



**Deccan Education Society's**  
**Fergusson College (Autonomous)**  
**Pune**

Learning Outcomes-Based Curriculum  
for 3/4 years B.Sc. /B.Sc. (Honours) Programme  
as per guidelines of  
**NEP-2020**

for  
**F. Y. B. Sc. (Physics)**  
With effect from Academic Year  
**2023-2024**

| Program Outcomes (POs) for B.Sc. |                                                                                                                                                                                                                                                                                                                  |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PO1</b>                       | <b>Disciplinary Knowledge:</b><br>Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.                                                    |
| <b>PO2</b>                       | <b>Critical Thinking and Problem solving:</b><br>Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.                                                                                                                      |
| <b>PO3</b>                       | <b>Social competence:</b><br>Display the understanding, behavioural skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.                                                                                                               |
| <b>PO4</b>                       | <b>Research-related skills and Scientific temper:</b><br>Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.                  |
| <b>PO5</b>                       | <b>Trans-disciplinary knowledge:</b><br>Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.                                                                                                            |
| <b>PO6</b>                       | <b>Personal and professional competence:</b><br>Performing dependently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics. |
| <b>PO7</b>                       | <b>Effective Citizenship and Ethics:</b><br>Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.                                                       |
| <b>PO8</b>                       | <b>Environment and Sustainability:</b><br>Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.                                                                                                        |
| <b>PO9</b>                       | <b>Self-directed and Life-long learning:</b><br>Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.                                                                                                                                      |

| PSO No.     | <b>Program Specific Outcomes(PSOs)</b><br><b>Upon completion of this programme the student will be able to</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>PSO1</b> | <b>Academic competence:</b><br>(i) <b>Develop</b> and <b>demonstrate</b> an understanding of the concepts related to heat, thermodynamic laws, electric field due to static charge distribution, Newtonian mechanics, wave properties of light, Newtonian mechanics, inertial and non-inertial frames of reference, radioactivity, elementary particles, quark model, physical systems from nano-scale to macroscopic scale, magnetostatics, Maxwell's equations and plane wave generation and quantum mechanical systems. Associate the fundamental concepts in physics and interpret information.<br>(ii) <b>Demonstrate independent</b> thinking and scientific temper. <b>Categorize</b> , calculate and <b>solve</b> problems using concepts of physics.                                                                                             |
| <b>PSO2</b> | <b>Personal and Professional Competence:</b><br>(i) Carry out laboratory-oriented numerical calculations and be capable in data visualization and interpretation. Perform, demonstrate and analyse experimental work with suitable techniques in physics to study the phenomena related to light, scientific instruments, material process, electrical and electronics applications.<br>(ii) Carry out the calculations in classical mechanics, quantum mechanics, mathematical methods and solids with advance techniques using computations and C-programming.<br>(iii) Analyse experimental results and interpret graphs.<br>(iv) Formulation of ideas, scientific writing and authentic reporting, effective presentation and communication skills through group discussion.                                                                          |
| <b>PSO3</b> | <b>Research Competence:</b><br>(i) Apply Physics concepts of thermodynamics, mechanics, wave optics, electronics and nuclear physics in day to day life. Integrate core concepts studied in materials science, electronics, and optics during experimentations and projects.<br>(ii) Integrate and explore techniques of synthesis, characterization of different materials and techniques of astronomical data analysis. Cultivate concepts of measurement techniques in physics and relate physics concepts in day to day life.<br>(iii) Integrate core physics subjects during experimentation and projects.<br>(iv) Apply numerical methods to solve various complex physical problems.<br>(v) Identify and interpret research literature, formulate ideas, write reports and review articles related to all subjects in physics.                     |
| <b>PSO4</b> | <b>Entrepreneurial and Social competence:</b><br>Enhance and empower the students with their self-reliance capabilities through the understanding of advance techniques, use of programming language, material processing, mathematical and classical concepts, advancement of electronics ideas with reference to advance techniques with their industrial applications.<br>(i) Employ experimental skills in industrial applications.<br>(ii) Develop scientific temperament and social awareness through internships and science popularization. Awareness of ethical issues: emphasis on academic and research ethics.<br>(iii) Outline the use of renewable sources for sustainable development of human beings.<br>(iv) Execute social competence including effective use of computer languages to meet global competencies in technological world. |

Fergusson College (Autonomous), Pune  
Proposed First Year Curriculum as per NEP 2020

**Department of Physics**  
**Structure for Major / Minor**

| Semester  | Paper Code             | Paper Title                                                 | Type              | Credits  |
|-----------|------------------------|-------------------------------------------------------------|-------------------|----------|
| <b>I</b>  | <b>PHY-100 (Major)</b> | General Physics Laboratory-I                                | <b>Practical</b>  | <b>2</b> |
|           | <b>PHY-101 (Major)</b> | Mechanics                                                   | <b>Theory</b>     | <b>4</b> |
|           | <b>PHY-120 (GE/OE)</b> | Physics in Daily Life                                       | <b>Theory</b>     | <b>2</b> |
|           | <b>PHY-121 (GE/OE)</b> | Photography I                                               | <b>Theory</b>     | <b>2</b> |
|           | <b>PHY-130 (VSC)</b>   | Renewable and Non-Conventional Energy and Energy Harvesting | <b>Voc. Skill</b> | <b>2</b> |
|           | <b>PHY-140 (SEC)</b>   | Basic Instrumentation Skills                                | <b>Skill</b>      | <b>2</b> |
|           | <b>IKS-101 (IKS)</b>   | Indian Knowledge Systems                                    | <b>IKS</b>        | <b>2</b> |
| <b>II</b> | <b>PHY-150 (Major)</b> | General Physics Laboratory-II                               | <b>Practical</b>  | <b>2</b> |
|           | <b>PHY-151 (Major)</b> | Thermal Physics                                             | <b>Theory</b>     | <b>4</b> |
|           | <b>PHY-161 (Minor)</b> | Mechanics and Properties of Matter                          | <b>Theory</b>     | <b>2</b> |
|           | <b>PHY-170 (GE/OE)</b> | Observational Astronomy                                     | <b>Theory</b>     | <b>2</b> |
|           | <b>PHY-171 (GE/OE)</b> | Photography II                                              | <b>Theory</b>     | <b>2</b> |
|           | <b>PHY-180 (VSC)</b>   | Solar PV System: Installation, Repairing and Maintenance    | <b>Voc. Skill</b> | <b>2</b> |
|           | <b>PHY-190 (SEC)</b>   | Electrical circuit and network skills                       | <b>Skill</b>      | <b>2</b> |

