Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune - 5

Second Year of B.Sc.
(2024 Course under NEP 2020)
Course Code: 24ScPhyU3101 Course Name: Oscillations and Waves

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus

Course Objectives:

- To understand the fundamental principles of oscillatory motion, including free, damped, and forced oscillations.
- To analyse simple harmonic motion (S.H.M) and its mathematical formulation.
- To study damped oscillations and their implications in real-world applications.
- To explore the concept of forced oscillations, resonance, and its applications in physical and electrical systems.
- To understand the mathematical formulation of wave motion, including longitudinal and transverse waves.
- To develop problem-solving skills related to oscillations and wave phenomena.

Course Outcomes:

CO No.	Course Outcomes (COs)	Bloom's Cognitive Level
CO1	Define the fundamental concepts of oscillations, including equilibrium conditions and simple harmonic motion.	1
CO2	Explain the mathematical formulation of damped and forced oscillations and their significance in various systems.	2
CO3	Apply differential equations to analyze undamped, damped, and forced oscillatory motion.	3
CO4	Analyze resonance phenomena, sharpness of resonance, and their applications in mechanical and electrical systems.	4
CO5	Evaluate wave equations, energy density, intensity, and their implications in seismic and gravitational waves.	5
CO6	Develop mathematical models and computational approaches to study oscillatory and wave motion in practical applications.	6

Course Contents

Unit 1	Undamped Free Oscillations	8 Lectures
	• Different types of equilibria (static, dynamic, stable, unstable, and metastable equilibrium) – definitions only with examples.	

	• Definitions of linear Simple Harmonic Motion (S.H.M) and angular S.H.M. • Differential equation for linear S.H.M. and its solution. • Composition of two perpendicular linear S.H.Ms. for frequency ratio 1:1 and 2:1 (analytical method). • Lissajous figures, their demonstration (optical and electrical method) and applications. • Problems	
Unit 2	Damped Oscillations	7 Lectures
	• Introduction • Differential equation for damped harmonic oscillator and its solution, discussion of different cases. • Logarithmic decrement. • Average energy of damped harmonic oscillator. • Quality factor. • Application: LCR series circuit. • Problems.	
Unit 3	Forced Oscillations	8 Lectures
	• Introduction. • Differential equation for forced oscillations and its solution. • Resonance: mechanical, acoustic and electrical. • Velocity and Amplitude resonance. • Sharpness of resonance and half width. • Average energy of forced oscillator. • Quality factor of forced oscillator. • Relation between quality factor and bandwidth. • Application of forced oscillations- LCR series circuit. • Problems.	
Unit 4	Wave Motion	7 Lectures
	• Introduction. • Equation for longitudinal waves and its solution (one dimension only). • Equation for transverse waves and its solution (one dimension only). • Energy density and intensity of a wave. • Qualitative discussion of seismic waves and gravitational waves. • Problems.	

References:

- The Physics of Waves and Oscillations - N. K. Bajaj, Tata McGraw- Hill, publication.
- Fundamentals of Vibrations and Waves - S. P. Puri, Tata McGraw-Hill publication.
- Waves and Oscillations - R.N. Chaudhari, New Age International (p) ltd.
- A Textbook on Oscillations, Waves and Acoustics - M. Ghosh, and D. Bhattacharya, S. Chand and Company Ltd.
- University Physics with Modern Physics(14th Edition) – Young Hugh D., Pearson

Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar (Autonomous), Pune - 411005

S.econd Year B.Sc. Physics

(2024 Course under NEP 2020)

Course Code: 24ScPhyU3102 **Course Name: Optics**

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **ESE: 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus

Course Objectives

- Analyze thin and thick lenses, utilize the lens and lens maker's equations, and solve problems involving magnification, deviation, and power of lenses.
- Distinguish between monochromatic and chromatic aberrations, explore reduction techniques, and comprehend the concept of achromatism for lenses in different configurations.
- Describe the working principles and applications of instruments like simple microscopes, compound microscopes, Ramsden's and Huygens' eye pieces.
- Comprehend the underlying physics of interference in thin films, wedge-shaped films, and Newton's Rings. Differentiate between Fresnel's and Fraunhofer's diffraction and understand applications like double-slit diffraction and plane diffraction gratings.
- Demonstrate understanding of concepts such as Brewster's Law, Malus' Law, and polarization by double refraction using devices like Nicol prisms.
- Enhance problem-solving skills through practical application of theories in geometrical optics, aberrations, interference, diffraction, and polarization.

