Anekant Education Society's

Tuljaram Chaturchand College
of Arts, Science and Commerce, Baramati
(Empowered Autonomous)

Four Year B.Sc. Degree Program in Physics

(Faculty of Science & Technology)

CBCS Syllabus

S.Y.B.Sc. (Physics) Semester -IV

For Department of Physics

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2024-2025

Title of the Programme: S.Y.B.Sc. (Physics)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Physics and related subjects, the Board of Studies in Physics at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the third semester of S.Y.B.Sc. Physics, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.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.

• Programme Specific Outcomes (PSOs)

PSO1: Understand basic mechanics and properties of matter.

PSO2: Illustrate the principles of electricity, magnetism, thermodynamics, optics and spectroscopy.

PSO3: Identify, formulate and analyze complex problems using basic principles of mathematics, physics and statistics.

PSO4: Design, construct and analyze basic electronic and digital circuits.

PSO5: Understand the basics of programming language and apply it to various numerical problems

PSO6: Develop effective communication skills

PSO7: Develop experimental skills and independent work culture through a series of experiments that compliment theories and projects.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Board of Studies (BOS) in Physics

From 2022-23 to 2024-25

Sr. No.	Name	Designation
1	Prof.Dr.A.E.Kalange	Vice-Principal, Chairman, BOS
2	Prof.Dr.S.S.Veer	Member, Expert from SPPU, Pune
3	Prof.Dr.K.Y.Rajpure	Member, Exprt from Shivaji University, Kolhapur
4	Prof.Dr.K.R.Priolkar	Member, Exprt from Goa University
5	Mr.Subhash Zambare	Representative from Industry
6	Dr.Swapnil Nardekar	Alumni & Research Scholar at Jehu National University, South Korea
7	Dr.R.D.Kale	Member
8	Dr.R.T.Sapkal	Member
9	Dr.S.B.Kulkarni	Member
10	Mr.S.B.Kakade	Member
11	Dr.V.S.Mohite	Member
12	Mrs.S.E.Bhosale	Member
13	Mr.S.S.Mhaske	Member
14	Mr.S.M.Thorat	Member
15	Phadtare Dnyneshwari	Student Representative
16	Hole Dhanshree	Student Representative

Credit Distribution Structure for S.Y.B.Sc.-2024-2025 (Physics)

Level	Semester	Major		Minor	GE/OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	III	PHY-201-MJM: Mathematical Methods in Physics PHY-202-MJM: Analog Electronics PHY-203-MJM: Basic Optics PHY-204-MJM: Practical –III Credits-2+2+2+2	--	PHY-211-MN Thermometry PHY-212-MN Minor Practical Credits-2+2	PHY-216-OE: Astronomy-III Credit- 2	PHY-221-VSC: Physics Workshop Skills-II Credit- 2	MAR/HIN/SAN-231-AEC: Credit- 2	PHY-235FP CC To be selected from the Basket Credit- 2+2	22	UG Certificate 44
	IV	PHY-251-MJM: Waves and Oscillations PHY-252-MJM – Digital Electronics PHY-253-MJM: Advanced Optics PHY-254-MJM: Practical –IV Credits-2+2+2+2	--	PHY-261-MN Atoms and Molecules PHY-262-MN Minor Practical Credits-2+2	PHY-266-OE: Astronomy-III (Practical) Credit- 2	PHY-276-SEC: Python programming in Physics Credit- 2	MAR/HIN/SAN-281-AEC: Credit- 2	PHY-285-CEP CC: To be selected from the Basket Credit- 2+2	22	
	Cum Cr.	**16**	**--**	**8**	**4**	**4**	**4**	**8**	**44**	

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
(Autonomous) S.Y. B.Sc. PHYSICS 2024-25

Sem	Course Type	Course Code	Course Title	Theory / Practical	Credits
III	Major Mandatory	PHY-201-MJM	Mathematical Methods in Physics	Theory	02
	Major Mandatory	PHY-202-MJM	Analog Electronics	Theory	02
	Major Mandatory	PHY-203-MJM	Basic Optics	Theory	02
	Major Mandatory	PHY-204-MJM	Practical –III	Practical	02
	Minor	PHY-241-MN	Thermometry	Theory	02
	Minor	PHY-242-MN	Minor Practical	Practical	02
	Open Elective (OE)	PHY-216-OE	Astronomy-III	Theory	02
	Vocational Skill Course (VSC)	PHY-221-VSC	Data Analysis and Graphing Software	Theory	02
	Ability Enhancement Course (AEC)	MAR-231-AEC HIN-231-AEC SAN-231-AEC	भाषिक उपयोजन व लेखन कौशल्ये हिंदी भाषा : सृजन कौशल प्राथमिक संभाषण कौशल्यम्	Theory	02
	Field Project (FP)	PHY-235-FP		Practical	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/ NCC-239-CC	To be selected from the Basket	Theory	02
				Total Credits Semester-III	**22**
IV	Major Mandatory	PHY-251-MJM	Waves and Oscillations	Theory	02
	Major Mandatory	PHY-252-MJM	Digital Electronics	Theory	02
	Major Mandatory	PHY-253-MJM	Advanced Optics	Theory	02
	Major Mandatory	PHY-254-MJM	Practical-IV	Practical	02
	Minor	PHY-261-MN	Atoms and Molecules	Theory	02
	Minor	PHY-262-MN	Practical	Practical	02
	Open Elective (OE)	PHY-266-OE	Astronomy-III	Practical	02
	Skill Enhancement Course (SEC)	PHY-276-SEC	Python Programming in Physics	Practical	02
	Ability Enhancement Course (AEC)	MAR-281-AEC HIN-281-AEC SAN-281-AEC	लेखननिर्मिती व परीक्षण कौशल्ये हिंदी भाषा : संप्रेषण कौशल प्रगत संभाषण कौशल्यम्	Theory	02
	Community Engagement Project (CEP)	PHY-285-CEP		Practical	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS/ NCC-289-CC	To be selected from the Basket	Theory	02
				Total Credits Semester-IV	**22**
				Cumulative Credits Semester III + Semester IV	**44**

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Major Mandatory (Theory)

Course Code : PHY-251-MJM

Course Title : Waves and Oscillations

No. of Credits : 02

No. of Teaching Hours : 30

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.

Course Outcome:

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: Application oriented problems

Topics and learning Points

Unit 1: Simple Harmonic Oscillations [8 L]

1.1.Simple harmonic oscillator and solution of the differential equation

1.2. Physical characteristics of SHM

1.3.Torsion pendulum, - measurements of rigidity modulus,

1.4.Compound pendulum, measurement of 'g',

1.5.Examples

Unit 2: Damped and Forced Oscillations [10 L]

2.1. Damped harmonic oscillator solution of the differential equation of damped oscillator

2.2. Energy considerations, logarithmic decrement

2.3. Relaxation time, quality factor

2.4 Differential equation of forced oscillator and its solution

2.5. Amplitude resonance

2.6. Velocity resonance

2.7 Examples

Unit 3: Wave Motion [12 L]

3.1 Concept of wave motion.

3.2. Electromagnetic wave and frequency

3.3. Wavelength and wave equation

3.4. Amplitude and period

3.5. Transverse waves on a string

3.6. Travelling and standing waves on a string

3.7. Normal modes of a string

3.8. Plane waves and spherical waves

3.9. Examples

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 Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Waves and Oscillations **Course Code**: PHY-251-MJM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	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	1	3		1			3
CO 2	3	3	1	3		2			3
CO 3	3	3			2				
CO 4	2	2	2		3		2	2	
CO 5	3	3		3					
CO 6	3	3		3					
CO7	3	3	2	3	3	3	2	2	3

Justification

PO1: Disciplinary Knowledge

CO1 (3): Understanding wave motion requires strong mathematical and physical knowledge, which is a fundamental part of disciplinary expertise.

