

## Annual Teaching Plan for the Year 2023-2024

F.Y.B.Sc Physics \* CBCS Pattern

Physics Paper I: Section I: Mechanics

Lectures: 36 Credits: 2

Sr.No.	Month	Syllabus
1	June	<b>. Motion: (9 Lectures)</b> Introduction to motion, Types of motion, Displacement, Velocity, Acceleration, Inertia Revision of completed syllabus
2	July	Motion: Newton's laws of motion with their explanations, Various types of forces in nature, Frames of reference (Inertial and Non inertial), Laws of motion and its real life applications, Problems Solving Revision of completed syllabus Assignment -I Unit Test-I <b>Work and Energy: (7 Lectures)</b> Kinetic energy, Work Energy Theorem, Work done with constant force, Work done with varying force (spring force), Conservative and Non conservative forces, Potential energy, Law of energy conservation, Gravitational potential energy, Problems solving. Assignment -II Unit test -II
3	Aug	<b>Fluid Mechanics: (8 Lectures)</b> Concept of viscous force and viscosity, Coefficient of viscosity, Steady and Turbulent flow, Reynolds number, Equation of continuity, Bernoulli's Principle, Applications of Bernoulli's Principle (Ventury Meter, Pitot Tube), Applications of viscous fluids, Revision of completed syllabus

		Problems solving. Assignment -III Unit test -III
4	Sept	<b>Properties of Matter: (12 Lectures)</b> Surface tension, Angle of contact, Factors affecting surface tension, Jaeger's method for determination of surface tension, Applications of surface tension. Work done during longitudinal strain, Volume strain, Shearing strain, Poisson's ratio, Relation between three elastic moduli, ( $Y$ , $\eta$ , $K$ ), Applications of elasticity, Revision of completed syllabus Problems solving. Assignment -IV Unit test -IV
5	Oct	Revision and Problem Solving Internal Examination

#### References-

1. Physics: Resnick, Halliday & Walker 9/e, Wiley.
2. University Physics: Sears and Zeemansky, XIth/XIIth Edition, Pearson Education.
3. Mechanics: D. S. Mathur, S. Chand and Company, New Delhi.
4. Elements of Properties of Matter: D. S. Mathur, S. Chand, New Delhi.
5. Concepts of Physics: H. C. Verma, Bharati Bhavan Publisher.
6. Problems in Physics: P. K. Srivastava, Wiley Eastern Ltd.
7. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir VI Edition. Pearson Education/Prentice Hall International, New Delhi.
8. Fundamentals of Mechanics: J C Upadhyaya, Himalaya Publishing House.
9. Mechanics: D. S. Mathur, Revised by P. S. Hemne, S. Chand and Company, New Delhi. **Learning Outcomes:**  
On successful completion of this course students will be able to do the following:
  1. Demonstrate an understanding of Newton's laws and applying them in calculations of the motion of simple systems.
  2. Use the free body diagrams to analyse the forces on the object.
  3. Understand the concepts of energy, work, power, the concepts of conservation of energy and be able to perform calculations using them.
  4. Understand the concepts of elasticity and be able to perform calculations using them.
  5. Understand the concepts of surface tension and viscosity and be able to perform calculations using them.
  6. Use of Bernoulli's theorem in real life problems.
  7. Demonstrate quantitative problem-solving skills in all the topics covered.

Sr.No.	Month	Syllabus
1	Dec	<p><b>Fundamentals of Thermodynamics (10 Lectures)</b></p> <p><b>Concept of thermodynamic state, Equation of state, Van der Waal's equation of state, Thermal equilibrium, Zeroth law of thermodynamics, Thermodynamic processes: Adiabatic, Isothermal, Isobaric and Isochoric changes, Indicator diagram, Work done during isothermal change, Adiabatic relations, Work done during adiabatic change, Internal energy, Internal energy as state function, First law of thermodynamics,</b></p> <p><b>Reversible and Irreversible changes,</b></p> <p><b>Problems.</b></p> <p><b>Revision and Problem Solving</b></p> <p><b>Test Conduction on fundamentals of Thermodynamics</b></p> <p><b>Tutorials on fundamentals of Thermodynamics</b></p>
2	Jan	<p><b>Applied Thermodynamics: (9 Lectures)</b></p> <p><b>Conversion of heat into work and its converse, Second law of thermodynamics, Concept of entropy, Temperature - entropy diagram, T-dS equations, Clausius - Clapeyron latent heat equations,</b></p> <p><b>Problems</b></p> <p><b>Revision and Problem Solving</b></p> <p><b>Test on Applied Thermodynamics</b></p> <p><b>Tutorials Applied Thermodynamics</b></p>
3	Feb	<p><b>Heat Transfer Mechanisms (9 Lectures)</b></p> <p><b>Carnot's cycle and Carnot's heat engine and its efficiency, Heat Engines: Otto cycle &amp; its efficiency, Diesel cycle &amp; its efficiency, Refrigerators: General principle and coefficient of performance of refrigerator, Simple structure of Vapour compression refrigerator, Air Conditioning: Principle and its applications, Problems.</b></p> <p><b>Revision and Problem Solving</b></p> <p><b>Test on Heat Transfer Mechanism</b></p>

