------------------------------|---------------------|
| 1 | Physics through experiments | B. Saraf | Vikas Publications | 2013 |
| 2 | A laboratory manual of Physics for undergraduate classes, 1 st Edition, | D P Khandelwal | Vikas Publications. | 1985 |
| 3 | B.Sc. Practical Physics (Revised Edition) | C. L Arora | S.Chand & Co. | 2007 |
| 4 | An advanced course in practical physics. | D. Chatopadhyay, PCRakshit, B. Saha | New Central Book Agency Pvt Ltd. | 2002 |

SEMESTER -II

Course Content

| | |
|--------------------------------------|---------------------------------|
| Phy-DSCT2: Electricity and Magnetism | Course Credits (L+T+P): 4+0+2=6 |
| Total Contact Hours: 52 | Duration of ESA: 3 hours |

Course Outcomes (COs):

1. Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.
2. Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
3. Apply Gauss's law of electrostatics to solve a variety of problems.
4. Describe the magnetic field produced by magnetic dipoles and electric currents.
5. Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.
6. Describe how magnetism is produced and list examples where its effects are observed.
7. Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.
8. Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

| Course Outcomes (COs) / Program Outcomes (POs) | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point, line, surface, and volume distributions of charges. | X | X | | | | |
| Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics. | X | | | | | |
| Apply Gauss's law of electrostatics to solve a variety of problems. | X | X | | | X | |
| Describe the magnetic field produced by magnetic dipoles and electric currents. | X | | | | | |
| Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields. | X | | | | | |
| Describe how magnetism is produced and list examples where its effects are observed. | X | | | | X | X |
| Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor. | X | X | | | X | X |

| | | | | | |
|--|---|--|--|---|---|
| Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines. | X | | | X | X |
| | X | | | | |

Note: Course Articulation Matrix relates course outcomes of the course with the corresponding program outcomes whose attainment in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

| Course Content Phy-DSCT2: Electricity and Magnetism (13 hours of teaching includes 3 hours of activities for each unit) | | Number of teaching hours |
|---|--|--------------------------|
| Unit- 1 | | |
| Chapter No.1 | Electric charge and field: Coulomb's law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy) . | 3 |
| Chapter No.2 | Gauss law: Gauss's law and its applications - electric fields of a (i) spherical charge distribution, (ii) line charge and (iii) an infinite flat sheet of charge. | 3 |
| Chapter No.3 | Electrostatic potential: Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole. | 7 |
| Topics for Self-study | Concept of Voltage and Current Sources, Kirchhoff's Laws, Power transform theorem. | |
| Suggested Activities | | |
| Activity No.1 | a. Learn the difference between and DC and AC electricity and their characteristics. b. Voltage and line frequency standards in different countries. c. A small project report on production of electricity as a source of energy: Different methods | |
| Activity No.2 | a. Learn to use a multimeter (analog and digital) to measure voltage, current and resistance. Continuity testing of a wire. b. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures. | |
| Reference: Weblink/YouTube/Book | | |
| Unit- 2 | | |
| Chapter No.4 | Conductors in electrostatic field: Conductors and insulators, conductors in electric field. Capacitance and | 6 |

| | | |
|--|--|----------|
| | capacitors, Expression for capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, Dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Gauss's law | |
| Chapter No.5 | DC currents: Electric currents and current density. Electrical conductivity and Ohm's law (Review). Network theorems (Thevenin's theorem, Superposition theorem and the maximum power transfer theorem), Transient currents in RC, LR and LCR circuits. | 7 |
| Topics for Self-study | AC Currents and voltages in pure R, L and C circuits | |
| Suggested Activities | | |
| Activity No.3 | a. Learn about electrical appliances which work with AC and DC electricity. b. Learn about types of resistors and their colour codes and types of capacitors (electrolytic and non-electrolytic) | |
| Activity No.4 | a. Learn about power transmission: 3-phase electricity, voltage and phase b. Visit a nearby electrical power station. Interact with line men, Electrical engineers and managers. Discuss about power loss in transmission. How to reduce it? c. Prepare a small project report on street lighting and types of electrical bulbs. | |
| Reference: Weblink/YouTube/Book | | |
| Unit- 3 | | |
| Chapter No.6 | Magnetism: Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Lorentz force, Hall effect in a conductor. Electromagnetic induction, Faraday's laws of induction, Lenz's Law, expression for self-inductance and energy stored in a magnetic field. Mutual inductance. conducting rod moving in a magnetic field. | 7 |
| Chapter No.7 | AC circuits: RMS and average value of AC, Response of series RL, RC, LCR circuits using j-operator method, Quality factor, admittance and impedance, power and energy in AC circuits. | 6 |
| Topics for Self-study | Response of parallel RL, RC, LCR circuits using j-operator method. | |
| Suggested Activities | | |
| Activity No.5 | a. Prepare a small project report on street lighting and types of electrical bulbs. b. Learn the measurement of electric current using tangent galvanometer. | |
| Activity No.6 | a. Build a small coil with insulated copper wire. Connect an ammeter micro/milli ammeter. Verify magnetic induction using a powerful bar magnet. | |
| Reference: Weblink/YouTube/Book | | |

| Unit- 4 | | |
|--|--|----------|
| Chapter No.8 | Electromagnetic waves: Equation of continuity, Maxwell's equations, displacement current, equation for propagation of electromagnetic wave, transverse nature of electromagnetic wave, energy transported by electromagnetic waves. Poynting vector, magnetic moment of a point charge moving in a circular loop, electric current in atoms, electron spin and magnetic moment. | 8 |
| Chapter No.9 | Magnetic materials: Magnetic intensity and magnetic induction, Intensity of magnetization, Susceptibility, Permeability, Types of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials. Classical Langevin's theory of diamagnetism, B-H hysteresis curves, Hard and soft magnetic materials. | 5 |
| Topics for Self-study | a. Super conductivity. b. At least two Applications of magnetic materials | |
| Suggested Activities | | |
| Activity No.7 | a. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets b. Learn the principle of working of a Gauss meter to measure magnetic field | |
| Activity No.8 | a. Model the earth's magnetic field with a diagram. b. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years. | |
| Reference: Weblink/YouTube/Book | | |

Reference Books

| Sl. No | Title of the book | Author(s) | Publisher | Year of Publication |
|---------------|--|-----------------------------------|---|----------------------------|
| 1 | Physics-Part-II | David Halliday and Robert Resnick | Wiley Eastern Limited | 2001 |
| 2 | Berkeley Physics Course, Vol-2, Electricity and Magnetism, Special Edition | Edward M Purce II | Tata Mc Graw-Hill Publishing Company Ltd, New Delhi | 2008 |

| Paper Code: Phy-DSCP1-Lab II | |
|--|---|
| List of Experiments to be performed in Lab II | |
| 1. | Verification of Superposition theorem. |
| 2. | Verification of Maximum power transfer theorem |
| 3. | Verification of Thevenin's theorem |
| 4. | Determination of L and C by equal voltage method |
| 5. | Determination of high resistance by leakage method using BG |
| 6. | Determination of mutual inductance using a Ballistic galvanometer. |
| 7. | Charging and discharging of a capacitor (energy dissipated during charging and time constant measurement.). |
| 8. | Frequency response of LCR Series resonance circuit |
| 9. | Frequency response of LCR Parallel resonance circuit. |
| 10. | Impedance of series RC circuits - determination of frequency of AC. |
| 11. | Identification and measurement of L, C and R elements in a black box |
| 12. | Determination of self-inductance of a coil using Anderson's bridge |
| 13. | Verification of laws of combination of capacitances using de-Sauty's bridge |
| 14. | Determination of inductance using Maxwell's impedance bridge |
| 15. | Determination of BH using Helmholtz double coil galvanometer. |

Note: A minimum of EIGHT experiments to be carried out

| Sl. No | Title of the Book | Authors Name | Publisher | Year of Publication |
|---------------|--|-------------------------------------|----------------------------------|----------------------------|
| 1 | Physics through experiments | B. Saraf | Vikas Publications | 2013 |
| 2 | A laboratory manual of Physics for undergraduate classes, 1 st Edition, | D P Khandelwal | Vikas Publications. | 1985 |
| 3 | B.Sc. Practical Physics (Revised Edition) | C. L Arora | S.Chand & Co. | 2007 |
| 4 | An advanced course in practical physics. | D. Chatopadhyay, PCRakshit, B. Saha | New Central Book Agency Pvt Ltd. | 2002 |

Open Elective Paper for I Semester

| Phy-OE6: Sports Science | | |
|--------------------------------|---|--|
| Credits: 03 | | No. of teaching hours: 3 hours per week |
| Unit | Content | Hrs. |
| 1 | Measurement: Physical quantities, Standards and Units, International system of Units, Standards of time, length and mass, Precision and significant figures | 4 |
| | Newton's laws of motion: Newton's first law. Force, mass. Newton's second law. Newton's third law, Mass and weight. Applications of Newton's laws. | 5 |
| | Projectile motion: Shooting a falling target, Physics behind Shooting, Javelin throw and Discus throw. | 4 |
| | Topics for self-study https://www.real-world-physics-problems.com/physics-of_sports.html | |
| | Total: | 13 |
| 2 | Conservation laws: Conservation of linear momentum, collisions – elastic and inelastic. Angular momentum. (Physics behind Carom, Billiards, Racing) | 4 |
| | Centre of mass: Physics behind Cycling, Rock climbing, Skating | 5 |
| | Gravitation: Origin, Newton's law of gravitation, Archimedes' principle, Buoyancy & Physics behind swimming | 4 |
| | Topic for self-study Archimedes' Principle: Made EASY Physics in You tube | |
| | Total: | 13 |
| 3 | Food and Nutrition: Proteins, Vitamins, Fat, Blood pressure. Problems due to the deficiency of vitamins | 5 |
| | Energy: Different forms of Energy, Conservation of mass-energy | 4 |
| | Physical exercises: Walking, Jogging and Running, Weight management | 4 |
| | Topic for self-study 10 Best Exercises for Everyone – Healthline | |
| | Total: | 13 |

Activity

1. Identify the methods of measurement of time, length and mass from ancient time and build models for them. (Reference: History of measurement - Wikipedia https://en.wikipedia.org/wiki/History_of_measurement)
2. Identify Physics principles behind various Sports activities.
<https://www.real-world-physics-problems.com/physics-of-sports.html>
3. List the difficulties experienced in Gymnastics, Cycling and Weight lifting.
4. List the difficulties experienced in swimming.
5. Learn breathing exercises.
6. Write an essay on Physical health v/s Mental health or conduct a debate on Physical health v/s Mental health.

Text Books

1. Yakov Perelman. Physics for Entertainment. CreateSpace Independent Pub, 2010.
2. Yakov Perelman. Physics Everywhere. Prodinnova Publishers, 2014.
3. Yakov Perelman. Mechanics for Entertainment. Prodinnova Publishers, 2014.
4. Vassilios McInnes Spathopoulos. An Introduction to the Physics of Sports. CreateSpace Independent Publishing Platform, 2013.
5. Walter Lewin. For the Love of Physics. Taxmann Publications Pvt. Ltd., 2012.
6. Swaminathan M. Handbook of Food and Nutrition. Bangalore Press. 2012.
7. Sri Lakshmi B. Food Science. New Age International Pub. 2015.

