Shri Acharyaratna Deshbhooshan Shikshan Prasarak Mandal, Kolhapur

Mahavir Mahavidyalaya, Kolhapur (Autonomous)

Affiliated to Shivaji University, Kolhapur

Syllabus for Choice Based Credit System (NEP 2020)
Bachelor of Science (B. Sc.) Programme

Part	II	Course	Physics

Under the Faculty of Science & Technology

(To be introduced from Academic Year 2024 – 25 onwards)

Subject to the revisions & modifications made from time to time

Mahavir Mahavidyalaya, Kolhapur (Autonomous)
Affiliated to Shivaji University, Kolhapur

(New syllabus under Autonomy to be introduced from June, 2024 onwards)

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP**		
Part	**II**	Semester	**III**
Course	**Physics**	Course Code	**DSC A1**
Paper No.	**V**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**04 / Week**
Course Title	**Thermal & Statistical Mechanics I**		

Course Objectives:	
i)	To understand thermo-dynamical state, thermodynamic equilibrium, various thermodynamic processes and first law of thermodynamics.
ii)	To understand second and third laws of thermodynamics, Carnot's theorem, working of Carnot's engine, otto engine and diesel engine and concept of entropy.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I : **Unit I - Kinetic Theory of Gases :** Mean free path, derivation of Maxwell's law of distribution of velocities and its experimental verification, Transport Phenomena: transport of momentum (viscosity), transport of thermal energy (conduction), Law of equipartition of energy (qualitative) and its applications to specific heat of monoatomic and diatomic gases. **Unit II - Thermometry :** Principle of thermometry, types of thermometers, Scales of temperature (Celsius, Kelvin, Fahrenheit and Rankine) , Mercury thermometer, Thermoelectric thermometer, Platinum resistance thermometer , Thermister.	01	15

Module II :		
Unit I - Thermodynamics I : Thermodynamic system, thermodynamic variables, equation of state, thermodynamic equilibrium, Zeroth Law of thermodynamics, Internal energy, First law of thermodynamics, conversion of heat into work, specific heats C_P & C_v , Applications of First Law (Isothermal process, Adiabatic process, Isochoric process, Isobaric process), relation between C_P & C_v , work done during isothermal and adiabatic processes, reversible & irreversible processes. **Unit I - Thermodynamics II :** Second law of thermodynamics, Carnot's ideal heat engine, Carnot's cycle (Working & efficiency), Carnot's theorem, Entropy (concept & significance), Entropy changes in reversible & irreversible processes, Third law of thermodynamics, Unattainability of absolute zero.	01	15

Course Outcomes:
On completion of the course, students will be able to:
i) Students will be able to explain thermo-dynamical state, thermodynamic equilibrium, various thermodynamic processes and first law of thermodynamics.
ii) Students will be able to explain second and third laws of thermodynamics, Carnot's theorem, working of Carnot's engine and concept of entropy..

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP**		
Part	**II**	Semester	**III**
Course	**Physics**	Course Code	**DSC A2**
Paper No.	**VI**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**04 / Week**
Course Title	**Waves & Acoustics of Buildings**		

Course Objectives:	
i)	To understand SHM and its solution, superposition principle and Lissajous figures and their uses.
ii)	To understand travelling and standing waves on a string, plane waves and spherical waves.
iii)	To define transducers and their types, to understand concept of acoustics of buildings, Sabine's experimental work and reverberation time.
iv)	To understand the Piezo-electric effect, detection of Ultrasonic waves and applications of ultrasonic waves.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	CR	IH
Module I:	01	15
Unit I - Superposition of Harmonic Oscillations : Linearity and superposition principle, Superposition of two collinear harmonic oscillations- for oscillations having equal frequencies (Analytical method) and oscillations having different frequencies (Beats),Superposition of two perpendicular harmonic oscillations- for oscillations having equal frequencies (Analytical method) and oscillations having different frequencies (Lissajous figures), Uses of Lissajous figures. **Unit II – A) Coupled Oscillations :** Frequencies of coupled oscillatory systems, normal modes and normal co-ordinates of vibrations, Degrees of freedom, Energy transfer in coupled oscillatory system.		

