**DEPARTMENT OF PURE AND APPLIED PHYSICS**
**B. Sc. (Physics) Course structure under NEP-2020**
**Academic year 2023 – 2024**

| Sem. | Courses | Course Code | Number of courses | Level | Credits | Credits (L+T+P) | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Major-I | PPUATT1 | Mechanics | 2 | 3 | (3+0+0) | 30 | 70 | 100 |
| | | PPUATL1 | Mechanics Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Minor-I | | Opted from the Pool Course offered by University | 2 | 4 | | 30 | 70 | 100 |
| | Multidisciplinary | | Opted from the Pool Course offered by the University | 1 | 3 | | 30 | 70 | 100 |
| | AEC | | Opted from the Pool Course offered by University | 1 | 2 | | 30 | 70 | 100 |
| | SEC | | Opted from the Pool Course offered by University | 1 | 3 | | 30 | 70 | 100 |
| | VAC-1 | | Opted from the Pool Course offered by University | 1 | 2 | | 30 | 70 | 100 |
| | VAC-2 | | Opted from the Pool Course offered by University | 1 | 2 | | 30 | 70 | 100 |
| | | | **Total** | | **20** | | | | **800** |
| 2 | Major-II | PPUBTT1 | Mathematical Physics-I | 2 | 4 | (3+1+0) | 30 | 70 | 100 |
| | Minor-II | | Opted from the Pool Course offered by University | 2 | 4 | | 30 | 70 | 100 |
| | Multidisciplinary | | Opted from the Pool Course offered by University | 1 | 3 | | 30 | 70 | 100 |
| | AEC | | Opted from the Pool Course offered by University | 1 | 2 | | 30 | 70 | 100 |
| | SEC | | Opted from the Pool Course offered by University | 1 | 3 | | 30 | 70 | 100 |
| | VAC-1 | | Opted from the Pool Course offered by University | 1 | 2 | | 30 | 70 | 100 |
| | VAC-2 | | Opted from the Pool Course offered by University | 1 | 2 | | 30 | 70 | 100 |
| | | | **Total** | | **20** | | | | **700** |
| 3 | Major-III | PPUCTT1 | Heat & Thermodynamics | 3 | 3 | (3+0+0) | 30 | 70 | 100 |
| | | PPUCTL1 | Heat & Thermodynamics Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Major-IV | PPUCTT2 | Waves & Optics | 3 | 3 | (3+0+0) | 30 | 70 | 100 |
| | | PPUCTL2 | Waves & Optics Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Minor-III | | Opted from the Pool Course offered by University | 3 | 4 | | 30 | 70 | 100 |
| | Multidisciplinary | | Opted from the Pool Course offered by University | 1 | 3 | | 30 | 70 | 100 |
| | AEC | | Opted from the Pool Course offered by University | 1 | 2 | | 30 | 70 | 100 |
| | SEC | | Opted from the Pool | 1 | 3 | | 30 | 70 | 100 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Course offered by University | | | | | | |
| | | | **Total** | | | **20** | | | **800** |
| 4 | Major-V | PPUDTT1 | Electricity & Magnetism | 3 | 3 | (3+0+0) | 30 | 70 | 100 |
| | | PPUDTL1 | Electricity & Magnetism Lab | 3 | 2 | (0+0+2) | 30 | 70 | 100 |
| | Major-VI | PPUDTT2 | Mathematical Physics-II | 3 | 4 | (4+0+0) | 30 | 70 | 100 |
| | | PPUDTL2 | Mathematical Physics-II Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Major-VII | PPUDTT3 | Classical Mechanics | 3 | 4 | (3+1+0) | 30 | 70 | 100 |
| | Minor-IV | | Opted from the Pool Course offered by University | 3 | 4 | | 30 | 70 | 100 |
| | AEC | | Opted from the Pool Course offered by University | 1 | 2 | | 30 | 70 | 100 |
| | | | **Total** | | **20** | | | | **700** |
| 5 | Major-VIII | PPUETT1 | Quantum Mechanics-I | 4 | 5 | (4+1+0) | 30 | 70 | 100 |
| | Major-IX | PPUETT2 | Statistical Mechanics | 4 | 4 | (4+0+0) | 30 | 70 | 100 |
| | | PPUETL2 | Statistical Mechanics Lab | 4 | 1 | (0+0+1) | 30 | 70 | 100 |