Internet Resources for Reference: Internet resources

1. <https://www.topendsports.com/biomechanics/physics.htm>
2. <https://www.real-world-physics-problems.com/physics-of-sports.html>
3. <https://www.healthline.com/>
4. <https://www.mayoclinic.org/>
5. <https://www.who.int/news-room/>

Open elective paper for II Semester

| Phy-OE1: Energy Sources | | |
|-------------------------|--|---|
| Credits: 03 | | No. of teaching hours: 3 hours per week |
| Unit | Content | Hrs. |
| 1 | Non-Renewable energy sources | |
| | Introduction: Energy concept-sources in general, its significance & necessity, Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin- Examples and limitations. Importance of Non-commercial energy resources | 5 |
| | Conventional energy sources: Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues & Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology. | 8 |
| | Total: | 13 |
| 2 | Renewable energy sources | |
| | Introduction: Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. | 5 |
| | Solar energy: Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. | 8 |
| | Total: | 13 |
| 3 | Wind and Tidal Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies, Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices, Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy | 7 |
| | Geothermal and hydro energy: Geothermal Resources, Geothermal Technologies. Hydropower resources, hydropower technologies, environmental impact of hydro power sources. Carbon captured technologies, cell, batteries, power consumption | 6 |
| | Total: | 13 |

Activity

1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs.
2. Conversion of vibration to voltage using piezoelectric materials.
3. Conversion of thermal energy into voltage using thermoelectric modules (using thermocouples or heat sensors)
4. Project report on Solar energy scenario in India
5. Project report on Hydro energy scenario in India
6. Project report on wind energy scenario in India
7. Field trip to nearby Hydroelectric stations.
8. Field trip to wind energy stations like Chitradurga, Hospet, Gadag, etc.
9. Field trip to solar energy parks like Yeramaras near Raichur.
10. Videos on solar energy, hydro energy and wind energy.

Reference Books

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford
5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy

Department of Physics

Syllabus for

III & IV Semester Physics Papers

Under-Graduate (UG) Program

Framed according to the National Education Policy (NEP 2020)

(Effective from the Academic Year 2022-23)

Course Structure
(Major Discipline: Physics)
Semester III & IV

| SEMESTER | Discipline Core Theory (DSCT) | Core Paper |
|-----------------|--------------------------------------|------------------------------|
| SEMESTER -3 | PHY.301 | Wave motion and optics |
| SEMESTER -4 | PHY.401 | Thermal Physics &Electronics |

Open Electives

| |
|-------------------------------------|
| III Semester |
| Phy-OEC: Optical Instruments |
| IV Semester |
| Phy-OEC: Electrical Instrumentation |

Detailed Syllabus
for III & IV Semester Physics Papers
Under-Graduate (UG) B.Sc. Program
Framed according to the National Education Policy (NEP)

III Semester B.Sc. Physics

| | |
|--|---------------------------------------|
| Phy-DSCT3: Wave Motion and Optics | Course Credits (L+T+P) : 4+0+1 |
| Total Contact Hours: 52 | Duration of ESA: 4 hours |

Course Content

PHY.301: Waves Motion and Optics

| Unit – 1: Waves and Superposition of Harmonic Waves (11 hours of teaching plus 2 hours of activities) | | |
|--|---|---------|
| Chapter No. 1 | Waves: Plane and Spherical Waves. Longitudinal and Transverse Waves. Characteristics of wave motion, Plane Progressive (Travelling) Wave and its equation (derivation), Wave Equation – Differential form (derivation). Particle and Wave Velocities - Relation between them, Energy Transport – Expression for intensity of progressive wave, Newton’s Formula for Velocity of Sound. Laplace’s Correction (Derivation). Brief account of Ripple and Gravity Waves. | 5 hours |
| Chapter No. 2 | Superposition of Harmonic Waves: Linearity and superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats) – Analytical treatment. Superposition of two perpendicular harmonic oscillations: Lissajous Figures with equal and unequal frequency- Analytical treatment. Uses of Lissajous’ figures. | 6 hours |
| Topics for Self-study | Study of coupled pendulum. Explain the impact on the motion of one pendulum due to that of the other pendulum by varying the length, and mass of pendulum. Prepare a report. | |
| Suggested Activities (Any two activities to be conducted compulsorily) | | |
| Activity No. 1 | We know that sound is produced because of vibration. Look into at least 10 musical instruments and identify the regions of vibrations that produces the sound and those parts which enhances the sound because of reverberation. 1. Identify one common element in all of these. Activity No. 1 2. Identify equipment’s which creates beats and try to explain the underlying basic principles. Demonstrate the examples of beats using two tuning forks. 3. Identify what will happen when you drop a stone in a standing water, and when your drop two stones side by side. Make your observations sketch them and comment on it in a report. | |
| Activity No. 2 | Draw two sine waves (amplitude vs time) one shifted with other in phase. Identify where the resonance occurs for each phase shift. Plot phase vs time taken for resonance. | |
| Activity No. 3 | Take smooth sand, place a pointed edged pen vertically on the sand. To the mid of the pen, connect two perpendicular threads. Pull these perpendicular threads by varying the forces and timings. Note down the different shapes produced on the sand. Try to interpret the shapes. Make a report of it | |
| Activity No. 4 | Hang a pot with sand, which has a hole in the bottom. Gently pull the pot on one side and observe the pattern formed by the sand on the floor. Report the observations. | |

| | | |
|--|---|---------|
| Activity No. 5 | <p>Take a stretched spring. Stretch it across two edges. Put a weight on the string, pluck it and measure the amplitude of the vibration. Students should measure the total damping time of oscillating spring. (Using mobile or scale) And plot graphs by</p> <ol style="list-style-type: none"> 1.Varying load on the spring and amplitude at the centre. 2. Take another weight and put that in another place and measure the amplitude of vibration at the centre. 3. Vary the load in the centre of the spring and measure the amplitude at the centre. <p>Note for the teachers for the activity: Make 3 groups among students and assign each group the activity of drawing one of the 3 graphs given below. Provide a few days to complete the activity. On the specific day, each group has to make a ppt presentation of the following three slides. On the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks.</p> <ol style="list-style-type: none"> 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. | |
| <p style="text-align: center;">Unit – 2 - Standing Waves and Acoustics (11 hours of teaching plus 2 hours of activities)</p> | | |
| Chapter No. 3 | <p>Standing Waves: Velocity of transverse waves along a stretched string (derivation), Standing (Stationary) Waves in a String - Fixed and Free Ends (qualitative). Theory of Normal modes of vibration in a stretched string, Energy density and energy transport of a transverse wave along a stretched string.</p> <p>Vibrations in rods – longitudinal and transverse modes (qualitative). Velocity of Longitudinal Waves in gases (derivation). Normal Modes of vibrations in Open and Closed Pipes – Analytical treatment. Concept of Resonance, Theory of Helmholtz resonator.</p> | 8 hours |
| Chapter No. 4 | <p>Acoustics: Absorption coefficient, Reverberation time - Sabine's Reverberation formula (derivation), Factors affecting acoustics in buildings, Requisites for good acoustics. Acoustic measurements – intensity and pressure levels.</p> | 3 hours |
| Topics for Self-study | List different phenomenon where standing waves are found in nature. Identify the phenomena and reason for standing waves. Also identify the standing waves in musical instruments. Make a report of it. | |
| <p style="text-align: center;">Suggested Activities (Any two activities to be conducted compulsorily)</p> | | |
| Activity No. 6 | <ol style="list-style-type: none"> 1. Go to 5 different newly constructed houses when they are not occupied and when they are occupied. Make your observations on sound profile on each room. Give reasons. Make a report of it. 2. Visit three very good auditoriums, list out different ways in which the acoustic arrangements have been done (as decoration and Civil works). Look for the reasons in Google and identify which is acoustically the best auditorium among the three you visited. Make a report of it. | |
| Activity No. 7 | <p>Take a bowl of different liquids (water, milk, kerosene, salt water, Potassium Permanganate (KMNO₄) solution. Place a small non oily floating material (ex: thin plastic) on the surface of the liquid. Drop a marble on the liquid at the centre of the bowl. Repeat the experiment by dropping the marble from the different heights. Plot a graph of-</p> <ol style="list-style-type: none"> 1. Height v/s time of oscillation 2. Weight of the marble v/s time of oscillation <p>Note for the teachers for the activity: Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. On the specific day, each group has to make a ppt presentation of the following three slides. On the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks.</p> <ol style="list-style-type: none"> 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--------------------|-------------|-------|------------|--------------------|-------------|----|-------------------------------|--|--|----|-------------------------------|--|--|----|--------------|--|--|----|--------------|--|--|----|--------------------------------|--|--|
| Activity No. 8 | Take two marbles of same weight. Drop both the marbles on the surface of the liquid from some height. With the help of the mobile take the picture and measure the position of interface of two wave fronts formed in the liquid. Plot graphs for different activities by doing the following activities. 1. By dropping two marbles of same weight from different heights. 2. By dropping two marbles of different weight from the same height Note for the teachers for the activity: Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. On the specific day, each group has to make a ppt presentation of the following three slides. On the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Unit – 3: Nature of light and Interference (11 hours of teaching plus 2 hours of activities) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chapter No. 5 | Nature of light: Corpuscular theory, The Wave model, Huygens’ wave theory, Maxwell’s electromagnetic waves, Dual nature of light, concept of wave packet. Group velocity and wave velocity-relation between them. | | 2 hours | | | | | | | | | | | | | | | | | | | | | | | | |
| Chapter No. 6 | Interference of light by division of wave front: Coherent source-Interference of light waves by division of wave-front, Young’s double slit interference-theory and experiment, Fresnel Biprism- theory and experiment (determination of wavelength) | | 4 hours | | | | | | | | | | | | | | | | | | | | | | | | |
| Chapter No. 7 | Interference of light by division of amplitude: at thin films - reflected and transmitted light, Colours of thin films; Theory of air wedge; Theory of Newton's rings (Reflection) - Determination of Refractive index of a liquid. Michelson Interferometer (qualitative) | | 5 hours | | | | | | | | | | | | | | | | | | | | | | | | |
| Topics for Self-study | Why colour strips are seen in paddles on roads in rainy seasons? Give reasons. Make a report of it. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Suggested Activities (Any two activities need to be conducted compulsorily) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Activity No. 9 | In the table given below explore which phenomenon can be explained by what and prepare report explaining it. <table><tr><td>Sl No</td><td>Phenomenon</td><td>Corpuscular Nature</td><td>Wave Nature</td></tr><tr><td>1.</td><td>Formation of images on lenses</td><td></td><td></td></tr><tr><td>2.</td><td>Formation of images on mirror</td><td></td><td></td></tr><tr><td>3.</td><td>Interference</td><td></td><td></td></tr><tr><td>4.</td><td>Polarization</td><td></td><td></td></tr><tr><td>5.</td><td>Diffraction due to single slit</td><td></td><td></td></tr></table> | | | Sl No | Phenomenon | Corpuscular Nature | Wave Nature | 1. | Formation of images on lenses | | | 2. | Formation of images on mirror | | | 3. | Interference | | | 4. | Polarization | | | 5. | Diffraction due to single slit | | |
| Sl No | Phenomenon | Corpuscular Nature | Wave Nature | | | | | | | | | | | | | | | | | | | | | | | | |
| 1. | Formation of images on lenses | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. | Formation of images on mirror | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3. | Interference | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4. | Polarization | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5. | Diffraction due to single slit | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | | |
|--|---|----------------|
| Activity No. 10 | <p>Take a bowl of different liquids (water, milk, kerosene, salt water, Potassium Permanganate (KMNO₄) solution). Place a small non oily floating material (ex: thin plastic) on the surface of the liquid. Drop two marbles of same weight (mass) from the same height on to the surface of the water but at the different time intervals. Analyze the wavefronts and draw pictures of different observations.</p> <p>Note to the teachers for the activity: Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity.</p> <p>On the specific day, each group has to make a ppt presentation of the following three slides. On the day of the presentation select a member from each group randomly to make the presentation.</p> <p>Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks.</p> <ol style="list-style-type: none">1. The first slide will explain the process of doing the experiment.2. In the second slide. Students will show the graph of measurement.3. In the third slide, they will list three observations from that study. | |
| Activity No.11 | Teachers should demonstrate the formation of Lissajous Figure using a CRO. Give different shapes of Lissajous Figure with varying frequency and amplitude. Then ask the students to comment on the observations and prepare a report. | |
| Unit – 4 - Diffraction and Polarization (11 hours of teaching plus 2 hours of activities) | | |
| Chapter No. 8 | Fraunhofer diffraction: Introduction- Fraunhofer diffraction- Theory of single slit diffraction, Two slit diffraction pattern (qualitative), Theory of diffraction Grating - oblique incidence – experimental determination of wavelength. Resolving power – Rayleigh criterion, Expression for resolving power of grating and telescope. | 4 hours |
| Chapter No. 9 | Fresnel Diffraction- Concept of Fresnel half period zones (mention of equations), Qualitative discussion on diffraction by a circular aperture and diffraction by an opaque disc, Zone plate (mention of equation for focal length) Comparison of Zone plate with lens, Theory of diffraction at a straight edge. | 3 hours |
| Chapter No. 10 | Polarization: Production of polarized light, Malus’ law, Phenomenon of double refraction in crystals, Huygens’s theory of double refraction (qualitative), Quarter wave plate and half wave plate, Optical activity, Laurent's half shade polarimeter. | 4 hours |
| Topics for Self-study | <p>Using CDs and DVDs as diffraction Grating Ref:https://www.nnin.org/sites/default/files/files/Karen_Rama_USING_CDs_AND_DVDs_AS_DIFFRACTION_GRATINGS_0.pdf Obtain the diffraction pattern using a CD and design an experiment to find the distance between the tracks on it.(Ref: https://www.brightubeducation.com/science-lessons-grades-9-12/39347-diffraction-experiment-measuring-groove-spacing-on-cds/, https://silo.tips/download/diffraction-from-a-compact-disk)</p> | |
| Suggested Activities (Any two activities to be conducted compulsorily) | | |
| Activity No. 11 | <p>Explain polarization of light with the help of a chart. List out the surfaces that reflect polarized light. Learn how polarization of light can be learnt by both transmission and reflection.</p> | |
| Activity No. 12 | <p>What is the physics behind making 3D movies? Group Discussion (https://www.slideserve.com/rae/physics-behind-3d-movies-powerpoint-ppt-presentation)</p> | |