**Teaching and Evaluation (Only for FORMAL education courses)**

| Course Credits | No. of Hours per Semester<br>Theory/Practical | No. of Hours per Week<br>Theory/Practical | Maximum Marks | CE<br>40 % | ESE<br>60% |
|----------------|-----------------------------------------------|-------------------------------------------|---------------|------------|------------|
| <b>1</b>       | <b>15 / 30</b>                                | <b>1 / 2</b>                              | <b>25</b>     | <b>10</b>  | <b>15</b>  |
| <b>2</b>       | <b>30 / 60</b>                                | <b>2 / 4</b>                              | <b>50</b>     | <b>20</b>  | <b>30</b>  |
| <b>3</b>       | <b>45 / 90</b>                                | <b>3 / 6</b>                              | <b>75</b>     | <b>30</b>  | <b>45</b>  |
| <b>4</b>       | <b>60 / 120</b>                               | <b>4 / 8</b>                              | <b>100</b>    | <b>40</b>  | <b>60</b>  |

**Eligibility: As per the rules and regulations of Savitribai Phule Pune University (SPPU)**

| F.Y.B.Sc. Semester I                                                                              |                                                                                                                                                                     |                         |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| PHY-100                                                                                           | General Physics Laboratory-I<br>(Major-Practical)                                                                                                                   | Credits: 2<br>Hours: 60 |
| <b>Course Outcomes (COs)</b><br><b>On completion of the course, the students will be able to:</b> |                                                                                                                                                                     |                         |
| CO1                                                                                               | Identify various components, devices, instruments and tools for specific applications. Recall the theory associated with each experiment.                           |                         |
| CO2                                                                                               | Illustrate skill of proper use of tools and test and measuring instruments.                                                                                         |                         |
| CO3                                                                                               | Calculate the values of physical quantities using suitable instruments.                                                                                             |                         |
| CO4                                                                                               | Explain the results by integrating the theory with experimental observations.                                                                                       |                         |
| CO5                                                                                               | Evaluate various physical quantities and measure the errors therein.                                                                                                |                         |
| CO6                                                                                               | Perform the experiments using proper procedures and specify the outcomes. Integrate the measuring instrumentation system with the experimental circuit as required. |                         |

Any 10 experiments: 8 compulsory + 1 Activity (Equivalent to Two Practical's)

| Expt. No. | Title of the Experiment                                             |
|-----------|---------------------------------------------------------------------|
| 1.        | Measurements using Vernier Caliper and Spectrometer                 |
| 2.        | Measurements using Micrometer Screw Gauge and Travelling Microscope |
| 3.        | Use of digital multimeter (DMM) and Cathode Ray Oscilloscope (CRO)  |
| 4.        | Moment of Inertia of a disc by torsional oscillations               |
| 5.        | Moment of inertia of a flywheel                                     |
| 6.        | 'Y' by bending                                                      |
| 7.        | Y and $\eta$ by Searles method                                      |
| 8.        | Viscosity by flow through a capillary tube by Poiseuille's method   |
| 9.        | Demo experiment I                                                   |
| 10.       | Demo experiment II                                                  |

| F.Y.B.Sc. Semester I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                              |                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------------------------|
| PHY-101                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Mechanics<br>(Major- Theory) | Credits: 4<br>Hours: 60 |
| Course Outcomes (COs)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                              |                         |
| On completion of the course, the students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                              |                         |
| <ul style="list-style-type: none"> <li>Understand laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean invariance. He / she will learn the concept of conservation of energy, momentum, angular momentum and apply them to basic problems.</li> <li>Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping.</li> <li>Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.</li> <li>Understand the phenomena of collisions and ideas about center of mass and laboratory frames and their correlation.</li> <li>Understand the principles of elasticity through the study of Young Modulus and modulus of rigidity.</li> <li>Understand simple principles of fluid flow and the equations governing fluid dynamics.</li> <li>Apply Kepler's law to describe the motion of planets and satellites in circular orbit, through the study of law of Gravitation.</li> <li>Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.</li> <li>Describe how fictitious forces arise in a non-inertial frame, e.g., why a person sitting in a merry-go-round experiences an outward pull.</li> <li>Describe special relativistic effects and their effects on the mass and energy of a moving object.</li> <li>Appreciate the nuances of Special Theory of Relativity (STR)</li> <li>In the laboratory course, the student shall perform experiments related to mechanics (compound pendulum), rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity) and fluid dynamics (verification of Stokes law, Searle method) etc.</li> </ul> |                              |                         |

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | No. of hours |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Fundamentals of Dynamics:</b> Reference frames. Inertial frames; Review of Newton's Laws of Motion. 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. Impulse<br><b>Work and Energy:</b> 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. | 10           |
| II   | <b>Collisions:</b> Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.<br><b>Rotational Dynamics:</b> Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum.                                                                                                                                                                                                                                                                                                                                                                                                 | 13           |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |    |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|     | 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                                                                                                                                                                                                                                                                                                                                |    |
| III | <b>Gravitation and Central Force Motion:</b> 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. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS)                            | 09 |
| IV  | <b>Non-Inertial Systems:</b> Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. Galilean transformations; Galilean invariance.                                                                                                                                                                                              | 07 |
| V   | <b>Special Theory of Relativity:</b> 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, frequency, and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass- energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum                              | 10 |
| VI  | <b>Elasticity:</b> Basic concepts of elasticity, Hook's law, three types of elastic moduli, Poisson's ratio, Relationship between elastic constant, bending of beam, bending moment, cantilever load at free end, loaded uniformly, due to its own weight. Determination of Y by bending of a uniformly loaded beam. Determination of elastic constant using Searle's method, Twisting torque on a Cylinder or Wire.<br><b>Fluid Motion:</b> Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube. | 11 |