Course Outcomes

Successful completion of this course student will able to:

CO NO.	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Recall fundamental concepts of geometrical optics, lens equations, and types of aberrations.	**1**
CO 2	Explain principles of interference, diffraction, and polarization phenomena.	**2**
CO 3	Solve numerical problems related to lenses, aberrations, and optical instruments.	**3**
CO 4	Compare monochromatic and chromatic aberrations, and diffraction types (Fresnel vs. Fraunhofer).	**4**
CO 5	Assess the effectiveness of optical instruments and aberration reduction techniques.	**5**
CO 6	Design problem-solving approaches using principles of optics for real-world applications.	**6**

Course Contents

Chapter 1	Geometrical Optics	6 Lectures
	• Introduction • Lenses: thin and thick • Sign convention • Thin lenses: lens equation • Lens maker equation • Magnification of thin lens • Deviation by thin lens • Power of thin lens • Equivalent focal length of two thin lenses • Cardinal points • Problems.	
Chapter 2	Lens Aberrations	6 Lectures
	• Introduction • Types of aberration: Monochromatic and chromatic • Types of monochromatic aberrations and their reductions • Types of chromatic aberrations • Achromatism: lenses in contact and separated by finite distance • Problems.	
Chapter 3	Optical Instruments	6 Lectures

	• Introduction • Simple Microscope • Compound Microscope • Ramsdens eye piece • Huygens eye piece • Problems.	
Chapter 4	Interference and Diffraction	7 Lectures
	• Revision to Interference • Phase change on reflection (Stokes Treatment) • Interference by parallel sided thin films, Interference due to reflected light, Interference due to refracted light • Interference due to Wedge Shaped thin film • Types Diffraction: Fresnel's diffraction and Fraunhoffer's diffraction • Fraunhoffer's diffractions at a double slit • Plane diffraction grating • Newton's Rings • Rayleigh's criterion for resolution • Problems.	
Chapter 5	Polarization	5 Lectures
	• Introduction • Brewster's law • Law of Malus • Polarization by double refraction. • Nicol prism. • Problems.	

References:

1) Sear's and Zimansky's University Physics with Modern Physics, Young and Freedman
2) The textbook of Optics, Brijlal and Subramnyam
3) Fundamentals of Optics, Jenkins and White, McGraw Hill Education India, 4th edition
4) Principles of optics, D.S. Mathur, Gopal Press, Kanpur

Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune - 5

Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU3103 Course Name: Lab Course on General Physics III

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Familiarity with physics courses in 10+2 level and first year B.Sc.
- Familiarity with Basic concepts in Physics

Course Objectives:

- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To learn the usage of optical systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Course Outcomes:

On completion of the course, student should be able to–

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Find the various procedures and techniques for the experiments related to general physics.	1
CO 2	Generalize the mathematical concepts/equations to obtain quantitative results.	2
CO 3	Integrate the basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result.	3
CO 4	Correlate the technical and evaluative skills using laboratory equipment, tools, and materials.	4
CO 5	Test practical knowledge by applying the experimental methods to correlate with the Physics theory.	5

CO 6	Adapt the knowledge of mechanical, electrical and optical systems for various measurements.	6

Course Contents

		(Any 15)
	1. Log Decrement in Air 2. Log Decrement in Water 3. Study of CRO (Frequency measurement and Lissagous figure) 4. Study of CRO (AC voltmeter calibration) 5. Characteristics of a semiconductor diode 6. Zener diode as a Regulator 7. Study of Rectifiers (Half wave, Full wave) 8. Study of Rectifiers (Bridge) 9. Study of Logic gates and verification of De-Morgan's theorem 10. Study of different types of thermometers 11. Thermal Conductivity by using Lee's method (rubber) 12. Thermal Conductivity by using Lee's method (plywood/cardboard sheet/acrylic) 13. Study of Spectrometer-angle of minimum deviation 14. Study of Spectrometer - Angle of prism 15. Calibration of Spectrometern 16. Computer : Trignometric functions using spreadsheet or any graphic softwares (sinx, cosx, tanx, ex, e-x, logx, lnx, xn) 17. Virtual Lab: Basic Electronics 18. Virtual Lab: Optics 19. Virtual Lab: Thermal Physics	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. Practical Physics, R.K.Shukla and Anchal Shrivastava
3. B. Sc. Practical Physics, Harnam Singh
4. University Physics with Modern Physics, Sears and Zemansky
5. Fundamental of Physics, Halliday and Resnick
6. Fundamental of Optics, Francis Jenkins, Harvey White
7. B. Sc. Practical Physics, C.L.Arora
8. https://phet.colorado.edu
9. https://vlab.amrita.edu/

Progressive Education Society's

Modern College of Arts, Science and Commerce,

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Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code:
24ScPhyU3501

Course Name: Lab Course on Electrical Circuits and Networks

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses:

- Familiarity with course 23ScPhyU1601
- Completed courses in first year B.Sc.