B) Waves Motion and Ultrasonic waves : Waves Motion: Transverse waves on a string, travelling and standing waves on a string, Normal modes of a string, Group velocity and Phase velocity, Ultrasonic waves: Piezo-electric effect, Production of ultrasonic waves by Piezo-electric generator, Detection of ultrasonic waves, Properties ultrasonic waves, Applications of ultrasonic waves.		
Module II : **Unit I - Sound and Acoustics of buildings :** Sound: Transducers and their characteristics, Pressure microphone, Moving coil loudspeaker, Acoustics of buildings: Reverberation and time of reverberation, Absorption coefficient, Sabine's formula for measurement of reverberation time. **Unit II – Viscosity :** Revision of viscosity, stream line flow, trubulent flow, Rate flow of liquid in a capillary tube - Poiseuille's formula, experimental determination of coefficient of viscosity of a liquid by Poiseuille's apparatus method, variations of viscosity of a liquid with temperature.	01	15

Course Outcomes:
After completion of the unit, students will be able to:
i) Students will be able to understand the SHM and its solution, superposition principle, Lissajous figures and their uses.
ii) Students will be able to understand travelling and standing waves on a string.
iii) Students will be able to define transducers and their types, concept of acoustic of buildings, Sabine's experimental work and reverberation time.
iv) Students will be able to understand the Piezo-electric effect, detection of Ultrasonic waves and their application.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP**		
Part	**II**	Semester	**IV**
Course	**Physics**	Course Code	**DSC B1**
Paper No.	**VII**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**04 / Week**
Course Title	**Thermal & Statistical Mechanics II**		

Course Objectives:	
i)	To understand Black body radiation, Planck's law, Rayleigh-Jean's law, Stefan Boltzmann law and Wien's displacement law.
ii)	To understand Phase Space, Macrostate, Microstate, Ensembles, Priori Probability.
iii)	To understand thermodynamic Probability and Maxwell Boltzmann Distribution law.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	CR	IH
Module I :	01	15
Unit I - Thermodynamic Potentials : Enthalpy, Gibbs, Helmholtz, Internal Energy functions, Maxwell's thermodynamical relations, Joule-Thomson effect, Clausius-Clapeyron equation, Expression for ($C_P - C_V$), C_P/C, TdS equations. **Unit II - Theory of Radiation :** Blackbody radiation and its importance, Experimental study of black body radiation spectrum, Concept of energy density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.		

Module II:		
Unit I - Classical statistics : Position space, Momentum space, Phase space, Microstate and Macrostate, Accessible microstates, priory probability, thermodynamic probability, probability distribution, Maxwell-Boltzmann distribution law, Evaluation of constants α and β, Entropy and Thermodynamic probability, Distribution of molecular speeds. **Unit II - Quantum statistics :** Bose-Einstein distribution law, photon gas, Fermi-Dirac distribution law, electron gas, comparison of M.B., B.E. and F.D. statistics.	01	15

Course Outcomes:
After completion of the unit, students will be able to:
i) Explain thermodynamical functions, Maxwell's relations, Joule-Thompson effect and Clausius Claperyon Equation .
ii) Explain Black body radiation, Planck's law, Rayleigh-Jean's law, Stefan Boltzmann law and Wien's displacement law.
iii) Explain Phase Space, macrostate, microstate, Ensembles, Priori and thermodynamic Probability.
iv) Explain Maxwell Boltzmann Distribution law.