## References

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.
8. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
9. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
10. Physics for scientists and Engineers with Modern Phys., J. W. Jewett, R. A. Seray, 2010, Cengage Learning
11. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
12. Concepts of Physics, Vol I: H. C. Varma, Bharati Bhavan Publishers

| F.Y.B.Sc. Semester I                                       |                                                                                                                                   |                         |
|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| PHY-120                                                    | Physics in Daily Life<br>(GE/OE-Theory)                                                                                           | Credits: 2<br>Hours: 30 |
| Course Outcomes (COs)                                      |                                                                                                                                   |                         |
| On completion of the course, the students will be able to: |                                                                                                                                   |                         |
| CO1                                                        | Recall, understand, use and apply the scientific knowledge set out in the syllabus.                                               |                         |
| CO2                                                        | Learn, recognize and apply basic physical principles related to climate, human body and Technology:                               |                         |
| CO3                                                        | Learn about earth's atmosphere and related phenomena.                                                                             |                         |
| CO4                                                        | Solve simple physics related problems. Apply the simple law of nature to different fields of science, engineering and technology. |                         |
| CO5                                                        | Evaluate relevant scientific information and make informed judgements about it                                                    |                         |

#### Learning outcomes

1. Every student will be able to study physics on a deeper level and to uses basic physics concepts to navigate everyday life.
2. Every student will be able to build essential scientific knowledge and skills for life-long learning.

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                                                                                       | No. of hours |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Physics in Earth's Atmosphere</b><br>Sun, Earth's atmosphere as an ideal gas; Pressure, temperature and density, Pascal's Law and Archimedes' Principle, Corioli's acceleration and weather systems, Rayleigh scattering, the red sunset, Reflection, refraction and dispersion of light, Total internal reflection, Rainbow.                                                                                               | 10           |
| II   | <b>Physics in Human Body and Sports</b><br>The eyes as an optical instrument, Vision defects, Rayleigh criterion and resolving power, Sound waves and hearing, Sound intensity, Decibel scale, Energy budget and temperature control, Physics in Sports: The sweet spot, Dynamics of rotating objects, Running, Jumping and pole vaulting, Motion of a spinning ball, Continuity and Bernoulli equations, Turbulence and drag. | 10           |
| III  | <b>Physics in Technology</b><br>Microwave ovens, Lorentz force, Global Positioning System, CCDs, Lasers, Displays, Optical recording, CD, DVD Player, Tape records, Electric motors, Hybrid car, Telescope, Microscope, Projector etc.                                                                                                                                                                                         | 10           |

#### References:

1. H. C. Verma, Concepts of Physics (Bharati Bhawan publishers and distributers, New Delhi, India) 2011.
2. Sears and Zeemansky, University Physics (Addison Wesley, Boston, USA) 2007.
3. B. Lal and Subramaniam, Electricity and Magnetism (Ratan Prakashan Mandir, Agra, India) 2013.



4. Physics in Daily Life, Jo Hermans, EDP Sciences
5. E. Hecht, Optics (Addison Wesley, Boston, USA) 2001.
6. M. Nelkon and P. Parker, Advanced Level Physics (Heinemann International, London, U.K.) 2012.
7. How Things Work, The Physics of Everyday Life, Louis A. Bloomfield, Wiley, 2013.

| F.Y.B.Sc. Semester I                                       |                                                                                |                         |
|------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------|
| PHY-121                                                    | Photography I<br>(GE/OE-Theory)                                                | Credits: 2<br>Hours: 30 |
| Course Outcomes (COs)                                      |                                                                                |                         |
| On completion of the course, the students will be able to: |                                                                                |                         |
| CO1                                                        | Identify the photographic process.                                             |                         |
| CO2                                                        | Explain the fundamentals of the photographic process.                          |                         |
| CO3                                                        | Use the photographic equipment for a given situation.                          |                         |
| CO4                                                        | Relate the role of light in a photographic process.                            |                         |
| CO5                                                        | Justify the use of photographic equipment for a given photographic assignment. |                         |

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | No. of hours |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <ol style="list-style-type: none"> <li>1. What is Photography? <ul style="list-style-type: none"> <li>- Meaning of Photography.</li> <li>- Photography as a Medium.</li> </ul> </li> <li>2. Formation of a Digital Image <ul style="list-style-type: none"> <li>- Digital image (Pixel) - (<i>Colour contents of a digital image</i>)</li> <li>- Technical Qualities of a Photograph (<i>Brightness, Sharpness, Colour, Contrast, Size, Motion Blur</i>)</li> </ul> </li> <li>3. History of Photography in Short <ul style="list-style-type: none"> <li>- Pinhole camera (<i>Basic construction and Diagrams for reference</i>)</li> <li>- Box Camera (<i>Basic construction and Diagrams for reference</i>)</li> <li>- Parallax error</li> <li>- Need for the Invention of a SLR</li> <li>- How SLRs removed the parallax error.</li> </ul> </li> <li>4. DSLR (Handling techniques) <ul style="list-style-type: none"> <li>- DSLR (<i>Definition, diagram and functioning of the various parts of DSLR</i>)</li> <li>- Advantages and Disadvantages of DSLR.</li> <li>- What is an Exposure</li> <li>- Equivalent exposures</li> </ul> </li> <li>5. Aesthetics of images <ul style="list-style-type: none"> <li>- Aesthetic qualities of an image (<i>Framing and Composition</i>)</li> <li>- Visual design elements (<i>Subject Attributes</i>)</li> <li>- Composition rules (<i>Rule of thirds, Golden points, Balance, Shapes, Leading Lines etc.</i>)</li> </ul> </li> <li>6. Formats and Lenses <ul style="list-style-type: none"> <li>- Camera Formats (<i>Small, Medium, Large</i>)</li> <li>- What is Perspective?</li> <li>- Lens Defects</li> </ul> </li> </ol> | 15           |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|           | <ul style="list-style-type: none"> <li>- Minimizing the distortion</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |
|           | 7. On camera Flash (Introduction) <ul style="list-style-type: none"> <li>- What is a Flash?</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |
| <b>II</b> | 1. Camera journey <ul style="list-style-type: none"> <li>- Camera History</li> <li>- Working of Camera</li> </ul> 2. SLR/DSLR <ul style="list-style-type: none"> <li>- Camera Handling</li> </ul> 3. Exposure Controls <ul style="list-style-type: none"> <li>- Exposure Triangle</li> </ul> 4. Aperture <ul style="list-style-type: none"> <li>- Working of Aperture</li> <li>- Depth of Field</li> <li>- Practical</li> </ul> 5. Shutter Speed <ul style="list-style-type: none"> <li>- Working of Aperture</li> <li>- Effect of Shutter Speed</li> <li>- Practical</li> </ul> 6. Sensitivity /ISO <ul style="list-style-type: none"> <li>- Working of Aperture</li> <li>- Effect of Sensitivity</li> <li>- Practical</li> </ul> 7. Lenses <ul style="list-style-type: none"> <li>- Human Eye</li> <li>- Photographic Lenses</li> <li>- Perspective</li> <li>- Normal/Wide/Tele/Zoom</li> </ul> 8. Sources of Light <ul style="list-style-type: none"> <li>- Natural / Artificial</li> <li>- Hard and Soft</li> </ul> 9. Using Reflected light <ul style="list-style-type: none"> <li>- Use of Reflector/ Diffuser in outdoor Photography</li> </ul> 10. Camera Flash and application <ul style="list-style-type: none"> <li>- What is on Camera Flash vs LED Flash</li> <li>- TTL vs Manual</li> </ul> 11. Using Flash in Outdoor/ indoor situations <ul style="list-style-type: none"> <li>- Direct vs Indirect flash</li> <li>- Flash Modifiers</li> </ul> | <b>15</b> |

