S.Y.B.Sc. (Physics)
Semester-III
&
Semester-IV
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 S.Y.B.Sc. Physics 2022 Pattern

Semester	Paper Code	Title of Paper	No. of Credits
III	USPH231	Mathematical Methods of Physics-I	3
	USPH232	Electronics/Instrumentation	3
	USPH233	Practical-I	2
IV	USPH241	Oscillations, waves, and Sound	3
	USPH242	Optics	3
	USPH243	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

CBCS Syllabus for S.Y.B.Sc. Physics (2022 Pattern)

Name of the Programme	**:** B.Sc. Physics
Programme Code	**:** USPH
Class	**:** S.Y.B.Sc.
Semester	**:** IV
Course Type	**:** Theory
Course Code	**:** USPH241
Course Title	**:** Oscillations, Waves and Sound
No. of Credits	**:** 03
No. of Teaching Hours	**:** 48

Course Objectives:

1. To learn about oscillations and vibrations
2. To understand the properties of waves
3. The course aims at developing a clear understanding of the fundamental concepts in oscillations, sound and waves and the application in real life oscillatory, sound, and optical systems, in communication and other applications.
4. To understand the properties of sound
5. To explain characteristics of sound
6. It introduces mechanical and electromagnetic waves and explores different wave phenomena like phase and group velocity, standing and propagating waves.
7. The course also includes an introduction to oscillation and wave analysis using Fourier transformations.

Course Outcomes:

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

CO1: Understand the mathematical description of travelling and standing waves.

CO2: Recognize the one-dimensional classical wave equation and its solutions.

CO3: Calculate the phase velocity of a travelling wave.

CO4: Explain in qualitative terms how frequency, amplitude, and wave shape affect the pitch, intensity, and quality of tones produced by musical instruments.

CO5: Understand physical characteristics of SHM and obtaining solution of the oscillator using differential equations

CO6: Calculate logarithmic decrement relaxation factor and quality factor of a harmonic oscillator.

CO7: Describe and calculate what happens when waves move from one medium to another and are able to explain dispersion and group and phase velocity.

Topics and Learning Points

Unit-1: Simple Harmonic Oscillations [16L]

Simple harmonic oscillator, and solution of the differential equation- Physical characteristics of SHM, torsion pendulum, - measurements of rigidity modulus, compound pendulum, measurement of 'g', Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy consideration with undamped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance, velocity resonance, problem solving.

Unit-2: Damped and Forced Oscillations [10L]

Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, Comparison with un-damped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance and velocity resonance, problem solving.

Unit-3: Wave Motion [10L]

Electromagnetic wave, frequency, amplitude, period, wavelength and wave equation, concept of wave motion, transverse waves on a string, travelling and standing waves on a string, normal modes of a string, group velocity, phase velocity, plane waves, spherical waves, wave intensity, problem solving.

Unit 4: Sound [12L]

Longitudinal wave, sound velocity, intensity, amplitude, frequency, acoustic parameters, simple harmonic motion, forced vibrations and resonance, application to saw tooth wave and square wave, intensity and loudness of sound, decibel, intensity level, musical notes, musical scale, reverberation, time of reverberation and its measurement, absorption coefficient, Sabine's formula, acoustic aspects of auditorium. problem solving.

References:

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. Waves and Oscillations, R.N. Chaudhari, New age international (p) ltd.

5. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986.Addison-Wesley

6. Sound, Mee, Heinmann, Edition - London

Mapping of USPH241: Oscillations, Waves and Sound

Programme Outcomes									
Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3								
CO2	3								
CO3		3							
CO4									
CO5	3								
CO6		3							
CO7				3					

Justification

PO1: Disciplinary Knowledge

CO1: Understand the mathematical description of travelling and standing waves.Weightage: 3

The understanding of the mathematical description of waves is foundational to the broader knowledge in waves and oscillations. Without a strong grasp of the mathematical representations, it is challenging to progress in the study of wave phenomena.

CO2: Recognize the one-dimensional classical wave equation and its solutions.Weightage: 3

Recognizing the classical wave equation and its solutions is directly aligned with the mathematical description of waves. This knowledge is fundamental for understanding how waves propagate and behave.

CO5: Understand physical characteristics of SHM and obtaining the solution of the oscillator using differential equations.Weightage: 3

Simple Harmonic Motion (SHM) is a type of oscillatory motion that is directly related to wave phenomena. Understanding the physical characteristics of SHM involves dealing with differential equations, which are essential for describing oscillatory behavior.

PO2: Critical Thinking and Problem Solving

CO3: Calculate the phase velocity of a travelling wave.Weightage: 3

Calculating the phase velocity requires critical thinking and problem-solving skills as it involves applying mathematical concepts to understand the motion of waves and their speed.

CO6: Calculate logarithmic decrement relaxation factor and quality factor of a harmonic oscillator.Weightage: 3

Calculating the logarithmic decrement and quality factor involves solving complex mathematical equations related to the behavior of a harmonic oscillator. This requires critical thinking skills to analyze and interpret the results.

