Progressive Education Society's
Modern College of Arts, Science and Commerce,
Shivajinagar, Pune - 5
Second Year of B.Sc.
(2023 Course under NEP 2020)

Course Code: 23ScPhyU3101 **Course Name: Lab course on 23ScPhyU3102**

Teaching Scheme: 8 Hours/Week **Credit: 04**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses:

- Familiarity with courses in first year B.Sc.
- Familiarity with topics learned in 23ScPhyU3102

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 topics in 23ScPhyU3102.	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	5

	methods to correlate with the Physics theory.	
CO 6	Adapt the knowledge of mechanical, electrical and optical systems for various measurements.	6

Course Contents

Section-I	**Oscillations and Waves**	**(Any 15)**
	1. Log Decrement in Air 2. Log Decrement in Water 3. Resonance pendulum 4. Study of coupled oscillator (Frequency in Normal Mode I, II and Mixed mode) 5. Study of coupled oscillator (Determination of coupling coefficient) 6. Frequency measurement using CRO 7. Study of Lissajous figures using CRO 8. AC voltmeter calibration using CRO 9. Threshold of Human audibility 10. Melde's experiment 11. Velocity of sound using Kundt's tube 12. Velocity of sound using Sonometer 13. Ultrasonic interferometer 14. Frequency of A.C. 15. Study of waveforms: Sine, Square, Triangular, Ramp, Rectangular 16. Virtual Lab: Pendulum lab 17. Virtual Lab: Calculus 18. Virtual lab: Normal modes	
Section-II	**Optics**	**(Any 15)**
	1. Study of laws of reflection 2. Study of laws of refraction 3. Study of Spectrometer-angle of minimum deviation 4. Study of Spectrometer - Angle of prism 5. Calibration of Spectrometer 6. Refractive index of liquid using hollow prism 7. Plane Diffraction Grating 8. Dispersive power of prism 9. Newton's ring: Determination of Radius of curvature. 10. Double refracting prism	

	11. Bi-prism 12. Resolving power of grating 13. Study of the characteristic of laser beam 14. Diffraction from cylindrical obstacle 15. Total internal reflection 16. Virtual Lab: Interference pattern 17. Virtual lab: Geometric optics 18. Virtual Lab: Bending light	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. B. Sc. Practical Physics, C.L.Arora
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
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Second Year of B.Sc.

(2023 Course under NEP 2020)

Course Code: 23ScPhyU3102 **Course Name:** Oscillations, Waves and Optics

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 & 23ScPhyU2101

Course Objectives:

- To Introduce students to Physics of Waves, Oscillations and Optics
- To study of simple harmonic motion and its simple applications
- To get familiar with concepts of ray optics

Course Outcomes:

CO No.	Course Outcomes (COs)	Blooms Cognitive Level
CO 1	Recall the definitions and characteristics of periodic motion. Recognize various applications of simple harmonic motion. Remember the conditions and phenomena associated with resonance in oscillatory systems. Identify the mathematical descriptions and characteristics of waves. Discuss the nature of light, Describe the laws of reflection and refraction.	1
CO 2	Interpret mathematical representation of wave motion, Relate sound properties to human perception and hearing. Compare and contrast Fresnel and Fraunhofer diffraction.	2
CO 3	Apply the principles of wave motion to analyze and solve problems related to mechanical waves. Apply the principles of optics to analyze and solve problems related to reflection, refraction, and dispersion of light.	3
CO 4	Analyze the behavior and characteristics of different types of oscillatory motion. Examine the phenomena of interference, beats and Doppler effect in sound. Analyze the properties of light waves and photons. Analyze the formation of images by lenses and optical instruments.	4
CO 5	Evaluate the significance and applications of different types of mechanical waves. Assess the impact of interference and superposition on wave behavior and propagation. Evaluate the performance and	5

	limitations of optical instruments. Assess the limitations and potential applications of interference and diffraction phenomena in optics.	
CO 6	Design experiments to demonstrate wave interference effects, Discuss the conservation laws associated with electromagnetic wave interactions. Design optical systems using reflection, refraction and interference.	6

