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.	
PO1	**Disciplinary Knowledge:** 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.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioural skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	**Research-related skills and Scientific temper:** 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.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** 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.
PO7	**Effective Citizenship and Ethics:** 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.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PSO No.	Program Specific Outcomes(PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) **Develop** and **demonstrate** 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. (ii) **Demonstrate independent** thinking and scientific temper. **Categorize**, calculate and **solve** problems using concepts of physics.
PSO2	**Personal and Professional Competence:** (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. (ii) Carry out the calculations in classical mechanics, quantum mechanics, mathematical methods and solids with advance techniques using computations and C-programming. (iii) Analyse experimental results and interpret graphs. (iv) Formulation of ideas, scientific writing and authentic reporting, effective presentation and communication skills through group discussion.
PSO3	**Research Competence:** (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. (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. (iii) Integrate core physics subjects during experimentation and projects. (iv) Apply numerical methods to solve various complex physical problems. (v) Identify and interpret research literature, formulate ideas, write reports and review articles related to all subjects in physics.
PSO4	**Entrepreneurial and Social competence:** 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. (i) Employ experimental skills in industrial applications. (ii) Develop scientific temperament and social awareness through internships and science popularization. Awareness of ethical issues: emphasis on academic and research ethics. (iii) Outline the use of renewable sources for sustainable development of human beings. (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	Paper Code	Paper Title	Type	Credits
I	Major	PHY-101	Mechanics	Theory	4
		PHY-100	Physics Practical - 1	Practical	2
	Minor	PHY-111	Mechanics and Properties of Matter	Theory	2
		PHY-112	Physics Practical - 1	Practical	2
	OE-1	PHY-120	Physics in Daily Life	Theory	2
	OE-2	PHY-121	Photography I	Theory	2
	SEC-1	PHY-140	Basic Instrumentation Skills	Skill	2
II	Major	PHY-151	Thermal Physics	Theory	4
		PHY-150	Physics Practical - 2	Practical	2
	Minor	PHY-161	Heat and Thermodynamics	Theory	2
		PHY-162	Physics Practical - 2	Practical	2
	OE-3	PHY-170	Observational Astronomy	Theory	2
	OE-4	PHY-171	Photography II	Theory	2

OE – Open Elective, SEC- Skill Enhancement Course

Teaching and Evaluation (Only for FORMAL education courses)

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

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

F. Y. B. Sc. Semester I		
PHY-101	**Mechanics (Major- Theory)**	**Number of Credits: 04**
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Identify the various physical parameters of mechanical systems.	1
CO2	Articulate the vectorial representation of various physical quantities of mechanics ex. Displacement, velocity, acceleration, momentum, forces, moments etc.	2
CO3	Apply the concepts of mechanics to different numerical problems in real world.	3
CO4	Explain the outcomes of real world problems.	4
CO5	Justify various mechanical system by using the different phenomenon of mechanics	5
CO6	Make models and demonstrate the same on the basis of concepts of mechanics.	6

Unit. No.	Title Of Unit and Contents	No. of hours
I	**Fundamentals of Dynamics:** 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 **Work and Energy:** Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non- conservative forces. Law of conservation of Energy.	**10**
II	**Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. **Rotational Dynamics:** Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical, and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation	**13**
III	**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS)	**09**
IV	**Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.	**07**

	Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. Galilean transformations; Galilean invariance.	
V	**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, 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	**Elasticity**: 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. **Fluid Motion:** 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-100	**Physics Practical -1 (Major- Practical)**	**Credits:** 2 **Hours:** 60
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify various components, devices, instruments and tools for specific applications. Recall the theory associated with each experiment.	1
CO2	Illustrate skill of proper use of tools and test and measuring instruments.	2
CO3	Calculate the values of physical quantities using suitable instruments.	3
CO4	Explain the results by integrating the theory with experimental observations.	4
CO5	Evaluate various physical quantities and measure the errors therein.	5
CO6	Perform the experiments using proper procedures and specify the outcomes. Integrate the measuring instrumentation system with the experimental circuit as required.	6