| | |
|------------------------|---|
| Activity No. 13 | List out different types of zone plates and look for their applications in day-to-day life. Prepare a report. |
| Activity No. 14 | Collect information and study how optically polarizing lenses are made. Visit a nearby lens making facility. Learn the principle behind sunglasses. Prepare a report. |

| Teaching and Learning Methodology |
|--|
| Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc. |
| Assessment Techniques |
| One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc. |

| Textbooks | | | | |
|------------------|--|---|---|----------------------------|
| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
| 1 | The Physics of Waves and Oscillations, | N K Bajaj | Tata McGraw-Hill Publishing Company Ltd., Second Edition, | 1984 |
| 2 | Waves and Oscillations | N Subramanyam and Brij Lal | Vikas Publishing House Pvt. Ltd., Second Revised Edition | 2010 |
| 3 | A Text Book of Sound | D R Khanna and R S Bedi | Atma Ram & Sons, Third Edition | 1952 |
| 4 | Oscillations and Waves | Satya Prakash | PragathiPrakashan, Meerut, Second Edition | 2003 |
| 5 | A Text Book of Optics | Brij Lal, M N Avadhanulu & N Subrahmanyam | S. Chand Publishing | 2012 |

| References Books | | | | |
|-------------------------|----------------------------------|---|--|----------------------------|
| Sl No | Title of the Book | Authors Name | Publisher | Year of Publication |
| 1 | Optics | Ajoy Ghatak | McGraw Hill Education (India) Pvt Ltd | 2017 |
| 2 | Berkeley Physics Course – Waves, | Frank S Crawford Jr. | Tata Mc Graw-Hill Publishing Company Ltd., Special Indian Edition, | 2011 |
| 3 | Optics | E. Hecht | Pearson Paperback | 2019 |
| 4 | Introduction To Optics | F. L. Pedrotti, L. M. Pedrotti & L. S. Pedrotti | Pearson India | 2008 |
| 5 | Fundamentals of Optics | F. Jenkins & H. White | McGraw Hill Education | 2017 |

Paper Code: PHY.302 - Lab III**List of Experiments to be performed in Lab III**

| | |
|---|--|
| 1 | Velocity of sound through a wire using Sonometer. |
| 2 | Frequency of AC using Sonometer. |
| 3 | Verification of Sabine's formula |
| 4 | To verify the laws of transverse vibration using Melde's apparatus. |
| 5 | Helmholtz resonator using tuning fork. |
| 6 | Helmholtz resonator using electrical signal generator. |
| 7 | Study of Lissajous figures using CRO |
| 8 | To determine refractive index of the material of a prism using sodium source. |
| 9 | To determine refractive index of a liquid by parallax method. |
| 10 | To determine the dispersive power and Cauchy constants of the material of a prism using Hg source. |
| 11 | To determine wavelength of sodium light using Fresnel Biprism. |
| 12 | Determination of radius of curvature of a lens using Newton's rings. |
| 13 | To determine the thickness of a paper using air-wedge. |
| 14 | Determination of wavelength of laser using diffraction |
| 15 | Study of Diffraction at a wire using laser |
| 16 | To determine wavelength of spectral lines of Hg source using plane diffraction grating. |
| 17 | To determine dispersive power and resolving power of a plane diffraction grating. |
| 18 | To verify Brewster's law. |
| 19 | To determine specific rotation of a solution using Polarimeter. |
| Note: A minimum of EIGHT experiments must be performed One hour of Laboratory time every week will be dedicated for suggested activities in the theory paper: Wave Motion and Optics. This is in addition to a total of 8 hour theory teaching during the entire semester (2 hours each for every Unit of the theory paper). | |

Reference Book for Laboratory Experiments

| Sl. No. | Title of the Book | Authors Name | Publisher | Year of Publication |
|---------|--|----------------------------------|---|---------------------|
| 1 | Advanced Practical Physics for students | B.L. Flint and H.T. Worsnop | Asia Publishing House. | 1971 |
| 2 | A Text Book of Practical Physics | I. Prakash & Ramakrishna | Kitab Mahal, 11 th Edition | 2011 |
| 3 | Advanced level Physics Practical | Michael Nelson and Jon M. Ogborn | Heinemann Educational Publishers, 4 th Edition | 1985 |
| 4 | A Laboratory Manual of Physics for undergraduate classes | D.P.Khandelwal | Vani Publications. | 1985 |

IV Semester Physics

| | |
|---|--------------------------------------|
| PHY.401: Thermal Physics & Electronics | Course Credits (L+T+P): 4+0+0 |
| Total Contact Hours: 52 | Duration of ESA: 4 hours |

| Course Content | | |
|---|--|----------------|
| PHY.401: Thermal Physics & Electronics | | |
| Unit – I: Thermodynamics | | |
| (11 hours of teaching plus 2 hours of activities) | | |
| Chapter No. 1 | Laws of Thermodynamics: Review of the concepts of Heat and Temperature – the zeroth law of thermodynamics, Thermodynamic variables - extensive and intensive, Equations of state, PV diagrams. | 2 hours |
| Chapter No. 2 | First Law of Thermodynamics: Differential form of the First law of Thermodynamics, Application of the first law for (i) Cyclic Process (ii) Adiabatic Process (iii) Isochoric Process (iv) Isobaric Process and (v) Isothermal Process. Equation of state for an adiabatic process (derivation) Work done in an isothermal and adiabatic process for an ideal gas, Internal Energy as a state function. | 3 hours |
| Chapter No. 3 | Second Law of Thermodynamics: Second law of thermodynamics (Kelvin’s & Clausius’ statements and their equivalence); Reversible and irreversible processes with examples; Heat engines: Carnot Engine; Carnot Cycle and its efficiency (derivation), Practical internal combustion engines-Otto and Diesel Cycles Carnot theorem, (qualitative treatment); Refrigerator- Coefficient of performance. Concept of Entropy, Second Law of Thermodynamics in terms of Entropy, Entropy in reversible process, Entropy in irreversible process, Principle of increase of entropy, Entropy change in (i) adiabatic process (ii) free expansion (iii) cyclic process (iv) isobaric process Third Law of Thermodynamics(Nernst Heat theorem): Statement, Significance and Unattainability of Absolute Zero | 6 hours |
| Topics for Self-study | (1) Discuss when the temperature of the body is locked until what time you hold the thermometer in contact with a body. Discuss it in contact with laws of thermodynamics. (2) Discuss why when a person works or does exercise, he sweats. Reason it with the laws of thermodynamics. | |
| Suggested Activities (Any two activities to be conducted compulsorily) | | |
| Activity No. 1 | We feel cold because coldness enters our body. Discuss the statement in day-to-day life. Approximately give examples of a) open system b) closed system and c) isolated system | |
| Activity No. 2 | Take four different sizes of same metal, preferable of same shape and give one piece to each group. Heat it uniformly on a hot plate. Keep a beaker of water with a thermometer immersed in it. Drop one hot metal into the water and record the temperature with time. | |

| | |
|-----------------------|--|
| | <p>Repeat the experiment for the other heated metal pieces of different sizes.</p> <ol style="list-style-type: none"> 1. Plot a graph for the volume of the metal piece used v/s respective temperature change observed. 2. Determine the heat capacity and specific heat of the metal used. <p>All groups shall also do the following activity: Note for the teachers for the activity: Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. On the specific day, each group has to make a ppt presentation of the following three slides. On the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks.</p> <ol style="list-style-type: none"> 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. |
| Activity No. 3 | <p>Take ice cubes of different size and immerse in water and measure the temperature change with time and repeat the experiment. Graph the observations.</p> <p>Note for the teachers for the activity: Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. On the specific day, each group has to make a ppt presentation of the following three slides. On the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks.</p> <ol style="list-style-type: none"> 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. |

| Unit – II (11 hours of teaching plus 2 hours of activities) | | |
|--|---|---------|
| Chapter No.4 | Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb’s Free Energy, properties and significance. Maxwell’s Thermodynamic Relations: Maxwell's thermodynamic relations (using Thermodynamic potentials), Applications of Maxwell’s Relations (1) Gibbs potential, First order Phase Transitions with examples, (2) Clausius – Clapeyron Equation. Joule-Thomson effect, Liquefaction of gases, Linde’s air liquefier | 5 hours |
| Chapter No.5 | Kinetic Theory of Gases: Maxwell's law of distribution of velocity (without derivation), Deduction of most probable velocity, mean velocity and root mean square velocity, Degrees of Freedom, Law of Equipartition of Energy. Derivation of Specific heats of ideal gas. | 3 hours |
| Chapter No. 6 | Black body radiation and its spectral energy distribution; Kirchhoff’s law, Stefan’s law and Stefan-Boltzmann's law, Wien’s displacement law, Rayleigh-Jeans law (Statements), Planck’s law (derivation)– deduction of Wien’s Law & Rayleigh – Jeans Law. | 3 hours |
| Topics for Self-study | (1) Equilibrium between phases -triple point of water. (2) Methods of producing low temperatures: (i) Joule Thomson (Joule Kelvin / Throttling / Porous plug) experiment. | |
| Suggested Activities (Any two activities to be conducted compulsorily) | | |