Course Contents

Unit 1	Periodic Motion	6 Lectures
	• Describing Oscillation • Simple Harmonic Motion • Energy in simple harmonic motion • Applications of simple harmonic motion • The simple pendulum • Damped oscillations • Forced oscillations and Resonance • Problems	
Unit 2	**Mechanical Waves**	**6 Lectures**
	• Types of mechanical waves • Periodic waves • Mathematical description of a wave • Speed of a transverse wave • Energy in wave motion • Wave interference, boundary conditions, and superposition • Standing waves on a string • Problems	
Unit 3	**The Nature and Phenomena of Light**	**6 Lectures**
	• The nature of light • Reflection and Refraction • Total internal reflection • Dispersion • Polarization • Scattering of light • Huygen's Principle • Problems	
Unit 4	**Geometric Optics**	**6 Lectures**
	• Reflection and Refraction at a plane surface • Reflection and Refraction at a spherical surface • Optical Instruments • Problems	
Unit 5	**Interference and Diffraction**	**6 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. Waves and Oscillations, N. K. Bajaj
4. The textbook of Optics, Brijlal and Subramnyam
5. Fundamentals of Optics, Jenkins and White, McGraw Hill Education India, 4th edition

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Second Year of B.Sc.
(2023 Course under NEP 2020)
Course Code: 23ScPhyU3301 Course Name: Mechanics and Properties of Matter (T+P)

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
- Familiarity with basic concepts of Motion, work and Energy, Fluid Mechanics, Properties of Matter

Course Objectives:

- To Study and. Demonstrate an understanding of Newton's laws and applying them in calculations of the motion of simple systems.
- Use the free body diagrams to analyze the forces on the object.
- Understand the concepts of energy, work, power, the concepts of conservation of energy and be able to perform calculations using them.
- Understand the concepts of elasticity and be able to perform calculations using them.
- To learn/Understand the concepts of
    1. Surface tension and viscosity and be able to perform calculations using them.
    2. Use of Bernoulli's theorem in real life problems.
    3. Demonstrate quantitative problem-solving skills in all the topics covered.

Course Outcomes:

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Define Newton's laws and apply them in calculations of the motion of simple systems.	1
CO 2	Summarize the Applications of Mechanics and Fluid Dynamics	2
CO 3	Apply Newton's Law and Basics Fluid dynamics in real life problems.	3
CO 4	Explain the free body diagrams to analyze the forces on the object.	4
CO 5	Evaluate different dynamics and static physical quantities for a given situation	5
CO 6	Solve the problems related to concepts of energy, work, power, the concepts of conservation of energy and being able to perform calculations using them.	6

Course Contents

Unit 1	Units, Physical Quantities, and Vectors	4
	• Standards and Units • Consistency and Conversions • Uncertainty and Significant Figures • Estimates and Orders of Magnitude • Vectors and Vector Addition • Components of Vectors • Unit Vectors • Products of Vectors	
Unit 2	Motion Along a Straight Line	4
	• Displacement, Time, and Average Velocity • Instantaneous Velocity • Average and Instantaneous Acceleration • Motion with Constant Acceleration • Freely Falling Bodies • Velocity and Position by Integration	
Unit 3	Motion in Two and Three Dimensions	2
	• Position and Velocity Vectors • The Acceleration Vector • Projectile Motion • Motion in a Circle	
Unit 4	Newton's Laws of Motion	4
	• Force and Interactions • Newton's First Law • Newton's Second Law • Mass and Weight • Newton's Third Law • Free-Body Diagrams	
Unit 5	Applying Newton's Laws	2
	• Newton's First Law: Particles in Equilibrium • Using Newton's Second Law: Dynamics of Particles • Frictional Forces • Dynamics of Circular Motion • The Fundamental Forces of Nature	
Unit 6	Work and Kinetic Energy	2
	• Work • Kinetic Energy and the Work–Energy Theorem • Work and Energy with Varying Forces • Power	
Unit 7	Potential Energy and Energy Conservation	2
	• Gravitational Potential Energy • Elastic Potential Energy • Conservative and Nonconservative Forces • Force and Potential Energy • Energy Diagrams	

References:

1. Sear's and Zimansky's University Physics with Modern Physics, Young and Freedman
2. Fundamentals of Physics, Resnick and Halliday
3. Classical Mechanics, 3rd Edition,Goldstein Herbert; Poole, Charles; Safko, John; published by Pearson Education
4. Classical Mechanics, N.C.Rana & P.S.Joag, Publisher, McGraw-Hill Education (India) Pvt Limited
5. Classical Mechanics, J.C.Upadhyaya, Himalaya Publishing House.