| | Major-X | PPUETT3 | Analog & Digital Electronics | 4 | 3 | (3+0+0) | 30 | 70 | 100 |
| | | PPUETL3 | Analog & Digital Electronics Lab | 4 | 2 | (0+0+2) | 30 | 70 | 100 |
| | Minor-V | | Opted from the Pool Course offered by University | 4 | 4 | | 30 | 70 | 100 |
| | Internship | | | | 2 | | 30 | 70 | 100 |
| | | | **Total** | | **21** | | | | **700** |
| 6 | Major-XI | PPUFTT1 | Quantum Mechanics-II | 4 | 4 | (4+0+0) | 30 | 70 | 100 |
| | | PPUFTL1 | Quantum Mechanics-II Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Major-XII | PPUFTT2 | Atomic & Molecular Physics | 4 | 5 | (4+1+0) | 30 | 70 | 100 |
| | Major-XIII | PPUFTT3 | Nuclear & Elementary Particle Physics | 4 | 4 | (4+0+0) | 30 | 70 | 100 |
| | | PPUFTL3 | Nuclear & Elementary Particle Physics Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Minor-VI | | Opted from the Pool Course offered by University | 4 | 4 | | 30 | 70 | 100 |
| | | | **Total** | | **19** | | | | **600** |
| 7(Hons. With Research ) | Major-XIV | PPUGTT1 | Condensed Matter Physics-I | 5 | 3 | (3+0+0) | 30 | 70 | 100 |
| | | PPUGTL1 | Condensed Matter Physics-I Lab | | 2 | (0+0+2) | 30 | 70 | 100 |
| | Major-XV | PPUGTT2 | Electromagnetic Theory | 5 | 5 | (4+1+0) | 30 | 70 | 100 |
| | Major-XVI | PPUGTT3 | Integral Transforms & Numerical Methods in Physics | 5 | 4 | (3+1+0) | 30 | 70 | 100 |
| | | PPUGTL3 | Integral Transforms & Numerical Methods in Physics Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Minor-VII | | Opted from the Pool Course offered by University | 5 | 4 | (3+0+1) | 30 | 70 | 100 |
| | | | **Total** | | **19** | | | | **600** |
| 8(Hons. With Research | Major-XVII | PPUHTT1 | Condensed Matter Physics-II | 5 | 4 | (3+1+0) | 30 | 70 | 100 |
| | | PPUHTL1 | Condensed Matter | | 1 | (0+0+1) | 30 | 70 | 100 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ) | | | Physics-II Lab | | | | | | |
| | Minor-VIII | | Opted from the Pool Course offered by University | 5 | 4 | | 30 | 70 | 100 |
| | Research project/dissertation | PPUHTD1 | Dissertation/ project work followed by seminar | | 12 | | 30 | 70 | 100 |
| | | | **Total** | | **21** | | | | **400** |
| 7.(Hons.) | Major-XIV | PPUGTT1 | Condensed Matter Physics-I | 5 | 3 | (3+0+0) | 30 | 70 | 100 |
| | | PPUGTL1 | Condensed Matter Physics-I Lab | | 2 | (0+0+2) | 30 | 70 | 100 |
| | Major-XV | PPUGTT2 | Electromagnetic Theory | 5 | 5 | (4+1+0) | 30 | 70 | 100 |
| | Major-XVI | PPUGTT3 | Integral Transforms & Numerical Methods in Physics | 5 | 4 | (3+1+0) | 30 | 70 | 100 |
| | | PPUGTL3 | Integral Transforms & Numerical Methods in Physics Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Minor-VII | | Opted from the Pool Course offered by University | 5 | 4 | | 30 | 70 | 100 |
| | Seminar-1 | | | | 1 | | 30 | 70 | 100 |
| | | | **Total** | | **20** | | | | **700** |
| 8.(Hons.) | Major-XVII | PPUHTT1 | Condensed Matter Physics-II | 5 | 4 | (3+1+0) | 30 | 70 | 100 |
| | | PPUHTL1 | Condensed Matter Physics-II Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Major-XVIII | PPUHTT2 | Experimental Techniques and Nanoscience | 5 | 3 | (3+0+0) | 30 | 70 | 100 |
| | | PPUHTL2 | Experimental Techniques and Nanoscience Lab | | 2 | (0+0+2) | 30 | 70 | 100 |
| | Minor-VIII | | Opted from the Pool Course offered by University | 5 | 4 | | 30 | 70 | 100 |
| | Minor-IX | | Opted from the Pool Course offered by University | 5 | 4 | | 30 | 70 | 100 |
| | Seminar-2 | | | | 2 | | 30 | 70 | 100 |
| | | | **Total** | | **20** | | | | **700** |