| | |
|-----------------------|--|
| Activity No. 4 | <p>1. Watch the you tube video: https://www.youtube.com/watch?v=bODiX2PjCPE and write a report on the difference between heat and temperature.</p> <p>2. Watch the you tube video https://www.youtube.com/watch?v=v5zAiWSi7rs “A simple animation showing the thermoelectric effect”(Seebeck effect) and explain it in your own words.</p> |
| Activity No. 5 | <p>Take two containers (cylindrical jars) A and B of identical size (volume 500 ml). Connect them to a reservoir (huge bottle containing water) through pipes of equal length, but of different radii of cross-section. Let container A be connected using a pipe of inner radius of 5 mm and container B be connected using a pipe of inner radius 1.5 mm. Sketch the graphs for the rise of water levels in containers A and B as a function of time when water was allowed to flow from the reservoir to the containers. Explain the results. What happens if the diameter of the containers A is larger than that of B, but pipes of equal length connecting the containers with the reservoir have same inner radii.</p> |
| Activity No. 6 | <p>A hot object at a temperature T is placed in an environment at a temperature T_0.</p> <p>The temperature of the object will be some function of time, $T(t)$. This function will satisfy the equation:</p> <p>(a) Explain “what this equation explains” in your own words.</p> <p>(b) Show that the function satisfies the above equation.</p> <p>(c) Plot $T(t)$ as a function of time t.</p> |
| Activity No. 7 | <p>Take two dissimilar metal wires. Spot weld them forming two junctions. Dip one junction in ice and heat the other junction with a burner. Plot a graph of time of heating v/s thermo EFM generated in the voltmeter.</p> <p>Note for the teachers for the activity: Make 3-4 groups among students and assign each group the activity of drawing one of the graphs given below. Provide a few days to complete the activity. One the specific day, each group has to make a ppt presentation of the following three slides. One the day of the presentation select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks.</p> <p>1. The first slide will explain the process of doing the experiment.</p> <p>2. In the second slide. Students will show the graph of measurement.</p> <p>3. In the third slide, they will list three observations from that study.</p> |

| | | |
|-----------------------------|---|----------------|
| | Unit – 3: Semiconductor devices (11 hours of teaching plus 2 hours of activities) | |
| Chapter No. 7 | Semiconductor devices: Intrinsic semiconductors - concept of holes – effective mass - expression for carrier concentration of holes and electrons – electrical conductivity. Extrinsic semiconductors and electrical conductivity (qualitative), p-n junction and its characteristics, Zener diode as voltage regulator- load and line regulation. | 5 hours |
| Chapter No. 8 | Junction Transistors: Basics of Bipolar Junction Transistors (BJT), BJT operation, Common Base, Common Emitter and Common Collector Characteristics. Field Effect Transistor (FET) and its characteristics. Transistor as a CE-Amplifier (qualitative) and Oscillator (Phase shift) | 6 hours |
| Topic for Self-study | Diode approximations | |

| Suggested Activities (Any two activities need to be conducted compulsorily) | |
|--|---|
| Activity No. 8 | a. Learn to identify the terminals of different types (packages) of BJTs. b. In the case of power transistors, learn how to fix a heat sink for the transistor. c. Learn the difference between BJT and FET from operational characteristics. |
| Activity No. 9 | Take any 3 diodes and assign one each to three groups of students. Ask them to measure diode resistance when dipped in ice and while heating the ice till it boils. Using this data, plot calibration curve of temperature v/s resistance and also the cooling curve of temperature v/s time for the diode by each group. Note for the teachers for the activity: Form 3 groups. Assign each group the activity of drawing one of the graphs. Provide a few days to complete the activity. On the specific day, each group has to make a ppt presentation of the following three slides. Select a member from each group randomly to make the presentation. Based on the work and presentation, teacher shall assign marks to each group, wherein all members of the group will get equal marks. 1. The first slide will explain the process of doing the experiment. 2. In the second slide. Students will show the graph of measurement. 3. In the third slide, they will list three observations from that study. |
| Activity No. 10 | Prepare a table consisting of (i) name of the semiconductor diode (Zener diode, Light Emitting Diode, Rectifier Diode, Schottky diode) (ii) its application/s (3) attach a sample photo for each type of semiconductor diode (4) give a link for the website where you got the sample photo of the diode. |

| Unit – 4: Electronics (11 hours of teaching plus 2 hours of activities) | | |
|--|--|---------|
| Chapter No. 9 | Electronics: Integrated Circuits, Operational Amplifier, Ideal characteristics of Op-Amp, Basic concepts of feedback and virtual ground, Inverting and Non- Inverting Configurations. Applications- Voltage Follower, Addition and Subtraction. | 4 hours |
| Chapter No. 10 | Digital Electronics: Analog and Digital circuits, Switching and Logic Levels, Digital Waveform. Number Systems: Decimal Number System, Binary Number System, Converting Decimal to Binary, Hexadecimal Number System: Converting Binary to Hexadecimal, Hexadecimal to Binary. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate, NAND Gate, NOR Gate, XOR Gate, Algebraic Simplification, De Morgan's theorem, Realization of NAND and NOR functions using TTL. | 7 hours |
| Topics for Self-study | (i)Understand the concept of virtual ground of an OP-AMP. (ii)Learn the different types of op-amps used for different applications. (iii)What is a buffer? Prepare a report on buffers and its application in instrumentation electronics. | |
| Suggested Activities (Any two activities need to be conducted compulsorily) | | |
| Activity No. 12 | Learn how to implement logic functions (AND, OR, NOT) using just diodes and resistors. With a circuit diagram show how different types of gates can be built by NAND Or NOR gates. | |
| Activity No. 13 | A bulb in a staircase has two switches, one switch being at the ground floor and the other one at the first floor. The bulb can be turned ON and also can be turned OFF by one of the switches irrespective of the state of the other switch. Explain switching of the bulb in terms of logic gate operation. | |

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|------------------------|---|
| Activity No. 14 | A man has to take a wolf, a goat, and some cabbage across a river. His rowboat has enough room for the man plus either the wolf or the goat or the cabbage. If he takes the cabbage with him, the wolf will eat the goat. If he takes the wolf, the goat will eat the cabbage. Only when the man is present are the goat and the cabbage safe from their enemies. All the same, the man carries wolf, goat, and cabbage across the river. How? Write the truth table for the above story and implement using digital gates. |
| Activity No. 15 | A locker has been rented in the bank. Express the process of opening the locker in terms of digital operation. |

Teaching and Learning Methodology

Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc.

Assessment Techniques

One minute paper/ Predict-Observe-Explain/ Think-Pair-Share/ Class Test/ Quiz/ Crosswords/ Group Assessment/ Assignment/ Peer-to-Peer Evaluation/Seminar etc

Textbooks

| Sl. No | Title of the Book | Authors Name | Publisher | Year of Publication |
|--------|--|---|------------------------------|---------------------|
| 1. | Heat and Thermodynamics | Brij Lal. N. Subrahmanyam and P.S.Hemne | S. Chand Publishing | 2001 |
| 2. | Heat and Thermodynamics | D. S. Mathur | S. Chand Publishing | 2008 |
| 3. | Heat and Thermodynamics | M.W. Zemansky and Richard Dittman | McGraw-Hill Education | 2017 |
| 4. | Thermal Physics | S C Garg, R M Bansal & C K Ghosh | McGrawHill Education (India) | 2013 |
| 5. | Fundamentals of Classical Thermodynamics | G. J. V. Wylen, R. E. Sonntag, C. Borgnakke | John Wiley | 1994 |
| 6. | Integrated Electronics | J. Millman, C. Halkias & C. Parikh | McGraw Hill Education | 2017 |
| 7. | Digital Fundamentals | T. L. Floyd | Pearson Education | 2005 |
| 8. | Principals of Electronics | V.K Mehta and Rohit Mehta | S. Chand Publishing | 2020 |

References Books

| Sl. No | Title of the Book | Authors Name | Publisher | Year of Publication |
|--------|---|----------------------------|---|---------------------|
| 1 | A Treatise on Heat | M. Saha & B. N. Srivastava | Hafner Publishing Company, Indian Press | 1958 |
| 2 | Thermodynamics, Kinetic theory & Statistical Thermodynamics | F. W. Sears & G. L. Sailer | Pearson Education | 1975 |
| 3 | Electronic Principles | A. Malvino and D. J. Bates | McGraw Hill Education | 2017 |
| 4 | Electronic Devices and Circuits | David A. Bell | PHI, New Delhi | 2004 |
| 5 | Basic Electronics | B. L. Theraja | S Chand and Co | 2006 |

Paper Code: PHY.402 - Lab IV

| List of Experiments to be performed in Lab IV | |
|---|--|
| 1 | Specific heat by Newton's law of cooling |
| 2 | Verification of Newton's law of cooling |
| 3 | Calibration of thermocouple for Temperature measurement |
| 4 | Thermal conductivity of a bad conductor by Lee's and Charlton's method |
| 5 | Thermal conductivity of rubber |
| 6 | Mechanical Equivalent of Heat by Callender and Barne's method |
| 7 | Coefficient of thermal conductivity of Copper by Searle's method |
| 8 | Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method |
| 9 | Determination of Stefan's constant/ Verification of Stefan's law |
| 10 | Variation of thermo-emf across two junctions of a thermocouple with temperature |
| 11 | Verification of Clausius-Clapeyron equation |
| 12 | Study of Gaussian distribution using Monte Carlo method. |
| 13 | Determination of Planck's constant. |
| Any FOUR of the above listed experiments 1-13 must be conducted in Lab IV | |
| 14 | V-I Characteristics of Silicon & Germanium PN Junction diodes (FB) |
| 15 | (i) V-I Characteristics of Zener Diode (ii) Regulated power supply (using Zener diode). |
| 16 | Characteristics of BJT in Common Emitter Configuration |
| 17 | Half Wave rectifier with and without Filter |
| 18 | Full Wave Rectifier with and without Filter |
| 19 | Determination of transistor h-parameter |
| 20 | Frequency response of a CE amplifier. |
| 21 | Frequency response of CC Amplifier (Emitter Follower). |
| 22 | Applications of Operational Amplifier: |
| 23 | Truth table verification of logic gates using TTL 74 series ICs. |
| 24 | Logic Gates; Combinational Circuits (Half adder and Full adder); |
| 25 | Experiments with CRO. |
| Any FOUR of the above listed experiments 14-24 must be conducted in Lab IV | |

Note: One hour of Laboratory time every week has to be dedicated for suggested activities in the theory

| Reference Books for Laboratory Experiments | | | | |
|--|---|--|---------------------------------|---------------------|
| Sl. No | Title of the Book | Authors Name | Publisher | Year of Publication |
| 1 | Advanced Practical Physics for students | B.L. Flint and H.T. Worsnop | Asia Publishing House. | 1971 |
| 2 | Basic Electronics Lab Manual 2015-16, | National Institute of Science Education and Research, Bhubaneswar, 2015. | NISER, Bhubaneswar | 2015 |
| 3 | Engineering Practical Physics | S. Panigrahi, B. Mallick | Cengage Learning India Pvt. Ltd | 2015 |

OPEN ELECTIVE PAPERS
PHY-OEC3: Optical Instruments (Credits: 3)
3 hours of teaching per week

| Unit I | | |
|--|---|----|
| Basics of Optics: Scope of optics, optical path, laws of reflection and refraction as per Fermat’s principle, magnifying glass, Lenses (thick and thin), convex and concave lenses, Lens makers formulae for double concave and convex lenses, lens equation. Focal and nodal points, focal length, image formation, combination of lenses, dispersion of light: Newton’s experiment, angular dispersion and dispersion power. Dispersion without deviation. (No derivations; concepts to be discussed qualitatively). | | 13 |
| Unit II | | |
| Camera and microscopes: Human eye (constitution and working), Photographic camera (principle, construction and working), Construction, working and utilities of (i) Simple microscopes (ii) Compound microscope (iii) Electron microscopes (iv) Binocular microscopes Self study: Experimental determination of magnifying power of a microscope. | | 13 |
| Unit III | | |
| Telescopes and Spectrometer: Construction, working and utilities of (i) Astronomical telescopes (ii) Terrestrial telescopes (iii) Reflecting telescopes, Construction, working and utilities of Eyepieces or Oculars (Huygens, Ramsden’s, Gauss) Spectrometer – Construction, working and utilities, measurement of refractive index. | | 13 |
| Self study | Telescopes used at different observatories in and outside India | |
| (11 hours of teaching plus 2 hours of activities) | | |

