Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE AND COMMERCE, BARAMATI

(Autonomous Status)

(Affiliated to Savitribai Phule Pune University, Pune)

Faculty of Science

Department of Physics

Syllabus Submitted to Academic Council

For

B.Sc. in Physics

From Academic Year 2022-2023

INDEX

Preamble:

Physics is concerned with the study of the universe from the smallest to the largest scale: it is about unravelling its complexities to discover the way it is and how it works. Discoveries in physics have formed the foundation of countless technological advances and play an important role in many scientific areas. Many techniques used in medical imaging, nanotechnology and quantum computing are derived from physics instrumentation. Even the World Wide Web was a spin-off from the information processing and communications requirements of high-energy particle physics. The contributions of physics to solving global problems such as energy production, environmental protection, global warming, and public health are essential and have an enormous impact on our society.

The systematic and planned curricula from first year to the third year shall motivate and encourage the students for pursuing higher studies in Physics and for becoming an entrepreneur.

Objectives:

- To provide in depth knowledge of scientific and technological aspects of Physics
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving, hand on activities, study visits, projects etc.
- To train students in skills related to research, education, industry, and market.
- To create foundation for research and development in Physics
- To develop analytical abilities towards real world problems
- To help student's build-up a progressive and successful career in Physics

Eligibility:

1. First Year B.Sc.: Higher Secondary School Certificate (10+2) Science stream or its equivalent Examination as per the University of Pune eligibility norms.
2. Second Year B.Sc.: Keeping terms of First Year of B.Sc. with Physics as one of the subjects. Other students if they fulfil the conditions approved by the equivalence Committee of Faculty of Science of the University of Pune are also eligible.
3. Third Year B.Sc.: Student shall pass all First Year B.Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Physics as one of the subjects.

Admissions will be given as per the selection procedure/policies adopted by the Tuljaram Chaturchand College, in accordance with conditions laid down by the Academic Council of Anekant Education Society's, Tuljaram Chaturchand College, Baramati, Reservation and relaxation will be as per the Government rules for minority institution.

Proposed Structure of B.Sc. degree in physics and syllabus for first year (Sem-II) degree in Physics as follows:

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F.Y., S.Y., T.Y.B. Sc. [Physics] Structure

2022-2025

Class	Semester	Paper-I	Paper-II	Paper-III
F.Y.B.Sc.	I	Mechanics & Properties of Matter	Electromagnetics	Practical-I
	II	Heat and Thermodynamics	Physics Principles and Applications	Practical-II
S.Y.B.Sc.	III	Mathematical Methods of Physics-I	Electronics-I/ Instrumentation	Practical-I
	IV	Oscillations, waves, and Sound	Optics	Practical-II

T.Y.B.Sc.		**Sem-I**	**Sem-II**
	1	Mathematical Methods of Physics-II	Electrodynamics
	2	Solid State Physics	Quantum Mechanics
	3	Classical Mechanics	Thermodynamics and Statistical Physics
	4	Atomic and Molecular Physics	Nuclear Physics
	5	Computational Physics with Python	Electronics II/ Advanced Electronics
	6	Elective-I (Select anyone) i) Elements of Material Science ii) Renewable Energy Sources iii) Physics and Technology of sensors. iv) Biophysics	Elective-II (Select anyone) i) Physics of Nanomaterials ii) Astronomy and Astrophysics iii) Medical Electronics iv) Microcontroller
	7	Practical -I	Practical –IV
	8	Practical -II	Practical -V
	9	Practical -III	Project

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Course Structure for F.Y.B.Sc. Physics 2022-23

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

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

Academic Year 2022-2023

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

USPH 121: Heat and Thermodynamics

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

A) Learning Outcome:

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

1 Describe the thermodynamic properties of a material.

2 Understand the ideal gas equation and its limitations.

3 Understand the real gas equation.

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

5 Understand principle of heat engines and calculate thermal efficiency.

6 Understand the principle of the refrigerators to calculate coefficient of performance

7 Understand phenomenon of 'entropy'

8 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)

3.1 Introduction (Joules law of heating)

3.2 Heat and work

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

3.4 Second law of thermodynamics

3.5 Concept of entropy, Enthalpy, Free energy

3.6 Maxwell's relations in thermodynamics

3.7 T-dS Equations

3.8 Clausius-Clapeyron First Latent heat equations

3.9 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

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:

1. To understand the general structure of atom, spectrum of hydrogen atom.
2. To understand the atomic excitation and LASER principles.
3. To understand the bonding mechanism and its different types.
4. To demonstrate an understanding of electromagnetic waves and its spectrum.
5. Understand the types and sources of electromagnetic waves and applications.
6. To demonstrate quantitative problem-solving skills in all the topics covered.

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.

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:

1. Acquire technical and manipulative skills in using laboratory equipment, tools and materials.
2. Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
3. Demonstrate an understanding of laboratory procedures including safety and scientific methods.
4. Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
5. Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

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