## Courses Offered by the Department of Pure & Applied Physics/School

| Sem. | Courses | Course Code | Number of courses | Level | Credits | Credits (L+T+P) | Int. Marks | Ext. Marks | Total |
|---|---|---|---|---|---|---|---|---|---|
| I | Minor-I Offered by the Department | PPUATG2 | Mathematical methods in Physical Sciences | 2 | 4 | (3+1+0) | 30 | 70 | 100 |
| | Multidisciplinary Offered by the School of Physical Sciences and Natural Sciences | PPUATM1 | Conceptual Understanding of Physical Science – I | 1 | 3 | (2+1+0) | 30 | 70 | 100 |
| | SEC Offered by the Department | PPUATS1 | Experimental Techniques in Physics | 1 | 3 | (2+0+1) | 30 | 70 | 100 |
| II | Minor-II Offered by the Department | PPUBTG1 | Mechanics | 2 | 3 | (3+0+0) | 30 | 70 | 100 |
| | | PPUBLG1 | Mechanics Lab | | 1 | (0+0+1) | 30 | 70 | 100 |
| | Multidisciplinary | | | 1 | 3 | 3(2+1+0) | 30 | 70 | 100 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Offered by the School of Physical Sciences and Natural Sciences | | | | | | | | |
| | SEC Offered by the Department | PPUBTS1 | Renewable Energy Resources | 1 | 3 | (2+0+1) | 30 | 70 | 100 |

**PHY- Physics, L-Lecture, T- Tutorial, P-Practical**

# DEPARTMENT OF PURE AND APPLIED PHYSICS
## B. Sc. (Physics) PO-PSO under NEP-2020
## Academic year 2023 – 2024

**Programme Outcomes:** B. Sc. (Physics)

**PO1: Knowledge:** Apply the knowledge of science, mathematics, scientific fundamentals and physics to the solution of complex scientific problems.

**PO2: Design Solutions:** Design solutions for problems in physics and design system components in regard to public health, safety, cultural, societal and environmental considerations.

**PO3: Analytical Thinking:** Analysis and interpretation of data to investigate problems, and synthesis of information to provide valid solution.

**PO4: Ethics:** Apply ethical principles and commit to professional ethics, and responsibilities and norms of the work practice.

**PO5: Independent & Team Work:** Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary settings

**PO6: Tools & Technique:** Create and apply appropriate techniques and scientific tools for prediction and modelling to complex activities in physics.

**PO7: Communication and Presentation Skills:** Communicate effectively by writing effective reports documentations and presentations.

**PO8: Applicability:** Demonstrate knowledge and understanding of principles of physics; manage projects in multidisciplinary environments as member or a team leader.

**PO9: Life-long Learning:** Understand the impact of scientific solutions in societal and environmental contexts and demonstrate the need of sustainable development and continue to learn throughout the life.

**Programme Specific Outcomes:**

**PSO1:** Acquire basic knowledge in different branches of physics such as mechanics, mathematical physics, electromagnetism, wave optics, quantum mechanics, nanomaterials, nuclear physics and basic analog and digital electronics etc.

**PSO2:** Understand different computer applications/programmes, experimental techniques and development of quantitative skills to solve mathematical and scientific problems.

**PSO3:** Attain fundamental knowledge in modern physics, statistical mechanics and various numerical techniques**.**

**PSO4:** Learn the fundamentals of research aspects, analysis and presentation through projects/dissertation and thesis writing.

**PSO5:** Empower the students towards great contribution of India to the development of classical principles/physics proposed by ancient and modern Indian physicists. Also, to learn about the sustainability related to energy and power loss.

**PSO6:** To learn about the various sophisticated instruments and techniques used for technological advancements in different areas of life as well as to search for different sourcesof renewable energy sustainability.

**Semester-I**

**Major-I : Mechanics** **Credits = 3(3+0+0)**
**Course Code: PPUATT1**

**Course Objectives**

- To empower the students to acquire theoretical concept and practical knowledge regarding motions, forces producing motion, and dynamics of very high-speed particles.
- To let the students acquire the basic requirements for their higher studies.
- To provide a theoretical basis for doing experiments in related areas.