Suggested Activities

1. Find position and size of the image in a magnifying glass and magnification.
2. Observe rain bows and understand optics. Create a rainbow.
3. Find out what makes a camera to be of good quality.
4. Observe the dispersion of light through prism.
5. Make a simple telescope using magnifying glass and lenses.
6. Learn principle of refraction using prisms.
7. Check bending of light in different substances and find out what matters here.
8. Learn about different telescopes used to see galaxies and their ranges

Reference Books

1. Galen Duree. Optics for Dummies. Wiley. 2011.
2. Blaker J W. Optics: An Introduction for Students of Engineering. Pearson, 2015.
3. Hecht E. Optics. Pearson. 5th Edition, 2019.
4. Khurana A K. Theory And Practice Of Optics & Refraction. Elsevier India. 2016.
5. [FlexBooks® 2.0](https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/section/19.9/primary/lesson/optical-instruments-ms-ps/)
<https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/section/19.9/primary/lesson/optical-instruments-ms-ps/>

PHY-OEC4: Electrical Instruments (Credits:3) 3 hours of teaching per week

| Unit I | | |
|-------------------|--|----------|
| Chapter No.1 | Voltage and current sources, Kirchoff's current and voltage laws, loop and nodal analysis of simple circuits with dc excitation. Ammeters, voltmeters: (DC/AC) | 03 hours |
| Chapter No.2 | Representation of sinusoidal waveforms, peak and rms values, power factor. Analysis of single-phase series and parallel R-L-C ac circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections. Wattmeters: Induction type, single phase and three phase wattmeter, Energy meters: AC. Induction type single phase and three phase energy meter | 05 hours |
| Chapter No. 3 | Instrument Transformers: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors; testing and applications. | 05 hours |
| Self study topics | Types of switches and Circuits, Safety precautions and rules in handling electrical appliances, Electric shock, first aid for electrical shocks, Fuses, MCB, ELCB and Relays, Filament lamp, Tube light, CFL and LED | |
| Activity No. 1 | Identify variety of electrical switches and note down their applications/utility. Reference: Weblink/Youtube/Book | |

| | | |
|------------------------------|---|-----------------|
| Activity No. 2 | Identify the hazards involved in handling electrical circuits and instruments, make a list of safety precautions as well as first aid for electrical shocks. Reference : Weblink/Youtube/Book | |
| Unit II | | |
| Chapter No. 4 | Galvanometers: General principle and performance equations of D'Arson Galvanometers, Vibration Galvanometer and Ballistic Galvanometer. | 03 hours |
| Chapter No. 5 | Potentiometers: DC Potentiometer, Crompton potentiometer, construction, standardization, application. AC Potentiometer, Drysdale polar potentiometer; standardization, application. | 03 hours |
| Chapter No. 6 | DC/AC Bridges: General equations for bridge balance, measurement of self-inductance by Maxwell's bridge (with variable inductance & variable capacitance), Hay's bridge, Owen's bridge, measurement of capacitance by Schearing bridge, errors, Wagner's earthing device, Kelvin's double bridge. | 07 hours |
| Topics for self study | Importance of grounding and Earthing. Methods for Earthing as suggested activities | |
| Activity No. 3 | Make a study of importance of grounding in electrical circuits. Reference: Weblink/Youtube/Book | |
| Activity No. 4 | Prepare a detailed account of various methods of earthing and their utility/applications Reference: Weblink/Youtube/Book | |
| Unit 3 | | |
| Chapter No.7 | Transducer: Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer (LVDT), Capacitive Transducers, Piezo-Electric transducers, Optical Transducer, Hall Effect Transducer | 6 Hours |
| Chapter No. 8 | CRO: Block diagram, Sweep generation, vertical amplifiers, use of CRO in measurement of frequency, phase, Amplitude and rise time of a pulse. Digital Multi- meter: Block diagram, principle of operation | 3 Hours |
| Chapter No. 9 | Basics of lead acid batteries, Lithium Ion Battery , Battery storage capacity, Coulomb efficiency, Numerical of high and low charging rates, Battery sizing | 4 Hours |
| Topics for self study | Basic study of Fuses, MCB, ELCB and Relays, Filament lamp, Tube light, CFL and LED | |
| Suggested Activities | | |
| Activity No. 5 | Prepare a document on evolution of incandescent bulbs to the present-day LED lights Reference : Weblink/Youtube/Book | |
| Activity No.6 | Make a comparative study of Fuses, MCB, ELCB and Relays highlighting their use and applications Reference : Weblink/Youtube/Book | |

Text Books

1. AK.Sawhney, A Course in Elec.&Electronics Measurements&Instrumentation ,Dhanpatrai& Co. 1978
2. A.D. Helfrick& W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques PHI,2016

References Books

1. D C Kulshreshtha, Basic Electrical Engineering, Mc Graw Hill Publications,2019
2. David G Alciatore and Michel B Hstand, Introduction to Mechatronics and Measurement Systems, 3rd, Tata McGraw Hill Education Private Limited, New Delhi., 2005
3. Vincent Del Toro, Electrical Engineering Fundamentals Prentice Hall India2009

COURSE PATTERN & SCHEME OF EXAMINATION for B.Sc. / B.Sc. (Hons.) as per NEP-2020

| Semester | Title of the Paper | Total No of hours | Hours per week | Marks | | Duration of Examination (hours) | Total Marks | Credits |
|----------------------|--|-------------------|----------------|-------------------|--------------------------|---------------------------------|-------------|---------|
| | | | | Theory/Practicals | Internal Assessment (IA) | | | |
| | | | | Max | Max | | | |
| 3rd Sem. | Phy-DSC3: Wave motion and Optics | 52 | 4 | 60 | 40 | CA CA/ CA | 100 | 4 |
| | Phy-DSCP3-Lab III | 40 | 4 | 25 | 25 | 3 | 50 | 2 |
| | Phy-OE5: Optical Instruments OR Phy-OE6: Elements of Astronomy and Astrophysics | 39 | 3 | 60 | 40 | CA CA/ CA | 100 | 3 |
| 4 th Sem. | Phy-DSC4: Thermal Physics & Electronics | 52 | 4 | 60 | 40 | CA CA/ CA | 100 | 4 |
| | Phy-DSCP4-Lab II | 40 | 4 | 25 | 25 | 3 | 50 | 2 |
| | Phy-OE7: Medical Physics OR Phy-OE8: Electrical Instruments | 39 | 3 | 60 | 40 | CA CA/ CA | 100 | 3 |

| Formative/Internal Assessment for Theory Papers | |
|---|-------|
| Assessment Occasion | Marks |
| Test-1 (Attendance+Activity + Self-study related) | 20 |
| Test-2 (Theory based) | 20 |
| Total | 40 |

***Questions should not be set on activity and self-study topics during end semester examinations.**

| Distribution of Marks for the Practical Examination (Phy-DSCP1 & Phy-DSCP2) | | |
|--|---|--------------|
| Sl No | Particulars | Marks |
| 1 | Writing Principle/Statement/Formulae with symbols, units and explanations. | 03 |
| 2 | Drawing illustrative diagrams and expected graphs | 03 |
| 3 | Setting up of the experiment& taking readings | 06 |
| 4 | Calculations and graphs drawn based on experimental data. | 05 |
| 5 | Accuracy of results with units | 03 |
| 6 | Valuation of Practical Record | 05 |
| Total Marks | | 25 |

III/IV Semester B.Sc. Examination, April/May (September/October) 2023

CBCS - 2021 ONWARDS

Subject: Physics

PHY-301/PHY-401:

Time: 2.30 hours

Max. Marks: 60

Instruction: Answer *any* FOUR questions from *each* part

PART- A

Each question carries 2 marks (concept based)

8 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 1,2,3,4,5,6,7,8)

PART-B (20 marks)

Each question carries 5 marks (numerical problems)*

8 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 9,10,11,12,13,14,15,16)*

PART-C (32 marks)

Each question carries 8 marks

8 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 17,18,19,20,21,22,23,24)*

***In each part, two questions from each unit will be set**

CBCS - 2021 ONWARDS

Subject: Physics

PHY-OEC3/PHY-OEC4:.....(Open Elective)

Time: 2 hours

Max. Marks: 60

Instruction: Answer *any* FOUR questions from *each* part

PART- A

Each question carries 2 marks (concept based)

6 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 1,2,3,4,5,6)

PART-B (20 marks)

Each question carries 5 marks **

6 QUESTIONS TO BE SET*

(Question Numbers: 7,8,9,10,11,12)***

PART-C (32 marks)

Each question carries 8 marks

6 QUESTIONS TO BE SET* (Answer any 4 questions)

(Question Numbers: 13,14,15,16,17,18)**

Note:

* All parts should have TWO questions each from 3 units of the open elective syllabus.

** Questions of Part B and Part C may contain subdivisions i.e., (i) questions 7 to 12 of Part B may be split into a, b & division of marks in such cases should be clearly indicated – for example 2 + 3=5 marks or 1+4=5 marks. Similarly (ii) question 13 to 18 of Part C may be split into a, b, c with division of marks clearly indicated – for example 3+5=8 marks or 2+6=8 marks or 2+3+3=8 marks and so on).

PROGRAM/COURSE STRUCTURE AND SYLLABUS

National Education Policy (NEP 2020) Based Curriculum

for

Bachelor of Science

in

PHYSICS

V & VI Semester Physics Papers

w.e.f

Academic Year 2023-24 onwards

Curriculum Structure - Physics

Semester - I to Semester-VI

| Sem | Code | DSC/OE | Title of the Paper |
|-----|-----------|--------|--|
| I | PHY-101 T | DSC | Mechanics & Properties of Matter |
| | PHY-101 P | | Mechanics & Properties of Matter lab |
| | PHY-OE1 | OE-1 | Physics for All |
| II | PHY-201 T | DSC | Electricity and Magnetism |
| | PHY-201 P | | Electricity and Magnetism lab |
| | PHY-OE2 | OE-2 | Energy Sources |
| III | PHY-301 T | DSC | Wave Motion and Optics |
| | PHY-301 P | | Wave Motion and Optics lab |
| | PHY-OE3 | OE-3 | Optical Instruments |
| IV | PHY-401 T | DSC | Thermal Physics and Electronics |
| | PHY-401 P | | Thermal Physics and Electronics lab |
| V | PHY-501 T | DSC | Classical and Quantum Mechanics |
| | PHY-501 P | | Classical and Quantum Mechanics lab |
| | PHY-502 T | DSC | Elements of Atomic, Molecular and Laser Physics |
| | PHY-502 P | | Atomic, Molecular and Laser Physics lab |
| VI | PHY-601 T | DSC | Elements of Condensed Matter Physics and Nuclear Physics |
| | PHY-601 P | | Condensed Matter Physics and Nuclear Physics lab |
| | PHY-602 T | DSC | Electronic Instrumentation, Electrodynamics, and Statistical Physics |
| | PHY-602 P | | Electronic Instrumentation and Statistical Physics lab |
| | | | Internship/Project |