Primary Information:			
Programme	**Bachelor of Science (B. Sc.) NEP**		
Part	**II**	Semester	**IV**
Course	**Physics**	Course Code	**DSC B2**
Paper No.	**VIII**	Course Type	**Semester**
Total Marks	**50 Marks**	Implementation	**2024 – 25**
Total Credits	**02**	Contact Hours	**04 / Week**
Course Title	**Optics**		

Course Objectives:	
i)	To understand the concept of cardinal points, optical magnifications, relations between them and the idea of resolution, difference between resolving and magnifying powers.
ii)	To understand division of amplitude, division of wavefront, formation of interference in various films, Fresnel diffraction, Fraunhofer diffraction, concept of half period zones, zone plates and difference between zone plate and a convex lens.
iii)	To understand double refraction, polarization, optical rotation, principle, construction and working of polarimeter.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

Modules	**CR**	**IH**
Module I :		
Unit I - Cardinal points : Cardinal points of an optical system (definitions only), graphical construction of image using cardinal points, Newton's formula, relation between f and f ' for any optical system, relation between lateral, axial and angular magnifications. **Unit II –A) Resolving Power of optical instruments :** Resolution, Resolving power of optical instruments, Rayleigh's criterion for the limit of resolution, Modified Rayleigh's criterion, comparison between magnification and resolution, resolving power of plane diffraction grating, resolving power of a prism.	01	15

B) Polarization of light : Idea of polarization, polarization by double refraction, Huygens explanation of double refraction through uniaxial crystals, Nicol prism(construction, working), production and detection of circularly and elliptically polarized light, optical rotation - laws of rotation of plane of polarization, polarimeter, Lauren half shade polarimeter		
Module II :	01	15
Unit I – Interference : Principle of Superposition ,Coherence and condition for interference, Division of amplitude and division of wave front, Division of wave front – Lloyds single mirror(determination of wavelength of light of monochromatic source),Division of amplitude- Interference in thin parallel films (reflected light only), Wedge shaped films, Newton's rings and its application for determination of wavelength and refractive indexof light. **Unit II – Diffraction :** Fraunhofer diffraction- Elementary theory of plane diffraction grating, Determination of wavelength of light using diffraction grating, Theory of Fresnel's half period zones, Zone plate (construction , working and its properties), Fresnel's diffraction at a straight edge.		

Course Outcomes:
After completion of the unit, students will be able to:
i) Students will be able to understand cardinal points, optical magnifications, relations between them, the idea of resolution, difference between resolving and magnifying powers.
ii) Students will be able to understand division of amplitude, division of wavefront, formation of interference in various films, Fresnel diffraction, Fraunhofer diffraction, half period zones, zone plates and difference between zone plate and a convex lens.
iii) Students will be able to understand double refraction, polarization, optical rotation , principle, construction and working of polarimeter.

Practical Course

Course Objectives:
1. To develop practical skills.
2. To study the cardinal points of an optical system.
3. To study the laws of probability distribution, black body radiation.
4. To determine dispersive power, refractive index, resolving power and wavelengths of different sources by various methods.

Course Syllabus
(CR = Credits / IH: Instructional Hours)

SEMISTERS	CR	IH
SEM I		
Group I (Thermal Physics and Statistical Mechanics I) : 1. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus. 2. To determine the coefficient of thermal conductivity of a bad conductor by Lee andCharlton's disc method. 3. To determine the temperature co-efficient of resistance by Platinum resistancethermometer. 4. To study the variation of thermoe.m.f. across two junctions of a thermocouple with temperature. 5. To record and analyze the cooling temperature of hot object as a function of time using a thermocouple. 6. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge. 7. To determine the value of Stefan's constant. 8. To determine Newton law of cooling.	02	

Group II (Waves and Acoustics of Buildings) : 1. To investigate the motion of coupled oscillators 2. To determine the frequency of an electrically maintained tuning fork by Melde'sexperiment and to verify λ2– T Law 3. To study Lissajous figures by using CRO 4. To determine coefficient of viscosity of water by capillary flow method (Poiseuille'smethod) 5. To determine velocity of sound in air by Kundt's tube and audio oscillatoror Phase shift method (CRO and microphone). 6. To determine viscosity of liquid by Searle's viscometer. 7. To determine velocity of sound in air by resonating bottle. 8. To determine frequency of a crystal oscillator		
SEM II	02	
Group III (Thermal Physics and Statistical Mechanics II) : 1. To determine the temperature coefficient of resistance using post office box. 2. To verify Stefan's fourth power law. 3. To determine specific heat of graphite. 4. To determine the ratio of specific heat of air by Kundt's tube. 5. To determine Joules constant by electric method 6. To determine the coefficient of thermal expansion in solids 7. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method. 8. To determine the thermal conductivity of metal bar by Forbes's method.		