PO4: Research-related Skills and Scientific Temper

CO7: Describe and calculate what happens when waves move from one medium to another and are able to explain dispersion and group and phase velocity.Weightage: 3

Understanding wave behavior when moving between media involves scientific temper and research-related skills. Describing and calculating dispersion, group and phase velocity requires a research-oriented approach to comprehend and apply these concepts.

CBCS Syllabus for S.Y.B.Sc. Physics (2022 Pattern)

Name of the Programme	**:** B.Sc. Physics
Programme Code	**:** USPH
Class	**:** S.Y.B.Sc.
Semester	**:** IV
Course Type	**:** Theory
Course Code	**:** USPH242
Course Title	**:** Optics
No. of Credits	**:** 03
No. of Teaching Hours	**:** 48

Course Objectives:

The specific learning objectives of this paper are as follows:

1. To learn the basic principles of geometric optics.
2. To apply the lens and mirror equations to determine image distances and magnifications for various optical systems.
3. To understand various optical aberrations, such as monochromatic aberration and chromatic aberration.
4. To be familiar with various optical instruments, including microscopes, eye pieces.
5. To understanding the wave nature of light, including topics like interference, diffraction.
6. To Understand the polarization of light, including the concept of polarizers, polarized light.
7. To developing the ability to solve complex problems related to optics.
8. To get hands-on experience with optical experiments and measurements in a laboratory

Course Outcomes:

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

CO1: Acquire the basic concept of wave optics.

CO2: Explain why a light beam spread out after passing through an aperture.

CO3: Understand the operation of many modern optical devices that utilize wave optics.

CO4: Describe how light can constructively and destructively interfere.

CO5: Summarize the polarization characteristics of electromagnetic wave.

CO6: Understand optical phenomenon such polarization, diffraction, and interference in terms of the wave model.

CO7: Analyze simple example of interference and diffraction.

CO8: Perform optical experiments and do measurements of optical parameters.

Topics and Learning Points

UNIT 1: Geometrical optics and Lens aberrations (16 L)

1.1. Introduction to lenses and sign conventions.

1.2. Thin lenses: Lens equation for single convex lens.

1.3. Lens maker formula.

1.4. Concept of magnification, deviation, and power of a thin lens.

1.5. Equivalent focal length of two thin lens system.

1.6. Concept of cardinal points.

1.7. Introduction to Aberration.

1.8. Types of aberration: Monochromatic and Chromatic Aberration (Only discussion).

1.9. Problems

UNIT 2: Optical Instruments (6L)

2.1 Introduction to optical instruments.

2.2 Types of optical instruments: Simple Microscope, Compound Microscope.

2.3 Eyepiece: Ramsden's eye piece, Huygens eye piece.

2.4 Problems.

UNIT 3: Interference and Diffraction (16 L)

3.1 Introduction to interference.

3.2 Types of Interference.

3.3 Phase change on reflection (Stokes treatment).

3.4 Interference due to reflected light.

3.5 Interference due to transmitted light. Newton's ring (to calculate wavelength).

3.6 Introduction to diffraction.

3.7 Types of diffraction.

3.8 Fraunhoffer's diffraction due to single slit and double slit (only qualitative discussion).

3.9 Plane transmission grating and grating equation.

3.10 Rayleigh criterion for resolution (only qualitative discussion)

3.11 Problems

UNIT 4: Polarization (10 L)

4.1 Introduction to polarization

4.2 Brewster's law

4.3 Malus's Law

4.4 Polarization by double refraction

4.5 Nicol Prism.

4.6 Application of polarization

4.7 Problems

References:

1. Optics - A.R. Ganesan, 4th edition, Pearson Education.
2. A Textbook of Optics - N. Subhramanyam, Brijlal, M.N. Avadhanulu, S. Chand Publication.
3. Physical Optics - A.K. Ghatak, McMillan, New Delhi
4. Fundamental of Optics - F.A. Jenkins, H.E.White, Mc Graw-Hilll International edition
5. Principles of Optics - D.S. Mathur, Gopal Press, Kanpur.

Mapping of USPH242: Optics

Programme Outcomes									
Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	3								
CO2		3							
CO3				3					
CO4									
CO5									
CO6	3								
CO7		3							

Justification

PO1: Disciplinary Knowledge

CO1: Acquire the basic concept of wave optics.Weightage: 3

Acquiring the basic concepts of wave optics is fundamental to disciplinary knowledge. This forms the foundation for understanding the behavior of light as a wave and is essential for progressing in the study of optics.

CO6: Understand optical phenomena such as polarization, diffraction, and interference in terms of the wave model.Weightage: 3

Understanding optical phenomena in terms of the wave model is crucial for gaining disciplinary knowledge in wave optics. It directly relates to the foundational concepts of wave optics.

CO8: Perform optical experiments and do measurements of optical parameters.Weightage: 2

Performing experiments and measurements is a practical aspect of disciplinary knowledge. While it is not directly about understanding wave optics concepts, it enhances the overall understanding and application of the knowledge acquired in the discipline.