NEP- Curriculum Framework

B.Sc. Physics – Course Matrix for V & VI Semester (w.e.f. A.Y. 2023-24 onwards)

| Course Code | Course Title | Course Category | Course Components | | | Credits |
|--|---|-----------------|-------------------|---|---|---------|
| | | | L | T | P | |
| PHY-501 T | Classical and Quantum Mechanics | DSC | 4 | 0 | 0 | 4 |
| PHY-501 P | Classical and Quantum Mechanics lab | | 0 | 0 | 2 | 2 |
| PHY-502 T | Elements of Atomic, Molecular and Laser Physics | DSC | 4 | 0 | 0 | 4 |
| PHY-502 P | Atomic, Molecular and Laser Physics lab | | 0 | 0 | 2 | 2 |
| PHY-601 T | Elements of condensed matter Physics and Nuclear Physics | DSC | 4 | 0 | 0 | 4 |
| PHY-601 P | Condensed matter and Nuclear Physics lab | | 0 | 0 | 2 | 2 |
| PHY-602 T | Electronic Instrumentation, Electrodynamics and Statistical Physics | DSC | 4 | 0 | 0 | 4 |
| PHY-602 P | Electronic Instrumentation, and Statistical Physics lab | | 0 | 0 | 2 | 2 |
| | Internship/ Project | | | | | 2 |
| Total Credits for Physics in V and VI semester | | | | | | 26 |

***DSC: Discipline Specific Core**

| Pedagogy (Theory) |
|--|
| Lecture/ PPT/ Videos/ Animations/ Role Plays/ Think-Pair-Share/ Predict-Observe-Explain/ Demonstration/ Concept mapping/ Case Studies examples/ Tutorial/ Activity/ Flipped Classroom/ Jigsaw/ Field based Learning/ Project Based Learning/ Mini Projects/ Hobby Projects/ Forum Theatre/ Dance/ Problem Based Learning/ Game Based Learning/ Group Discussion/ Collaborative Learning/ Experiential Learning / Self Directed Learning etc. |
| Pedagogy (Practical's) |
| Demonstration/Experiential Learning / Self Directed Learning etc. |

| Formative Assessment for Theory | |
|---|-----------------|
| Assessment Occasion/ type | Marks |
| IA-1 | 10 |
| IA-2 | 10 |
| Assignments | 10 |
| Quiz / Presentation / Creating diagrams/ charts / Class work / Case study / Viva / Field work/SSR/ etc. | 05 |
| Activity report | 05 |
| Total | 40 Marks |

| Formative Assessment for Practical | |
|---|-----------------|
| Assessment Occasion/ type | Marks |
| IA-1 | 10 |
| IA-2 | 10 |
| Assignment | 05 |
| Total | 25 Marks |

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|----------------------------|---|----------------------------|---------|
| Program Name | B.Sc in Physics | Semester | V |
| Course Title | Classical Mechanics and Quantum Mechanics | | |
| Course Code: | PHY-501 T | No. of Credits | 04 |
| Contact hours | 60 Hours | Duration of SEA/Exam | 2 hours |
| Formative Assessment Marks | 40 | Summative Assessment Marks | 60 |

| Course Outcomes (Cos) | |
|---|--------|
| <p>After the successful completion of the course, the student will be able to</p> <ul style="list-style-type: none"> Revise the knowledge of differential equations and vector calculus. These basic mathematical structures are essential in solving problems in various branches of Physics. Revise the knowledge of the Newtonian, the Lagrangian and the Hamiltonian formulations of classical mechanics and their applications in appropriate physical problems. Know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and ability to discuss and interpret experiments that reveal the dual nature of matter Understand the theory of quantum measurements, wave packets and uncertainty principle. | |
| Contents | 60 Hrs |
| <p>Unit I</p> <p>Calculus: Overview of Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions, Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only)</p> <p>Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients.</p> <p>Vector Calculus: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.</p> <p>Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities and standard properties.</p> | 13 Hrs |
| <p>Activity</p> <ul style="list-style-type: none"> Student shall develop an understanding of various aspects of harmonic oscillations and waves specially superposition of collinear and perpendicular harmonic oscillations. | 01 Hr |
| <p>Topics for self study</p> <ul style="list-style-type: none"> Solenoidal and irrotational vectors. | 01 Hr |

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|---|---------------|
| <p style="text-align: center;">Unit II</p> <p>Newtonian Mechanics: Frames of references, Newton's laws of motion, inertial and non-inertial frames. Mechanics of a particle, Conservation of linear momentum, Angular momentum and torque, conservation of angular momentum, work done by a force, conservative force and conservative energy.</p> <p>Lagrangian Mechanics : Introduction, Basic concepts, coordinate systems, degrees of freedom; Constraints and their classifications, Generalized coordinates, Principle of Virtual work, D'Alembert's principle and Lagrangian equations from D'Alembert's principle. Example - Simple pendulum.</p> | 13 Hrs |
| <p style="text-align: center;">Activities</p> <ul style="list-style-type: none"> Conduct the simulation of the Atwood's machine experiment using the following link https://www.thephysicsaviary.com/Physics/Programs/Labs/AtwoodLab/ Find the slope of the velocity-time graph to get the acceleration. Do multiple scenarios and observe how the acceleration of the system varies with total mass or with driving force and prepare a report on the same. | 01 Hr |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Apply Lagrangian Mechanics to solve linear harmonic oscillator problem. | 01 Hr |
| <p style="text-align: center;">Unit III</p> <p>Variational principle: Hamilton's principle, Deduction of Hamilton's principle, Hamilton's principle for non-holonomic systems.</p> <p>Hamiltonian Mechanics: The Hamiltonian of a system, Hamilton's equations of motion, Hamilton's equations from variational principle, Integrals of Hamilton's equations, energy integrals, Canonical Transformations, Poisson Brackets, fundamental properties and equations of motion in Poisson Brackets.</p> | 13 Hrs |
| <p style="text-align: center;">Activity</p> <p>Compare the Lagrangian formalism and the Hamiltonian formalism by creating a two-column chart. Label one side "Lagrangian" and the other side "Hamiltonian" and discuss the similarities and differences. Here are some ideas to get you started:</p> <ul style="list-style-type: none"> What are the basic variables in each formalism? What are the form and number of the equations of motion derived in each case? Compare Lagrangian "state space" with the Hamiltonian "phase space"? | 01 Hr |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Lagrange's equation of motion from Hamilton's principle | 01 Hr |
| <p style="text-align: center;">Unit IV</p> <p>Introduction to Quantum Mechanics</p> <p>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 Compton shift (With derivation).</p> <p>Matter waves: de Broglie hypothesis of matter waves, concept of wave packets, Group and Phase velocities and relation between them, Davisson- Germer experiment and its significance. Heisenberg uncertainty principle-different forms, illustration of uncertainty principle by Gamma ray microscope experiment. Applications-why electron cannot exist in nucleus? Two-slit experiment with photons and electrons. Linear superposition principle as a consequence.</p> | 13Hrs |
| <p style="text-align: center;">Activities</p> | |

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|---|--------------|
| <ul style="list-style-type: none"> Conduct the virtual lab to demonstrate Photoelectric effect experiment using the following link https://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1 <p>Make a report of the calculations on the following questions.</p> <ul style="list-style-type: none"> Determine the minimum frequency required to have Photoelectric effect for an EM radiation, when incident on a zinc metal surface. Determine the target material if the threshold frequency of EM radiation is 5.5×10^{15} Hz in a particular photoelectric experimental set up. Determine the maximum kinetic energy of photo-electrons emitted from a Zinc metal surface, if the incident frequency is 3×10^{15} Hz. What should be the stopping potential for photoelectrons if the target Material used is Platinum and incident frequency is 2×10^{15} Hz? | 01 Hr |
| <p>Topics for self study</p> <ul style="list-style-type: none"> Consequences of the uncertainty relations: Diffraction of electrons at a single slit. | 01 Hr |

| REFERENCES |
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| 1. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education. |
| 2. Classical Mechanics, B A Kagali and T Shivalingaswamy, Himalaya publications, 2018. |
| 3. Classical Mechanics, G. Aruldas, 2008, Prentice-Hall of India Private limited, New Delhi. |
| 4. Classical Mechanics, Takwale and Puranik-1989, Tata McGraw Hill, new Delhi |
| 5. Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, 2009. |
| 6. Physics for Scientists and Engineers with Modern Physics, Serway and Jewett, 9th edition, Cengage Learning, 2014. |
| 7. Quantum Physics, Berkeley Physics Course Vol. 4. E.H. Wichman, Tata McGraw-Hill Co., 2008. |
| 8. Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, McGraw Hill, 2003. |
| 9. P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill publication, ISBN: 9780070146174. |
| 10. Ajoy Ghatak, S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer Publication, ISBN 978-1-4020-2130-5. |
| 11. Modern Physics; R. Murugesan & K. Sivaprasath; S. Chand Publishing. |
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| 14. Physics for Degree Students B.Sc., Third Year, C.L. Arora and P.S. Hemne, 1st edition, S. Chand & Company Pvt. Ltd., 2014. |
| 15. Mathematical Physics --- H. K. Dass and Dr. Rama Verma Mathematical Methods for Physicists (4th Edition) George Arfken and Hans J. Weber Academic Press San Diego (1995) |
| 16. Mathematical Physics - P.K. Chatopadhyay-Wiley Eastern Limited New Delhi (1990) |

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| 17. Introduction to mathematical Physics – Charlie Harper, Prentice-Hall of India Private Limited New-Delhi (1995) |
| 18. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. rd Bence, 3rd ., 2006, Cambridge Press |
| 19. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications |
| 20. .H C Verma (2016) Quantum Physics,, 2nd Edn, Surya Publications |

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|--|--|----------------------|-----------------|
| Course Title | Classical and Quantum Mechanics Lab | Practical Credits | 02 |
| Course Code | PHY-501 P | Contact Hours | 4 Hours |
| Formative Assessment | 25 Marks | Summative Assessment | 25 Marks |
| Course Outcomes: After completion of this course, the student will be able to <ul style="list-style-type: none"> Design experimental set-ups related to classical and quantum mechanics. | | | |
| Practical Content | | | |
| 1. To determine 'g', the acceleration due to gravity, at a given place, from the LT^2 graph, for a simple pendulum. 2. Evaluation of errors and least square fit. 3. To Study the effect of mass of the bob on the time period of the simple pendulum. 4. To Study the effect of amplitude of oscillation on the time period of the simple pendulum. 5. Determine the acceleration of gravity is to use an Atwood's machine. 6. Study the conservation of energy and momentum using projectile motion. 7. Verification of the Principle of Conservation of Linear Momentum 8. Determination of Planck constant and work function of the material of the cathode using Photo-electric cell. 9. Determination of electron charge 'e' by Millikan's Oil drop experiment. 10. To study the characteristics of solar cell. 11. To find the value of e/m for an electron by Thomson's method using bar magnets. 12. To determine the value of e/m for an electron by magnetron method. 13. Determination of quantum efficiency of Photodiode. 14. Determination of Planck's constant –using LED. 15. Determination of ratio of electronic charge to Boltzmann constant (e/k) using a silicon transistor. 16. Determination of Stefan's constant. 17. Simulations of Physics concepts based on online virtual lab (using MHRD web resource). NOTE: Students have to perform at-least EIGHT Experiments from the above list. | | | |

REFERENCES

1. B.Sc Practical Physics by C.L Arora.
2. B.Sc Practical Physics by Harnam Singh and P.S Hemne.
3. Practical Physics by G.S Squires.
4. Scilab Manual for CC-XI: Quantum Mechanics & Applications (32221501) by Dr Neetu Agrawal, Daulat Ram College, of Delhi.
5. Scilab Textbook Companion for Quantum Mechanics by M. C. Jain.
6. Computational Quantum Mechanics using Scilab, BIT Mesra.
7. B.Sc Practical Physics by C.L Arora.
8. Advanced Practical Physics for Students by Worsnop B L and Flint H T.
9. Experiments and Video Analysis in Classical Mechanics (Series title: Undergraduate Lecture Notes in Physics) March 2017, DOI: [10.1007/978-3-319-52407-8](https://doi.org/10.1007/978-3-319-52407-8), Edition: 1, Publisher: Springer International Publishing. ISBN 978-3-319-52406-1 / ISBN 978-3-319-52407-8 (eBook)