#### References:

1. Langford's Advanced Photography - the Guide for aspiring Photographers
2. The camera by Ansel Adams
3. Basic Photography, M. J. Langford, Focal Press
4. Focal encyclopaedia of Photography, Focal Press
5. A large number of photography related sites are available on the internet.  
<https://www.youtube.com/@PIXELVILLAGE>  
<https://www.youtube.com/@theartofphotography>

| F.Y.B.Sc. Semester I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                   |                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------|
| PHY-130                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Renewable and Non-Conventional Energy and Energy Harvesting (VSC) | Credits: 2<br>Hours: 30 |
| Course Outcomes (COs)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                   |                         |
| On completion of the course, the students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                   |                         |
| <ul style="list-style-type: none"> <li>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. Some of the renewable sources of energy which should be studied here are: (i) off-shore wind energy, (ii) tidal energy, (iii) solar energy, (iv) biogas energy and (v) hydroelectricity. All these energy sources should be studied in detail.</li> <li>Learn about piezoelectricity, carbon- captured technologies like cells, batteries.</li> <li>The students should observe practical demonstrations of (i) training modules of solar energy, wind energy etc., (ii) Conversion of vibration into voltage using piezoelectric materials, (iv) conversion of thermal energy into voltage using thermoelectric modules.</li> </ul> |                                                                   |                         |

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | No. of hours |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Fossil fuels and Alternate Sources of energy:</b> Fossil fuels and nuclear energy, their limitation, 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.<br><b>Solar energy:</b> Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. | 9            |
| II   | <b>Wind Energy harvesting:</b> Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.<br><b>Ocean Energy:</b> Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.<br><b>Geothermal Energy:</b> Geothermal Resources, Geothermal Technologies.<br><b>Hydro Energy:</b> Hydropower resources, hydropower technologies, environmental impact of hydro power sources.                                                                                                                                                                                            | 12           |
| III  | <b>Piezoelectric Energy harvesting:</b> Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric Energy harvesting applications, Human power.<br><b>Electromagnetic Energy Harvesting:</b> Linear generators, physics mathematical models, recent applications                                                                                                                                                                                                                                                                                                                                                                                                                              | 9            |

|  |                                                                                                                                                                                                                                                                |  |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | Carbon captured technologies, cell, batteries, power consumption<br>Environmental issues and Renewable sources of energy, sustainability.                                                                                                                      |  |
|  | Demonstrations and Experiments<br>1. Demonstration of Training modules on Solar energy, wind energy, etc.<br>2. Conversion of vibration to voltage using piezoelectric materials<br>3. Conversion of thermal energy into voltage using thermoelectric modules. |  |

## References

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 Sukhatme Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
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](http://en.wikipedia.org/wiki/Renewable_energy)

| F.Y.B.Sc. Semester I                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                       |                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------------|
| PHY-140                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Basic Instrumentation Skills<br>(SEC) | Credits: 2<br>Hours: 30 |
| Course Outcomes (COs)                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                       |                         |
| On completion of the course, the students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                     |                                       |                         |
| <ul style="list-style-type: none"> <li>• After the successful completion of the course the student is expected to have the necessary working knowledge on accuracy, precision, resolution, range and errors/uncertainty in measurements.</li> <li>• He/she will acquire hands on skills in the usage of oscilloscopes, multimeters, oscillators and</li> <li>• He/she also would have gained knowledge on the working and operations of generators, digital meters.</li> </ul> |                                       |                         |

*This course is to get exposure with various aspects of instruments and their usage through hands-on mode.*

## Skills to be learned

- 1] Develop skills to use basic electrical instruments like multimeter, cathode ray oscilloscope.
- 2] Acquire efficiency in making signal generators and analysis of obtained signals.
- 3] Learn to understand and use various types of digital instruments.
- 4] Develop knowledge of making measurements with instruments.

| Unit | Contents                                                                                                                                                                                                                                                                                           | No. of hours |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Basic of Measurement:</b><br>Instruments accuracy, precision, sensitivity, resolution range etc.<br>Errors in measurements Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance.<br>Specifications of a multimeter and their significance. | 6            |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>II</b>  | <b>Cathode Ray Oscilloscope:</b><br>Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working. | <b>12</b> |
| <b>III</b> | <b>Signal Generators and Analysis Instruments:</b><br>Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.                                                                                                                                                                                                                                                                                                                                                       | <b>5</b>  |
| <b>IV</b>  | <b>Digital Instruments:</b><br>Principle and working of digital meters. Comparison of Analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter. Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/frequency counter, time- base stability, accuracy and resolution.                                                                                                                                                                                 | <b>7</b>  |

