

**“Dissemination of Education for Knowledge, Science and Culture”**  
- Shikshanmaharshi Dr. Bapuji Salunkhe

**Shri Swami Vivekanand Shikshan Sanstha's**  
**Vivekanand College, Kolhapur (Autonomous)**



***DEPARTMENT OF PHYSICS***

**B.Sc. Part - II**  
**Semester-III & IV**

**SYLLABUS**

**Under Choice Based Credit System**

**to be implemented from Academic Year 2022-23**



**B. Sc. Part – II CBCS**  
**Semester - III Paper- III**  
**Thermal Physics and Statistical Mechanics -I and Waves and Optics - I**  
**(DSC -1001 C)**

**Theory: 60 Hours (75 lectures of 48 minutes)**

**Credits -4**

**Course Outcomes:** After the completion of the course the student will be able to -

CO<sub>1</sub>: Demonstrate and understand the basic primary knowledge of Thermal Physics, Statistical Mechanics, waves, and Optics.

CO<sub>2</sub>: get a proficiency in solving problems in Thermal Physics, Statistical Mechanics, waves, and Optics.

CO<sub>3</sub>: Understand the basic concepts of kinetic theory of gases, transport phenomena, thermometry, thermodynamic laws, thermodynamic process, isothermal and adiabatic process, entropy, harmonic oscillations, oscillations of different frequencies, Lissajous figures, coupled oscillations, ultrasonic waves their applications, acoustic of building and reverberations

CO<sub>4</sub>: Develop the critical skill in students to understand Thermal Physics, Statistical Mechanics, waves and Optics.

**Section-I: Thermal Physics and Statistical Mechanics -I**

Unit	Syllabus	Lectures
Unit 1	<p><b>Kinetic Theory of Gases and thermometry</b></p> <p>Mean free path, expression, approximate method derivation of Maxwell's law of distribution of velocities and its experimental verification, Transport Phenomena: transport of momentum (viscosity), transport of thermal energy (conduction), Transport of mass (diffusion), Law of equipartition of energy (qualitative) and its applications to specific heat of monoatomic and diatomic gases. Thermometry: Concept of heat and temperature, temperature scales, principle of thermometry mercury thermometer, platinum resistance thermometer, thermocouple. (Principle, construction and theory)</p>	18
Unit 2	<p><b>Laws of Thermodynamics:</b></p> <p>Thermodynamic system, thermodynamic variables, thermodynamic state, equation of state, thermodynamic equilibrium, Zeroth Law of thermodynamics, Internal energy, First law of thermodynamics, conversion of heat into work, specific heats CP &amp; CV, Applications of First Law (Isothermal process, Adiabatic process, Isochoric, Isobaric), relation between CP &amp; CV, work done during isothermal and adiabatic processes, reversible &amp; irreversible processes, Second law of thermodynamics, Carnot's ideal heat engine, Carnot's cycle (Working, efficiency), Carnot's theorem, Entropy (concept &amp; significance), change in entropy, Entropy changes in reversible &amp; irreversible processes, Third law of thermodynamics, Entropy change in conduction of heat, diffusion of gases, physical significance of entropy, Un-attainability of absolute zero. Zero point energy.</p>	18





## Section-II: Waves and Optics - I

Unit	Syllabus	Lectures
Unit 1	<p><b>1. Superposition of Harmonic Oscillations:</b> Linearity and superposition principle, Composition of two simple harmonic motions, Superposition of two collinear harmonic oscillations- for oscillations having equal frequencies (Analytical and geometrical methods) and oscillations having different frequencies (Beats), Superposition of two perpendicular harmonic oscillations- for oscillations having equal frequencies (Graphical and analytical methods) and oscillations having different frequencies (Lissajous figures), Uses of Lissajous figures.</p> <p><b>2. Coupled Oscillations:</b> Normal modes of vibration, normal coordinates, degrees of freedom, types of coupling, frequency of oscillatory systems, Energy transfer in coupled oscillatory system.</p> <p><b>3. Waves Motion and Ultrasonic waves:</b> Waves Motion: Transverse waves on a string, travelling and standing waves on a string, Normal modes of a string, Group velocity and Phase velocity, Plane waves, Spherical waves. Ultrasonic waves: Piezo-electric effect, Production of ultrasonic waves by Piezo-electric generator, Detection of ultrasonic waves, Properties ultrasonic waves, Applications of ultrasonic waves.</p>	18
Unit 2	<p><b>1. Sound and Acoustics of buildings:</b> Sound: Transducers and their characteristics, Pressure microphone, Moving coil loudspeaker, Intensity and loudness of sound, Decibels, Intensity levels, musical notes, musical scale. Acoustics of buildings: Reverberation and time of reverberation, Absorption coefficient, concept of perfect absorber, optimum reverberation, Sabine's formula for measurement of reverberation time, Acoustic aspects of halls and auditoria.</p> <p><b>2. Viscosity:</b> Revision of viscosity, stream line flow, turbulent flow, coefficient of viscosity, critical velocity, 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 lubrication and pressure</p> <p><b>3. Physics of low pressure:</b> Definition of vacuum , Production and measurement of low pressure, Exhaust pump ,Rotary pump, Diffusion pump, Molecular pump, Knudsen absolute gauge, Pirani gauge, Detection of leakage.</p>	18