**Learning Outcomes**

Upon successful completion of this course

- Students will be able to understand basic concepts about Newtonian mechanics.
- Students will have an understanding of the fundamentals of special theory of relativity, which is very fundamental for further higher studies in physics.

**Unit I**

**Fundamentals of Dynamics:** Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket. Motion of a projectile in uniform gravitational field Dynamics of a system ofparticles. Centre of Mass. Principle of conservation of momentum.

**Work and Energy:** Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy

**Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

**Unit II**

**Rotational Dynamics:** Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

**Fluid Motion:** Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube**.**

**UNIT III**

**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws.Satellite in circular orbit and applications.

**Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame.Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications

**Unit IV**

**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, Variation of mass with velocity. Mass-energy Equivalence (only problems)

**Reference Books:**

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Additional References:

8. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
9. University Physics. F.W Sears, M.WZemansky, H.D Young 13/e, 1986, Addison Wesley
10. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
11. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | PSO | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO1 | 3 | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - |
| CO2 | 3 | 1 | - | - | - | 2 | - | 1 | - | - | 3 | 2 | - | - | - |
| CO3 | - | - | - | - | - | - | - | 2 | 1 | - | - | - | 1 | - | - |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

**Laboratory course (Any 5 experiments)**

**Major-I Lab: Mechanics Lab** **Credits = 1 (0+0+1)**
**Course Code: PPUALT1**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the Motion of Spring and calculate (a) Spring constant, (b) g
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
5. To determine the elastic Constants of a wire by Searle's method.
6. To determine the value of g using Kater's Pendulum.
7. To determine coefficient of viscosity of Glycerine by Stoke's method

**Minor-I : Mathematical Methods in Physical Sciences** **Credits = 4(3+1+0)**
**Course Code: PPUATG1**

**Course Objectives**

- To let the students familiarize with ODEs and their applications in physical sciences.
- To learn the basics of PDEs and their solutions.
- To acquaint the students with vector differentiation and their physical significances.
- To introduce the concepts of vector integration and it's applications.

**Learning Outcomes:**

Upon successful completion of this the students will be able to

- Identify the occurrences and applications of ODEs and PDEs in physical sciences
- Understand the basics of vector differentiations, divergence and curl.
- Develop a thorough understanding of various aspects of vector integrations.

**Unit – I:** First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Examples of differential equations in physical sciences.

**Unit – II:** Calculus of functions of more than one variable: Partial derivatives, exact and inexactdifferentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

**Unit - III**: Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vectorfield. Del and Laplacian operators. Vector identities.

**Unit – IV:** Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields.
Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications(no rigorous proofs).

**Reference Books:**


1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn.,Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and BartlettLearning
7. Mathematical Physics, Goswami, 1st edition, Cengage Learning
8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press

9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley&M.P.Hobson, 2011, Cambridge Univ. Press.
11. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.

**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | | | | PSO | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO1 | 3 | 3 | 3 | - | 2 | 2 | 1 | 2 | 2 | - | - | - | 3 | 2 | 2 | - | - | - |
| CO2 | 3 | 2 | 3 | - | 2 | 2 | 1 | 2 | 2 | - | - | - | 3 | 2 | 2 | - | - | - |
| CO3 | 3 | 2 | 3 | - | 2 | 2 | 1 | 2 | 2 | - | - | - | 3 | 2 | 2 | - | - | - |
| CO4 | 3 | 2 | 3 | - | 2 | 1 | 1 | 2 | 2 | - | - | - | 3 | 2 | 2 | - | - | - |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

**Multidisciplinary -I : Conceptual Understanding of Physical Science – I** **Credits = 3(2+1+0)**
**Course Code: PPUATM1**

**Course Objectives**

- To let the students attain a comprehensive knowledge and coherent understanding of phenomena involved in physical sciences
- To let the students acquire practical and procedural knowledge required for carrying out skilled work/tasks related to physical sciences
- To build capacity to understand from what has been learned, translate concepts to real-life situations
- To build capacity to find solutions to specific problems

**Learning Outcomes:**

Upon successful completion of this course the students will be able to

- Understand physical phenomena and different processes in physical sciences
- Understand the basics of mechanical world around us
- Develop a thorough understanding of various aspects of daily life chemistry

**Unit-I: Chemistry in daily life:**

Organic molecules in daily life: Chemistry of carbohydrates, amino acids, lipids, fats, soaps, detergents: General structure, source, and applications. General introduction to pesticides (natural and synthetic), benefits and adverse effects, synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT); Quinones (Chloranil). Chemical constitution and physiological functions of vitamins A, vitamin C (Ascorbic acid).