Course Objectives:

- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To learn the usage of optical systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Course Outcomes:

On completion of the course, student should be able to–

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Find the various procedures and techniques for the experiments.	1
CO 2	Generalize the electrical and mathematical concepts/equations to obtain quantitative results.	2
CO 3	Integrate the basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result.	3
CO 4	Correlate the technical and evaluative skills using laboratory equipment, tools, and materials.	4
CO 5	Test practical knowledge by applying the experimental methods to correlate with the Physics theory.	5
CO 6	Adapt the knowledge of electrical networks for various measurements.	6

Course Contents

		(Any 15)
	1. Use of Galvanometer as voltmeter 2. Use of Galvanometer as ammeter 3. Verification Thevenin's theorem 4. Verification Norton's theorem 5. Verification Maximum power transfer theorem 6. Study of domestic wiring 7. Study of types of cables, connectors and switches 8. Study of Loading effect 9. Study of types of relay 10. working of electric geyser 11. Study of Home protector systems 12. Study of DC motor 13. Study of Dimmerstat 14. Determine resonant frequency of LCR ckt (Series) 15. Determine resonant frequency of LCR (parallel) 16. Virtual Lab: Faraday's law 17. Virtual Lab: Circuit construction kit AC 18. Virtual Lab: Circuit construction kit DC	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. Practical Physics, R.K.Shukla and Anchal Shrivastava
3. B. Sc. Practical Physics, Harnam Singh
4. University Physics with Modern Physics, Sears and Zemansky
5. Fundamental of Physics, Halliday and Resnick
6. Fundamental of Optics, Francis Jenkins, Harvey White
7. B. Sc. Practical Physics, C.L.Arora
8. https://phet.colorado.edu
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Progressive Education Society's

Modern College of Arts, Science and Commerce,
Shivajinagar, Pune - 5
Second Year of B.Sc.
(2024 Course under NEP 2020)

Course Code:24ScPhyU3901 **Course Name: Astronomy in India**

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus

Course Objectives:

- To understand fundamental concepts of astronomy, including the structure of the Sun, Solar System, stars, galaxies, and cosmology.
- To study the principles of space and astrophysics, including general relativity and gravitation.
- To explore astronomical observatories and research facilities in India and their contributions to astrophysics.
- To analyze the role of observational and theoretical astronomy in understanding celestial phenomena.
- To develop problem-solving skills in astrophysical applications using mathematical and computational approaches.

Course Outcomes:

CO No.	Course Outcomes (COs)	Bloom's Cognitive Level
CO1	Recall fundamental concepts of astronomy, including the Sun, Solar System, stars, galaxies, and cosmology.	1
CO2	Explain key principles of space physics, general relativity, and gravitation. Interpret their significance in astrophysical phenomena.	2
CO3	Apply theoretical frameworks to analyze planetary motion, stellar evolution, and galaxy dynamics..	3
CO4	Analyze observational techniques used in Indian astronomical facilities and evaluate their contributions to astrophysical research.	4

CO5	Evaluate the role of radio, optical, and space-based observatories in advancing modern astronomy. Assess their impact on astrophysical discoveries.	5
CO6	Interpret astronomical data to understand celestial events and phenomena. Assess their significance in astrophysical contexts.	6

Course Contents

Unit 1	**Preliminaries**	**15 Lectures**
	• The Sun • Solar System Studies • Stars and Galaxies • Galaxies and Cosmology • Space and Astrophysics • General Relativity and Gravitation	
Unit 2	**Astronomical Facilities in India**	**15 Lectures**
	• Vainu Bappu Observatories • Rangapur Observatory • Nainital Observatory • Gurushikhar IR Observatory • Kodaikanal Observatory • Udaipur Solar Observatory • Radio Astronomy: NCRA, Raman • Research Institute, Bengaluru • PRL, Ahamdabad.	

References:

- An Introduction to Astrophysics - Baidyanath Basu ,Tanuka Chattopadhyay
- Astronomy in India - Rajesh khochar and Jayanti Narlikar
- Astrophysics and Cosmology -Roger Blandford ,David Gross.
- Astronomy and Astrophysics - Mohit Kumar Sharma

Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune - 5

S.Y.B.Sc. Physics

(2024 Course under NEP 2020)

Course Code : 24ScPhyU3301 **Course Name : Introduction to Optics**

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **ESE : 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus

Course Objectives:

- To get familiar with concepts of ray optics.
- To understand lights' behaviour of light, Properties and interactions with matter.

Successful completion of this course students will able to:

CO No.	Course Outcomes (COs)	Blooms Cognitive Level
CO1	Discuss the nature of light, Describe the laws of reflection and refraction.	1
CO2	Compare and contrast Fresnel and Fraunhofer diffraction.	2
CO3	Apply the principles of optics to analyze and solve problems related to reflection, refraction, and dispersion of light.	3
CO4	Analyze the formation of images by lenses and optical instruments.	4
CO5	Evaluate the performance and limitations of optical instruments. Assess the limitations and potential applications of interference and diffraction phenomena in optics.	5
CO6	Design experiments to demonstrate wave interference effects, Design optical systems using reflection, refraction and interference.	6

Course Contents

Unit 1	The Nature and Phenomena of Light	12 Lectures
	• The nature of light • Reflection and Refraction	

	• Total internal reflection • Dispersion • Polarization • Scattering of light • Huygen's Principle • Problems	
Unit 2	**Geometric Optics**	**6 Lectures**
	• Reflection and Refraction at a plane surface • Reflection and Refraction at a spherical surface • Optical Instruments • Problems	
Unit 3	**Interference and Diffraction**	**12 Lectures**
	• Interference and Coherent sources • Two-source interference of light • Intensity in interference patterns • Interference in thin films • Rayleigh criterion • Fresnel and Fraunhofer Diffraction • Diffraction from a single slit • Intensity in the single-slit pattern • Problems	