**Reference Books:**

1. Heat and Thermodynamics- Brijlal and N. Subramanyam, S. Chand and company LTD
2. A treatise on Heat- Meghnad Saha and B.N. Srivastava, Indian Press
3. Heat and Thermodynamics- Brijlal and N.Subramanyam, S.Chand and company LTD
4. Text book of heat- J.B. Rajam ,S.Chand and company Ltd
5. Heat and Thermodynamics (8th Ed)-M.W. Zemansky and R.Dittman, McGraw Hill
6. Heat Thermodynamics and Statistical physics- J.P. Agrawal and Satya Prakash, Pragati Prakashan
7. The Physics of Waves and Oscillations- N. K. Bajaj, Tata McGraw-Hill Pvt. Ltd.,
8. New Delhi, Reprint 2010
9. (Chapter 2, pp. 54)
10. Elements of properties of matter-D. S. Mathur, S. Chand & company Pvt. Ltd., New Delhi, Reprint 2016
11. (Chapter 4, pp. 110)
12. Physics for degree students- C. L. Arora and Dr. P. S. Hemne, S Chand & Company Pvt. Ltd., Second revised Edition, reprint 2014, Ram Nagar, New Delhi
13. A textbook of sound – N SubrahmanyamBrijlal, Vikas Publishing House Pvt. Ltd., New Delhi,
14. (Chapter 1, pp. 17, Chapter 2, pp 29)
15. Oscillations & Waves- Satya Prakash, Pragati Prakashan, Meerut, 3rd Edition
16. (Chapter 4, pp. 161)
17. The Physics of Waves and Oscillations- N. K. Bajaj, Tata McGraw-HillPvt. Ltd.,
18. New Delhi, Reprint 2010
19. (Chapter 5, pp. 177)
20. Classical Mechanics – Gupta Kumar Sharma, Pragati Prakashan, Meerut, Reprint 2016 (Chapter 8)
21. Introduction to Classical Mechanics- Nikhil Ranjan Ray, Vikas Publishing.
22. ( Chapter 12, pp 306-317)
23. Introduction to Classical Mechanics by R. G. Takwale& P. S. Puranik, McGraw hill education (India) Pvt,Ltd.
24. (Chapter 6 pp 179)
25. Oscillations & waves-Satya Prakash, Pragati Prakashan, Meerut,3rd Edition





## B. Sc. Part – II CBCS

### Semester – IV Paper- IV

#### Thermal Physics and Statistical Mechanics -II and Optics (DSC -1001 D)

Theory: 60 Hours (75 lectures of 48 minutes)

Credits -4

**Course Outcomes:** After the completion of the course the student will be able to -

CO<sub>1</sub>: Demonstrate and understand the basic primary knowledge of Electricity, Magnetism and Electromagnetic Theory and will demonstrate a proficiency in solving problems in Thevenin's theorem, and Norton's theorem, magnetism, electrostatics etc.

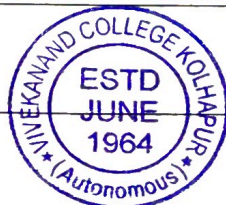
CO<sub>2</sub>: Understand the basic concepts of Ballistic galvanometer, networks theorem, magnetostatics and electrostatics. electricity, and magnetism etc.

CO<sub>3</sub>: Demonstrate a proficiency in solving problems in gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Maxwell's equations, and Electromagnetic wave propagation.

CO<sub>4</sub>: Understand the basic concepts of gradient, divergence, Curl and their significance, Gauss-divergence theorem and Stoke's theorem of vectors, Electromagnetic Induction, Maxwell's equations, and Electromagnetic wave propagation etc.

#### Section-I: Thermal Physics and Statistical Mechanics -II

Unit	Syllabus	Lectures
Unit 1	<p><b>1. Thermodynamic Potentials:</b> Enthalpy, Gibbs, Helmholtz, Internal Energy functions, Maxwell's thermodynamical relations, Joule-Thomson effect, Clausius- Clapeyron equation, Expression for (CP – CV), CP/CV, TdS equations.</p> <p><b>2. Theory of Radiation:</b> Thermal radiations, Blackbody radiation and its importance, Black body in practice, its temperature dependence ,emissive power, absorptive power, pressure of radiation ,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.</p>	18
Unit 2	<p><b>1. Classical statistic:</b> Degrees of freedom, momentum space, position space, Phase space, Microstate and Macrostate, Accessible microstates, priory probability thermodynamic probability, probability distribution, Maxwell-Boltzmann distribution law, energy or speed, evaluation of constants <math>\alpha</math> and <math>\beta</math>, Entropy and Thermodynamic probability, Distribution of molecular speeds.</p> <p><b>2. Quantum statistics:</b> Need of quantum statics, Bose-Einstein distribution law, photon gas, Planck, s radiation law Fermi-Dirac distribution law, free electron in metal, electron gas, comparison of M.B., B.E., and F.D. statistics.</p>	18