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|---|---|----------------------------|-----------------|
| Program Name | B.Sc in Physics | Semester | V |
| Course Title | Elements of Atomic, Molecular & Laser Physics | | |
| Course Code: | PHY-502 T | No. of Credits | 04 |
| Contact hours | 60 Hours | Duration of SEA/Exam | 2 hours |
| Formative Assessment Marks | 40 | Summative Assessment Marks | 60 |
| Course Outcomes (Cos) After the completion of the course, the student will be able to <ul style="list-style-type: none"> Describe atomic properties using basic atomic models. Interpret atomic spectra of elements using vector atom model. Interpret molecular spectra of compounds using basics of molecular physics. Explain laser systems and their applications in various fields. | | | |
| Contents | | | 60 Hours |
| Unit I Basic Atomic models Thomson's atomic model; Rutherford atomic model – Model, Theory of alpha particle scattering, Rutherford scattering formula; Bohr atomic model – postulates, Derivation of expression for radius, total energy of electron; Origin of the spectral lines; Spectral series of hydrogen atom; Effect of nuclear motion on atomic spectra - derivation; Ritz combination principle; Correspondence principle; Critical potentials – critical potential, excitation potential and ionization potential; Atomic excitation and its types, Franck-Hertz experiment; Sommerfeld's atomic model – model, Derivation of condition for allowed elliptical orbits | | | 13Hrs |
| Activity <ul style="list-style-type: none"> Students to search critical, excitation and ionization potentials of different elements and plot the graph of critical /excitation / ionization potentials versus atomic number/mass number/neutron number of element. Analyze the nature of the graph and draw the inferences. | | | 01 Hr |
| Topics for self study <ul style="list-style-type: none"> Deduce ground energy states for various elements in the periodic table and elucidate of the possible microstates in p1, p2, p3, p4, p5, p6 configuration. | | | 01 Hr |
| Unit II Vector atomic model and optical spectra Vector atom model – model fundamentals, spatial quantization, spinning electron; Quantum numbers associated with vector atomic model; Coupling schemes – L-S and j-j schemes; Pauli's exclusion principle; Magnetic dipole moment due to orbital motion of electron – derivation; Magnetic dipole moment due to spin motion of electron; Lande g-factor and its calculation for different states; Stern-Gerlach experiment – Experimental arrangement and Principle; Fine structure of spectral lines with examples; Spin-orbit coupling/Spin-Orbit Interaction – qualitative; Optical spectra – spectral terms, spectral notations, selection rules, intensity rules; Fine structure of the sodium D-line; Zeeman effect: Types, Experimental study and classical theory of normal Zeeman effect, Zeeman shift expression (no derivation), examples; Stark effect: Experimental study, Types and examples. | | | 13Hrs |

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|---|---|
| <p style="text-align: center;">Activity</p> <ul style="list-style-type: none"> Students to couple a p-state and s-state electron via L-S and j-j coupling schemes for a system with two electrons and construct vector diagrams for each resultant. Analyze the coupling results and draw the inferences | <p style="text-align: center;">01 Hr</p> |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Paschen-back effect | <p style="text-align: center;">01 Hr</p> |
| <p style="text-align: center;">Unit III</p> <p>Molecular Physics</p> <p>Types of molecules based on their moment of inertia; Types of molecular motions and energies; Born-Oppenheimer approximation; Origin of molecular spectra; Nature of molecular spectra; Theory of rigid rotator – energy levels and spectrum, Qualitative discussion on Non-rigid rotator and centrifugal distortion; Theory of vibrating molecule as a simple harmonic oscillator – energy levels and spectrum; Electronic spectra of molecules – fluorescence and phosphorescence; Raman effect – Stoke's and anti-Stoke's lines, characteristics of Raman spectra, classical and quantum approaches, Experimental study of Raman effect; Applications of Raman effect</p> | <p style="text-align: center;">13Hrs</p> |
| <p style="text-align: center;">Activity</p> <ul style="list-style-type: none"> Students to estimate energy of harmonic vibrating molecules CO, HCl and plot the graph of vibrational energy versus vibrational quantum number 'v'. Analyze the nature of the graph and draw the inferences. | <p style="text-align: center;">01 Hr</p> |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Effect of isotopes on rotational energies. List out the molecules that are Raman and IR active | <p style="text-align: center;">01 Hr</p> |
| <p style="text-align: center;">Unit IV</p> <p>Laser Physics</p> <p>Ordinary light versus laser light; Characteristics of laser light; Interaction of radiation with matter - Induced absorption, spontaneous emission and stimulated emission with mention of rate equations; Einstein's A and B coefficients – Derivation of relation between Einstein's coefficients and radiation energy density; Possibility of amplification of light; Population inversion; Methods of pumping; Metastable states; Requisites of laser – energy source, active medium and laser cavity; Difference between Three level and four level lasers with examples; Types of lasers with examples; Construction and Working principle of Ruby Laser and He-Ne Laser; Application of lasers (qualitative) in science & research, isotope separation, communication, fusion, medicine, industry, war and space.</p> | <p style="text-align: center;">13Hrs</p> |
| <p style="text-align: center;">Activity</p> <ul style="list-style-type: none"> Students to make a report on different lasers used in medical field (ex: eye surgery, endoscopy, dentistry etc.), list their parameters and analyze the need of these parameters for specific application, and draw the inferences. | <p style="text-align: center;">01 Hr</p> |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Holography: basic principle, types of holograms and applications | <p style="text-align: center;">01 Hr</p> |

REFERENCES

1. Modern Physics, R. Murugesan, Kiruthiga Sivaprakash, Revised Edition, 2009, S. Chand & Company Ltd.
2. Atomic & Molecular spectra: Laser, Raj Kumar, Revised Edition, 2008, Kedar Nath Ram Nath Publishers, Meerut.
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4. Concepts of Atomic Physics, S.P. Kuila, First Edition, 2018, New Central Book Agency (P) Ltd.
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9. LASERS: Fundamentals & applications, K. Thyagrajan & A. K. Ghatak, 2010, Tata McGraw Hill.
10. A. K. Saxena, (2009), Atomic and molecular Spectra and Lasers, CBS Publishers, 1st Edition.

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|--|--|----------------------|-----------------|
| Course Title | Atomic, Molecular & Laser Physics Lab | Practical Credits | 02 |
| Course Code | PHY-502 P | Contact Hours | 04 Hours |
| Formative Assessment | 25 Marks | Summative Assessment | 25 Marks |
| Practical Content | | | |
| <p style="text-align: center;">List of Experiments</p> <ol style="list-style-type: none"> 1. To determine Planck's constant using Photocell. 2. To determine Planck's constant using LED. 3. To determine wavelength of spectral lines of mercury source using spectrometer. 4. To determine the value of Rydberg's constant using diffraction grating and hydrogen discharge tube. 5. To determine the wavelength of H-alpha emission line of Hydrogen atom. 6. To determine fine structure constant using fine structure separation of sodium D-lines using a plane diffraction grating. 7. To determine the ionization potential of mercury. 8. To determine the absorption lines in the rotational spectrum of Iodine vapor. 9. To determine the force constant and vibrational constant for the iodine molecule from its absorption spectrum. 10. To determine the wavelength of laser using diffraction by single slit/double slits. 11. To determine wavelength of He-Ne laser using plane diffraction grating. 12. To determine angular spread of He-Ne laser using plane diffraction grating. 13. Study of Raman scattering by CCl₄ using laser and spectrometer/CDS. 14. Analysis of rotational spectrum of nitrogen molecule. 15. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr). 16. Analysis of absorption spectrum of KMnO₄. 17. To determine the value of Rydberg's constant using hydrogen spectrum. 18. Analysis of band spectrum of PN molecule. <p style="text-align: center;">NOTE: Students have to perform at-least EIGHT Experiments from the above list.</p> | | | |

| REFERENCES |
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| 1. B.Sc Practical Physics by C.L Arora. |
| 2. B.Sc Practical Physics by Harnam Singh and P.S Hemne. |
| 3. Practical Physics by G.S Squires. |
| 4. B.Sc Practical Physics by C.L Arora. |
| 5. Advanced Practical Physics for Students by Worsnop B L and Flint H T. |

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|----------------------------|--|----------------------------|---------|
| Program Name | B.Sc | Semester | VI |
| Course Title | Elements of Condensed Matter & Nuclear Physics | | |
| Course Code: | PHY-601 T | No. of Credits | 4 |
| Contact hours | 60 Hours | Duration of SEA/Exam | 3 hours |
| Formative Assessment Marks | 40 | Summative Assessment Marks | 60 |

| Course Outcomes (Cos) | |
|---|--------|
| <p>After the successful completion of the course, the student will be able to:</p> <ul style="list-style-type: none"> • Explain the basic properties of nucleus and get the idea of its inner information. • Understand the concepts of binding energy and binding energy per nucleon v/s mass number graph. • Describe the processes of alpha, beta and gamma decays based on well-established theories. • Explain the basic aspects of interaction of gamma radiation with matter by photoelectric effect, Compton scattering and pair production. • Explain the different nuclear radiation detectors such as ionization chamber, GMC etc. | |
| Contents | 60 Hrs |
| <p>Unit I</p> <p>Crystal systems and X-rays: Crystal structure: Space Lattice, Lattice translational vectors, Basis of crystal structure, Types of unit cells, primitive, non-primitive cells. Seven crystal systems, Coordination numbers, Miller Indices, Expression for inter planar spacing.</p> <p>X Rays: Production and properties of X rays, Coolidge tube, Continuous and characteristic X-ray spectra; Moseley's law. X-Ray diffraction, Scattering of X-rays, Bragg's law.</p> <p>Crystal diffraction: Bragg's X-ray spectrometer- powder diffraction method, Intensity vs. 2θ plot (qualitative).</p> <p>Free electron theory of metals: Classical free electron model (Drude-Lorentz model), expression for electrical and thermal conductivity, Weidman-Franz law, Failure of classical free electron theory; Quantum free electron theory, Fermi level and Fermi energy, Fermi-Dirac distribution function (expression for probability distribution $F(E)$, statement only); Fermi Dirac distribution at $T=0$ and $E < E_f$, at $T \neq 0$ and $E > E_f$, $F(E)$ vs. E plot at $T = 0$ and $T \neq 0$. Density of states for free electrons (statement only, no derivation). Qualitative discussion of lattice vibration and concept of Phonons. Specific heats of solids: Classical theory, Einstein's and Debye's theory of Specific heats (qualitative).</p> | 13 Hrs |
| <p>Activity</p> <ul style="list-style-type: none"> • Students to construct seven crystal systems with bamboo sticks and rubber bands. Use foamball as atoms and study the BCC and FCC systems. | 1Hr |
| <p>Topics for self study</p> <ul style="list-style-type: none"> • Different techniques involved for Crystal Growth. | 1Hr |