4	Mar	<p><b>Thermometry: (8 Lectures)</b></p> <p><b>Concept of heat &amp; temperature, Principle of thermometry, Temperature scales &amp; inter conversions, Principle, Construction and Working: (Liquid thermometers, Liquid filled thermometers, Gas filled thermometers, Bimetallic thermometers, Platinum resistance thermometer, Thermocouple),</b></p> <p><b>Problems.</b></p> <p><b>Revision and Problem Solving</b></p> <p><b>Test on Thermometry</b></p> <p><b>Internal Examination on entire syllabus.</b></p>
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**Reference Books:**

1. Concept of Physics: H. C. Verma, Bharati Bhavan Publisher.
2. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand and Company Ltd.
3. Heat and Thermodynamics: Mark W. Zemansky, Richard H. Dittman, 7 th Edition, Mc-Graw Hill International Edition.
4. Thermodynamics and Statistical Physics: J. K. Sharma, K. K. Sarkar, Himalaya Publishing House.
5. Thermal Physics (Heat and Thermodynamics): A. B. Gupta, H. P. Roy books and Allied (P) Ltd. Calcutta.
6. Instrumentation: Devices & Systems, Rangan, Mani, and Sarma.

**Learning Outcomes:**

After successfully completing this course, the student will be able to do the following:

1. Describe the properties of and relationships between the thermodynamic properties of a pure substance.
2. Describe the ideal gas equation and its limitations.
3. Describe the real gas equation.
4. Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.
5. Analyse the heat engines and calculate thermal efficiency.
6. Analyze the refrigerators, heat pumps and calculate coefficient of performance.
7. Understand property 'entropy' and derive some thermo dynamical relations using entropy concept.
8. Understand the types of thermometers and their usage.

By- S. K. Thorat

Annual Teaching Plan for the Year 2023-2024

S.Y.B. Sc. (Physics) Semester III (Paper I)

PH211: MATHEMATICAL MEHODS IN PHYSICS

Tentative schedule

2 Credit Course

Sr.No.	Month	Syllabus
1	June	. Complex Numbers (3 L) 1.1 Introduction to complex numbers. 1.2 Rectangular, polar and exponential forms of complex numbers Revision and problem solving
2	July	I. Complex Numbers (4L) 1.3 Argand diagram 1.4 Algebra of complex numbers using mathematical and Argand diagram 1.5 De-Moivre's Theorem 1.6 Powers, roots and log of complex numbers. 1.7 Trigonometric, hyperbolic and exponential functions. 1.8 Applications of complex numbers to determine velocity and acceleration in curved motion Revision and problem solving 1.9 Problems. 2. Partial Differentiation (3L) 2.1 Definition of partial differentiation 2.2 Successive differentiation 2.3 Total differentiation 2.4 Exact differential Revision and problem solving Test on Complex Numbers and Partial Differentiation Assignment I
3	Aug	2. Partial Differentiation (5L) 2.5 Chain rule