References:

1. Sear's and Zimansky's University Physics with Modern Physics, Young and Freedman
2. Fundamentals of Physics, Resnick and Halliday
3. The textbook of Optics, Brijlal and Subramnyam, Fundamentals of Optics, Jenkins and White, McGraw Hill Education India, 4th edition

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Modern College of Arts, Science and Commerce,

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Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU3302 Course Name: Minor Physics Lab I

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Familiarity with physics courses in 10+2 level and first year B.Sc.
- Familiarity with Basic concepts in Physics

Course Objectives:

- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To learn the usage of optical systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Course Outcomes:

On completion of the course, student should be able to–

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Find the various procedures and techniques for the experiments related to general physics.	1
CO 2	Generalize the mathematical concepts/equations to obtain quantitative results.	2
CO 3	Integrate the basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result.	3
CO 4	Correlate the technical and evaluative skills using laboratory equipment, tools, and materials.	4
CO 5	Test practical knowledge by applying the experimental methods to correlate with the Physics theory.	5
CO 6	Adapt the knowledge of mechanical, electrical and optical systems for various measurements.	6

Course Contents

		(Any 15)
	1. Log Decrement in Air 2. Log Decrement in Water 3. Study of CRO (Frequency measurement and Lissagous figure) 4. Study of CRO (AC voltmeter calibration) 5. Characteristics of a semiconductor diode 6. Zener diode as a Regulator 7. Study of Rectifiers (Half wave, Full wave) 8. Study of Rectifiers (Bridge) 9. Study of Logic gates and verification of De-Morgan's theorem 10. Study of different types of thermometers 11. Thermal Conductivity by using Lee's method (rubber) 12. Thermal Conductivity by using Lee's method (plywood/cardboard sheet/acrylic) 13. Study of Spectrometer-angle of minimum deviation 14. Study of Spectrometer - Angle of prism 15. Calibration of Spectrometern 16. Computer : Trignometric functions using spreadsheet or any graphic softwares (sinx, cosx, tanx, ex, e-x, logx, lnx, xn) 17. Virtual Lab: Basic Electronics 18. Virtual Lab: Optics 19. Virtual Lab: Thermal Physics	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. Practical Physics, R.K.Shukla and Anchal Shrivastava
3. B. Sc. Practical Physics, Harnam Singh
4. University Physics with Modern Physics, Sears and Zemansky
5. Fundamental of Physics, Halliday and Resnick
6. Fundamental of Optics, Francis Jenkins, Harvey White
7. B. Sc. Practical Physics, C.L.Arora
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Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU3401 **Course Name: Energy Storage Systems**

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses:

- Completed first year course 23ScPhyU1401 and 23ScPhyU2401

Course Objectives: Students will be able to

- Understand the various types of energy storage technologies
- Analyze thermal storage systems
- Analyze different battery storage technologies
- Analyze the thermodynamics of Fuel cell
- Study the various applications of energy storage

Course Outcomes:

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Understand different types of storage technologies	1
CO 2	Design a thermal storage system	2
CO 3	Evaluate the performance of fuel cells under different operating conditions.	3
CO 4	Select and defend appropriate fuel cell technology for a given application	4
CO 5	Review the present energy scenario and the need for energy storage	5
CO 6	Facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of Alternative Energy storage technology	6

Course Contents

Unit 1	INTRODUCTION	5 Lectures
	• Necessity of energy storage • Types of energy storage • comparison of energy storage technologies • Applications	
Unit 2	MECHANICAL ENERGY STORAGE	7 Lectures
	• Flywheel energy storage system	

	• Pumped hydro energy storage • Compressed air energy storage • Mechanical energy storage coupled to hybrid systems	
Unit 3	CHEMICAL AND THERMAL ENERGY STORAGE	8 Lectures
	• Thermal Storage-Types-Modeling of thermal storage units-simple water and rock bed storage system-pressurized water storage system- • Thermal properties of materials, Sensible heat storage, Latent heat storage, Advances in thermal storage • Chemical Storage- Chemical reaction storage, Thermo-Chemical reactions, Hydrogen storage	
Unit 4	ELECTRICAL ENERGY STORAGE AND FUEL CELL	10 Lectures
	• Capacitor energy storage, Inductor energy storage • Battery energy storage: Primary Batteries: the alkaline dry cell; Secondary Batteries: The Lead Acid Battery; Lithium-ion batteries; Lead-acid, nickel-metal (Cd/Fe/Mn) hydrite and Zinc batteries, • Electro-magnetic Energy Storage Systems: Supercapacitors, History, Working principle of fuel cells, • Types of Fuel Cells: AFC, PAFC, SOFC, MCFC, DMFC, relative merits and demerits, Fuel cell characterization In-situ and ex-situ characterization techniques, I-V curve, frequency response analyses; Fuel cell system integration • Application of Fuel Cells Fuel Cell usage for domestic power systems, large scale power generation, Automobile, Environmental analysis. Future trends in fuel cells, portable fuel cells, laptops, mobiles, submarines.	