**Unit-II: Measurement:**

Physical quantities and dimensions of physical quantities, dimensional analysis and its applications.
**Kinematics:** Motion in a straight line: Position-time graph, speed and velocity. Uniform and non-uniform motion, average speed and instantaneous velocity. Uniformly accelerated motion, velocity time and position-time graphs, and relations for uniformly accelerated motion (graphical treatment), Scalar and Vector products of Vectors.

**Unit-III:Laws of Motion:**

Intuitive concept of force. Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion. Law of conservation of linear momentum and its applications.

**Work, Energy and Power:**

Work done by a constant force and a variable force; kinetic energy, work-energy theorem, power. Notion of potential energy, potential energy of a spring, conservative forces; conservation of mechanical energy (kinetic and potential energies); non-conservative forces.

**Unit-IV:Gravitation:** Kepler's laws of planetary motion. The universal law of gravitation. Acceleration due to gravity and its variation with altitude and depth. Gravitational potential energy; gravitational potential. Escape velocity.

**References:**


1. *"Organic Chemistry",* **I. L. Finar,** Vol. I & II, 5th Edition (1975), Reprinted in1996, ELBS and Longman Ltd., New Delhi.
2. "Biochemistry" **L. Stryer**, 5th edition (2002) Freeman & Co New York.
3. "Principles of Biochemistry" **D. L. Nelson M.M. Cox, Lehninger**, 3rd edition (2002) McMillan North Publication.
4. R. Cremlyn: *Pesticides*, John Wiley
5. Mechanics, J.C. Upadhyaya, 2017, Ram Prasad Publications, Agra.
6. Classical Mechanics, 2014 J.C. Upadhyaya, Himalaya Publishing House.
7. NCERT, Physics Part-1


**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | PSO | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO1 | 3 | 2 | 3 | - | - | 1 | - | 1 | 2 | 3 | - | - | - | - | - |
| CO2 | 3 | 3 | 2 | - | 1 | 1 | - | 2 | 2 | 3 | - | - | - | - | 2 |
| CO3 | 2 | 2 | 3 | - | - | 1 | - | 1 | 2 | 3 | - | - | - | - | 1 |
| CO4 | 2 | 3 | 3 | - | 1 | 1 | - | 1 | 2 | 3 | - | - | - | - | 1 |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

**SEC-I: Experimental Techniques in Physics** **Credits = 3(2+0+1)**
**Course Code: PPUATS1**

**Course Objectives:**
The course aims to develop an understanding of

- Knowledge about basic apparatus use in physics.
- Develop conceptual competence in the learners and make them realize and appreciate the interface of Physics with other disciplines.
- Expose the learners to different processes used in Physics-related industrial and technological applications

**Learning Outcomes:**
Upon successful completion of this course, students will be able to address following points:

- Learn the various apparatus for measurements
- Students will able to learn how to measure various physical quantities by the instruments.
- Knowledge of digital multimeter.

**Unit I**: Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units, significant figures, Instruments accuracy, precision, sensitivity, resolution, range, least count of different instruments etc. Errors in measurements.

**Unit-II** Basic Apparatus: Length and Time Measurements - Vernier calipers, Screw gauge, spherometer, Stop watch, Stop clock and Digital timer; Measurement of Temperature, Relation among various units of temperature, Mercury thermometer, sensitive thermometer.

**Unit III:** Basic of resistance and its measurements, color coding for the resistance value, Series and parallel combination of resistances and its value determination.

**Unit IV:** Use of analog millimeter: basic concept of voltage, current, ac and dc voltage and current, principles of measurement of dc voltage and dc current, ac voltage and ac current, specifications of a multimeters and their significance, Power and its units.