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

Expt. No.	Title of the Experiment
1.	Measurements using Vernier Calliper 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 η 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-111	**Mechanics and Properties of matter (Minor- Theory)**	**Credits:** 2 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Identify fundamental principles of mechanics.	1
CO2	Illustrate fundamental laws of mechanics with suitable examples.	2
CO3	Apply the physical principles of mechanics to real life problems.	3
CO4	Compare the properties and applications of various materials.	4
CO5	Justify the quantitative problem-solving skills in all the topics covered.	5
CO6	Develop an intuition towards problems solving and design realistic applications in the physical world.	6

Unit. No.	Title of Unit and Contents	No. of Lectures
I	**Moment of Inertia** **Moment of Inertia:** 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 **Gyroscope: Principal, construction, working and applications**	10
II	**Gravitation:** 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	8
III	**Elasticity:** Basic concepts of elasticity, Hook's law, three types of elastic moduli, Poisson's ratio, Relationship between Y, k, η. 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	8
IV	**Fluid Mechanics:** 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: Venturi meter, Pitot tube, Aerofoil, Bunsen burner, Atomizer, Spinning of a ball. Critical velocity and Reynold's number	10

References:

1. University Physics: Sears and Zeemansky, XIIth edition, Pearson Education
2. Physics: Volume I, Resnick/Halliday/Krane John Wiley & Sons (Sea) pvt ltd. 4th 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 I		
PHY-112	**Physics Practical - 1 (Minor-Practical)**	**Credits:** 2 **Hours:** 60
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Assemble various components, devices, instruments, and tools for different applications.	1
CO2	Understand the use of various measuring instruments.	2
CO3	Calculate the values of physical quantities using suitable instruments.	3
CO4	Write the results by integrating the theory with experimental observations.	4
CO5	Evaluate various physical quantities and measure the errors therein.	5
CO6	Perform the experiments using proper procedures and specify the outcomes. Integrate the measuring instrumentation system with the experimental circuit as required.	6

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

Expt. No.	Title of the Experiment
1.	Measurements using Vernier Calliper 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 η 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-120	**Physics in Daily Life (OE-1)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Recall, understand, use and apply the scientific knowledge set out in the syllabus.	1
CO2	Learn, recognize and apply basic physical principles related to climate, human body and Technology:	2
CO3	Learn about earth's atmosphere and related phenomena.	3
CO4	Solve simple physics related problems. Apply the simple law of nature to different fields of science, engineering and technology.	4
CO5	Evaluate relevant scientific information and make informed judgements about it	5

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. No.	Title of Unit and Contents	No. of hours
I	**Physics in Earth's Atmosphere** 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	**Physics in Human Body and Sports** 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	**Physics in Technology** 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** **(OE-2)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify the photographic process.	1
CO2	Explain the fundamentals of the photographic process.	2
CO3	Use the photographic equipment for a given situation.	3
CO4	Relate the role of light in a photographic process.	4
CO5	Justify the use of photographic equipment for a given photographic assignment.	5

Unit. No.	Title of Unit and Contents	No. of hours
I	1. What is Photography? - Meaning of Photography. - Photography as a Medium. 2. Formation of a Digital Image - Digital image (Pixel) - *(Colour contents of a digital image)* - Technical Qualities of a Photograph *(Brightness, Sharpness, Colour, Contrast, Size, Motion Blur)* 3. History of Photography in Short - Pinhole camera *(Basic construction and Diagrams for reference)* - Box Camera *(Basic construction and Diagrams for reference)* - Parallax error - Need for the Invention of a SLR - How SLRs removed the parallax error. 4. DSLR (Handling techniques) - DSLR *(Definition, diagram and functioning of the various parts of DSLR)* - Advantages and Disadvantages of DSLR. - What is an Exposure - Equivalent exposures 5. Aesthetics of images - Aesthetic qualities of an image *(Framing and Composition)* - Visual design elements *(Subject Attributes)* - Composition rules *(Rule of thirds, Golden points, Balance, Shapes, Leading Lines etc.)* 6. Formats and Lenses - Camera Formats *(Small, Medium, Large)* - What is Perspective? - Lens Defects - Minimizing the distortion 7. On camera Flash (Introduction) - What is a Flash?	**15**