### References

1. Basic Electronics solid state - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
5. Electronic Devices and circuits, S. Salivahanan & N. S. Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill

| <b>F.Y.B.Sc. Semester I</b>                                       |                                                                                                          |                                 |
|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>IKS-101</b>                                                    | <b>Indian Knowledge Systems (IKS)</b>                                                                    | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b>                                      |                                                                                                          |                                 |
| <b>On completion of the course, the students will be able to:</b> |                                                                                                          |                                 |
| CO1                                                               | Recall the basic concepts of Indian Knowledge System (IKS)                                               |                                 |
| CO2                                                               | Articulate the foundation of IKS and explain historical and cultural context of Indian knowledge systems |                                 |
| CO3                                                               | Use the knowledge of IKS to understand discipline specific case studies.                                 |                                 |
| CO4                                                               | Develop critical thinking and problem-solving skills in the context of Indian knowledge systems.         |                                 |

| <b>Unit</b> | <b>Contents</b>                                                                                                                     | <b>No. of hours</b> |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>I</b>    | <b>Overview of IKS</b><br>• Survey of IKS Domains: A broad overview of disciplines included in the IKS and historical developments. | <b>15</b>           |

|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | <ul style="list-style-type: none"> <li>• Sources of IKS knowledge, classification of IKS texts, a survey of available primary texts, translated primary texts, and secondary resource materials. Differences between a sutra, bhashya, karika, and vartika texts. Fourteen/eighteen vidyasthanas, tantrayukti</li> <li>• Vocabulary of IKS: Introduction to Panchamahabhutas, concept of a sutra, introduction to the concepts of non-translatables (Ex. dharma, punya, aatma, karma, yagna, shakti, varna, jaati, moksha, loka, daana, itihaasa, puraana etc.) and importance of using the proper terminology. Terms such as praja, janata, loktantra, prajatantra, ganatantra, swariva, surajya, rashtra, desh.</li> <li>• Philosophical foundations of IKS: Introduction to Samkhya, vaisheshika and Nyaya</li> <li>• Methods in IKS: Introduction to the concept of building and testing hypothesis using the methods of tantrayukti. Introduction to pramanas and their validity, upapatti; Standards of argumentation in the vada traditions (introduction to concepts of vaada, samvaada, vivaada, jalpa, vitanda). Concept of poorvapaksha, uttarapaksha.</li> </ul> |           |
| <b>II</b>  | <b>Case Studies (Few of these may be selected as appropriate)</b> <ul style="list-style-type: none"> <li>• Mathematics of Madhava, Nilakantha Somayaji</li> <li>• Astronomical models of Aryabhata</li> <li>• Wootz steel, Aranumula Mirrors, and lost wax process for bronze castings</li> <li>• Foundational aspects of Ayurveda</li> <li>• Foundational aspects of Ashtanga yoga</li> <li>• Foundational aspects of Sangeeta and Natya Shastra</li> <li>• Discipline Specific Case Study</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>10</b> |
| <b>III</b> | <b>India and the World:</b><br>Influence of IKS on the world, knowledge exchanges with other classical civilizations. and inter-civilizational exchanges                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>5</b>  |

### References:

1. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).
2. Indian Knowledge Systems: Vol I and II, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).
3. The Beautiful Tree: Indigenous India Education in the Eighteenth Century. Dharampal, Biblia Impex, New Delhi, 1983. Reprinted by Keerthi Publishing House Pvt Ltd. Combatore, 1995.
4. Indian Science and Technology in the Eighteenth Century, Dharampal. Delhi: Impex India, 1971. The British Journal for the History of Science.
5. The Wonder That Was India, Arthur Llewellyn Basham, 1954, Sidgwick & Jackson.
6. The India they saw series (foreigner visitors on India in history from 5CE to 17th century), Ed. Meenakshi Jain and Sandhya Jain, Prabhat Prakashan

| F.Y.B.Sc. Semester II                                      |                                                                                                                                                                     |                         |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| PHY-150                                                    | General Physics Laboratory-II<br>(Major- Practical)                                                                                                                 | Credits: 2<br>Hours: 60 |
| Course Outcomes (COs)                                      |                                                                                                                                                                     |                         |
| On completion of the course, the students will be able to: |                                                                                                                                                                     |                         |
| CO1                                                        | Identify various components, devices, instruments and tools for specific applications. Recall the theory associated with each experiment.                           |                         |
| CO2                                                        | Illustrate skill of proper use of tools and test and measuring instruments.                                                                                         |                         |
| CO3                                                        | Calculate the values of physical quantities using suitable instruments.                                                                                             |                         |
| CO4                                                        | Explain the results by integrating the theory with experimental observations.                                                                                       |                         |
| CO5                                                        | Evaluate various physical quantities and measure the errors therein.                                                                                                |                         |
| CO6                                                        | Perform the experiments using proper procedures and specify the outcomes. Integrate the measuring instrumentation system with the experimental circuit as required. |                         |

Any 12 experiments: 10 compulsory + 1 Activity (Equivalent to Two Practical)

| Expt. No. | Title of the Experiment                                |
|-----------|--------------------------------------------------------|
| 1.        | Determination of frequency of A. C.                    |
| 2.        | Thermal conductivity by Lee's method                   |
| 3.        | Calibration of Thermocouple                            |
| 4.        | Study and calibration of the spectrometer              |
| 5.        | Surface Tension by Jaegers method                      |
| 6.        | Plotting of graph and analysis using linear regression |
| 7.        | Thermal conductivity of a rubber tube                  |
| 8.        | Temperature coefficient of resistance                  |
| 9 & 10    | Study visit                                            |

| F.Y.B.Sc. Semester II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   |                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------|
| PHY-151                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Thermal Physics<br>(Major-Theory) | Credits: 4<br>Hours: 60 |
| Course Outcomes (COs)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                   |                         |
| On completion of the course, the students will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                   |                         |
| <ul style="list-style-type: none"> <li>Learn the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations. They are also expected to learn Maxwell's thermodynamic relations.</li> <li>Know the fundamentals of the kinetic theory of gases, Maxwell-Boltzmann distribution law, equipartition of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.</li> <li>Have a knowledge of the real gas equations, Van der Waal equation of state, the Joule-Thompson effect.</li> </ul> |                                   |                         |

