F.Y.B.Sc. (Physics)
Semester-I
&
Semester-II
Syllabus

2022 Pattern

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science and Commerce, Baramati

(Autonomous Status)

(Affiliated to Savitribai Phule Pune University, Pune)

Course Structure for F.Y.B.Sc. Physics 2022-Pattern

Semester	Paper Code	Title of Paper	No. of Credits
I	USPH111	Mechanics & Properties of Matter	2
	USPH112	Electromagnetics	2
	USPH113	Practical-I	2
II	USPH121	Heat and Thermodynamics	2
	USPH122	Physics Principles and Applications	2
	USPH123	Practical-II	2

Program Outcomes

PO1: Disciplinary Knowledge

PO2: Critical Thinking and Problem solving

PO3: Social competence

PO4: Research-related skills and Scientific temper

PO5: Trans-disciplinary knowledge

PO6: Personal and professional competence

PO7: Effective Citizenship and Ethics

PO8: Environment and Sustainability

PO9: Self-directed and Life-long learning

SYLLABUS (CBCS) FOR F.Y.B.Sc. PHYSICS (W.E.F. June 2022)

Academic Year 2022-2023

F.Y.B.Sc. PHYSICS (Semester- II)

USPH121: Heat and Thermodynamics

Credit: 2 **No. of lectures: 36**

A) Learning Outcome:

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

CO1: Describe the thermodynamic properties of a material.

CO2: Understand the ideal gas equation and its limitations and real gas equation.

CO3: Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process

CO4: Understand principle of heat engines and calculate thermal efficiency.

CO5: Understand the principle of the refrigerators to calculate coefficient of performance

CO6: Understand phenomenon of 'entropy'

CO7: Understand the types of thermometers and their uses

TOPICS/CONTENTS:

UNIT 1: Equation of state (8L)

1.1 Introduction: (ideal and real gas)

1.2 Andrew's Experiment

1.3 Van der Waals 'equation of state, critical constants and reduced equation of state

1.4 Joule-Thomson porous plug experiment (Throttling process)

1.5 Problem Solving

UNIT 2: Concepts of Thermodynamics (10L)

2.1 Introduction: (Thermodynamic state of a system, Zeroth law of thermodynamics, Thermodynamic equilibrium, reversible and irreversible processes)

2.2 Thermodynamic Processes: isothermal, adiabatic, isochoric and isobaric

2.3 Work done during isothermal change

2.4 Adiabatic relations for perfect gas

2.5 Work done during adiabatic change

2.6 First law of thermodynamics and its applications

2.7 Problem Solving

UNIT 3: Applied Thermodynamics (10L)

1.1 Introduction (Joules law of heating)

1.2 Heat and work

1.3 Carnot's cycle and Carnot's heat engine and its efficiency

1.4 Second law of thermodynamics

1.5 Concept of entropy, Enthalpy, Free energy

1.6 Maxwell's relations in thermodynamics

1.7 T-dS Equations

1.8 Clausius-Clapeyron First Latent heat equations

1.9 Problem Solving

UNIT 4: Heat Transfer Mechanisms (8L)

4.1 Introduction (Kinematics of heat)

4.2 Heat Engines: Otto cycle and its efficiency and Diesel cycle and its efficiency

4.3 Refrigerators: Principle and coefficient of performance of refrigerator

4.4 Air conditioning: Principle and its application

4.5 Temperature Scales: Celsius, Fahrenheit and Kelvin scale and Reaumur scale

4.6 Problem Solving

References:

1. Physics: 4th Edition, Volume I, Resnick/Halliday/Krane JOHN WILEY & SON (SEA) PTE LTD
2. Concept of Physics: H.C. Verma, Bharati Bhavan Publishers
3. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand & Company Ltd, New Delhi
4. Heat and Thermodynamics: Mark. W. Zemansky, Richard H. Dittman, Seventh Edition, McGraw-Hill International Editions
5. Thermodynamics and Statistical Physics: J.K. Sharma, K.K. Sarkar, Him

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3			2					2
CO 2	3		2						
CO 3	3	2							
CO 4	3	2						2	
CO 5	3					2			
CO 6	3								
CO7	2			2			2		

Justification

PO1: Disciplinary Knowledge

CO1: Describe the thermodynamic properties of a material. Weightage: 3

This CO directly addresses the thermodynamic properties of materials, aligning with the development of disciplinary knowledge.