CO2 (3): The classical wave equation and its solutions are core physics topics, directly related to disciplinary knowledge.

CO3 (3): Calculating phase velocity involves mathematical principles and physics concepts, showcasing strong disciplinary knowledge.

CO4 (2): Qualitative analysis of wave properties links to foundational knowledge but less directly than CO1 or CO2.

CO5 (3): Solving SHM using differential equations is a core physics skill.

CO6 (3): Concepts like logarithmic decrement and quality factor require a solid understanding of oscillatory systems in physics.

CO7 (3): Application-oriented problems necessitate a strong grasp of disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO1 (2): Understanding mathematical descriptions involves critical thinking but less direct problem-solving.

CO2 (3): Recognizing and solving the wave equation emphasizes problem-solving and critical analysis.

CO3 (3): Calculating phase velocity requires analytical skills.

CO4 (2): Explaining qualitative aspects demands critical thinking but involves less direct problem-solving.

CO5 (3): Applying differential equations to solve SHM is problem-solving-centric.

CO6 (3): Computing quality factors demonstrates critical and analytical thinking.

CO7 (3): Real-world applications require critical thinking and practical problem-solving.

PO3: Social Competence

CO1 (1): Minimal link; foundational understanding doesn't directly impact social skills.

CO2 (1): Solving equations has limited social relevance.

CO4 (2): Explaining wave behavior in musical tones has societal relevance in understanding sound and its applications.

CO7 (2): Application-based problems can have societal implications, linking physics to broader contexts.

PO4: Research-related Skills and Scientific Temper

CO1 (3): Wave concepts form the basis of experimental and theoretical research.

CO2 (3): Solutions of wave equations are essential in physics research.

CO5 (3): Analytical skills for solving oscillatory systems promote scientific temper.

CO6 (3): Calculating oscillatory parameters is crucial for experimental research and analysis.

CO7 (3): Application problems foster research-oriented thinking**.**

PO5: Trans-disciplinary Knowledge

CO3 (2): Phase velocity concepts can connect physics to engineering and technology.

CO4 (3): Explaining sound properties links physics with music and acoustics.

CO7 (3): Application problems encourage integration of physics with other disciplines.

PO6: Personal and Professional Competence

CO1 (1): Limited direct impact on personal or professional competence.

CO6 (2): Understanding oscillatory properties can contribute to professional growth in specialized fields.

CO7 (3): Application-based learning fosters problem-solving skills useful in professional settings.

PO7: Effective Citizenship and Ethics

CO4 (2): Understanding sound properties has ethical implications in reducing noise pollution and improving societal well-being.

CO7 (2): Application-oriented problems can address real-world ethical issues.

PO8: Environment and Sustainability

CO4 (2): Understanding wave behavior in musical instruments contributes indirectly to sustainable practices, such as sound management.

CO7 (2): Real-world applications can include sustainability-focused problems.

PO9: Self-directed and Life-long Learning

CO1 (3): Mathematical descriptions encourage lifelong learning in physics.

CO2 (3): Learning classical wave equations builds a foundation for advanced studies.

CO7 (3): Application-based learning fosters curiosity and independent exploration.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Major Mandatory (Theory)

Course Code : PHY-252-MJM

Course Title : Digital Electronics

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

The course objectives of this syllabus typically to focus on equipping students with knowledge and skills related to the design, analysis, and application of digital systems. Following are the course objectives of this course:

1. Learn the basic concepts of digital electronics, including binary systems, Boolean algebra, and logic gates.
2. Develop skills in analysing and designing combinational circuits like multiplexers, decoders, encoders, and arithmetic circuits (e.g., adders, subtractors).
3. Study the principles of flip-flops, counters, registers, and state machines.
4. Master binary, octal, hexadecimal number systems and understand binary arithmetic.
5. Use Karnaugh maps and Boolean algebra simplification techniques to minimize logic circuits.
6. Gain hands-on experience with simulation tools to design and test digital circuits.
7. Understand the practical applications of digital circuits.
8. Engage in problem-solving and project-based activities to develop thinking and practical knowledge in digital circuit design.

Course Outcomes:

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

CO1. Students will be able to explain the fundamental concepts of digital logic, including binary systems, logic gates, and Boolean algebra.

CO2. Students will be able to design and analyse combinational logic circuits such as adders, multiplexers, decoders, and encoders.

CO3. Students will be able to design and implement sequential circuits like flip-flops, registers, counters.

CO4. Students will demonstrate the ability to simplify complex Boolean expressions using Karnaugh maps and Boolean algebra to optimize circuit designs.

CO5. Students will understand different number systems (binary, octal, decimal, hex)

CO6. Students will gain hands-on experience using simulation software to design, simulate, and test digital circuits.

CO7. Students will develop problem-solving abilities and thinking skills.

Topics and Learning Points

UNIT 1: NUMBER SYSTEM AND BOOLEAN ALGEBRA [10L]

1.1 Binary Number system, Decimal to Binary and Binary to Decimal Conversion, Octal Numbers, Hexadecimal Numbers, Binary Addition, Binary Subtraction using 2's Complement Method. ASCII code, Excess-3 code, Gray Code

1.2 Basic Gates- AND, OR and NOT Gates. XOR and XNOR Gates, NAND and NOR Gates as Universal Gates.

1.3 Boolean Laws. Simplification of Logic Circuit using Boolean algebra, De Morgan’s Theorems

UNIT 2: COMBINATIONAL CIRCUIT [10L]

2.1 Introduction to SOP and POS techniques

2.2 Reduction of Boolean expression using K-map methods (up to 4 variables),

2.3 Design of half adder, full adder, half subtractor, full subtractor

2.4 Introduction to multiplexer (4:1) and de multiplexer (1:4)

UNIT 3: SEQUENTIAL CIRCUIT [10L]

3.1 Flip flops: RS flip flop using NAND/NOR clocked RS, D, JK, and T flip flops, preset and clear inputs.

3.2 Counters 4-bit ripple counter, 4-bit parallel counter.

3.3 Registers, Buffer registers (SISO, SIPO, PISO, PIPO) use of register as a memory.

References:

1. Digital Fundamentals by T. L. Floyd, Pearson International Publications, Ninth Edition, 2000.
2. Electronics Principles by Malvino and Leach, Mc. Graw Hill, Third edition. 2000.
3. Modern Digital Electronics by R P Jain, Tata McGraw-Hill Education, 2003.
4. Electronics Analog and Digital by I. J. Nagrath, PHI Learning Pvt. Ltd., 2013 Edition.
5. Principles of Digital Electronics by K. Meena, PHI Learning Pvt. Ltd., Fourth Printing, 2013.
6. Basic Electronics by R. S. Sedha, S. Chand publication

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Digital Electronics **Course Code**: PHY-252-MJM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	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	3	1	3	2	2			3
CO 2	3	3		3	3		2	2	
CO 3	3	3				3			
CO 4	3	3		3				2	3
CO 5	3								
CO 6	3	3	2	3	3	3	2		3
CO7	3	3	2	3	3	3	2	2	3

Justification

PO1: Disciplinary Knowledge

CO1 (3): Fundamental concepts of digital logic, binary systems, and Boolean algebra are foundational knowledge for the discipline of digital electronics.