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | No. of hours |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Introduction to Thermodynamics</b><br>Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between $C_p$ and $C_v$ , Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. | 8            |
| II   | <b>Second Law of Thermodynamics:</b> Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2 <sup>nd</sup> Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.                                             | 10           |
| III  | <b>Entropy:</b> Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Temperature-Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero                                                                                                                                   | 7            |
| IV   | <b>Thermodynamic Potentials:</b> Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications.<br>Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations.                                                                                                                 | 7            |



|             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>V</b>    | <b>Maxwell's Thermodynamic Relations:</b> Derivations and applications of Maxwell's Relations, Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Values of $C_p$ - $C_v$ , (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.                                                                                                                                                                                                                                                                               | <b>7</b>  |
| <b>VI</b>   | <b>Kinetic Theory of Gases Distribution of Velocities:</b> Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.                                                                                                                                                                                                                                                                                 | <b>7</b>  |
| <b>VII</b>  | <b>Molecular Collisions:</b> Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.                                                                                                                                                                                                                                                                                                                                                                                       | <b>4</b>  |
| <b>VIII</b> | <b>Real Gases:</b> Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on $\text{CO}_2$ Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling. | <b>10</b> |

**(Include related problems for each topic)**

### References

1. Heat and Thermodynamics and Statistical Physics, BrijLal, Dr. N. Subrahmanyam, P. S. Hemne, S. Chand Publications
2. Concepts of Physics, Vol I: H. C. Varma, BharatiBhavan Publishers
3. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
4. A Treatise on Heat, MeghnadSaha, and B.N.Srivastava, 1958, Indian Press
5. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
6. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
7. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
8. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
9. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.
10. Thermal Physics, B.K. Agrawal, LokBharti Publications.

| <b>F.Y.B.Sc. Semester II</b>                                      |                                                              |                                 |
|-------------------------------------------------------------------|--------------------------------------------------------------|---------------------------------|
| <b>PHY-161</b>                                                    | <b>Mechanics and Properties of matter<br/>(Minor-Theory)</b> | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b>                                      |                                                              |                                 |
| <b>On completion of the course, the students will be able to:</b> |                                                              |                                 |
| <b>CO1</b>                                                        | Identify fundamental principles in mechanics.                |                                 |

|     |                                                                                                                                                                                               |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO2 | Illustrate Newton's laws of gravitation and Kepler's laws of planetary motion. Explain viscosity of Fluid, law of energy conservation and applications of Bernoulli's theorems with examples. |
| CO3 | Apply the physical principles of moment of inertia in terms of the mass distribution from the rotational axis to various symmetrical bodies.                                                  |
| CO4 | Analyse the properties and applications of elasticity with experiments.                                                                                                                       |
| CO5 | Justify the quantitative problem-solving skills in all the topics covered.                                                                                                                    |
| CO6 | Develop an intuition towards problems solving and design realistic applications in the physical world.                                                                                        |

| Unit | Contents                                                                                                                                                                                                                                                                                                                                                                                                     | No. of hours |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Moment of Inertia:</b> Definition of MI, Radius of gyration, Statement of parallel and perpendicular axis theorems. Derivation of MI of: Circular Ring, Circular Disc, Annular Ring, Spherical shell & solid sphere, Hollow cylinder & Solid cylinder, Flywheel, axel & its Applications, Spring<br><b>Gyroscope: Principal, construction, working and applications</b>                                   | 9            |
| II   | <b>Gravitation:</b> Newton's law of gravitation, Gravitational force, Gravitational field and Gravitational potential, Gravitational potential energy of a multi-particle system, uniform solid sphere and galaxy, Central force, Kepler's laws of planetary motion                                                                                                                                          | 6            |
| III  | <b>Elasticity:</b> Basic concepts of elasticity, Hook's law, three types of elastic moduli, Poisson's ratio, Relationship between $Y$ , $k$ , $\eta$ . Bending of beam, bending moment, cantilever load at free end, loaded uniformly, due to its own weight. Determination of $Y$ by bending of a uniformly loaded beam. Determination of elastic constant using Searle's method                            | 6            |
| IV   | <b>Fluid Mechanics:</b> Laminar and viscous flow, viscosity, Coefficient of viscosity, Streamline flow and Turbulent flow (Tubular flow), Equation of continuity of flow, Energy of fluid. Bernoulli's theorem (Steady flow), Euler's equation, Applications of Bernoulli's theorem: Venturimeter, Pitot tube, Aerofoil, Bunsen burner, Atomizer, Spinning of a ball. Critical velocity and Reynold's number | 9            |

### References

1. University Physics: Sears and Zeemansky, XII<sup>th</sup> edition, Pearson Education
2. Physics: Volume I, Resnick/Halliday/Krane John Wiley & Sons (Sea) pvt ltd. 4<sup>th</sup> edition.
3. Properties of Matter: D. S. Mathur, Shamlal Charitable Trust New Delhi
4. Mechanics: D. S. Mathur, S. Chand and Company New Delhi.
5. Concepts of Physics, Vol I: H. C. Varma, Bharati Bhavan Publishers

| F.Y.B.Sc. Semester II                                      |                                           |                         |
|------------------------------------------------------------|-------------------------------------------|-------------------------|
| PHY-170                                                    | Observational Astronomy<br>(GE/OE-Theory) | Credits: 2<br>Hours: 30 |
| Course Outcomes (COs)                                      |                                           |                         |
| On completion of the course, the students will be able to: |                                           |                         |

- Develop ability to find and identify celestial objects.
- Develop proficiency in the use of telescopes.
- Develop proficiency in the use of CCD cameras and image processing.
- Develop familiarity with some of the fundamental physical laws that govern the Universe

| Unit | Contents                                                                                                                                                                      | No. of Hours |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Distances and Measurements</b><br>Celestial Sphere, Celestial Co-Ordinate System, Astronomical Unit, Red shift, Magnitude Scale                                            | 8            |
| II   | <b>Solar System</b><br>Planets and their orbits, Asteroids, Comets, Moon phases, Tides and types of Eclipses.                                                                 | 7            |
| III  | <b>Telescopes and Detectors</b><br>Types of Telescopes, Types of Mounts, Types of Detectors, Eye as Detector                                                                  | 7            |
| IV   | <b>Observation and Imaging</b><br>Use of Stellarium, Imaging of celestial objects with CCD, DSLR and Photometer, Atmospheric effects and limitations, Differential Photometry | 8            |