References:

[1] Energy Storage 2010th Edition by Robert Huggins
[2] Lithium-Ion Batteries: Fundamentals and Applications (Electrochemical Energy Storage and Conversion) by Yuping Wu
[3] Storing Energy: with Special Reference to Renewable Energy Sources by Trevor M. Letcher
[4] Electrochemical Energy Storage for Renewable Sources and Grid Balancing by Patrick T. Moseley(Editor), Jürgen Garche
[5] Nanomaterials for Energy Conversion and Storage by Dunwei Wang (Editor), Guozhong Cao

Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune - 5

Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU4101 Course Name: Heat and Thermodynamics

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus
- Completed first year course 23ScPhyU1101

Course Objectives:

- To Introduce students to concepts of Thermal Physics and Electronics.

Course Outcomes:

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Defining laws of thermodynamics and thermodynamics processes.	1
CO 2	Understanding the concepts of work done for different thermodynamics processes.	2
CO 3	Examining Otto cycle and Diesel cycle.	3
CO 4	Explaining principle construction and working off thermometers.	4
CO 5	Evaluating T-dS equations and Clausius- Clapeyron latent heat equations.	5
CO 6	Adapting the knowledge of Carnot's cycle.	6

Course Contents

Unit 1	Temperature and Heat	7 Lectures
	• Temperature and Thermal Equilibrium • Thermometers and Temperature Scales • Gas Thermometers and Kelvin Scale • Thermal Expansion • Quantity of Heat • Calorimetry and Phase changes • Mechanism of Heat Transfer	
Unit 2	Thermal Properties of Matter	7 Lectures
	• Equations of State • Molecular Properties of Matter • Kinetic-Molecular Model of an Ideal Gas • Heat Capacities • Molecular Speeds • Phases of Matter	
Unit 3	The First Law of Thermodynamics	8 Lectures
	• Thermodynamic Systems • Work Done During Volume Changes • Paths Between Thermodynamic States • Internal Energy and the First Law of Thermodynamics • Kinds of Thermodynamic Processes • Internal Energy of an Ideal Gas • Heat Capacities of an Ideal Gas • Adiabatic Processes for an Ideal Gas	
Unit 4	The Second Law of Thermodynamics	8 Lectures
	• Directions of Thermodynamic Processes • Heat Engines • Internal-Combustion Engines • Refrigerators • The Second Law of Thermodynamics • The Carnot Cycle • Entropy • Microscopic Interpretation of Entropy	

References:

1. Sear's and Zimansky's University Physics with Modern Physics, Young and Freedman
2. Fundamentals of Physics, Resnick and Halliday

Progressive Education Society's

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Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU4102 Course Name: Electronics I

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus
- Completed first year course 23ScPhyU1101

Course Objectives:

- To Introduce students to concepts Electronics.
- To study the construction and characteristics of semiconductor devices. (Diode and BJT)
- To study the operational amplifier and its simple applications.
- To get familiar with concepts of digital electronics
- To learn number systems and their representation
- To understand basic logic gates, Boolean algebra and k-maps and simple combinational circuits.

Course Outcomes:

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Identify electronic components with their characteristics	1
CO 2	Express relations for norton's current,thevenin's voltage,norton/thevenin resistance, maximum power transfer,current gain in BJT	2
CO 3	Prepare different circuits using diodes,transistor, and digital logic	3
CO 4	Explain operation of different circuits, transistor digital gates.	4
CO 5	Test different electronic circuits.	5
CO 6	Use simulation software to simulate simple electronic circuits based on diode, transistor, logic gate, digital ICs.	6

Course Contents

Unit 1	Analog Electronics I	10 Lectures
	● Revision: Voltage and current sources (AC and DC) ● Active and passive components ● LCR series and parallel circuits ● Semiconductors: conductors, semiconductors (n-and p- type), insulators on the basis of energy bands and band gap ● Diodes: Zener, photodiode and LED, Applications of diodes ● BJT: Construction and working, α and β parameters, CB, CE and CC configurations, Input and output characteristics.	
Unit 2	Digital Electronics	10 Lectures
	●Number systems and interconversions: binary, hexadecimal, octal and decimal. Boolean algebra and identities ●Codes: gray code, 1's and 2's compliment of binary, Alphanumeric and ASCII code ●Logic gates: Basic and derived gates, IC's, De Morgan's theorems and interconversion of logic gates, Application of gates ●Problems	
Unit 3	Combinational and Sequential Circuits	10 Lecture
	●Multiplexers and De-multiplexers ●Encoders and Decoders ●Flip flops: construction and truth tables (RS , JK, Master slave JK, D- and T- flip flops) ●Counters ●Registers ● Applications of combinational and sequential circuits	

References:

1. Electronic Principles, Albert Malvino
2. Digital Computer Electronics, Albert Malvino

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Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU4103 Course Name: Lab Course on General Physics IV

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Familiarity with physics courses in 10+2 level and first year B.Sc.
- Familiarity with Basic concepts in Physics

Course Objectives:

- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To learn the usage of optical systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Course Outcomes:

On completion of the course, student should be able to–

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Find the various procedures and techniques for the experiments related to general physics.	1
CO 2	Generalize the mathematical concepts/equations to obtain quantitative results.	2
CO 3	Integrate the basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result.	3
CO 4	Correlate the technical and evaluative skills using laboratory equipment, tools, and materials.	4
CO 5	Test practical knowledge by applying the experimental methods to correlate with the Physics theory.	5

CO 6	Adapt the knowledge of mechanical, electrical and optical systems for various measurements.	6

Course Contents

		(Any 15)
	1. Resonance Pendulum 2. Study of coupled oscillator comprising two simple pendulums (Frequency in Normal Mode I, II and Mixed mode) 3. Study of coupled oscillator comprising two simple pendulums (determination coupling coefficient) 4. Study of Thermistor - Temperature Coefficient of Resistance 5. Study of Thermocouple 6. Newton's ring: Determination of Radius of curvature 7. Diffraction from cylindrical obstacle 8. Dispersive power of glass prism 9. Double refracting prism 10. Transistor Characteristics (CE Configuration) 11. Construction of AND, OR, NOT gates using NAND and NOR gates 12. Ex-OR using AND, OR, NOT and only NAND gates 13. Study of Multiplexer/Demultiplexer/ Encoder/ Decoder 14. Computer: Inverse of Matrix 15. Computer: Geometric figures using equations (Circle, Ellipse, Parabola, Hyperbola) 16. Virtual Lab: Basic Electronics 17. Virtual Lab: Thermal Physics 18. Virtual Lab: Optics	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. Practical Physics, R.K.Shukla and Anchal Shrivastava
3. B. Sc. Practical Physics, Harnam Singh
4. University Physics with Modern Physics, Sears and Zemansky
5. Fundamental of Physics, Halliday and Resnick
6. Fundamental of Optics, Francis Jenkins, Harvey White
7. B. Sc. Practical Physics, C.L.Arora
8. https://phet.colorado.edu
9. https://vlab.amrita.edu/

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S.Y.B.Sc. Physics

(2024 Course under NEP 2020)

Course Code : 24ScPhyU4501 Course Name : Lab Course on Energy Studies

Teaching Scheme: TH: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **ESE : 30 Marks**

Pre-requisite Courses:

- Familiarity with Renewable and Non-Renewable Energy Sources

Course Objectives:

- To study the basic concepts regarding fundamentals of renewable energy
- To impart knowledge about importance of renewable energy and its practical applications

Course Outcomes:

On completion of the course, student should be able to–

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Operational experience on solar cooker	1
CO 2	Measurement of I-V characteristic of Mono-Crystalline and Poly-Crystalline PV module	2
CO 3	Measurement of illumination using Lux meter	3
CO 4	Learn the functioning of box-type solar cooker, hybrid solar cooker	4
CO 5	Covers the modern knowledge and on-field practices of solar PV systems.	5
CO 6	Characterize the biomass qualitatively and quantitatively	6

Course Contents

		(Any 15)
	1. Solar Radiation Measurements 2. Calculate Fill Factor and Efficiency of c-Si Solar Cell 3. I-V Characteristics of c-Si Solar Cell: Series Connection 4. I-V Characteristics of c-Si Solar Cell: Parallel Connection 5. Calculate Fill Factor and Efficiency of Polycrystalline-Si Solar Cell 6. Energy Content in Wind Mill 7. Study of Domestic Hot Water System 8. Calculate Efficiency and Heat Loss Coefficient of FPC 9. Calculate first figure of merit in Box Type Solar Cooker 10. Calculate Second figure of merit and Boiling point of Box Type Solar Cooker 11. Determine efficiency of Solar Still 12. Determine efficiency of Solar Dryer 13. Calculate Efficiency and Heat Loss Coefficient of Parabolic Concentrator 14. Estimation of Solar Constant 15. Determine Calorific value of Cow-dung 16. Study of Solar Chimney 17. Virtual Lab: Green House Effect 18. Virtual Lab: Wind energy Labs 19. Virtual Lab: Solar Energy Measurements – Pyranometer 20. Virtual Lab: Energy Storage Labs	

References:

1. Sukhatme S P, Solar Energy: principles of Thermal Collection and Storage, TataMcGrawHill.
2. Duffie J A, Beckman W A, Solar Engineering of Thermal Processes, Johnn Wiley.
3. Goswami D Y, Frank Kreith and Kreider J F, Principles of Solar Engineering, Taylor and Francis, USA.
4. Garg H P, Prakash S, Solar Energy: Fundamental and Application, Tata McGrowHill, New Delhi.
5. Kreith F, Kreider J F, Principles of Solar Engineering, McGrawHill.
6. Kreider J F, Kreith F, Solar Energy Handbook, McGrawHill.
7. Bent Sorensen, Renewable Energy, Academic press, New York.
8. Tiwari, G N, Solar Energy, Fundamentals Design, Modeling and Applications, Narosa, New Delhi