CO2 (3): Designing and analyzing combinational circuits require strong disciplinary knowledge.

CO3 (3): Sequential circuit design is a core skill in digital electronics.

CO4 (3): Simplifying Boolean expressions is central to optimizing digital systems.

CO5 (3): Understanding number systems is foundational to digital electronics.

CO6 (3): Practical work with simulation software enhances disciplinary expertise.

CO7 (3): Problem-solving abilities stem directly from core disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO1 (2): Explaining basic concepts involves critical thinking but less active problem-solving.

CO2 (3): Designing combinational circuits requires analytical and problem-solving skills.

CO3 (3): Sequential circuit implementation involves critical thinking and iterative problem-solving.

CO4 (3): Simplifying complex Boolean expressions demands advanced problem-solving techniques.

CO6 (3): Simulating and testing circuits enhances analytical thinking and practical problem-solving.

CO7 (3): Problem-solving and critical thinking are explicitly addressed in this outcome.

PO3: Social Competence

CO1 (1): Limited relevance to social competence.

CO6 (2): Collaborative work in simulation software fosters teamwork and communication skills.

CO7 (2): Problem-solving abilities can enhance collaborative environments and group tasks.

PO4: Research-related Skills and Scientific Temper

CO1 (2): Understanding fundamental concepts aids in developing a scientific temper.

CO2 (3): Designing and analyzing circuits fosters a research-oriented mindset.

CO4 (3): Simplification techniques like Karnaugh maps promote systematic and research-driven approaches.

CO6 (3): Simulation and testing of circuits enhance experimental research skills.

CO7 (3): Developing problem-solving skills contributes to scientific inquiry and research aptitude.

PO5: Trans-disciplinary Knowledge

CO1 (2): Concepts like Boolean algebra have applications in mathematics and computer science.

CO2 (3): Circuit design connects electronics with other domains like computer engineering.

CO6 (3): Simulation software bridges digital electronics and software engineering.

CO7 (3): Problem-solving often requires integrating knowledge from multiple disciplines.

PO6: Personal and Professional Competence

CO1 (2): Foundational knowledge contributes indirectly to professional competence.

CO3 (3): Sequential circuit design enhances professional expertise.

CO6 (3): Hands-on experience with software tools builds career-ready skills.

CO7 (3): Problem-solving and critical thinking are key to personal and professional growth.

PO7: Effective Citizenship and Ethics

CO2 (2): Designing circuits with optimized resource usage aligns with ethical engineering practices.

CO6 (2): Simulation tools can promote ethical decision-making in digital circuit design.

CO7 (2): Problem-solving abilities can contribute to societal and ethical responsibilities.

PO8: Environment and Sustainability

CO2 (2): Optimized circuit designs contribute to reduced energy consumption and sustainable engineering.

CO4 (2): Simplifying Boolean expressions supports resource-efficient circuit implementation.

CO7 (2): Practical problem-solving can consider environmental factors in digital design.

PO9: Self-directed and Life-long Learning

CO1 (3): Understanding fundamental concepts builds a strong base for lifelong learning.

CO4 (3): Simplification techniques encourage independent exploration and deeper understanding.

CO6 (3): Hands-on practice fosters curiosity and self-learning.

CO7 (3): Developing thinking skills promotes adaptability and continuous learning.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Major Mandatory (Theory)

Course Code : PHY-253-MJM

Course Title : Advanced Optics

No. of Credits : 02

No. of Teaching Hours : 30

Teaching Hours : 30

Course Objectives:

1.The course on Optics aims to provide students with a fundamental understanding of the behaviour and properties of light and its interaction with matter

2.Construct ray diagrams for converging and diverging lenses in order to locate the image

3. Calculate the magnification of a lens

4. Distinguish between real and virtual images

Course Outcomes:

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

CO1: Understanding of Basic Optics Principles.

CO2: Application of Optical Theories to solve real-world problems.

CO3: Hands-on experience with optical instruments such as lenses, mirrors, microscopes, and telescopes, understanding their design and working principles.

CO4: understanding dual nature of light, as both a wave and a particle in various contexts.

CO5: Develop ability to mathematical model and predict light behaviour in different media using equations like Snell's Law, lens formulas etc.

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

CO7: Technological Applications of Optics in modern technologies such as lasers, holography, optical fibre and optical communication system etc.

Topics and Learning Points

UNIT 1: Interference **[11 L]**

1.1 Revision to Interference

1.2 Phase change on reflection (Stokes Treatment)

1.3 Interference by parallel sided thin films

1.4 Interference due to reflected light

1.5 Interference due to refracted light

1.6 Interference due to Wedge Shaped thin film

1.7 Principle, construction and working of Michelson Interferometer & its applications.

1.8 Newton's Rings

1.9 Problems.

UNIT 2: Diffraction **[11 L]**

2.1 Types of Diffraction: Fresnel's diffraction and Fraunhoffer's diffraction

2.2 Fraunhoffer's diffractions at a double slit

2.3 Plane diffraction grating

2.4 Rayleigh's criterion for resolution

2.5 Problems.

UNIT 3: Polarization **[08 L]**

3.1 Introduction

3.3 Brewster's law

3.4 Law of Malus

3.4 Polarization by double refraction.

3.5 Nicol prism.

3.6 Elliptically and circularly polarized light

3.7 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 Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Advanced Optics **Course Code**: PHY-253-MJM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	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	1	2					3
CO 2	3	3			3		2	2	
CO 3	3	3	2	3	3	3			3
CO 4	3								
CO 5	3	3		3		3			3
CO 6	3	3		3					
CO7	3	3	2	3	3	3	3	3	3

Justification

PO1: Disciplinary Knowledge

CO1 (3): Understanding basic optics principles is foundational to the discipline of optics and photonics.

CO2 (3): Applying optical theories to real-world problems is a direct demonstration of core disciplinary knowledge.

CO3 (3): Hands-on experience with optical instruments solidifies theoretical knowledge and practical understanding.

CO4 (3): Understanding the dual nature of light is fundamental to optics and quantum mechanics.

CO5 (3): Mathematical modeling of light behavior requires in-depth knowledge of physics and optics principles.

CO6 (3): Understanding phenomena like polarization and diffraction reflects core disciplinary expertise.

CO7 (3): Applications in lasers, holography, and fiber optics are key areas of modern optical science.

PO2: Critical Thinking and Problem Solving

CO1 (2): Basic understanding requires critical thinking but not extensive problem-solving.

CO2 (3): Solving real-world optical problems requires strong critical thinking and analytical skills.

CO3 (3): Hands-on experimentation involves troubleshooting and problem-solving.

CO5 (3): Mathematical modeling of light behavior emphasizes problem-solving.

CO6 (3): Analyzing optical phenomena demands critical thinking and interpretation of experimental results.