#### References

1. Electronic Imaging in Astronomy: Detectors and Instrumentation by Ian S. McLean, Publication: Springer
2. Practical Astronomy with Your Calculator by Peter Duffett-Smith by Cambridge University Press
3. Observational Astrophysics by R. C. Smith, Publication Cambridge University Press
4. Astronomical Techniques by W. A. Hiltner (Ed), Publication: Cambridge University Press
5. Astronomical Photometry by Henden and Kaitchuck, Publication: Van Nostrand Reinhold

| F.Y.B.Sc. Semester II                                             |                                                                                |                                       |
|-------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------|
| PHY-171                                                           | <b>Photography II</b><br>(GE/OE-Theory)                                        | <b>Credits: 2</b><br><b>Hours: 30</b> |
| <b>Course Outcomes (COs)</b>                                      |                                                                                |                                       |
| <b>On completion of the course, the students will be able to:</b> |                                                                                |                                       |
| CO1                                                               | Identify the photographic process.                                             |                                       |
| CO2                                                               | Explain the fundamentals of the photographic process.                          |                                       |
| CO3                                                               | Use the photographic equipment for a given situation.                          |                                       |
| CO4                                                               | Relate the role of light in a photographic process.                            |                                       |
| CO5                                                               | Justify the use of photographic equipment for a given photographic assignment. |                                       |

| Unit | Contents                                                                                                                                                                                        | No. of hours |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>1. Application of Photography</b><br>- Genres in Photography<br>- Areas of working in Photography ( <i>Documentation, Print / Magazine media, Event Photography, Industrial Photography,</i> | 15           |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |    |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|    | <p><i>Nature Photography, Space and Astro, Food, Lifestyle, Fashion Photography, etc.)</i></p> <p><b>2. Compositions in Photography</b></p> <ul style="list-style-type: none"> <li>- Composition rules and design principles</li> <li>- Appeal to emotions through Photography (<i>studying the impact of photos on People</i>)</li> <li>- Screening of the images and discussing the compositional values. (<i>Criticizing and appreciating the Photographs based on compositional values.</i>)</li> </ul> <p><b>3. Paintings Vs. Photography</b></p> <ul style="list-style-type: none"> <li>- Comparative study of Paintings and Photographs.</li> <li>- Limitations</li> <li>- Defining the advantages of Photography.</li> </ul> <p><b>4. Coloured Vs. Black / White images</b></p> <ul style="list-style-type: none"> <li>- What is Chroma(<i>Achromatic and Chromatic Images</i>)</li> <li>- What is a Grayscale?</li> <li>- How the Photographic images have evolved.</li> <li>- Differences based on Technical / Aesthetical Aspects.</li> <li>- Limitations and Advantages over one another.</li> <li>- Observation based discussions over the screening of images.</li> </ul> <p><b>5. Use of Images in Advertising</b></p> <ul style="list-style-type: none"> <li>- What is Advertising?</li> <li>- Advertisement Photography</li> <li>- Need and the application approach towards Photographic Ads.</li> </ul> <p><b>6. Basics of Visual Literacy</b></p> <ul style="list-style-type: none"> <li>- What is Visual Literacy (<i>How a human being perceives a visual</i>)</li> <li>- Visual culture</li> <li>- Analyzing the Photos by various Photographers.</li> </ul> |    |
| II | <p><b>1. Application of Photography</b></p> <ul style="list-style-type: none"> <li>- Genres in Photography</li> <li>- Areas of working in Photography (<i>Documentation, Print / Magazine media, Event Photography, Industrial Photography, Nature Photography, Space and Astro, Food, Lifestyle, Fashion Photography, etc.)</i></li> </ul> <p><b>2. Compositions in Photography</b></p> <ul style="list-style-type: none"> <li>- Composition rules and design principles</li> <li>- Appeal to emotions through Photography (<i>studying the impact of photos on People</i>)</li> <li>- Screening of the images and discussing the compositional values. (<i>Criticizing and appreciating the Photographs based on compositional values.</i>)</li> </ul> <p><b>3. Paintings Vs. Photography</b></p> <ul style="list-style-type: none"> <li>- Comparative study of Paintings and Photographs.</li> <li>- Limitations</li> <li>- Defining the advantages of Photography.</li> </ul> <p><b>4. Coloured Vs. Black / White images</b></p> <ul style="list-style-type: none"> <li>- What is Chroma(<i>Achromatic and Chromatic Images</i>)</li> <li>- What is a Greyscale?</li> <li>- How the Photographic images have evolved.</li> <li>- Differences based on Technical / Aesthetical Aspects.</li> <li>- Limitations and Advantages over one another.</li> </ul>                                                                                                                                                                                                                                                                                                                       | 15 |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <ul style="list-style-type: none"> <li>- Observation based discussions over the screening of images.</li> </ul> <p><b>5. Use of Images in Advertising</b></p> <ul style="list-style-type: none"> <li>- What is Advertising?</li> <li>- Advertisement Photography</li> <li>- Need and the application approach towards Photographic Ads.</li> </ul> <p><b>6. Basics of Visual Literacy</b></p> <ul style="list-style-type: none"> <li>- What is Visual Literacy (<i>How a human being perceives a visual</i>)</li> <li>- Visual culture</li> <li>- Analyzing the Photos by various Photographers.</li> </ul> |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