II	1. Camera journey - Camera History - Working of Camera 2. SLR/DSLR - Camera Handling 3. Exposure Controls - Exposure Triangle 4. Aperture - Working of Aperture - Depth of Field - Practical 5. Shutter Speed - Working of Aperture - Effect of Shutter Speed - Practical 6. Sensitivity /ISO - Working of Aperture - Effect of Sensitivity - Practical 7. Lenses - Human Eye - Photographic Lenses - Perspective - Normal/Wide/Tele/Zoom 8. Sources of Light - Natural / Artificial - Hard and Soft 9. Using Reflected light - Use of Reflector/ Diffuser in outdoor Photography 10. Camera Flash and application - What is on Camera Flash vs LED Flash - TTL vs Manual 11. Using Flash in Outdoor/ indoor situations - Direct vs Indirect flash - Flash Modifiers	**15**

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/@PIXELVIILAGE
   https://www.youtube.com/@theartofphotography

F. Y. B. Sc. Semester I		
PHY-140	**Basic Instrumentation Skills (SEC-1)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Identify different type of Analog and Digital instruments.	1
CO2	Interpret the principle of operation of various instruments.	2
CO3	Apply the principles of operations of various instruments to measure physical quantities.	3
CO4	Explain the working of various measuring instruments like CRO, Multi-meter, etc.	4

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. No.	Title of Unit and Contents	No. of hours
I	**Basic of Measurement:** Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.	**6**
II	**Cathode Ray Oscilloscope:** 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.	**12**
III	**Signal Generators and Analysis Instruments:** 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.	**5**

IV	**Digital Instruments:** 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.	**7**

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

F. Y. B. Sc. Semester II		
PHY-151	**Thermal Physics (Major-Theory)**	**Credits:** 4 **Hours:** 60
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Recall and describe the concepts of Thermodynamics.	1
CO2	Discuss the behaviour of real gases and ideal gases.	2
CO3	Compute the thermodynamic quantities associated with different types of processes.	3
CO4	Explain concepts of Thermodynamics and Kinetic theory of gases to elaborate deviations from ideal behaviour in real gases.	4
CO5	Justify the transport phenomenon to real world scenario such as heat conduction and diffusion processes.	5
CO6	Integrate the knowledge of Thermodynamics and Kinetic theory to solve problems.	6

Unit. No.	Title of Unit and Contents	No. of hours
I	**Introduction to Thermodynamics** 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	**Second Law of Thermodynamics:** 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, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature.	**10**
III	**Entropy:** Concept of Entropy, Clausius Theorem. 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.	**7**
IV	**Thermodynamic Potentials:** Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. 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.	**7**

V	**Maxwell's Thermodynamic Relations:** Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.	**7**
VI	**Kinetic Theory of Gases Distribution of Velocities:** 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.	**7**
VII	**Molecular Collisions:** 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.	**4**
VIII	**Real Gases:** Behaviour of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on 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.	**10**

(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, Bharati Bhavan Publishers
3. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
4. A Treatise on Heat, Meghnad Saha, 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, Lok Bharti Publications.