CO7 (3): Technological applications require creative problem-solving in practical scenarios.

PO3: Social Competence

CO1 (1): Basic understanding of optics has limited direct relevance to social competence.

CO3 (2): Working with optical instruments in group settings fosters teamwork and collaboration.

CO7 (2): Technological applications like fiber optics and communication systems can improve social infrastructure and quality of life.

PO4: Research-related Skills and Scientific Temper

CO1 (2): Basic principles of optics encourage curiosity and scientific exploration.

CO3 (3): Hands-on experience with instruments is crucial for experimental research.

CO4 (3): Understanding the dual nature of light fosters a research-oriented mindset.

CO5 (3): Mathematical modeling of light behavior supports research in theoretical and applied optics.

CO6 (3): Analysis of polarization, diffraction, and interference is essential for experimental and theoretical research.

CO7 (3): Applications in advanced technologies like lasers and optical communication encourage innovation and research.

PO5: Trans-disciplinary Knowledge

CO2 (3): Applying optical theories connects physics with engineering, materials science, and communication technologies.

CO3 (3): Hands-on instrument experience integrates optics with mechanical and electronic engineering.

CO7 (3): Applications like optical fiber communication link optics with IT and telecommunications.

PO6: Personal and Professional Competence

CO3 (3): Hands-on experience with instruments builds career-ready technical skills.

CO5 (3): Developing mathematical models enhances professional competence.

CO7 (3): Technological applications are directly relevant to modern industries and professional development.

PO7: Effective Citizenship and Ethics

CO2 (2): Solving real-world optical problems can have societal benefits, such as improving health care or communication.

CO7 (3): Applications like optical communication systems and sustainable technologies contribute to societal well-being.

PO8: Environment and Sustainability

CO2 (2): Applying optical theories to solve real-world problems can promote sustainable solutions.

CO7 (3): Modern optical technologies, such as energy-efficient lasers and optical fibers, contribute to environmental sustainability.

PO9: Self-directed and Life-long Learning

CO1 (3): Understanding basic principles builds a foundation for lifelong learning in optics.

CO3 (3): Hands-on learning with instruments encourages curiosity and independent exploration.

CO5 (3): Mathematical modeling skills are essential for continuous learning in physics and technology.

CO7 (3): Exploring technological applications fosters adaptability and lifelong learning.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : USPH

Class : S.Y.B.Sc.

Semester : IV

Course Type : Major Mandatory (Practical)

Course Code : PHY-254-MJM

Course Title : Practical IV

No. of Credits : 02

No. of Teaching Hours : 60

Course Outcomes:

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

CO1: Application of Oscillatory Motion: Students will understand and experimentally verify the principles of simple harmonic motion (SHM) and damped and forced oscillations

CO2: Wave Propagation and Speed Determination: Students will be able to experimentally measure the speed of sound in different media and demonstrate the relationship between wave speed, frequency, and wavelength

CO3: Mastery of Optical Instruments: Students will develop hands-on skills with optical instruments, including microscopes, spectrometers etc, for the precise measurement of optical properties

CO4: Light Phenomena Experimentation: Students will conduct experiments on interference, diffraction, and polarization of light, gaining a deeper understanding of wave nature and principles of light.

CO5: Circuit Design and Logic Implementation: Students will design and implement basic digital circuits, using logic gates to create functional systems that perform binary operations such as addition, subtraction, and logic switching

CO6: Use of Measurement Tools: Students will learn to use multimeters, oscilloscopes, and function generators for digital and analog signal measurements in the context of electronics experiments.

CO7: Problem-Solving Skills: Students will develop the ability to troubleshoot and solve problems that arise during experimental setups in the fields of waves, optics, and electronics.

List of Experiments

Students have to perform at least 8 experiments

Section I: Waves & Oscillations

1. Logarithmic decrement (in air and water).

2. Study of coupled oscillators comprising two simple pendulum (Mechanical) and determination of coupling coefficient.

3. 'g' by bar pendulum.

4. Measurement of coefficient of absorption of sound for different materials (cork, thermocol, mica, Teflon, paper etc.).

5. Directional characteristics of Microphone.

6. Velocity of sound by Phase shift method.

Section II Digital electronics:

1. Logic Gates (Basic Universal De Morgan's Theorems)

2. Half/full adder using gates

3. Half/full subtractor using gates

Section III: Optics

1.Dispersive power of glass prism.

2. Total internal reflection using LASER beam and glass prism

3. Diffraction at the edge of a razor blade

4. Optical activity of sugar solution using Polarimeter

5. Goniometer to determine cardinal points and focal length

6. Double refracting prism

Additional Activities (Any two)

1. Plotting of any two graphs using spreadsheets (of data obtained from various experiments performed by the student).

2. Any two computer aided demonstrations (Using computer simulations or animations).

3. Demonstrations –Any two demonstrations.

4. Study tour with report.

5. Mini project.

Total Experiments: 8 + Two Activities

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Major Mandatory (Practical) **Course Code**: PHY-254-MJM

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	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	3		3					3
CO 2	3	3		3	3		2	2	
CO 3	3		2		3	3			3
CO 4	3			3					
CO 5	3	3	2		3	3	2	2	3
CO 6	3	3		3		3			
CO7	3	3	2	3	3	3	2	2	3

Justification

PO1: Disciplinary Knowledge

CO1 (3): Understanding oscillatory motion is fundamental to physics and mechanics.

CO2 (3): Wave propagation principles are core concepts in physics.

CO3 (3): Mastery of optical instruments directly applies to the study of light and optics.

CO4 (3): Experimental understanding of light phenomena like interference and diffraction is critical to optics.

CO5 (3): Circuit design involves foundational knowledge of digital electronics.

CO6 (3): Using measurement tools requires knowledge of electronics and instrumentation.

CO7 (3): Problem-solving during experimental setups reflects the application of disciplinary knowledge.

PO2: Critical Thinking and Problem Solving

CO1 (3): Experimental verification of oscillatory motion develops analytical thinking.

CO2 (3): Measuring wave speed requires critical thinking and problem-solving in experimental contexts.

CO5 (3): Designing circuits involves critical thinking for functional implementation.

CO6 (3): Using tools like oscilloscopes to diagnose electronic circuits builds problem-solving skills.

CO7 (3): Troubleshooting experimental setups requires both critical thinking and practical problem-solving.

PO3: Social Competence

CO3 (2): Using optical instruments fosters teamwork and collaborative lab work.

CO5 (2): Circuit design projects can involve group collaboration, enhancing social skills.

CO7 (2): Solving experimental problems in a group setting fosters social competence.

PO4: Research-related Skills and Scientific Temper

CO1 (3): Experimenting with oscillatory motion encourages a research-oriented approach.

CO2 (3): Measuring wave speed promotes scientific temper through empirical analysis.

CO4 (3): Conducting experiments on light phenomena develops research skills.

CO6 (3): Using measurement tools builds technical skills essential for experimental research.

CO7 (3): Problem-solving during experiments fosters research-oriented thinking.

PO5: Trans-disciplinary Knowledge

CO2 (3): Wave propagation concepts connect physics with fields like acoustics and engineering.

CO3 (3): Using optical instruments integrates optics with biomedical and material sciences.

CO5 (3): Circuit design links physics with computer science and electronics engineering.