PO2: Critical Thinking and Problem Solving

CO2: Explain why a light beam spread out after passing through an aperture.Weightage: 3

Explaining the phenomenon of light beam spreading out through an aperture requires critical thinking skills. It involves applying the principles of wave optics to analyze and solve the problem.

CO7: Analyze simple examples of interference and diffraction.Weightage: 3

Analyzing interference and diffraction examples involves critical thinking skills. It requires the ability to apply wave optics concepts to understand and interpret optical phenomena.

PO4: Research-related Skills and Scientific Temper

CO3: Understand the operation of many modern optical devices that utilize wave optics.Weightage: 3

Understanding the operation of modern optical devices involves scientific temper and research-related skills. It requires the ability to apply wave optics concepts to analyze and comprehend the functioning of advanced optical technologies.

CBCS Syllabus for S.Y.B.Sc. Physics (2022 Pattern)

Name of the Programme	**:** B.Sc. Physics
Programme Code	**:** USPH
Class	**:** S.Y.B.Sc.
Semester	**:** IV
Course Type	**:** Practical
Course Code	**:** USPH243
Course Title	**:** Practical-II
No. of Credits	**:** 03
No. of Teaching Hours	**:** 48

Course Objectives:

1. To develop analytical abilities toward real-world problems
2. To familiarize with current and recent scientific and technological developments
3. To enrich knowledge through problem-solving, hands-on activities, study visits, projects etc
4. To help develop habit of practice in the experimental skill developments.
5. To introduce students to different apparatus & instruments, and demonstrate the skill based experiments.
6. To explain association between theoretical ideas and experimental skills.
7. To help grow confidence while performing the practical individually.

Course Outcomes:

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

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: Understand physical characteristics of SHM and obtaining solution of the oscillator using differential equations

CO7: Calculate logarithmic decrement relaxation factor and quality factor of a harmonic oscillator

Topics and Learning Points

List of Experiments: (Students must perform Any 8 Experiments)

1. Study of spectrometer and determination of angle of prism
2. Determination of wavelength of LASER light by plane diffraction grating
3. Study of laser beam diversity.
4. Thickness of sharp blade by laser diffraction.
5. Verification of inverse square law.
6. Velocity of sound by phase shift method
7. Measurement of coefficient of absorption of sound for different materials (cork, thermocol, mica, paper etc.)
8. Coupling strength of Coupled Oscillator
9. Determination of wavelength of light using Newton's Ring method.
10. Directional characteristics of Microphone.
11. Plotting various trigonometric functions using MS-excel/Origin software: sinx, cosx, tanx, e^{x} , e^{-x} , logx, lnx, x^{n}
12. Least Square Fitting
13. Equations and Graphs using MS-excel for the following figures: circle, ellipse, parabola, hyperbola.

Additional Activities

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

1. Light reflection, refraction, diffraction etc
2. Newton's ring
3. Telescope

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

1. A.C Sonometer
2. Doppler Effect
3. Newton's Rings-Wavelength of light
4. Laser beam divergence and spot size

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

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

OR

2. Industrial Visit /Study Tour / Field Visit

❖ Students must perform at least two additional activities out of three activities in addition to eight experiments mentioned above. Total Laboratory work with additional activities should be equivalent to TEN

Mapping of USPH243: Practical-II

Programme Outcomes									
Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1									
CO2		**3**		**3**					
CO3									
CO4		**3**							
CO5			**3**						
CO6	**3**								
CO7	**3**								

Justification

PO1: Disciplinary Knowledge

CO6: Understand physical characteristics of SHM and obtain the solution of the oscillator using differential equations.Weightage: 3

Understanding the physical characteristics of Simple Harmonic Motion (SHM) and solving differential equations are directly related to disciplinary knowledge in physics and oscillatory motion.

CO7: Calculate logarithmic decrement relaxation factor and quality factor of a harmonic oscillator.

Weightage: 3

Calculating logarithmic decrement and quality factor involves applying advanced concepts related to harmonic oscillators, contributing directly to disciplinary knowledge in the field of physics.

PO2: Critical Thinking and Problem Solving

CO2: Demonstrate an ability to collect data through observation and/or experimentation and interpret data.

Weightage: 3

Collecting and interpreting data require critical thinking skills. These skills are crucial for analyzing experimental results and drawing meaningful conclusions, contributing to problem-solving abilities.

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

Visualizing abstract concepts as authentic phenomena requires critical thinking. This skill enhances the understanding of theoretical concepts, contributing to a deeper level of comprehension.

PO3: Social Competence

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

Weightage: 3

Collaborative learning and teamwork in laboratory settings directly contribute to social competence. Working effectively with others in a scientific context is essential for success and mirrors real-world professional collaborations.

PO4: Research-related Skills and Scientific Temper

CO2: Demonstrate an ability to collect data through observation and/or experimentation and interpret data.

Weightage: 3

The ability to collect and interpret data is a fundamental research-related skill. It reflects a scientific temper and is essential for conducting meaningful research within the discipline.