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Second Year of B.Sc.
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Course Code: 23ScPhyU3301 **Course Name: Physics Minor Lab II**

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

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

Prerequisite Courses:

- Familiarity with concepts in physics at 10+2 level
- Familiarity with content from course 23ScPhyU2301

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 23ScPhyU3301.	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. Measurements using Vernier calipers. 2. Measurements using Micrometer screw gauge. 3. Measurements using Travelling Microscope. 4. Measurements using Spectrometer. 5. M. I. of flywheel. 6. Flat spiral spring 7. M. I. of Disc by Torsional Oscillations 8. Modulus of rigidity (η) of Disc by Torsional Oscillations 9. Surface Tension by Capillary Rise Method 10. Coefficient of Viscosity by Stokes' Method 11. Calculate 'g' by simple pendulum 12. Y by bending 13. Virtual Lab: Kepler's law 14. Virtual Lab: Gravity force lab 15. Virtual Lab: Hooke's law 16. Virtual Lab: Principle of conservation of energy	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. B. Sc. Practical Physics, C.L.Arora
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

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Second Year of B.Sc.
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Course Code: 23ScPhyU3401 **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

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Second Year of B.Sc.
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Course Code: 23ScPhyU3501 **Course Name: Electrical Circuits and Network Skills**

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	5

	methods to correlate with the Physics theory.	
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. B. Sc. Practical Physics, C.L.Arora
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
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Second Year of B.Sc.

(2023 Course under NEP 2020)

Course Code: 23ScPhyU3002 **Course Name: Field Project in Physics**

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

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

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Second Year of B.Sc.

(2023 Course under NEP 2020)

Course Code: 23ScPhyU4101 **Course Name: Thermal Physics and Electronics**

Teaching Scheme: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 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.
- 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	Defining laws of thermodynamics and thermodynamics processes. Identify electronic components with their characteristics	1
CO 2	Understanding the concepts of work done for different thermodynamics processes. Express relations for norton's current,thevenin's voltage,norton/thevenin resistance, maximum power transfer,current gain in BJT	2
CO 3	Examining Otto cycle and Diesel cycle. Prepare different circuits using diodes,transistor, and digital logic	3
CO 4	Explaining principle construction and working off thermometers. Explain operation of different circuits, transistor digital gates.	4
CO 5	Evaluating T-dS equations and Clausius- Clapeyron latent heat equations. Test different electronic circuits.	5
CO 6	Adapting the knowledge of Carnot's cycle. Use simulation software to simulate simple electronic circuits based on diode, transistor, logic gate, digital ICs.	6

Course Contents

Section I: Thermodynamics		
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	
Section II: Basic Electronics		
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. Sear's and Zimansky's University Physics with Modern Physics, Young and Freedman
2. Fundamentals of Physics, Resnick and Halliday
3. Electronic Principles, Albert Malvino
4. Digital Computer Electronics, Albert Malvino

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Second Year of B.Sc.
(2023 Course under NEP 2020)

Course Code: 23ScPhyU4102 **Course Name: Lab course based on 23ScPhyU4101**

Teaching Scheme: 8 Hours/Week **Credit: 04**

Examination Scheme: CIA: 40 Marks **End-Sem: 60 Marks**

Prerequisite Courses:

- Familiarity with course 23ScPhyU1601
- Familiarity with topics covered in first year B.Sc.
- Familiarity with topics covered in 23ScPhyU4101

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 23ScPhyU4101.	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, thermal and optical systems for various measurements.	6

Course Contents

Section I	Thermodynamics	**(Any 15)**
	1. Study of different types of thermometers 2. Thermal Conductivity by using Lee's method (rubber) 3. Thermal Conductivity by using Lee's method (plywood/cardboard sheet/acrylic) 4. Study of Thermistor - Temperature Coefficient of Resistance 5. Study of Thermocouple 6. Platinum resistance thermometer 7. Forbes Method 8. Thermal Conductivity of rubber Tube 9. Specific heat of graphite 10. J by calorimeter 11. Verification of Newton's law of cooling 12. Verification of Stefan's constant 13. Temperature measurement using Wein displacement law 14. Study of specific and latent heat 15. Study of Optical Pyrometer 16. Virtual lab: Ideal gas law 17. Virtual lab: Kinematic equation 18. Virtual lab: Energy forms and changes	
Section II	Basic Electronics	**(Any 15)**
	1. Study of Active and Passive components 2. Characteristics of a semiconductor diode 3. Zener diode as a Regulator 4. Transistor characteristics (CB configuration) 5. Transistor characteristics (CE configuration) 6. Transistor amplifier (AF)	