		<p>2.6 Theorems of differentiation</p> <p>2.7 Change of variables from Cartesian to polar co-ordinates.</p> <p>2.8 Conditions for maxima and minima (without proof)</p> <p>2.10 Problems.</p> <p>Revision and problem solving</p> <p>3. Vector Algebra (06L)</p> <p>3.1 Introduction to scalars and vectors:</p> <p>3.2 dot product and cross product of two vectors and its physical significance</p> <p>3.3 Scalar triple product and its geometrical interpretation.</p> <p>3.4 Vector triple product and its proof.</p> <p>3.5 Problems.</p> <p>Revision and problem solving</p> <p>Test on Partial Differentiation and Vector Algebra</p> <p>Assignment 2</p>
4	Sept	<p>4. Vector Analysis (7L)</p> <p>4.1 Introduction</p> <p>4.2 Scalar and vector fields</p> <p>4.3 Differentiation of vectors with respect to scalar.</p> <p>4.4 Vector differential operator and Laplacian operator</p> <p>4.5 Gradient of scalar field and its physical significance.</p> <p>4.6 Divergence of scalar field and its physical significance</p> <p>4.7 Curl of vector field</p> <p>4.8 Vector identities</p> <p>4.9 Problems.</p> <p>Revision and problem solving</p> <p>Test on Vector Analysis</p> <p>Assignment3</p>
5	Oct	<p>. Differential Equation (04L)</p> <p>5.1 Frequently occurring partial differential equations (Cartesian coordinates)</p>

	<p>5.2 Degree, order, linearity and homogeneity of differential equation.</p> <p>5.3 Concept of Singular points. Example of singular points  <math>(x = 0, x = x_0 \text{ and } x = \infty)</math>  of differential equation.</p> <p>5.4 Problems.</p> <p>Additional Activity:</p> <p>Four tutorials containing 10 unsolved problems each from suggested references.</p> <p>Revision and problem solving</p> <p>Test on Differential Equation</p> <p>Assignment 4</p> <p>Internal examination</p>
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Note- Extra lectures will be taken if required

Reference Books:

1. Methods of Mathematical Physics by Laud, Takwale and Gambhir
  2. Mathematical Physics by B. D. Gupta
  3. Mathematical Physics by Rajput and Gupta
  4. Mathematical Methods in Physical Science by Mary and Boas
  5. Vector analysis by Spiegel and Murre
  6. Mathematical Methods for Physicists by Arfken and Weber, 5th Edition, Academic Press.
- By- S. K Thorat

S.Y.B. Sc. (Physics) Semester IV (Paper I)  
 PH221: OSCILLATIONS, WAVES AND SOUND  
 Tentative schedule  
 2 Credit Course

Sr.No.	Month	Syllabus
1	Dec	<p>1. Undamped Free Oscillations (07L)</p> <p>1.1 Different types of equilibria (stable, unstable, and neutral equilibrium)</p> <p>1.2 Potential well and periodic oscillations, Approximation of a general potential well <math>V(x)</math> to a parabola for small oscillations</p> <p>1.3 Definition of linear and angular S.H.M.</p> <p>1.4 Differential equation of S.H.M. and its solution (exponential form)</p> <p>1.5 Composition of two perpendicular linear S.H.Ms. for frequencies 1:1 and 1:2 (Analytical method)</p> <p>1.6 Lissajous's figures and its uses, Applications (mechanical, electrical and optical)</p> <p>Revision and problem solving</p> <p>1.7 Problems.</p> <p>2. Damped Oscillations (02L)</p> <p>2.1 Introduction</p> <p>2.2 Differential equation of damped harmonic oscillator and its solution, discussion of different cases.</p> <p>2.3 Logarithmic decrement</p> <p>Revision and problem solving</p> <p>Test on Undamped Free Oscillations</p> <p>Tutorials on Undamped Free Oscillations</p>
2	Jan	<p>2. Damped Oscillations (05L)</p> <p>2.4 Energy equation of damped oscillations</p> <p>2.5 Power dissipation</p> <p>2.6 Quality factor</p> <p>2.7 Application: LCR series circuit</p> <p>2.8 Problems.</p> <p>3. Forced Oscillations (08L)</p> <p>3.1 Forced oscillation with one degree of freedom</p>

		<p>3.2 Differential equation of forced oscillation and its solution (transient and steady state) Amplitude of forced oscillation</p> <p>3.3 Resonance and its examples: mechanical (Barton's pendulum), optical (sodium vapour lamp),</p> <p>3.4 Velocity and Amplitude resonance</p> <p>3.5 Sharpness of resonance</p> <p>3.6 Energy of forced oscillations</p> <p>3.7 Power dissipation</p> <p>3.8 Quality factor and Bandwidth</p> <p>3.9 Application of forced oscillations</p> <p>3.10 Equation of coupled oscillations,</p> <p>3.11 Problems.</p> <p>Revision and problem solving</p> <p>Test Conduction on Damped Oscillations and Undamped Free Oscillations</p> <p>Tutorials on Damped Oscillations and Undamped Free Oscillations</p>
3	Feb	<p>4. Wave Motion (06L)</p> <p>4.1 Differential equations of wave motion in continuous media</p> <p>4.2 Equations for longitudinal waves and it's solution (one dimension only)</p> <p>4.3 Equation for transverse waves and its solution (one dimension only)</p> <p>4.4 Energy density and intensity of a wave</p> <p>4.5 Discussion of seismic waves</p> <p>4.6 Problems.</p> <p>Revision and problem solving</p> <p>5. Doppler Effect (03L)</p> <p>5.1 Explanation of Doppler effect in sound</p> <p>5.2 Expression for apparent frequency in different cases.</p> <p>5.3 Asymmetric nature of Doppler effect in sound</p> <p>Test Conduction on Wave Motion and Doppler Effect</p> <p>Tutorials on Heat Wave Motion and Doppler Effect</p> <p>Revision and problem solving</p>