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| <p style="text-align: center;">Unit II</p> <p>Magnetic Properties of Matter Review of basic formulae: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, magnetization (M), Classification of Dia, Para, and Ferro magnetic materials; Langevin Classical Theory of Para magnetism. Curie's law, Ferromagnetism and Ferromagnetic Domains (qualitative). Discussion of B-H Curve. Hysteresis and Energy Loss.</p> <p>Dielectrics: Static dielectric constant, polarizability (electronic, ionic and orientation), calculation of Lorentz field (derivation), Clausius-Mosotti equation (derivation), dielectric loss. Piezo electric effect, cause, examples and applications.</p> <p>Superconductivity: Definition, Experimental results – Zero resistivity and Critical temperature–The critical magnetic field – Meissner effect, Type I and type II superconductors.</p> | 13 Hrs |
| <p style="text-align: center;">Activity</p> <ul style="list-style-type: none"> Using vegetable oil and iron fillings students to make ferrofluids and see how it behaves in the presence of magnetic field. https://nationalmaglab.org/magnet-academy/try-this-at-home/making-ferrofluids/ | 1Hr |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Hard and Soft magnetic materials . | 1Hr |
| <p style="text-align: center;">Unit III</p> <p>General Properties of Nuclei: Constituents of nucleus and their intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy ,main features of binding energy versus mass number curve, angular momentum, parity, magnetic moment, electric moments.</p> <p>Radioactivity decay: Radioactivity : definition of radioactivity, half life, mean life, radioactive equilibrium (a) Alpha decay: basics of α-decay processes, theory of α emission (brief), Gamow factor, Geiger-Nuttall law. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion (Definition)</p> | 13 Hrs |
| <p style="text-align: center;">Activity</p> <ul style="list-style-type: none"> Prepare the list of alpha emitters from Uranium series. Search the kinetic energy of alpha particle emitted by these alpha emitters. Collect the required data such as half life or decay constant. Verify Geiger-Nuttall law. | 1Hr |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Radioactivity versus Transmutation | 1Hr |
| <p style="text-align: center;">Unit IV</p> <p>Interaction of Nuclear Radiation with matter: Gamma ray interaction through matter, Photoelectric effect, Compton scattering, pair production, Energy loss due to ionization (quantitative description of Bethe Bloch formula), energy loss of electrons, Cerenkov radiation.</p> <p>Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility) qualitative only, Accelerators: Cyclotrons and Synchrotrons.</p> | 13 Hrs |
| <p style="text-align: center;">Activity</p> <ul style="list-style-type: none"> Simulation on Photo electric effect , Compton scattering and Cyclotron | 1Hr |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Nuclear reactors in India | 1Hr |

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2. Fundamentals of Solid State Physics-B.S.Saxena,P.N. Saxena,Pragati prakashan Meerut(2017).
3. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
4. Nuclear Physics, Irving Kaplan, Narosa Publishing House
5. Introduction to solid State Physics, *Charles Kittel*, VII edition, (1996)
6. Solid State Physics- A J Dekker, MacMillan India Ltd, (2000)
7. Essential of crystallography, M A Wahab, Narosa Publications (2009)
8. Solid State Physics-S O Pillai-New Age Int. Publishers (2001).
9. Concepts of nuclear physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
10. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
11. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
12. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (Institute ofPhysics (IOP) Publishing, 2004).
13. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
14. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier,2007).

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|---|---|----------------------|-----------------|
| Course Title | Condensed Matter & Nuclear Physics Lab | Practical Credits | 02 |
| Course Code | PHY-601 P | Contact Hours | 4 Hours |
| Formative Assessment | 25 Marks | Summative Assessment | 25 Marks |
| Practical Content | | | |
| List of Experiments | | | |
| Condensed Matter Physics | | | |
| <ol style="list-style-type: none"> Hall Effect in semiconductor: determination of mobility, hall coefficient. Energy gap of semiconductor (diode/transistor) by reverse saturation method. Energy gap of a Thermistor. Fermi Energy of Copper. Analysis of X-ray diffraction spectra and calculation of lattice parameter. Plank's constant by LED. Specific Heat of Solid by Electrical Method. Determination of Dielectric Constant of Non polar liquid. Determination of dipole moment of organic liquid. B-H Curve Using CRO. Spectral Response of Photo Diode and its I-V Characteristics. Determination of particle size from XRD pattern using Debye-Scherrer formula. | | | |
| Nuclear Physics | | | |
| <ol style="list-style-type: none"> Study the characteristics of Geiger-Muller Tube. Determine the threshold voltage, plateau region and operating voltage. Study the absorption of beta particles in aluminum foils using GM counter and determine mass attenuation coefficient of aluminum foils. Study the absorption of beta particles in thin copper foils using G M counter and determine mass attenuation coefficient. Study the attenuation of gamma rays in lead foils using Cs-137 source and G M counter. Calculate mass attenuation coefficient of Lead for Gamma. Determine the end point energy of Tl-204 source by studying the absorption of beta particles in aluminum foils. Study the attenuation of gamma rays in polymeric materials using Cs-137 source and G M counter. Verification of inverse square law using GM counter. | | | |
| NOTE: Students have to perform at-least EIGHT Experiments from the above list. | | | |

| REFERENCES | |
|------------|--|
| 1. | IGNOU : Practical Physics Manual |
| 2. | Saraf : Experiment in Physics, Vikas Publications |
| 3. | S.P. Singh : Advanced Practical Physics |
| 4. | Melissos : Experiments in Modern Physics |
| 5. | Misra and Misra, Physics Lab. Manual, South Asian publishers, (2000) |
| 6. | Gupta and Kumar, Practical physics, Pragati prakashan, (1976) |

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|----------------------------|---|----------------------------|----------------|
| Program Name | B.Sc in Physics | Semester | VI |
| Course Title | Electronic Instrumentation , Electrodynamics and Statistical Physics | | |
| Course Code: | PHY-602 T | No. of Credits | 04 |
| Contact hours | 60 Hours | Duration of SEA/Exam | 2 hours |
| Formative Assessment Marks | 40 | Summative Assessment Marks | 60 |

| Course Outcomes (Cos) | |
|--|---------------|
| <p>After the completion of the course, the student will be able to</p> <ul style="list-style-type: none"> Identify different types of measuring instruments used in practice and understand their basic working principles Have an understanding of the measurement of voltage and current. Have an understanding of working of rectifiers, filters, oscillators and connect the concepts learnt to their practical use in daily life. Describe basics of electrodynamics. Apply classical statistics to physical situations. Apply quantum statistics to physical problems. | |
| Contents | Hours |
| <p align="center">Unit I</p> <p>Basic electrical measuring instruments Cathode ray oscilloscope- Block diagram, basic principle, electron beam, CRT features, signals display. Basic elements of digital storage oscilloscopes. Basic DC voltmeter for measuring potential difference, Extending Voltmeter range, AC voltmeter using rectifiers. Basic DC ammeter, requirement of a shunt, Extending of ammeter ranges. Passive and active filters. Types of filters, Circuitry and Cut-off frequency and frequency response of Passive (RC) and Active filters (op-amp based filters in non inverting mode): Low pass, high pass. (First order). Op-amp Oscillators: positive feedback concept-oscillator operation- Barkhausen Criterion; types of oscillator circuits (Qualitative)-Phase shift oscillator and Wien bridge oscillator using op-amp.</p> | 13 Hrs |
| <p align="center">Activity</p> <ul style="list-style-type: none"> Explore where signal filtering network is used in real life. Visit a nearby telephone exchange and discuss with the Engineers and technicians. Prepare a report | 1 Hr |
| <p align="center">Topics for self study</p> <ul style="list-style-type: none"> Multirange voltmeter and ammeter | 1 Hr |

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|---|---------------|
| <p style="text-align: center;">Unit II</p> <p>Basics of Electrodynamics Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.</p> | 13 Hrs |
| <p style="text-align: center;">Activity</p> <ul style="list-style-type: none"> Students to identify different wave equations in physics and learn to solve the equations by different techniques | 1 Hr |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Physical meaning of divergence and curl operators and apply the knowledge to understand Maxwell's equations. | 1 Hr |
| <p style="text-align: center;">Unit III</p> <p>Classical Statistics Macro state & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) –Applications to Specific Heat and its Limitations.</p> | 13Hrs |
| <p style="text-align: center;">Activity</p> <ul style="list-style-type: none"> Students to learn Binomial distribution using coins and plot the distribution curve | 1 Hr |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Factors affecting Maxwell Boltzmann distribution curve | 1 Hr |
| <p style="text-align: center;">Unit IV</p> <p>Quantum Statistics Bose-Einstein distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law. Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit.</p> | 13Hrs |
| <p style="text-align: center;">Activity</p> <ul style="list-style-type: none"> Students to search the contribution of Indian scientist S.N.Bose in Bose-Einstein Condensation and makes the presentation of the study. | 1 Hr |
| <p style="text-align: center;">Topics for self study</p> <ul style="list-style-type: none"> Comparison between Bose-Einstein distribution and Fermi-Dirac Distribution. | 1 Hr |

REFERENCES

1. Electronic Instrumentation, 3rd Edition, H.S. Kalsi, McGraw Hill Education India Pvt. Ltd. 2011
2. Instrumentation – Devices and Systems (2nd Edition)– C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill Education Pvt. Ltd. (Especially for circuitry and analysis of signal generators and filter
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
4. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
5. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
6. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
7. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
8. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, OxfordUniversity Press.

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|---|---|----------------------|-----------------|
| Course Title | Electronic Instrumentation and Statistical Physics lab | Practical Credits | 2 |
| Course Code | PHY-602 P | Contact Hours | 4 Hours |
| Formative Assessment | 25 Marks | Summative Assessment | 25 Marks |
| Practical Content | | | |
| <p style="text-align: center;">List of Experiments</p> <ol style="list-style-type: none"> 1. Calibration of a low range voltmeter using a potentiometer. 2. Calibration of an ammeter using a potentiometer. 3. Study the frequency response of a Passive low Pass Filter (RC). 4. Study the frequency response of a Passive high Pass Filter (RC). 5. Applications of CRO in the calculation of r m s voltage and frequency of A.C. 6. Design and construct a Phase shift oscillator using IC 741 op-amp. 7. Design and construct a Wien bridge oscillator using IC 741 op-amp. 8. Study the frequency response of a first order op-amp low pass filter. 9. Study the frequency response of a first order op-amp high pass filter. 10. Verification of Maxwell's distribution of velocity. 11. Maxwell distribution of velocities for electron using vacuum diode. 12. Monte Carlo experiment –To determine the value of Pi. 13. Dice experiment – to study statistical nature of results. 14. Study of micro and macro states using 3 dice. <p>NOTE: Students have to perform at-least EIGHT Experiments from the above list.</p> | | | |

REFERENCES

1. IGNOU : Practical Physics Manual
2. B. Saraf ,(2013),Physics through experiments, Vikas Publications
3. S.P. Singh : Advanced Practical Physics
4. C.L.Arora, (2007),*B. Sc Practical Physics*, S.Chand &Co, Revised Edition
5. Misra and Misra, Physics Lab. Manual, South Asian publishers, (2000)
6. Gupta and Kumar, Practical physics, Pragati prakashan, (1976)

MAHARANI LAKSHMI AMMANI COLLEGE FOR WOMEN AUTONOMOUS

V /VI Semester B.Sc. Examination January/June 2024

NEP syllabus 2023 onwards

PHYSICS

Paper-V/VI

Course Code: Title of the Paper

Time: 2.5 Hours

Max. Marks: 60

PART-A

Answer any SIX questions. Each question carries ONE mark

(6 × 1 = 6 marks)

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8

PART-B

Answer any SIX questions. Each question carries TWO marks

(6 x 2 = 12 marks)

- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.

PART-C

Answer any THREE questions. Each question carries FOUR marks

(3 X 4 = 12 marks)

- 17.
- 18.
- 19.
- 20.

PART-D

Answer any FIVE questions. Each question carries SIX marks

(5 x 6 = 30 marks)

- 21.
- 22.
- 23.
- 24.
- 25.
- 26.
- 27.
- 28.