CO7 (3): Troubleshooting experimental setups fosters interdisciplinary problem-solving.

PO6: Personal and Professional Competence

CO3 (3): Mastery of optical instruments enhances technical competence.

CO5 (3): Circuit design skills are valuable for careers in technology and engineering.

CO6 (3): Proficiency with measurement tools builds professional expertise in electronics.

CO7 (3): Developing troubleshooting skills supports personal and professional growth.

PO7: Effective Citizenship and Ethics

CO2 (2): Understanding sound propagation has implications for community noise management.

CO5 (2): Designing circuits ethically impacts the quality and sustainability of technology.

CO7 (2): Troubleshooting in collaborative environments promotes ethical teamwork.

PO8: Environment and Sustainability

CO2 (2): Understanding wave propagation in different media contributes to sustainable sound technologies.

CO5 (2): Designing efficient circuits reduces electronic waste and energy consumption.

CO7 (2): Problem-solving encourages sustainable experimental practices.

PO9: Self-directed and Life-long Learning

CO1 (3): Experimenting with oscillatory motion fosters curiosity and independent learning.

CO3 (3): Gaining proficiency with optical instruments promotes adaptability and continuous learning.

CO5 (3): Circuit design and logic skills are foundational for future learning in electronics.

CO7 (3): Troubleshooting experimental problems builds a habit of self-directed learning.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc Physics (2023 Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : PHY

Class : S.Y.B.Sc.

Semester : IV

Course Type : Minor (Theory)

Course Code : PHY-261-MN

Course Title : Atoms & Molecules

No. of Credits : 02

No. of Teaching Hours : 30

Course Objectives:

1. Identify properties of the nucleus and other sub-atomic particles.
2. Describe theories explaining the structure of atoms and the origin of the observed spectra.

Course Outcomes:

Learning Outcomes: After the completion of this course students will be able to

CO1: Significance of element for understanding of physics principles

CO2: Demonstrate understanding of the scientific method of work and the evolution of physics from the classical to its modern era.

CO3: Demonstrate knowledge and understanding of electric and magnetic phenomena in everyday life.

CO4: Discuss the nature of light and the electromagnetic spectrum and outline practical applications.

CO5: Demonstrate knowledge of the fundamentals of important physics theories (e.g. relativity, quantum) and discuss the way they challenge our preconceptions.

CO6: To understand the general structure of atom, spectrum of hydrogen atom.

CO7: Applications of knowledge for making various models for easy understanding and explanation

Topics and Learning Points

UNIT 1: Physics of Atoms **(10L)**

1.1 Introduction

1.2 Thomson Model

1.3 Rutherford Atom Model

1.4 Bohr Atom Model

1.5.Problem Solving

UNIT 2: Physics of Molecules **(10L)**

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 etc

2.4 Rotational energy levels of a diatomic molecule

2.5 Vibrational energy levels of a diatomic molecule

2.6 Problem Solving

UNIT 3: Interaction of Light with Atoms and Molecules **(10L)**

3.1 Introduction to absorption, spontaneous and stimulated emission.

3.2 Basic principles of laser operation.

3.3 Helium-Neon laser,

3.4 Semiconductor lasers.

3.5 Applications of lasers

3.6 Problem Solving

References:

1. Elements of Modern Physics- Arther Baiser
2. Fundamentals of atomic structure and atomic model- Gerhard Hertzberg
3. Atomic Structure and Atomic Spectra- White
4. Atomic and Nuclear Physics- Subramanyam
5. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer
6. University Physics: F. Sears and M. Zeemansky, XIth/XIIth Edition, Pearson Education

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Atoms & Molecules **Course Code**: PHY-261-MN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	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	3		3		3			3
CO 3	3	3	2	3	3	3	2	2	3
CO 4	3		2	3	3		2	2	
CO 5	3	3			3	3			3
CO 6	3			3					
CO7	3	3	2	3	3	3	2	2	3

Justification

PO1: Disciplinary Knowledge

CO1 (3): Understanding the significance of elements in physics principles forms the core disciplinary knowledge.

CO2 (3): Understanding the scientific method and the evolution of physics is essential for grasping the discipline's foundations.

CO3 (3): Electric and magnetic phenomena are fundamental aspects of physics.

CO4 (3): The nature of light and the electromagnetic spectrum is central to understanding modern physics.

CO5 (3): Knowledge of relativity and quantum theories is foundational to advanced physics.

CO6 (3): Atomic structure and hydrogen spectra are core topics in atomic physics.

CO7 (3): Developing models aids in explaining complex physics principles.

PO2: Critical Thinking and Problem Solving

CO1 (2): Recognizing the significance of elements encourages critical thinking but less direct problem-solving.

CO2 (3): Understanding physics' evolution involves analytical skills and interpretation.

CO3 (3): Analyzing electric and magnetic phenomena in daily life fosters problem-solving.

CO5 (3): Relativity and quantum theories challenge students to rethink preconceptions, demanding critical thinking.

CO7 (3): Developing problem-solving skills and troubleshooting experimental setups requires analytical thinking.

PO3: Social Competence

CO3 (2): Understanding electric and magnetic phenomena enhances discussions about their societal applications.

CO4 (2): Exploring light and its practical applications fosters communication about science's impact on daily life.

CO7 (2): Collaborative problem-solving in experiments builds teamwork and social interaction.

PO4: Research-related Skills and Scientific Temper

CO2 (3): Studying the scientific method and physics evolution promotes research-oriented thinking.

CO3 (3): Investigating everyday electric and magnetic phenomena encourages experimental research skills.

CO4 (3): Exploring the electromagnetic spectrum involves analyzing scientific data and applications.

CO6 (3): Understanding atomic structure and spectra enhances research aptitude.

CO7 (3): Solving experimental problems fosters a scientific approach to inquiry.

PO5: Trans-disciplinary Knowledge

CO3 (3): Knowledge of electric and magnetic phenomena connects physics with engineering and technology.

CO4 (3): Applications of light and electromagnetic waves link physics to fields like communications and medicine.

CO5 (3): Relativity and quantum theories impact diverse disciplines, including cosmology and materials science.

CO7 (3): Creating models for easy understanding fosters interdisciplinary problem-solving.

PO6: Personal and Professional Competence

CO2 (3): Understanding physics' evolution contributes to personal growth and professional competence.

CO3 (3): Mastery of electric and magnetic concepts has direct professional applications.

CO5 (3): Relativity and quantum theories are essential for advanced research and technical careers.

CO7 (3): Problem-solving and model-building enhance technical expertise.

PO7: Effective Citizenship and Ethics

CO3 (2): Knowledge of electric and magnetic phenomena contributes to energy efficiency and safety discussions.

CO4 (2): Applications of light and waves promote awareness of technologies that benefit society.

CO7 (2): Problem-solving in collaborative environments encourages ethical teamwork and decision-making.

PO8: Environment and Sustainability

CO3 (2): Understanding electric phenomena can contribute to sustainable energy solutions.

CO4 (2): Exploring light applications like solar energy promotes environmental sustainability.

CO7 (2): Applying physics knowledge responsibly supports sustainable experimental practices.

PO9: Self-directed and Life-long Learning

CO2 (3): Understanding physics' evolution fosters curiosity and lifelong learning.

CO4 (3): Investigating the electromagnetic spectrum encourages independent exploration.