CO2: Understand the ideal gas equation and its limitations and real gas equation.Weightage: 3

Understanding gas equations is fundamental to thermodynamics and contributes directly to disciplinary knowledge.

CO3: Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.Weightage: 3

Applying the laws of thermodynamics is a core aspect of disciplinary knowledge in this field.

CO4: Understand the principle of heat engines and calculate thermal efficiency.Weightage: 3

Understanding the principle of heat engines is central to thermodynamics, contributing directly to disciplinary knowledge.

CO5: Understand the principle of refrigerators to calculate coefficient of performance.Weightage: 3

Justification: Understanding the principle of refrigerators is crucial in the field of thermodynamics, aligning directly with disciplinary knowledge.

CO6: Understand the phenomenon of ‘entropy’.Weightage: 3

Entropy is a key concept in thermodynamics, and understanding it is essential for disciplinary knowledge.

CO7: Understand the types of thermometers and their uses.Weightage: 2

While understanding thermometers is relevant to thermodynamics, it has a partial connection to disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO3: Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.Weightage: 3

Formulating relations based on thermodynamic laws requires critical thinking skills, aligning with this PO.

CO4: Understand the principle of heat engines and calculate thermal efficiency.Weightage: 3

Calculating thermal efficiency involves problem-solving skills, contributing directly to critical thinking and problem-solving.

PO3: Social Competence

CO2: Understand the ideal gas equation and its limitations. Weightage: 2

Understanding the ideal gas equation has social applications, but the direct link may not be as strong.

PO4: Research-related Skills and Scientific Temper

CO1: Describe the thermodynamic properties of a material. Weightage: 2

Describing thermodynamic properties can be part of research-related skills, but the link may not be as direct.

CO7: Understand the phenomenon of 'entropy'. Weightage: 2

Understanding entropy involves a scientific temper, contributing to research-related skills, but the link may not be as strong.

PO5: Trans-disciplinary Knowledge

CO8: Understand the types of thermometers and their uses. Weightage: 2

Understanding types of thermometers has applications in various fields, but the direct trans-disciplinary link may not be as strong.

PO6: Personal and Professional Competence

CO5: Understand the principle of heat engines and calculate thermal efficiency. Weightage: 2

Understanding heat engines and calculating thermal efficiency contributes to personal and professional competence, though the link may not be as direct.

PO7: Effective Citizenship and Ethics

CO7: Understand the phenomenon of 'entropy'. Weightage: 2

Understanding entropy may have ethical implications, contributing to effective citizenship, though the link may not be as strong.

PO8: Environment and Sustainability

CO4: Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process. Weightage: 2

Applying thermodynamic laws can indirectly contribute to considerations of environment and sustainability.

PO9: Self-directed and Life-long Learning

CO1: Describe the thermodynamic properties of a material. Weightage: 2

Describing thermodynamic properties can be part of self-directed and life-long learning, but the link may not be as direct.

F.Y.B.Sc. PHYSICS (Semester- II)

USPH 122: Physics Principles and Applications

Credit: 2 **No. of lectures: 36**

A) Learning Outcome:

On successful completion of this course students will be able to do the following:

CO1: To understand the general structure of atom, spectrum of hydrogen atom.

CO2: To understand the atomic excitation and LASER principles.

CO3: To understand the bonding mechanism and its different types.

CO4: To demonstrate an understanding of electromagnetic waves and its spectrum.

CO5: Understand the types and sources of electromagnetic waves and applications.

CO6: To demonstrate quantitative problem-solving skills in all the topics covered.

CO7: Understand construction and working principle based instruments for various application and their use in research or project work.