## References

1. Langford's Advanced Photography - the Guide for aspiring Photographers
2. The camera by Ansel Adams
3. Basic Photography, M. J. Langford, Focal Press
4. Focal encyclopaedia of Photography, Focal Press
5. A large number of photography related sites are available on the internet.  
<https://www.youtube.com/@PIXELVILLAGE>  
<https://www.youtube.com/@theartofphotography>

| F.Y.B.Sc. Semester II                                             |                                                                                     |                                 |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------|
| PHY-180                                                           | <b>Solar PV System: Installation, Repairing and Maintenance (VSC)</b>               | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b>                                      |                                                                                     |                                 |
| <b>On completion of the course, the students will be able to:</b> |                                                                                     |                                 |
| CO1                                                               | Learn basics of light conversion in electricity.                                    |                                 |
| CO2                                                               | Hands on training will motivate to use Solar PV system.                             |                                 |
| CO3                                                               | Become entrepreneur / self-employed.                                                |                                 |
| CO4                                                               | Analyzed of MSEB electricity bill and design and sizing of off-grid PV system.      |                                 |
| CO5                                                               | Participants will learn about solar PV module and batteries used in solar PV plant. |                                 |

## Objectives:

1. In this skill-oriented course, students will study the basics of solar photovoltaic (PV) cells, modules, and system components.
2. Design and sizing of off-grid PV system for homes, apartments as well as commercial offices.
3. Understanding energy conversion from sunlight to electricity and working with solar conversion equipment.
4. This Course will give the hands-on experience needed to become self-employed.

| Unit | Contents                                                                                                                                                                                                                             | No. of hours |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I    | <b>Introduction</b><br>The Sun, Earth, and Renewable Energy, Photovoltaic Effect, Working of Solar cell, Types of Solar cell, PV Modules and Arrays, Module Parameters, Sunshine and Shadow, tracking mechanism, Aligning the Array. | 6            |

|            |                                                                                                                                                                                                                                                                                                                                                                           |           |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>II</b>  | <b>Solar Radiations and Measurement</b><br>Introduction, Solar Constant, Solar Radiation at the Earth Surface, Need of Solar Radiation<br>Measurement, Instruments for the Measurement of Solar Radiation, Pyrheliometer, Pyranometer, Sunshine Recorder, Sun Meter or Lux Meter                                                                                          | <b>6</b>  |
| <b>III</b> | <b>Basics Solar PV Systems</b><br>Basic types of PV Systems On grid and off grid, DC to AC Conversion, Building-integrated Photovoltaics, Engineering and Architecture, Balancing of PV system. System Components, Batteries, Charge Controllers, Inverters, Hybrid Systems, System Sizing, Applications of off grid PV System.                                           | <b>6</b>  |
|            | <b>Activity:</b><br>1. Estimate the value of the Solar Constant.<br>2. Study of intensity variation on the performance of PV module.<br>3. Study of series and parallel combination of the PV modules.<br>4. Measurement of Solar radiation measurement using Sunmeter and Pyranometer.<br>5. Analysis of MSEB electricity bill.<br>6. Energy Farm/PV Plant visit report. | <b>18</b> |

### References

1. Solar Energy, S.P. Sukhatme (second edition), Tata McGraw Hill Ltd, New Delhi.
2. Solar Energy Utilisation, G. D. RAI (5th edition), Khanna Publishers, Delhi.
3. Electricity from Sunlight, An Introduction to Photovoltaics, Paul A. Lynn, John Wiley & Sons, Ltd.
4. Solar Electricity, 2nd edition, T. Markvart, John Wiley & Sons, Ltd.
5. Solar Photovoltaic Basics, White Sean, Taylor & Francis Ltd.

| <b>F.Y.B.Sc. Semester II</b>                                                                                                                                                                                                                                        |                                                    |                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------|
| <b>PHY-190</b>                                                                                                                                                                                                                                                      | <b>Electrical circuit and network skills (SEC)</b> | <b>Credits: 2<br/>Hours: 30</b> |
| <b>Course Outcomes (COs)</b>                                                                                                                                                                                                                                        |                                                    |                                 |
| <b>On completion of the course, the students will be able to:</b>                                                                                                                                                                                                   |                                                    |                                 |
| <ul style="list-style-type: none"> <li>• After the completion of the course the student will acquire necessary skills/ hands-on experience /working knowledge on Inductors, capacitors, diodes, transistors, LDR, switches, voltage and current sources.</li> </ul> |                                                    |                                 |

### Skills to be learned

- 1] Skills to understand various types of electronic components and circuits
- 2] Skills to understand and operate electronic circuits
- 3] Develop knowledge of solid-state devices and their uses.
- 4] Skills to construct simple circuits using various electronic components.

| <b>Unit</b> | <b>Contents</b>                                                                                                                                         | <b>No. of hours</b> |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>I</b>    | <b>Fundamentals of Electronics</b><br>Introduction to Electronics, circuit symbols.<br>Electronic Components: Resistors, Capacitors, Inductors, Relays, | <b>8</b>            |

|            |                                                                                                                                                                                                                                                                                                                                                    |           |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|            | Batteries, Switches, LDR, LED, Photodiode, Thermistors<br>Series and parallel combination of resistors, capacitors and inductors<br>Voltage and Current Sources: Variable and constant voltage and current sources                                                                                                                                 |           |
| <b>II</b>  | <b>Network Theorems and its Applications</b><br>Kirchoff's Voltage Law and Kirchoff's Current Law, Thevenin, Norton, superposition and maximum power transfer theorems and applications.                                                                                                                                                           | <b>10</b> |
| <b>III</b> | <b>Diode and Transistors:</b><br>1. <b>Diodes:</b> Construction and working, Types of diodes Biasing, I/V Characteristics, Diode as switch and rectifier.<br>2. <b>Transistors:</b> Construction and working, Types of Transistors, Biasing: CB, CC, CE, I/V Characteristics, Transistor as switch. Power Transistor 3055, Transistor as amplifier | <b>8</b>  |
| <b>IV</b>  | <b>Simple Electronic Circuits</b><br>1. Multimeter Circuit<br>2. LED Circuit with potentiometer<br>3. Simple Temperature Monitor using transistors and diodes<br>4. Simple LDR Circuit                                                                                                                                                             | <b>4</b>  |

### References

1. Basic Electronics: Solid State by B. L. Theraja (Publication S Chand and Company Ltd)
2. Principles of Electronics by V. K. Mehta (Publication S Chand)
3. Basic Electronics Devices, Circuits And It Fundamentals by Santiram Kal (Publication PHI)