CO5 (3): Relativity and quantum theories challenge learners to continuously update their knowledge.

CO7 (3): Troubleshooting problems builds habits of self-directed and continuous learning.

CBCS Syllabus as per NEP 2020 for S.Y.B.ScPhysics (2023Pattern)

Name of the Programme : B.Sc. Physics

Programme Code : PHY

Class : S.Y.B.Sc.

Semester : IV

Course Type : Minor (Practical)

Course Code : PHY-262-MN

Course Title : Minor Practical

No. of Credits : 02

No. of Teaching Hours : 30

Course Outcomes:

Learning Outcome:

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

CO1: Use various instruments and equipment.

CO2: Design experiments to test a hypothesis and/or determine the value of an unknown quantity.

CO3: Investigate the theoretical background to an experiment.

CO4: Set up experimental equipment to implement an experimental approach.

CO5: Analyze data, plot appropriate graphs and reach conclusions from your data analysis.

CO6: Work in a group to plan, implement and report on a project/experiment.

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

List of Experiments: (Students have to perform Any 08 Experiments)

1. Frank-Hertz Experiment (Demonstration of Atomic Energy Levels)
2. Study of Hydrogen Spectrum (Using Spectrometer)
3. UV-Visible Spectroscopy of Simple Molecules
4. Measurement of Wavelength Using a Prism Spectrometer
5. Determination of Rydberg Constant
6. Atomic Spectra Using a Diffraction Grating
7. Determination of the Speed of Light Using a Laser
8. Spectral Lines of Sodium Vapor
9. Study of Fluorescent Lamps and CFL Spectrum

10. Polarization of Light and Its Applications
11. Wavelength of Light Using a Diffraction Grating
12. Thin Film Interference
13. Laser Reflection and Refraction
14. Diffraction by a Hair

2.Additional Activities

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

A. 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.

B. Study tour /visit

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Minor Practical **Course Code**: PHY-262-MN

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	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	1	2	3	3			3
CO 2	3	3		3	3		2	2	
CO 3	3	3		3					3
CO 4	3					3			
CO 5	3	3		3		3			3
CO 6	3	2	3		3	3	2	2	
CO7	3	3	2	3	3	3	2	2	3

Justification

PO1: Disciplinary Knowledge

CO1 (3): Using various instruments and equipment is foundational to experimental physics and disciplinary knowledge.

CO2 (3): Designing experiments involves applying core physics concepts.

CO3 (3): Investigating the theoretical background is essential for understanding physics principles.

CO4 (3): Setting up experimental equipment applies physics knowledge to practical situations.

CO5 (3): Analyzing data and drawing conclusions showcases an understanding of fundamental physics.

CO6 (2): Group work enhances applied knowledge but less directly relates to individual disciplinary expertise.

CO7 (3): Developing experimental models reinforces physics concepts and aids comprehension.

PO2: Critical Thinking and Problem Solving

CO1 (2): Using instruments involves some problem-solving but less critical analysis.

CO2 (3): Designing experiments to test hypotheses develops critical thinking and problem-solving.

CO3 (3): Investigating theoretical backgrounds enhances analytical skills.

CO5 (3): Data analysis and graph plotting are direct applications of critical thinking.

CO6 (2): Group collaboration involves problem-solving but is less individually focused.

CO7 (3): Creating models to explain concepts requires creative problem-solving.

PO3: Social Competence

CO1 (1): Instrument use has limited impact on social competence.

CO6 (3): Working in groups to plan and report on experiments fosters teamwork and collaboration.

CO7 (2): Creating models may involve group discussions, enhancing social skills.

PO4: Research-related Skills and Scientific Temper

CO1 (2): Using instruments builds technical skills relevant to research but lacks direct scientific inquiry.

CO2 (3): Experiment design fosters scientific temper and research-oriented skills.

CO3 (3): Investigating theoretical backgrounds develops a research mindset.

CO5 (3): Analyzing data and interpreting results are essential research skills.

CO7 (3): Creating experimental models encourages innovation and research-based explanations.

PO5: Trans-disciplinary Knowledge

CO1 (2): Instrument use integrates physics with other disciplines, such as engineering.

CO2 (3): Experiment design often draws on interdisciplinary knowledge.

CO6 (3): Group projects involve planning and integration of diverse perspectives.

CO7 (3): Experimental models often span multiple fields, such as physics, engineering, and education.

PO6: Personal and Professional Competence

CO1 (3): Proficiency in using instruments enhances technical competence.

CO4 (3): Setting up experimental equipment develops professional readiness.

CO5 (3): Data analysis and conclusions are essential for scientific and professional work.

CO6 (3): Working in groups builds teamwork, planning, and reporting skills.

CO7 (3): Developing models demonstrates professional creativity and competence.

PO7: Effective Citizenship and Ethics

CO2 (2): Designing experiments contributes to ethical and responsible scientific inquiry.

CO6 (2): Group work encourages ethical behavior and teamwork.

CO7 (2): Experimental models can promote physics awareness and responsible science communication.

PO8: Environment and Sustainability

CO2 (2): Experiment design can incorporate sustainable practices.

CO6 (2): Group projects may encourage sustainable approaches to experimentation.

CO7 (2): Developing models could include sustainability-focused concepts.

PO9: Self-directed and Life-long Learning

CO1 (3): Instrument use encourages self-directed exploration and mastery.

CO3 (3): Investigating theoretical backgrounds promotes curiosity and lifelong learning.

CO5 (3): Data analysis skills are essential for continuous learning in science.

CO7 (3): Developing experimental models fosters independent problem-solving and learning.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. Physics (NEP 1.0 Pattern)

Name of the Programme	**:** B.Sc. Physics
Programme Code	**:** PHY
Class	**:** S.Y.B.Sc.
Semester	**:** IV
Course Type	**:** OE (Practical)
Course Code	**:** PHY-266-OE
Course Title	**:** Indian Astronomy
No. of Credits	**:** 02
No. of Teaching Hours	**:** 60

Course Objectives:

A) अभ्यासक्रमाची उद्दिष्टे

१) विद्यार्थ्यांना दोन ताऱ्यामधीलअंतरे कसे काढतात याबद्दल माहिती मिळू शकेल.

२) प्रकाशाच्या विविध गुणधर्माबद्दल माहिती मिळू शकेल.

३) विद्यार्थ्यांना पृथ्वीवरील गुरुत्वाकर्षणबद्दल माहिती मिळू शकेल.

४) विद्यार्थी दिवस व रात्र का होतात ? याबद्दल माहिती मिळू शकेल.

Course Outcomes:

B) अभ्यासक्रमाची फलिते

CO1. विद्यार्थ्यांना आकाशाबद्दल माहिती होणार आहे. तारे व तारकासमूह याबद्दल माहिती मिळणार आहे.

CO2. गणितीय पद्धतीचा वापर करून दोन ग्रहांमधील अंतरे कशी काढली जातात याची माहिती मिळणार आहे.

CO3. प्रकाशाचे परावर्तन व अपवर्तन काय असते हे सांगू शकतील.

CO4. लोलकाच्या साहाय्याने प्रकाशाचे पृथक्करण कशा प्रकारे होते हे सांगू शकतील.

CO5. प्रयोगशाळेत गुरुत्वाकर्षणाची किंमत कशा प्रकारे काढली जाते हे सांगू शकतील.