B) TOPICS/CONTENTS:

UNIT 1: Physics of Atoms **(08L)**

1.1 Introduction to Atom (Atomic Models: Thomson, Rutherford, Bohr)

1.2 Atomic Spectrum

1.3 The Bohr Theory of the Hydrogen Atom

1.4 Energy levels of Hydrogen Spectrum

1.5 Frank-Hertz experiment

1.6 Problems

UNIT 2: Physics of Molecules **(08L)**

2.1 Introduction to Bonding Mechanisms

2.2 Forces between Atoms

2.3 Types of Bonding: Ionic Bonds, Covalent Bonds, Van der Waals Bonds, Hydrogen Bond, Metallic Bond

2.4 Rotation energy levels of a diatomic molecule

2.5 Vibration energy levels of a diatomic molecule

2.6 Problems

UNIT 3:. LASERS and its Applications (07L)

3.1 Introduction to LASERS

3.2 Basic Principle of Lasers: Three Processes

3.3 Characteristics of Lasers: brief explanation

3.4 Population Inversion and Pumping

3.5 Types of Lasers

3.6 Applications of Lasers

3.7 Problems

UNIT 4: Sources of Electromagnetic Waves (13L)

4.1 Introduction to Electromagnetic Waves: Historical Perspective

4.2 General properties of Electromagnetic radiations

4.3 Electromagnetic spectrums and its sources

4.4 Production of electromagnetic waves: Hertz experiment

4.5 Plank's hypothesis of Photons (Concept only)

4.6 Sources of Electromagnetic Waves

4.7 Applications of Electromagnetic Waves: Microwave, RADAR, X-Ray, Solar Cell

4.8 Problems

Books/References

1. Concepts of Modern Physics: A Beiser (6th ed., McGraw Hill, 2003)

2. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer

3. Sears and Zemansky's University Physics: H.D. Young R. A. Freedman, Sandin (11th Ed. Pearson Education)

4. University Physics: F. Sears and M. Zeemansky, XIth/XIIth Edition, Pearson Education

5. An Introduction to LASERS- Theory and Applications: M.N. Avdhanulu, S. Chand Publications

6. LASERS: M. N. Avdhanulu, S. Chand Publications.

7. Fundamental of molecular Spectroscopy: by C.N. Banwell (3rd Edition) McGRAW-HILL Book company Europe.

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3								2
CO 2	3								
CO 3	3								
CO 4	3								
CO 5	3								
CO 6	3	3							
CO7	3			3					

Justification

PO1: Disciplinary Knowledge

CO1: To understand the general structure of the atom, spectrum of the hydrogen atom.Weightage: 3

Understanding the structure of the atom and the spectrum of the hydrogen atom is foundational knowledge in the discipline.

CO2: To understand atomic excitation and LASER principles.Weightage: 3

Justification: Understanding atomic excitation and LASER principles is directly related to disciplinary knowledge in physics.

CO3: To understand the bonding mechanism and its different types.Weightage: 3

Understanding the bonding mechanism is a core aspect of disciplinary knowledge in chemistry.

CO4: To demonstrate an understanding of electromagnetic waves and their spectrum.Weightage: 3

Understanding electromagnetic waves and their spectrum is fundamental knowledge in physics and contributes to disciplinary knowledge.

CO5: Understand the types and sources of electromagnetic waves and applications.Weightage: 3

Understanding types, sources, and applications of electromagnetic waves directly contributes to disciplinary knowledge.

CO6: To demonstrate quantitative problem-solving skills in all the topics covered.Weightage: 3

Problem-solving skills are essential for mastering disciplinary knowledge in any field.

CO7: Understand construction and working principle based instruments for various applications and their use in research or project work.Weightage: 3

Understanding the construction and working principles of instruments for various applications directly aligns with disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO6: To demonstrate quantitative problem-solving skills in all the topics covered.Weightage: 3

Quantitative problem-solving skills are a direct reflection of critical thinking and problem-solving abilities.

PO4: Research-related Skills and Scientific Temper

CO7: Understand construction and working principle based instruments for various applications and their use in research or project work.Weightage: 3

Knowledge of instruments and their application in research or project work is directly related to research-related skills and scientific temper.

PO9: Self-directed and Life-long Learning

CO1: To understand the general structure of the atom, spectrum of the hydrogen atom.Weightage: 2

Understanding foundational concepts supports self-directed and

F.Y.B.Sc. PHYSICS (Semester- II)

USPH 123: Practical-II

Credit: 2 **No. of Practicals: 10**

A) Learning Outcome:

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

CO1: Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
CO2: Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
CO3: Demonstrate an understanding of laboratory procedures including safety and scientific methods.
CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
CO5: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.
CO6: Apply knowledge in understanding the experimental Principles in Project work for demonstration.
CO7: Experimental Models for easy understanding and explanation Physics concepts.