4	Mar	<p>5.4 Doppler effect in light, symmetric nature of Doppler effect in light.</p> <p>5.5 Applications: Red shift, Violet shift, Radar,</p> <p>5.6 Problems</p> <p>Revision and problem solving.</p> <p>6. Sound (05L)</p> <p>6.1 Definition of sound intensity, loudness, pitch, quality and timber</p> <p>6.2 Acoustic intensity level measurement</p> <p>6.3 Acoustic pressure and it's measurement</p> <p>6.4 Reverberation time and Reverberation of a hall</p> <p>6.5 Sabine's formula (without derivation)</p> <p>6.6 Stroboscope</p> <p>6.7 Problems</p> <p>Revision and problem solving</p>
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Note Extra lectures will be taken if required

Reference Books:

1. Waves and Oscillations, Stephenson
2. The physics of waves and oscillations, N. K. Bajaj, Tata McGraw- Hill, Publishing co. ltd.
3. Fundamentals of vibration and waves, SPPuri, Tata McGraw-Hill Publishing co. ltd.
4. A text book of sound, Subramanyam and Brijlal, Vikas Prakashan
5. Sound, Mee, Heinmann, Edition - London
6. Waves and Oscillations, R.N. Chaudhari, New age international (p)ltd.

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# Annual Teaching Plan for the Year 2023-2024

T.Y.B.Sc. (Physics) (Semester-V)

PHY-354: Atomic and Molecular Physics

Lectures: 36 (Credits-02)

Sr.No.	Month	Syllabus
1	June	<b>Atomic structure (6 L)</b> 1. Revision of various atomic models 2. Vector atom model (Concepts of space quantization and electron spin) 3. Pauli Exclusion Principle and electron configuration, Quantum states, Spectral notations of quantum states. 4. Problems Revision and Problem Solving
2	July	<b>One and Two Valence electron systems (12 L)</b> 1. Spin-Orbit Interaction (Single valence electron atom), Energy levels of Na-atom, Selection rules, Spectra of sodium atom, Sodium doublet. 2. Spectral terms of two electron atoms, terms for equivalent electrons, LS and JJ-coupling schemes. 3. Singlet-Triplet separations for interaction energy of LS coupling, Lande's interval rule, Spectra of Helium atom. 4. Problems Revision and Problem solving
3	Aug	<b>Zeeman Effect (4 L)</b> 1. Zeeman Effect 2. Experimental arrangement 3. Normal and anomalous Zeeman Effect 4. Stark effect (Qualitative discussion)

		<p>5. Applications of Zeeman effects</p> <p>6. Problems</p> <p>Revision and Problem solving</p> <p><b>Molecular spectroscopy (8 L)</b></p> <p>1. Introduction of molecular spectra and its types</p> <p>2. Rotational energy levels, Rotational spectra of rigid diatomic molecule</p> <p>3. Vibrational energy levels</p> <p>4. Rotational and Vibrational spectra</p> <p>5. Electronic spectra of molecules</p> <p>6. Applications of UV-Vis spectroscopy</p> <p>7. Problems</p> <p>Revision and Problem Solving</p>
4	Sept	<p><b>Raman spectroscopy (6 L)</b></p> <p>1. History of Raman effect, Molecular polarizability</p> <p>2. Classical theory and Quantum theory of Raman Effect</p> <p>3. Characteristics Raman Lines and Applications of Raman spectroscopy</p> <p>Revision and Problem Solving</p>
5	Oct	<p>Revision and Problem Solving</p> <p>Internal Examination</p>