CO6. एका सूक्ष्मबिंदूमधून प्रकाशाचे विवर्तन कसे होते ? हे सांगू शकतील.

CO7. वेगवेगळ्या मूलद्रव्यांबद्दल माहिती सांगू शकतील.

Topics and Learning Points

विद्यार्थ्यांना खाली दिलेल्या यादीमधील कोणतेही (आठ) प्रयोग करायचे आहेत.

प्रयोगांची यादी

१) आकाशाची ओळख (ग्रह, तारे, नक्षत्र)

२) प्रकाशाचे विवर्तन कसे होते याचा अभ्यास करणे.

३) दोन ताऱ्यांतील अंतर काढणे.

४) पृथ्वीवरील गुरुत्वाकर्षण मोजणे

५) मूलद्रव्यांचीओळख करून घेणे.

६) प्रकाशाचे अपवर्तन, परावर्तनयाचा अभ्यास करणे.

७) प्रकाशाचे विकेंद्रीकरण कसे होते याचा अभ्यास करणे.

८) दिवस व रात्र का होतात ? याचा अभ्यास करणे.

९) सूर्यग्रहण व चंद्रग्रहण म्हणजे काय ? याचा अभयास करणे.

१०) प्रकाशाचे लोलकाच्या साहाय्याने केलेले पृथक्करण याचा अभयास करणे.

संदर्भ साहित्य

१. आकाशाशी जडले नाते - डॉ . जयंत नारळीकर

२. वेध अंतराळाचा - लीना दामले

३. अंतराळातील गंमत जंमत - रमेश के महाले

४. ओळख नभांगणाची - हेमंत माने

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Indian Astronomy **Course Code**: PHY-266-OE

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	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	2		3
CO 2	3	3		3	3			2	
CO 3	3	3			3		2		3
CO 4	3			3		3		2	
CO 5	3	3		3					
CO 6	3	3	2	3		3		2	3
CO7	3	3	2		3	2	2		3

Justification

PO1: Disciplinary Knowledge

CO1 (3): आकाश, तारे, व तारकासमूह यांची माहिती देणे भौतिकशास्त्रातील मूलभूत ज्ञान आहे.

CO2 (3): ग्रहांमधील अंतर मोजण्यासाठी गणितीय पद्धतींचा उपयोग हा शास्त्रीय ज्ञानाचा मुख्य भाग आहे.

CO3 (3): प्रकाशाचे परावर्तन आणि अपवर्तन यांचा अभ्यास हा भौतिकशास्त्रातील महत्त्वाचा भाग आहे.

CO4 (3): लोलकाच्या साहाय्याने प्रकाशाचे पृथक्करण समजणे भौतिकशास्त्राच्या शाखेचे महत्त्वाचे कौशल्य आहे.

CO5 (3): गुरुत्वाकर्षणाची किंमत काढणे हे प्रयोगशाळा कौशल्याचे मूलभूत ज्ञान आहे.

CO6 (3): प्रकाशाचे विवर्तन समजणे हे भौतिकशास्त्रातील मूलभूत संकल्पनेशी संबंधित आहे.

CO7 (3): मूलद्रव्यांबद्दल माहिती हे विज्ञानाचे मुख्य तत्व आहे.

PO2: Critical Thinking and Problem Solving

CO2 (3): गणितीय पद्धतीचा वापर करून अंतरे मोजणे ही समस्या सोडवण्याची कौशल्ये विकसित करते.

CO3 (3): परावर्तन व अपवर्तन यांचा अभ्यास समीकरणांच्या स्वरूपात समस्यांचे समाधान देतो.

CO5 (3): गुरुत्वाकर्षणाच्या किंमतीची मोजणी करण्याची प्रक्रिया विचारशक्ती व समस्या सोडवण्यावर आधारित आहे.

CO6 (2): प्रकाशाचे विवर्तन समजण्यासाठी विचारांची प्रक्रिया गरजेची आहे.

CO7 (2): मूलद्रव्यांची माहिती समजून घेणे थोड्या प्रमाणात समस्या सोडवण्यावर आधारित आहे.

PO3: Social Competence

CO1 (2): आकाश व तारकासमूहांची माहिती इतरांशी संवाद साधण्यासाठी उपयुक्त ठरते.

CO6 (2): प्रकाशाचे विवर्तन समजून सांगणे इतरांशी शास्त्रीय चर्चा करण्यासाठी उपयुक्त ठरते.

CO7 (2): मूलद्रव्यांची माहिती इतरांशी सामायिक करताना सामाजिक कौशल्ये विकसित होते.

PO4: Research-related Skills and Scientific Temper

CO2 (3): ग्रहांमधील अंतर काढण्यासाठी गणितीय पद्धतींचा वापर संशोधनात्मक विचारशक्तीला चालना देतो.

CO4 (3): प्रकाश पृथक्करणाची प्रक्रिया वैज्ञानिक दृष्टिकोन विकसित करते.

CO5 (3): प्रयोगशाळेत गुरुत्वाकर्षणाची किंमत मोजणे ही संशोधनाची पद्धत शिकवते.

CO6 (3): प्रकाशाचे विवर्तन समजून घेतल्याने वैज्ञानिक दृष्टिकोन विकसित होतो.

PO5: Trans-disciplinary Knowledge

CO2 (3): गणितीय पद्धती व खगोलशास्त्र यामध्ये समन्वय साधण्याची क्षमता विकसित होते.

CO3 (3): परावर्तन व अपवर्तन हे भौतिकशास्त्र व तंत्रज्ञान यांना जोडणारे आहे.

CO7 (3): मूलद्रव्यांबद्दलची माहिती भौतिकशास्त्र, रसायनशास्त्र व जीवशास्त्र यांना जोडते.

PO6: Personal and Professional Competence

CO1 (2): आकाशातील घटकांचे ज्ञान वैयक्तिक व व्यावसायिक कौशल्यांसाठी उपयोगी ठरते.

CO4 (3): प्रकाश पृथक्करणाच्या प्रयोगांमुळे व्यावसायिक प्रयोग कौशल्ये विकसित होतात.

CO6 (3): प्रकाशाचे विवर्तन समजून घेतल्याने प्रयोगशीलतेत वाढ होते.

CO7 (2): मूलद्रव्यांची माहिती व्यावसायिक संवादात मदत करते.

PO7: Effective Citizenship and Ethics

CO1 (2): आकाशविषयक ज्ञान जागरूक नागरिक बनण्यासाठी प्रेरित करते.

CO3 (2): प्रकाशविज्ञानाचा अभ्यास शास्त्रीय विचारांचा प्रसार करण्यासाठी उपयुक्त ठरतो.

CO7 (2): मूलद्रव्यांचे ज्ञान नागरिकांसाठी वैज्ञानिक योगदान ठरू शकते.

PO8: Environment and Sustainability

CO2 (2): ग्रहांमधील अंतर मोजणे व त्यांच्या स्थितीचा अभ्यास पर्यावरणीय शाश्वततेसाठी उपयुक्त ठरतो.

CO4 (2): प्रकाश पृथक्करण प्रक्रियेमुळे पर्यावरणीय समस्यांवरील उपाय शोधता येतात.

CO6 (2): विवर्तन प्रक्रियांचा उपयोग पर्यावरण विज्ञानात होऊ शकतो.