Group IV (Optics) : 1. To determine the Resolving Power of a Prism. 2. To determine the Resolving Power of a Plane Diffraction Grating. 3. To determine wavelength of sodium light using diffraction due to straight edge. 4. To determine wavelength of sodium light using Newton's Rings. 5. To determine wavelength of Laser light using diffraction single slitS 6. Goniometer I-To study cardinal points of optical system 7. Goniometer II- To study the equivalent focal length of optical system. 8. To study angle of specific rotation of sugar using Polarimeter.		

Course Outcomes:
On completion of this course students will be expected to:
1) Students will be able to take measurements and readings with practical skills.
2) Students will be able to study the laws of probability distribution, black body radiation.
3) Students will be able to determine dispersive power, refractive index, resolving power of various materials, wavelengths of different sources by various methods.
4) Students will be able to plot the cardinal points of an optical system.

Text Books for Reading	
1.	Text book of optics for B.Sc. classes- BrijLal and N.Subrahmanyam, S.Chand & Company Ltd. New Delhi, 2006
2.	Wave Optics- R. K. Verma, Discovery Publishing House New Delhi, 2006
3.	A text book of light- 8th Edition,D. N. Vasudeva, Atma Ram & Sons, Delhi (1976)
4.	Fundamentals of Optics- 4th Edition ,FranciesA.Jenkins and Harvey E.White, Tata McGraw-Hill Education Private Ltd., New Delhi 2011
Books for Reference	
1.	Principles of Physics-10th Edition, Halliday and Resnick, Wiley
2.	University Physics- 14th Edition, H.D. Young and R. A. Freedman, Pearson publication.
Books for Practical	
1.	Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, AsiaPublishing House.
2.	Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.
4.	B.Sc. Practical Physics, C.L.Arora, S.Chand& Company Pvt.Ltd., New Delhi

Suggested methods of Teaching:	
i)	Offline Traditional Board Teaching
ii)	Power Point Presentation
iii)	Online Teaching on platform of Zoom or Google Meet

Scheme of Course Evaluation		
1.	End Semester Examination (ESE)	40
2.	Continuous Internal Evaluation (CIE)	10
3.	**Total Marks**	**50**

Suggested techniques for Continuous Internal Evaluation (10 Marks)	
1.	Seminar
2.	Field Report
3.	Assignments
4.	Open book test
5.	Offline / online MCQ test
6.	Symbolic test
7.	Oral
8.	Surprise test
9.	Formula Test
10.	Attendance

Question Paper Pattern (40 Marks) Theory Exam		
Q. No.	**Nature / Type of Question**	**Marks**
1.	Multiple Choice Questions (MCQ) 6 Questions	**6 Marks** (1 Marks for each question)
2.	Write the answers in short 5 Questions	**10Marks** (2 Marks for each question)
3.	Write short notes Attempt any 3 out of 5 questions	**12Marks** (4 Marks for each question)
4.	Write descriptive questions Attempt any 2 out of 4 questions	**12 Marks** (6 Marks for each question)
5.	**Total**	**40 Marks**

Practical Examination

(A) The practical examination will be conducted on one day for three hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the semister. Candidates must produce their journals at the time of practical examination.

Question Paper Pattern (50 Marks) **Semisterwise Practical Exam**		
Semister	**Nature / Type of Question**	**Marks**
III	Group I : One experiment Group II : One experiment Certified Journal (05 marks) & Oral (05 marks)	**20** **20** **10**
	Total Marks (For Semister III)	**50**
IV	Group III : One experiment Group IV : One experiment Certified Journal (05 marks) & Oral (05 marks)	**20** **20** **10**
	Total Marks (For Semister IV)	**50**
Total Marks		**100**