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Second Year of B.Sc.
(2024 Course under NEP 2020)

Course Code : 24ScPhyU4301 **Course Name : Introduction to Heat and Thermodynamics**

Teaching Scheme: 2 Hours/Week **Credit: 02**
Examination Scheme: CIA : 20 Marks **ESE : 30 Marks**

Prerequisite Courses:
- Familiarity with 10+2 level physics syllabus
- Familiarity with 24ScPhyU1101

Course Objectives:
- To introduce students to concepts of Thermal Physics.
- To study the laws of thermodynamics and thermodynamics processes.
- To study Thermal Properties of Matter.

Successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Defining laws of thermodynamics and thermodynamics processes.	1
CO 2	Understanding the concepts of work done for different thermodynamics processes.	2
CO 3	Examining Otto cycle and Diesel cycle.	3
CO 4	Explaining principle construction and working off thermometers.	4
CO 5	Evaluating T-dS equations and Clausius- Clapeyron latent heat equations.	5
CO 6	Adapting the knowledge of Carnot's cycle.	6

Course Contents

Unit 1	Temperature and Heat	7 Lectures

	• Temperature and Thermal Equilibrium • Thermometers and Temperature Scales • Gas Thermometers and Kelvin Scale • Thermal Expansion • Quantity of Heat • Calorimetry and Phase changes • Mechanism of Heat Transfer	
Unit 2	Thermal Properties of Matter	7 Lectures
	• Equations of State • Molecular Properties of Matter • Kinetic-Molecular Model of an Ideal Gas • Heat Capacities • Molecular Speeds • Phases of Matter	
Unit 3	The First Law of Thermodynamics	8 Lectures
	• Thermodynamic Systems • Work Done During Volume Changes • Paths Between Thermodynamic States • Internal Energy and the First Law of Thermodynamics • Kinds of Thermodynamic Processes • Internal Energy of an Ideal Gas • Heat Capacities of an Ideal Gas • Adiabatic Processes for an Ideal Gas	
Unit 4	The Second Law of Thermodynamics	8 Lectures
	• Directions of Thermodynamic Processes • Heat Engines • Internal-Combustion Engines • Refrigerators • The Second Law of Thermodynamics • The Carnot Cycle • Entropy • Microscopic Interpretation of Entropy	

References:

1. Sear's and Zimansky's University Physics with Modern Physics, Young and Freedman
2. Fundamentals of Physics, Resnick and Halliday

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Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU4302 Course Name: Minor Physics Lab II

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Familiarity with physics courses in 10+2 level and first year B.Sc.
- Familiarity with Basic concepts in Physics

Course Objectives:

- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To learn the usage of optical systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Course Outcomes:

On completion of the course, student should be able to–

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Find the various procedures and techniques for the experiments related to general physics.	1
CO 2	Generalize the mathematical concepts/equations to obtain quantitative results.	2
CO 3	Integrate the basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result.	3
CO 4	Correlate the technical and evaluative skills using laboratory equipment, tools, and materials.	4

CO 5	Test practical knowledge by applying the experimental methods to correlate with the Physics theory.	5
CO 6	Adapt the knowledge of mechanical, electrical and optical systems for various measurements.	6

Course Contents

		(Any 15)
	1. Resonance Pendulum 2. Study of coupled oscillator comprising two simple pendulums (Frequency in Normal Mode I, II and Mixed mode) 3. Study of coupled oscillator comprising two simple pendulums (determination coupling coefficient) 4. Study of Thermistor - Temperature Coefficient of Resistance 5. Study of Thermocouple 6. Newton's ring: Determination of Radius of curvature 7. Diffraction from cylindrical obstacle 8. Dispersive power of glass prism 9. Double refracting prism 10. Transistor Characteristics (CE Configuration) 11. Construction of AND, OR, NOT gates using NAND and NOR gates 12. Ex-OR using AND, OR, NOT and only NAND gates 13. Study of Multiplexer/Demultiplexer/ Encoder/ Decoder 14. Computer: Inverse of Matrix 15. Computer: Geometric figures using equations (Circle, Ellipse, Parabola, Hyperbola) 16. Virtual Lab: Basic Electronics 17. Virtual Lab: Thermal Physics 18. Virtual Lab: Optics	

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1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. Practical Physics, R.K.Shukla and Anchal Shrivastava
3. B. Sc. Practical Physics, Harnam Singh
4. University Physics with Modern Physics, Sears and Zemansky
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Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU4401 **Course Name: Biomass and Wind Energy**

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses:

- Completed first year course 24ScPhyU1401 and 24ScPhyU2401

Course Objectives: Students will be able to

1. To introduce the energy conversion technologies related to biomass
2. To familiarize the properties of biomass and its energy products
3. To analyze the feasibility of power production from biomass sources
4. Learn the fundamental concepts about wind energy systems and devices
5. Design wind turbine blades and know about applications of wind energy for electricity generation