	7. Study of Rectifiers (Half wave, Full wave) 8. Study of Rectifiers (Bridge) 9. Characteristics of JFET 10. Study of Logic gates 11. Verification of De-Morgan's theorem I and II 12. Construction of AND, OR, NOT gates using NAND gates 13. Construction of AND, OR, NOT gates using NOR gates 14. Ex-OR using AND, OR, NOT and only NAND gates 15. Binary half adder 16. Virtual lab: Capacitor lab 17. Virtual lab: Ohm's law 18. Virtual lab: Resistance in wire	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. B. Sc. Practical Physics, C.L.Arora
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.
(2023 Course under NEP 2020)
Course Code: 23ScPhyU4301 Course Name : Electricity and Magnetism (T+P)

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
- Familiarity with basic concepts of calculus

Course Objectives:
- To Study Basics of Electrostatics and Magnetostatics in Vacuum and in Dielectric Media
- To enrich knowledge of Electricity and Magnetism through problem solving

Course Outcomes:
On completion of the course, student will be able to–
- Apply Classical Theory of Electromagnetics to simple systems

Course Contents

Unit 1	Electric Charge and Electric Field	4
	• Electric Charge • Conductors, Insulators, and Induced Charges • Coulomb's Law • Electric Field and Electric Forces • Electric-Field Calculations • Electric Field Lines • Electric Dipoles	
Unit 2	Gauss's Law	3
	• Charge and Electric Flux • Calculating Electric Flux • Gauss's Law • Applications of Gauss's Law	
Unit 3	Electric Potentials	3
	• Electric Potential Energy • Electric Potential • Calculating Electric Potential • Equipotential Surfaces	
Unit 4	Capacitance and Dielectrics	3
	• Capacitors and Capacitance • Capacitors in Series and Parallel • Energy Storage in Capacitors and Electric-Field Energy	

	• Dielectrics • Molecular Model of Induced Charge	
Unit 5	Current, Resistance, and Electromotive Force	2
	• Current • Resistivity • Resistance • Electromotive Force and Circuits • Energy and Power in Electric Circuits • Theory of Metallic Conduction	
Unit 7	Magnetic Field and Magnetic Forces	3
	• Magnetism • Magnetic Field • Magnetic Field Lines and Magnetic Flux • Motion of Charged Particles in a Magnetic Field • Applications of Motion of Charged Particles • Magnetic Force on a Current-Carrying Conductor • Force and Torque on a Current Loop • The Direct-Current Motor • The Hall Effect	
Unit 8	Sources of Magnetic Field	2
	• Magnetic Field of a Moving Charge • Magnetic Field of a Current Element • Ampere's Law • Applications of Ampere's Law	

References:

1. Sear's and Zimansky's University Physics with Modern Physics, Young and Freedman
2. Fundamentals of Physics, Resnick and Halliday
3. Introduction to Electrodynamics, David J. Griffitth
4. Electromagnetics, B. B. Laud, New Age International publisher

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Course Code: 23ScPhyU4301 **Course Name: Physics Minor Lab III**

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

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

Prerequisite Courses:

- Familiarity with course 23ScPhyU1601
- Familiarity with the topics covered in 23ScPhyU4301

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 23ScPhyU4301.	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. Verification of Kirchhoff's current law 2. Verification of Kirchhoff's voltage law 3. Vector diagrams of L-R circuit 4. Resonant frequency of LCR circuit 5. Self-inductance using Maxwell's bridge 6. Study of potential divider circuit 7. Wheatstone's bridge 8. Light dependent resistor (LDR) 9. Equivalent resistance in series and parallel 10. Equivalent capacitance in series and parallel 11. Charging of capacitor 12. Discharging of capacitor 13. Study of B-H curve 14. Frequency of A.C. 15. Dielectric constant 16. Virtual Lab: Capacitor 17. Virtual Lab: Coulomb's law 18. Virtual Lab: Faraday's law	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. B. Sc. Practical Physics, C.L.Arora
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. https://phet.colorado.edu

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Second Year of B.Sc.

(2023 Course under NEP 2020)

Course Code: 23ScPhyU4401 **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 23ScPhyU1401 and 23ScPhyU2401

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.

(2023 Course under NEP 2020)

Course Code: 23ScPhyU4601 **Course Name: 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:

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