**References**
1. B L Theraja : A text book in Electrical Technology
2. M G Say : Performance and design of AC machines
3. Venugopal : Digital Circuits and Systems

**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | PSO | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO1 | 3 | 3 | 3 | - | - | 3 | | 1 | 3 | 3 | 3 | - | - | - | 2 |
| CO2 | 3 | 2 | 3 | - | - | 3 | | 1 | 3 | 3 | 3 | - | - | - | 2 |
| CO3 | 3 | 2 | 3 | - | - | 3 | | 2 | 3 | 3 | 3 | - | - | - | 2 |

**SEC -1 Lab: Experimental Techniques in Physics Lab**

**Experiments**

1. Least count determination of various instruments.
2. Use of Vernier callipers
3. Use of Screw gauge
4. Digital timer
5. Measurement of Temperature
6. Measurement of dc voltage and dc current, ac voltage, ac current and resistance by multi-meter.
7. Measurement of resistance, capacitance and inductance.

**Semester-II**

**Major-II : Mathematical Physics-I** **Credits = 4(3+1+0)**
**Course Code: PPUATT2**

**Course Objectives**

- To let the students familiarize with ODEs and their applications in physical sciences.
- To learn the basics of PDEs and their solutions.
- To acquaint the students with vector differentiation and their physical significances.
- To introduce the concepts of vector integration and it's applications.

**Learning Outcomes:**

Upon successful completion of this the students will be able to

- Identify the occurrences and applications of ODEs and PDEs in physical sciences
- Understand the basics of vector differentiations, divergence and curl.
- Develop a thorough understanding of various aspects of vector integrations.
- Enhance the knowledge and applications of matrices

**Unit – I:** First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Examples of differential equations in physics.

**Unit – II:** Calculus of functions of more than one variable: Partial derivatives, exact and inexactdifferentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

**Unit - III**: 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. Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications(no rigorous proofs).

**Unit – IV:** Determinants, Matrices, Addition Subtraction and Multiplication of Matrices, Rank of a Matrix**,** Inverse and Trace of a Matrix, Transpose of a matrix, Unitary Matrices, Hermitian and skew-Hermitian Matrices, Symmetric and Skew-symmetric Matrices, Orthogonality, Eigen values, Eigen vectors and Diagonalistaion of Matrices.

**Reference Books:**


1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn.,Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and BartlettLearning
7. Mathematical Physics, Goswami, 1st edition, Cengage Learning
8. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F.Riley&M.P.Hobson, 2011, Cambridge Univ. Press.
11. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.


**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | PSO | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO1 | 3 | 3 | 3 | - | - | 2 | - | 2 | 2 | 3 | 1 | 1 | - | - | 1 |
| CO2 | 3 | 3 | 3 | - | - | 2 | - | 2 | 2 | 3 | 1 | 1 | - | - | 1 |
| CO3 | 3 | 3 | 3 | - | - | 2 | - | 2 | 2 | 3 | 1 | 1 | - | - | 1 |
| CO4 | 3 | 3 | 3 | - | - | 2 | - | 2 | 2 | 3 | 1 | 1 | - | - | 1 |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

**Minor-II : Mechanics** **Credits = 3(3+0+0)**
**Course Code: PPUBTG1**

**Course Objectives**

- To empower the students to acquire theoretical concept and practical knowledge regarding motions, forces producing motion, and dynamics of very high-speed particles.
- To let the students acquire the basic requirements for their higher studies.
- To provide a theoretical basis for doing experiments in related areas.

**Learning Outcomes**

Upon successful completion of this course

- Students will be able to understand basic concepts about Newtonian mechanics.
- Students will have an understanding of the fundamentals of special theory of relativity, which is very fundamental for further higher studies in physics.

**Unit I**

**Fundamentals of Dynamics:** Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket.Motion of a projectile in uniform gravitational field Dynamics of a system of particles.Centre of Mass. Principle of conservation of momentum.

**Work and Energy:** Work and Kinetic Energy Theorem. Conservative and non-conservative forces.Potential Energy.Energy diagram. Stable and unstable equilibrium.Elastic potential energy. Force as gradient of potential energy. Work & Potential energy.Work done by non-conservative forces.Law of conservation of Energy

**Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

**Unit II**

**Rotational Dynamics:** Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

**Fluid Motion:** Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube**.**

**UNIT III**

**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy.Inertial and gravitational mass.Potential and field due to spherical shell and solid sphere.Motion of a particle under a central force field.Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws.Satellite in circular orbit and applications.

**Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force. Coriolis force and its applications

**Unit IV**

**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity.Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, Variation of mass with velocity. Mass-energy Equivalence (only problems)

**Reference Books:**

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Additional References:

8. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
9. University Physics. F.W Sears, M.WZemansky, H.D Young 13/e, 1986, Addison Wesley
10. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
11. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | PSO | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO1 | 3 | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - |
| CO2 | 3 | 1 | - | - | - | 2 | - | 1 | - | - | 3 | 2 | - | - | - |
| CO3 | - | - | - | - | - | - | - | 2 | 1 | - | - | - | 1 | - | - |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

**Laboratory course (Any 5 experiments)**

**Minor-II Lab:** Mechanics Lab
**Course Code:** PPUALG2

**Credits = 1 (0+0+1)**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the Motion of Spring and calculate (a) Spring constant, (b) g
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
5. To determine the elastic Constants of a wire by Searle's method.
6. To determine the value of g using Kater's Pendulum.
7. To determine coefficient of viscosity of Glycerine by Stoke's method

**SEC-II: Renewable Energy Resources** **Credits = 3(2+0+1)**
**Course Code: PPUBTS1**

**Course Outcomes:**

- To understand the Energy policies and to know some of the renewable energy sources such as solar energy, off-shore wind energy, tidal energy, biogas energy and hydroelectricity.
- Illustrate Photovoltaic conversion mechanism.
- Appraise wind energy conversion and ocean energy
- Conversion of vibration into voltage using piezoelectric materials,
- Conversion of thermal energy into voltage using thermoelectric modules.
- The students are expected to learn not only the theories of the renewable sources of energy, but also to have hands-on experiences on them wherever possible.

**Unit – I: Renewable Energy Sources:** Solar, wind, small hydro, biomass, geothermal and ocean energy, energy flow in ecosystem, Solar Energy Resources, Solar radiation: Spectrum of EM radiation, sun structure and characteristics.

**Unit – II: Photovoltaic Materials and Devices:**
Photovolatic phenomena, Bulk and thin solar cell materials, p-n junction: homo and hetero junctions; Electrical and optical properties of photovoltaic / semiconductor materials, power conversion efficiency, factors affecting the PCE, solar cell design, various parameters of solar cell.

**Unit – III: Solar Thermal Conversion:**
Solar thermal collectors- flat plate collectors, concentrating collectors; solar heating of buildings; solar still; solar water heaters; solar driers; conversion of heat energy in to mechanical energy, solar thermal power generation systems.

**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. University Press, in association with The Open University. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. on- conventional energy resources, B H Khan, Tata McGraw-Hill Publication 2006, ISBN 0-07-060654-42
8. Renewable Energy Resources Paperback John Twidell and Tony Weir ,Routledge, Taylor& Francis, 2015
9. Solar Photovoltaic's: Fundamentals, Technologies And Applications, CHETAN SINGH SOLANKI, PHI Learning Pvt. Ltd., Third Edition 2015
10. Non – Conventional Energy Resources: G. D. Rai, KhannaPublishers,2008.
11. Solar Energy Fundamentals, Technology, and Systems, Klaus JägerOlindoIsabella Arno H.M. SmetsRenéA.C.M.M. van SwaaijMiroZeman Delft University of Technology, 2014

**Course Outcomes and their mapping with Programme Outcomes:**

| CO | PO | | | | | | | | | PSO | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| CO1 | 1 | 1 | - | - | - | - | - | 3 | 2 | 1 | 2 | - | 2 | - | 3 |
| CO2 | 1 | 1 | - | - | - | - | - | 3 | 2 | 1 | 2 | - | 2 | - | 3 |
| CO3 | 1 | 1 | - | - | - | - | - | 3 | 2 | 1 | 2 | - | 2 | - | 2 |
| CO4 | 1 | 1 | - | - | - | - | - | 3 | 2 | 1 | 2 | - | 2 | - | 1 |
| CO5 | 1 | 1 | - | - | - | - | - | 3 | 2 | 1 | 2 | - | 2 | - | 1 |
| CO6 | 1 | 2 | - | - | - | - | - | 3 | 2 | 1 | 2 | - | 2 | - | 1 |

Weightage: 1-Sightly; 2-Moderately; 3-Strongly

**SEC-II Lab: Renewable Energy Resources Lab**

1. Study of characteristic properties of the Solar cell
2. To design the prototype of different renewable energy resources
3. To study the photoelectric effect