F. Y. B. Sc. Semester II		
PHY-150	**Physics Practical - 2** **(Major- Practical)**	**Credits:** 2 **Hours:** 60
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify various components, devices, instruments and tools for specific applications. Recall the theory associated with each experiment.	1
CO2	Illustrate skill of proper use of tools and test and measuring instruments.	2
CO3	Calculate the values of physical quantities using suitable instruments.	3
CO4	Explain the results by integrating the theory with experimental observations.	4
CO5	Evaluate various physical quantities and measure the errors therein.	5
CO6	Perform the experiments using proper procedures and specify the outcomes. Integrate the measuring instrumentation system with the experimental circuit as required.	6

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

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 (Line and Exponential)
7.	Specific heat of solids
8.	Temperature coefficient of resistance
9 & 10	Study visit

F. Y. B. Sc. Semester II		
PHY-161	**Heat and Thermodynamics** **(Minor-Theory)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Recall the concepts of Thermodynamics.	1
CO2	Discuss the behaviour of real gases and ideal gases.	2
CO3	Compute the thermodynamic quantities associated with different types of processes.	3
CO4	Explain the working of heat engine, different types of thermometers. Compare types of heat engines and their working; temperature scales.	4
CO5	Determine work done, efficiency of heat engines and coefficient of performance of refrigerators, temperatures using different scales and principles of thermometers.	5
CO6	Specify the different types of thermodynamic processes in daily life.	6

Unit. No.	Title Of Unit and Contents	No. of hours
I	**Concepts of Thermodynamics:** Thermodynamic state of a system and zeroth law of thermodynamics, Thermodynamic Equilibrium, Adiabatic and isothermal changes, Work done during isothermal changes, Adiabatic relations for perfect gas, Work done during adiabatic change, Indicator Diagram, First law of Thermodynamics, Reversible and Irreversible processes	7
II	**Applied Thermodynamics:** Conversion of heat into work and its converse, Carnot's cycle and Carnot's heat engine and its efficiency, Second law of Thermodynamics, Concept of entropy, Temperature Entropy diagram, T-dS Equation, Clausius- Clapeyron latent heat equations	6
III	**Heat Transfer Mechanisms:** Heat Engines (Otto cycle and its efficiency, Diesel cycle and its efficiency), Refrigerators (General principle and coefficient of performance of refrigerator, The Carnot refrigerator, Simple structure of vapour compression refrigerator), Air conditioning principle and its applications	7
IV	**Equation of state:** Equations of state, Andrew's experiment, Amagat's experiment**,** Van der Waals' equation of state**,** Critical constants**,** Reduced equation of state, Joule-Thomson porous plug experiment	6
V	**Thermometry:** Temperature Scales (Centigrade, Fahrenheit and Kelvin scale), Principle, construction and working of following thermometers (Liquid and gas thermometers, Resistive type thermometers, Thermocouple as thermometer, Pyrometers)	4

References:

1. Physics: Volume I, Resnick/Halliday/Krane John Wiley & Sons (Sea) pvt ltd
2. Sears and Zemansky's University Physics, 12th Edition, H. D. Young, R. A. Freedman, A. L. Ford,F. W. Sears, Pearson Education
3. Concept of Physics Vol II: H. C. Verma, Bharati Bhavan Publishers
4. Heat and thermodynamics: Singhal, Agarwal and Prakash.
5. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand & Company Ltd, New Delhi

F. Y. B. Sc. Semester II		
PHY-162	**Physics Practical - 2** **(Minor- Practical)**	**Credits:** 2 **Hours:** 60
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Assemble various components, devices, instruments, and tools for different applications.	1
CO2	Understand the use of various measuring instruments.	2
CO3	Calculate the values of physical quantities using suitable instruments.	3
CO4	Write the results by integrating the theory with experimental observations.	4
CO5	Evaluate various physical quantities and measure the errors therein.	5
CO6	Perform the experiments using proper procedures and specify the outcomes. Integrate the measuring instrumentation system with the experimental circuit as required.	6

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

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.	Thermistor characteristics
5.	Surface Tension by Jaegers method
6.	Plotting of graph and analysis using linear regression
7.	Specific heat of solids
8.	Temperature coefficient of resistance
9 & 10	Study visit