Course Outcomes:

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Relate the knowledge in properties of biomass and energy conversion process	1
CO 2	Compare the characteristics of products obtained from biomass pyrolysis	2
CO 3	Identify the basics of biomass gasification and gasifier design	3
CO 4	Analyze the potential of electrical power production from biomass	4
CO 5	Explain the application of wind energy and wind energy conversion system	5
CO 6	Elaborate the applications of different renewable energy sources like wind, biomass energy etc.	6

Course Contents

Unit 1	Biomass Energy	7 Lectures

	• Introduction • Why Biomass Energy? • Advantages and Disadvantages of Biomass Energy • Biomass Sources • Biomass Characteristics • Energy Farming etc.	
Unit 2	Biofuel Production Processes	7 Lectures
	• Purpose of Biomass Conversion to Biofuel Production • Biomass Conversion Routes • Physical Method of Conversion of Biomass • Thermo-Chemical Conversion • Biomass Gasification • Types of Gasifier • Operational Parameters of Biogas Plant • Ethanol from Biomass	
Unit 3	Wind Energy	8 Lectures
	• Introduction • Major Factors Which Accelerated Development of Wind Power • Advantages and Disadvantages of Wind Energy • Origin of Winds • Factors Affecting on Wind Speed	
Unit 4	**Wind Energy Conversion Technologies**	8 Lectures
	• Classification and Description of Wind Machines • Horizontal Wind Mills • Vertical Wind Mills • Energy Available in Wind • Power Vs Wind Speed Characteristics • Betz limit • Wind Energy Conversion Systems • Wind-Diesel Hybrid System • Applications of Wind Energy	

References:

1. Sergio C. Capareda “Introduction to Biomass Energy Conversions”, 2019, CRC Press, Taylor and Francis Group.
2. Sergio C. Capareda “Introduction to Renewable Energy Conversions”, 2019, CRC Press, Taylor and Francis Group.
3. Erik Dahlquist, “Biomass as Energy Source: Resources, systems and applications”, Sustainable Energy Developments series, 2012, CRC Press, Taylor and Francis Group.
4. Anju Dahiya, “Bioenergy: Biomass to Biofuels”, 2014, Academic press, Elsevier Publication.
5. D.P.Kothari, K.C Singal and Rakesh Ranjan “Renewable Energy Sources And Emerging Technologies”, 2011, PHI Learning Private Ltd, New Delhi
6. Wind energy Conversion Systems - Freris L.L. (Prentice Hall1990)
7. Wind Turbine Technology: Fundamental concepts of wind turbine technology Spera D.A. (ASME Press, NY, 1994)
8. Wind Energy Systems - G.L. Johnson (Prentice Hall, 1985)

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Second Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU4601 Course Name: Lab Course on Computational Physics Skills II

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses:

- Completed first year course 23ScPhyU1101, 23ScPhyU2101 23ScPhyU2601

Course Objectives:

- To understand various numerical methods used in computation physics
- To be able to write an algorithm/ pseudo code and corresponding Python code to solve problems involving the numerical methods
- To be able to represent the results using graphs using Matplotlib in Python

Course Outcomes:

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Explain numerical methods in the course content	1
CO 2	Compare computational errors in numerical methods in the course content	2
CO 3	Apply the numerical methods to write a python code	3
CO 4	Analyze the errors in Python program output for the numerical methods	4
CO 5	Determine which of the method suits the best for solving a given problem based on their computation complexity and error	5
CO 6	Solve a given problem based on the numerical methods using Python program	6

Course Contents

Unit 1	Random Numbers	2 Experiments
	• Value of π using Random Numbers (Monte Carlo Simulation) • Monte Carlo Integration	
Unit 2	Roots of Algebraic and Transcendental Equations	4 Experiments

	• Bisection Method • Secant Method • Newton-Raphson Method • System of Equations	
Unit 3	Interpolation by Finite Differences Methods	2 Experiments
	• Interpolation with Forward Differences • Interpolation with Backward Differences	
Unit 4	Numerical Differentiation	1 Experiments
	• Derivatives with Forward Difference	
Unit 5	Numerical Integration	3 Experiments
	• Rectangular Rule • Trapezoidal Rule • Simpson's 1/3rd Rule	
Unit 6	Ordinary Differential Equations	2 Experiments
	• Euler's Method • Runge- Kutta Method	
Unit 7	Solving System of Linear Equation	1 Experiment
	• Gauss Elimination Method	

References:

1. Scientific Computation in Python (2nd Edition), Abhikit Kar Gupta, Techno World Publication
2. Computational Physics: Problem Solving with Python, 4th Edition, Rubin H. Landau, Manuel J. Páez, Cristian C. Bordeianu, Wiley-VCH
3. Introduction to Methods of Numerical Analysis, (5th Edition), S. S. Sastry, Prentice Hall India
4. http://www.python.org
5. https://numpy.org/