PO9: Self-directed and Life-long Learning

CO1 (3): आकाशाविषयी माहिती सतत शिकण्याची सवय लावते.

CO3 (3): परावर्तन व अपवर्तन प्रक्रियांचा अभ्यास जीवनभर शिकण्याची वृत्ती निर्माण करतो.

CO5 (3): प्रयोगशाळेतील प्रक्रिया शास्त्र विषयातील स्वयंपूर्ण शिक्षणाला चालना देते.

CO7 (3): मूलद्रव्यांवरील अभ्यास आत्मनिर्भर व आजीवन शिक्षणासाठी प्रेरणा देतो.

CBCS Syllabus as per NEP 2020 for S.Y.B.Sc. Physics (2023 Pattern)

Name of the Programme	**:** B.Sc. Physics
Programme Code	**:** USPH
Class	**:** S.Y.B.Sc.
Semester	**:** IV
Course Type	**:** VSC (Theory)
Course Code	**:** PHY-276-SEC
Course Title	**:** Python Programming in Physics
No. of Credits	**:** 02
No. of Teaching Hours	**:** 30

Course Objectives:

1. To understand the object-oriented concepts using Python in problem solving.
2. To understand the fundamentals of Python programming concepts and its applications.
3. To elucidate solving Physics problems using Python programming language
4. To train the students in solving computational physics problems

Course Outcome:

CO1: Apply the knowledge of Physical science to solve complex real-life Physics problems.

CO2: Identify, formulate, review research literature, and analyze complex Physics problems and reaching substantiated conclusions.

CO3: Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusion.

CO4: Demonstrate knowledge and understanding of the Physics and Python programming principles and apply these to one's own project work.

CO5: Develop a solid understanding of the Python programming language.

CO6: Apply Python programming to solve physics problems numerically.

CO7: Gain hands-on experience in implementing Monte Carlo simulations using Python.

List of Experiments: (Students must perform Any 10 Experiments)

1. Write a Python program that calculates the factorial of a number using a for loop. The number should be input by the user.
2. Write a Python program that prints the first 10 numbers of the Fibonacci sequence using a for loop.

3. Write a Python program that prints all prime numbers between 1 and 50. Use continue to skip non-prime numbers.
4. Draw a simple line chart showing the trend of a numerical variable over time.
5. Draw a scatter plot to show the relationship between two numerical variables.
6. Write a program that uses the trapezoid method to return the integral of a function over a given range.
7. Write a program of Simpson's Method.
8. Plot sine and cosine over the range $\{-\pi, \pi\}$.
9. Write simple Python program using operators: a) Arithmetic Operators b) Logical Operators.
10. A ball is thrown upwards with initial velocity v_0 = 5m/s and an initial height y_0 = 3 m. Write a Python program to plot y(t) from t = 0 until the ball hits the ground.
11. Program to plot the motion of a mass and spring on a horizontal surface with friction.
12. The number of radioactive atoms that decay in a given time period is proportional to the number of atoms in the sample. Write a program that uses Euler's method to plot N(t). Have your program also plot the exact solution, $N(t) = No^{e-\lambda t,}$ for comparison.
13. Program to plot the motion of a simple pendulum.
14. Use of Monte Carlo method.
15. Program to plot the wave motion.

Additional Activity (Any one Activity equivalent to two experiments)

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

1. Simulation/Demonstration/Mini Project.
2. Industrial Visit / Study Tour / Field visit.

Mapping of Program Outcomes with Course Outcomes

Class: S.Y.B.Sc (Sem- IV) **Subject**: Physics

Course: Python Programming in Physics **Course Code**: PHY-276-SEC

Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	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	3			3			2	3
CO 2	3			3					
CO 3	3	3	2	3			2	2	3
CO 4	3	3			3	3			
CO 5	3					3			3
CO 6	3	3		3	3		2	2	
CO7	3	3	2	3	3	3	2	2	3

Justification

PO1: Disciplinary Knowledge

CO1 (3): Applying physical science principles to solve real-life problems is a core aspect of disciplinary knowledge.

CO2 (3): Analyzing and formulating complex physics problems strengthens foundational knowledge.

CO3 (3): Research-based methods enhance understanding of advanced disciplinary concepts.

CO4 (3): Integrating physics and Python programming demonstrates interdisciplinary application of knowledge.

CO5 (3): Understanding Python programming supports disciplinary applications in computational physics.

CO6 (3): Numerical problem-solving using Python applies knowledge to practical physics scenarios.

CO7 (3): Implementing Monte Carlo simulations bridges theoretical physics and computational approaches.

PO2: Critical Thinking and Problem Solving

CO1 (3): Solving real-life physics problems develops critical thinking skills.

CO2 (3): Research literature analysis and problem formulation enhance problem-solving abilities.

CO4 (3): Applying Python programming to project work requires critical analysis and decision-making.

CO6 (3): Numerical solutions in Python foster analytical and computational problem-solving.

CO7 (3): Monte Carlo simulations require innovative approaches to tackle complex physics problems.

PO3: Social Competence

CO3 (2): Collaboration during research and data analysis fosters teamwork and communication skills.

CO7 (2): Sharing Monte Carlo simulation insights promotes collaborative competence and peer learning.

PO4: Research-related Skills and Scientific Temper

CO2 (3): Identifying and analyzing physics problems develop a scientific mindset and research-oriented thinking.

CO3 (3): Designing experiments, interpreting data, and synthesizing information build research-related skills.

CO6 (3): Using Python for numerical solutions integrates computational methods into scientific research.

CO7 (3): Monte Carlo simulations support research-focused problem-solving and exploration.

PO5: Trans-disciplinary Knowledge

CO1 (3): Applying physics principles to real-world problems involves interdisciplinary knowledge.

CO4 (3): Python programming principles integrate computer science and physics.

CO6 (3): Numerical problem-solving highlights the fusion of physics and computational techniques.

CO7 (3): Monte Carlo simulations leverage computational methods across disciplines.

PO6: Personal and Professional Competence

CO4 (3): Python programming and physics integration demonstrate readiness for project-based and professional roles.

CO5 (3): Mastery of Python programming builds a skill set essential for scientific and technical careers.

CO7 (3): Hands-on experience with Monte Carlo simulations enhances professional competence.

PO7: Effective Citizenship and Ethics

CO3 (2): Research methods promote ethical and responsible scientific inquiry.

CO6 (2): Applying Python programming to solve real-world problems emphasizes responsible use of technology.

CO7 (2): Simulation techniques contribute to ethical problem-solving in complex systems.

PO8: Environment and Sustainability

CO1 (2): Applying physics to solve real-life problems often involves addressing sustainability challenges.

CO3 (2): Research methods can include sustainability-focused applications.

CO6 (2): Numerical problem-solving can model and address environmental issues.

CO7 (2): Monte Carlo simulations can analyze scenarios related to sustainability and resource optimization.

PO9: Self-directed and Life-long Learning

CO1 (3): Solving complex problems promotes a habit of continuous learning.

CO3 (3): Research-based knowledge fosters curiosity and lifelong engagement in science.

CO5 (3): Learning Python supports adaptability and continuous skill enhancement.

CO7 (3): Monte Carlo simulations encourage independent exploration and application of advanced computational methods.