**Reference books:**

- 1) R. Murugesan, Er. K. Sivaprasath, Modern Physics, S. Chand, 2014, Revised edition
- 2) Robert Eiseberg, Robert Resnik, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, Wiley, 2016, 2nd edition
- 3) G. Aruldhas, Molecular structure and Spectroscopy, PHI, 2015, 2nd edition
- 4) Colin Banwell, Elaine McCash, Fundamentals of Molecular Spectroscopy, TMH, 4th ed
- 5) Arthur Baiser, Concepts of Modern Physics, McGraw Hill International, 4th edition
- 6) White H. E, Introduction to Atomic spectra, McGraw Hill Internationa

# Annual Teaching Plan for the Year 2022-2023

T.Y.B.Sc. (Physics) (Semester-VI)

PHY-366 Elective-II (U): Renewable Energy Sources-II

Lectures: 36 (Credits-02)

Sr.No.	Month	Syllabus
1	Dec	<b>Bioenergy and Biofuels: (10L)</b>  Bioenergy: 1. Introduction to Bioenergy 2. Basic Routs: Biochemical, Thermochemical, Transesterification 3. Biochemical- Biogas generation/methanation 4. Biogas plant: Floating gas holder and fixed dome type biogas plant, construction and working 5. Factors affecting on bio-digestion (list of factors).  Revision
2	Jan	6. Thermochemical: Pyrolysis, Gasification, Carbonization 7. Transesterification: 8. Comparative study of floating gas holder and fixed dome type biogas plant. 9. Working of downdraft gasifier. 10. Various methods to obtain energy from biomass.  Biofuel: 1. Introduction to Biofuels 2. Production of Biofuels (Jatropa and Sugar cane bagasse)  Revision
3	Feb	<b>Wind Energy (08L)</b> 1. Introduction to wind energy. 2. Principles and components of wind energy conversion system. 3. Classification of wind machines: Horizontal axial machine and vertical axial machine. 4. Advantages and disadvantages of wind energy.

		5. Wind data Revision
4	Mar	<b>Other Energy Sources: (08L)</b> 1. Introduction to tidal and geothermal energy. 2. Tidal energy: methods of utilization of tidal energy. 3. Advantages and disadvantages of tidal power generation. 4. Geothermal energy: Geothermal sources and energy conversion. 5. Advantages and disadvantages of geothermal energy. 6. Introduction to Thermocell Revision
5	Oct	<b>4: Energy Management: (10L)</b> 1. Introduction to Energy Management (Definition, Principles etc) 2. Need of Energy Saving and Management 3. Different strategies of Energy Management 4. Role of Energy Managers and Auditors, 5. Energy Audit Measurements and Instruments, and Preparation of Energy Audit Report (in brief). 6. Case studies of Energy Audit & Management (e.g. Industries & Green Buildings, Boilers, Furnaces, Refrigeration and Air conditioning, Cogeneration, Waste Heat recovery, Electric motors, Pumping systems, Fans and blowers, Cooling Towers, Industrial/Commercial Lighting system, BEE Star rated equipment) any one Revision

Reference books:

1. Non-conventional Energy Sources, G. D. RAI (4th edition), Khanna Publishers, Delhi.
2. Solar Energy, S.P. Sukhatme (second edition), Tata Mc Graw Hill Ltd, New Delhi.
3. Solar Energy Utilisation, G. D. RAI (5th edition), Khanna Publishers, Delhi.
4. Energy Management: W.R.Murphy, G.Mckay (Butterworths).
5. Energy Management Principles: C.B.Smith (Pergamon Press).

6. Efficient Use of Energy: I.G.C.Dryden (Butterworth Scientific)
7. Energy Economics -A.V.Desai (Wiley Eastern)
8. Industrial Energy Conservation: D.A. Reay (Pergamon Press)
9. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley Inter science publication)
10. Industrial Energy Management and Utilisation –L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington)
11. Hand book of Energy Audit by Sonal Desai (Publisher Tata McGraw Hill.)
12. Energy Management and Conservation Handbook, Frank Kreith and Yogi Goswami, (CRC Press)

List of Experiments: (Any Two)

1. Fuel value of wood/charcoal.
2. Study of sensible heat storage using liquid.
3. Selective and Non-selective coatings – Determination of Selectivity ratio.
4. To do energy audit of home/society/college/industry and prepare a detail audit report.
5. Study and analysis of home Electricity Bill
6. Study of Power consumption of conventional tube light vs LED fitting