Syllabus:

1. Heat and Thermodynamics (Any Four)

1. Interpretation of isothermal and adiabatic curves on PV diagrams (Theoretical). Theoretical study of Carnot's cycle by drawing graphs of isothermal and adiabatic curves.
2. Temperature coefficient of resistance (TCR)
3. Thermal conductivity by Lee's method
4. Specific heat of graphite
5. Study of Peltier effect
6. Study of Solar constant

2. Physics Principles & Applications (Any Four)

1. Study of spectrometer and determination of angle of prism
2. Diameter of thin wire using LASER
3. Charging & discharging of capacitor
4. Determination of wavelength of LASER light by plane diffraction grating
5. Determination of frequency of AC mains using sonometer.
6. Determination of coefficient of Viscosity by Poiseuille's method

3. Additional Activities

1. Demonstrations (Any two demonstrations equivalent to two experiments)

1. Biprism
2. LASER
3. Telescope
4. Center of Mass and Center of gravity

2. Computer aided demonstrations using computer simulations or animations (Any one demonstrations equivalent to two experiments)

1. Carnot engine, diesel engine
2. Graphs and their slopes, and Kinematics graphs (using computer simulations)
3. Mini projects/Hands on activities

3. Student Involvement (Any one equivalent to two experiments)

1. Mini Projects

Group of 4 students should carry out mini project with the report.

Students have to perform at least two additional activities out of three activities in addition to sixteen experiments mentioned above. Total Laboratory work with additional activities should be equivalent to twenty experiments.

OR

2. Industrial Visit /Study Tour / Field Visit

	Programme Outcomes (POs)								
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	3			2					
CO 2		3							
CO 3							3	2	
CO 4	3	3		2					
CO 5			3		2	2			
CO 6		2							2
CO7	3								

Justification

PO1: Disciplinary Knowledge

CO1: Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.Weightage: 3

Acquiring technical skills in a laboratory setting is fundamental to building disciplinary knowledge.

CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena. Weightage: 3

CO7: Experimental Models for easy understanding and explanation of Physics concepts. Weightage: 3

Creating experimental models for better understanding involves disciplinary knowledge and direct application, indicating a strong relationship.Weightage: 3

Visualizing and experiencing abstract concepts directly contribute to disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO2: Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.Weightage: 3

Critical thinking is essential in collecting and interpreting data in a laboratory setting.

CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.Weightage: 3

Visualizing and experiencing abstract concepts require critical thinking skills.

CO6: Apply knowledge in understanding the experimental Principles in Project work for demonstration.Weightage: 2

Applying knowledge in project work involves problem-solving skills, but the link may not be as direct as in other cases.

PO3: Social Competence

CO5: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.Weightage: 3

Collaborative learning and teamwork in a laboratory setting directly contribute to social competence.

PO4: Research-related Skills and Scientific Temper

CO1: Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.Weightage: 2

Acquiring technical skills can be part of research-related skills, but the link may not be as direct.

CO4: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.Weightage: 2

Visualizing abstract concepts can be part of developing a scientific temper, but the link may not be as strong.

PO5: Trans-disciplinary Knowledge

CO5: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings. Weightage: 2

Collaborative learning and teamwork contribute to trans-disciplinary knowledge, but the link may not be as strong.

PO6: Personal and Professional Competence

CO5: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.Weightage: 2

Collaborative learning and teamwork contribute to personal and professional competence, though the link may not be as direct.

PO7: Effective Citizenship and Ethics

CO3: Demonstrate an understanding of laboratory procedures including safety and scientific methods.Weightage: 3

Understanding laboratory procedures, especially safety and scientific methods, directly contributes to effective citizenship and ethics.

PO8: Environment and Sustainability

CO3: Demonstrate an understanding of laboratory procedures including safety and scientific methods.Weightage: 2

Adhering to laboratory safety procedures can indirectly contribute to considerations of environment and sustainability.

PO9: Self-directed and Life-long Learning

CO6: Apply knowledge in understanding the experimental Principles in Project work for demonstration.Weightage: 2

Applying knowledge in project work is relevant to self-directed and life-long learning, though the link may not be as direct.