F. Y. B. Sc. Semester II		
PHY-170	**Observational Astronomy (OE-3)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Describe the Physical universe and identify constellations, stars, planets, on the celestial sphere.	1
CO2	Understand the basic properties of light, fundamentals of human vision and apply it to astronomical observations using binoculars and telescopes.	2
CO3	Demonstrate the ability to use star charts and stellarium.	3
CO4	Distinguish between the concept of universal and local time, sidereal and synodic months, solar and lunar eclipses.	4
CO5	Measure astronomical distances of planets and stars.	5
CO6	Plan meteor shower observations using stellarium and sky charts and locate objects in the sky.	6

Unit. No.	Title of Unit and Contents	No. of Hours
I	**Distances and Measurements** Celestial Sphere, Celestial Co-Ordinate System, Astronomical Unit, Red shift, Magnitude Scale	**8**
II	**Solar System** Planets and their orbits, Asteroids, Comets, Moon phases, Tides and types of Eclipses.	**7**
III	**Telescopes and Detectors** Types of Telescopes, Types of Mounts, Types of Detectors, Eye as Detector	**7**
IV	**Observation and Imaging** 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: Spinger
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	**Photography II** **(OE-4)**	**Credits:** 2 **Hours:** 30
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Identify the photographic process.	1
CO2	Explain the fundamentals of the photographic process.	2
CO3	Use the photographic equipment for a given situation.	3
CO4	Relate the role of light in a photographic process.	4
CO5	Justify the use of photographic equipment for a given photographic assignment.	5

Unit. No.	Title of Unit and Contents	No. of hours
I	**1. Application of Photography** - Genres in Photography - Areas of working in Photography *(Documentation, Print / Magazine media, Event Photography, Industrial Photography, Nature Photography, Space and Astro, Food, Lifestyle, Fashion Photography, etc.)* **2. Compositions in Photography** - Composition rules and design principles - Appeal to emotions through Photography *(studying the impact of photos on People)* - Screening of the images and discussing the compositional values. *(Criticizing and appreciating the Photographs based on compositional values.)* **3. Paintings Vs. Photography** - Comparative study of Paintings and Photographs. - Limitations - Defining the advantages of Photography. **4. Coloured Vs. Black / White images** - What is Chroma*(Achromatic and Chromatic Images)* - What is a Grayscale? - How the Photographic images have evolved. - Differences based on Technical / Aesthetical Aspects. - Limitations and Advantages over one another. - Observation based discussions over the screening of images. **5. Use of Images in Advertising** - What is Advertising? - Advertisement Photography - Need and the application approach towards Photographic Ads. **6. Basics of Visual Literacy** - What is Visual Literacy *(How a human being perceives a visual)* - Visual culture - Analyzing the Photos by various Photographers.	**15**

II	**1. Application of Photography** - Genres in Photography - Areas of working in Photography *(Documentation, Print / Magazine media, Event Photography, Industrial Photography, Nature Photography, Space and Astro, Food, Lifestyle, Fashion Photography, etc.)* **2. Compositions in Photography** - Composition rules and design principles - Appeal to emotions through Photography *(studying the impact of photos on People)* - Screening of the images and discussing the compositional values. *(Criticizing and appreciating the Photographs based on compositional values.)* **3. Paintings Vs. Photography** - Comparative study of Paintings and Photographs. - Limitations - Defining the advantages of Photography. **4. Coloured Vs. Black / White images** - What is Chroma*(Achromatic and Chromatic Images)* - What is a Greyscale? - How the Photographic images have evolved. - Differences based on Technical / Aesthetical Aspects. - Limitations and Advantages over one another. - Observation based discussions over the screening of images. **5. Use of Images in Advertising** - What is Advertising? - Advertisement Photography - Need and the application approach towards Photographic Ads. **6. Basics of Visual Literacy** - What is Visual Literacy *(How a human being perceives a visual)* - Visual culture - Analyzing the Photos by various Photographers.	**15**

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/@PIXELVIILAGE
   https://www.youtube.com/@theartofphotography