Bachelor of Science
B.Sc. Physics Semester I

Course Code	US01CPHY51	Title of the Course	Mechanics-I, Network Analysis and Optics
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To understand the theoretical concepts of material behaviour with particular emphasis on their elastic property 2. To understand the basic concepts of types of waves with special reference to Ultrasonic waves and its applications. The unit also introduces understanding of oscillations with special emphasis on properties of simple harmonic motion observed in case studies of different types of pendulums. 3. To understand simplification of complex electrical networks and use of bridge circuits to for the measurements of Resistance Capacitance Inductance and Frequency 4. In this course, students will be introduced to fundamental concepts of waves and classical optics with application to interference and diffraction. They will be introduced to various optical instruments and their resolving power.

Course Content

Unit	Description	Weightage* (%)
1.	**<u>Elasticity</u>** Introduction, Definitions of Load, Stress and Strain, Hooke's Law & Stress-strain diagram, Factors affecting elasticity, Three types of elasticity:(i) Young's modulus (ii) Bulk Modulus and (iii) Modulus of Rigidity, Work done per unit volume in elongation strain, Deformation of a cube- (Bulk modulus, Modulus of rigidity, Young modulus), Relation connecting three elastic constants, Poisson's ratio, Limiting values of σ, Determination of Poisson's ratio for rubber, Twisting couple on a cylinder (or wire), Torsional pendulum, Determination of η-Statical method (Horizontal twisting apparatus for a rod), Dynamical method (Maxwell's vibrating needle method), Bending of beams, Bending moment, The cantilever-when the weight of beam is ineffective, Depression of a beam supported at the ends-when the beam is loaded at the centre. [D.S. Mathur 8.1,8.2, 8.3, 8.7,8.8, 8.11, 8.12, 8.13, 8.14, 8.15, 8.16,	25%

	8.18, 8.20, 8.22, 8.26, 8.27,8.29,8.30,8.33] Related Numerical	
2.	**Wave and Oscillations** Ultrasonic waves: Introduction, Generation of ultrasonics, Piezoelectric effect, Piezoelectric generator, advantages of Piezoelectric generator, Magnetostriction effect, Magnetostriction oscillator, Advantages and disadvantages of Magnetostriction oscillator, Detection of ultrasonics, Properties of ultrasonics, Applications of ultrasonics Simple Harmonic Motion: Introduction to an acceleration due to gravity, The simple pendulum, Drawbacks of a simple pendulum, Compound pendulum, Centre of oscillation, Interchangeability of centers of suspension and oscillation, Centre of percussion, Other points collinear with C.G. about which the time period is the same, Conditions for maximum and minimum time periods, Bar pendulum, Determination of radius of gyration 'k', Kater's reversible pendulum [K. Rajagopal 2.1, 2.2, 2.3, 2.5, 2.5.1, 2.6, 2.7, 2.7.1, 2.8, 2.9,2.11] [D.S. Mathur 6.1,6.2, 6. 4, 6.5, 6.6,6.7,6.8, 6.9] Related Numerical	25%
3.	**Network Analysis and Bridge Circuits** Elementary Network Theory: Voltage divider rule, Superposition theorem, Network terminology, Network analysis by mesh currents (two & three mesh network), Circuit analysis by Node-pair voltages (one & two node pair voltage method), Thevenin's theorem, Norton's theorem Bridges and their application: Introduction, Whetstone bridge, Basic operation, Measurement errors, AC bridges and their application, Condition for bridge balance, Application of the Balance equation, Maxwell bridge, Hay Bridge, Schering bridge, Wien bridge [Del Toro 3.4, 3.5, 3.6, 3.7, 3.8, 3.9] [Cooper and Helfrick 5.1, 5.2, 5.2.1, 5.2.2, 5.5, 5.5.1, 5.6, 5.7, 5.8,5.10] Related Numerical	25%
4.	**Optics** **Interferometry** Introduction to interference, Jamin's interferometer, Rayleigh's refractometer, Michelson's interferometer; Types of fringes, white light fringes, Uses: measurement of wavelength of light from a	25%

	monochromatic source, measurement of refractive index of a thin plate **Resolving power of optical instruments** Resolving power, Rayleigh's criterion; limit of resolution, limit of resolution of the eye, resolving power Telescope, Resolving power of light microscope, Resolving power of a diffraction Grating, Resolving power of prism spectroscope [Vasudev14.1,14.2,14.3,14.4,14.4(a), 14.4(b), 17.1, 17.1(a), 17.2, 17.5 , 17.9, 17.11] Related Numerical	

Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: On the successful completion of the course, the students will be able to understand	
	elastic nature of material, types of elastic modulus and different methods to determine elastic modulus.
	principle, production and properties of Ultrasonic waves, uses of Ultrasonic waves – NDT techniques SONAR. Determination of acceleration of gravity with different types of pendulums.
	network techniques, like mesh analysis and node analysis, to write equations for complex linear electrical circuits. To apply Thevenin's and Norton theorems to analyze and design for maximum power transfer. Concepts of DC & AC bridges and measurements of Resistance, Capacitance, Inductance and Frequency.
	basic concepts of interference and its applications in various interferometry apparatus. How to derive resolving power of various optical instruments and how it can be modified.

Suggested References:	
Sr. No.	References
1.	Elements of Properties of Matter D.S. Mathur S. Chand & Co., New Delhi (2006)
2.	Engineering Physics K. Rajagopalan PHI Learning Private Ltd. New Delhi (2009)
3.	Principles of Electrical Engineering (2nd Edition) Vincent Del Toro PHI Learning Private Ltd. New Delhi (2010)
4.	Electronic instrumentation and Measurement Techniques William D. Cooper and Albert D. Helfrick, Prentice-Hall of India private Ltd (2014)
5.	A textbook of light (10th Edition) D. N. Vasudeva Atma Ram & Sons, Delhi (1987)

6.	A textbook of OPTICS N. Subrahmanyam, Brij Lal and M. N. Avadhanulu S. Chand Publication, New Delhi (2006)

On-line resources to be used if available as reference material
On-line Resources:
https://phys.libretexts.org/
http://hyperphysics.phy-astr.gsu.edu/
https://www.feynmanlectures.caltech.edu/II_38.html
https://nptel.ac.in/courses/115/106/115106119/
https://physicstoday.scitation.org/doi/10.1063/1.1580055: Fundamentals and Applications of Ultrasonic Waves
https://www.allaboutcircuits.com/textbook/direct-current/chpt-10/what-is-network-analysis/
https://www.youtube.com/watch?v=UA1qG7Fjc2A
https://www.explainthatstuff.com/howinterferometerswork.html https://opentextbc.ca/universityphysicsv3openstax/chapter/the-michelson-interferometer/

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