26. (Chapter 8, pp315, 319)
27. A Text book of sound- Khanna and Bedi, Atma Ram & sons, Delhi
28. (Chapter 4, pp 62)(Chapter 7, pp 135)(Chapter 3, pp46)(Chapter 22, pp442)
29. Waves and Oscillations-Subrahmanyam Brijlal, Vikas Publishing House Pvt. Ltd.,  
New Delhi, 2nd Revised Edition
30. New Delhi, 2nd Revised Edition
31. (Chapter 12,pp 296)(Chapter 11, pp.282)
32. Waves and Oscillations – Dr. D. N. Tripathy, Kedarnant Ramnant Meerut ,  
Delhi.
33. (Chapter 14, pp259)





## Section-II: Optics

Unit	Syllabus	Lectures
Unit 1	<p><b>1. Cardinal points:</b> Thick lens, combination of lenses (system) Cardinal points of an optical system (definitions only), graphical construction of image using cardinal points, Newton's formula, relation between <math>f</math> and <math>f'</math> for any optical system, relation between lateral, axial and angular magnifications.</p> <p><b>2. Resolving Power of optical instruments:</b> 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.</p> <p><b>3. Polarization of light:</b> Revision of plane of vibration, plane polarization, perpendicular vibration, parallel vibrations, polarization by reflection and refraction, 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.</p>	18
Unit 2	<p><b>1. Interference:</b> 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 index of light.</p> <p><b>2. Diffraction:</b> Revision of wave fronts and 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.</p>	18

### Reference books:

1. Heat and Thermodynamics-M.W.Zemasky and R. Dittman, McGraw Hill.
2. Physics for degree students B.Sc. second year- Arora, Hemne, S. Chand.
3. Concepts of Modern Physics- Arthur Beiser, McGraw-Hill.
4. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa.
6. University Physics- Ronald Lane Reese, Thomson Brooks/Cole.
7. Heat Thermodynamics and Statistical Physics, N. Subramaniam, Brijlal, P. Hemne, 2008, S. Chand.



8. Text book of optics for B.Sc.Classes- BrijLal and N.Subrahmanyam, S.Chand & Company Ltd. New Delhi, 2006
9. Wave Optics- R. K. Verma, Discovery Publishing House New Delhi, 2006
10. A text book of light- 8<sup>th</sup> Edition,D. N. Vasudeva, Atma Ram & Sons, Delhi (1976)
11. Fundamentals of Optics- 4<sup>th</sup> Edition ,Francies A.Jenkins and Harvey E.White. Tata McGraw-Hill Education Private Ltd., New Delhi 2011
12. Optics- 2<sup>nd</sup> Edition, Ajay Ghatak, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
13. Principles of Physics-10th Edition, Halliday and Resnick, Wiley
14. University Physics- 14<sup>th</sup> Edition, H.D. Young and R. A. Freedman, Pearson

**Skill Enhanced Course (SEC) I  
(Thermal Physics and Optics)  
B.Sc. II (Credit 2)**

1. Adjustment of spectrometer
  - a) Leveling of spectrometer
  - b) Least count of spectrometer
  - c) Schuster's method
  - d) Measurement of angle of deviation
2. Adjustment and alignment of optical bench
  - a) Adjustment of slit
  - b) Alignment of slit with eyepiece
  - c) Removal of lateral shift
  - d) Determination of fringe width
  - e) Obtain the fringe pattern using biprism, single mirror, double mirror
3. Determination of focal lengths
  - a) Convex lens
  - b) Concave lens
  - c) Plane glass
4. Study of reflection and refraction
  - a) Plane glass
  - b) Mirror
  - c) Water
5. Study of principle of thermometry
  - a) Thermometric substances
  - b) Types of thermometers
  - c) Different thermometric scales





## **Skill Enhanced Course (SEC) II**

### **(General Physics, Electricity and Magnetism and Electronics)**

#### **B.Sc. II (Credit 2)**

1. Determination of elastic constants of given material
  - a) Young's Modulus
  - b) Bulk Modulus
  - c) Poisson's Ratio
  - d) Modulus of rigidity
2. Study of errors in measurements
  - a) Determination of mean
  - b) Determination of deviation
  - c) Probable error
3. Study of measuring instruments
  - a) Stop watch
  - b) Traveling microscope
  - c) Vernier caliper
  - d) Screw Gauge
  - e) Spherometer etc.
4. Study of types of radiations
  - a) Ultra-violet
  - b) Visible
  - c) Infrared
  - d) Microwave etc.
5. Use of CRO to measure frequency of ac mains
6. Study of colour code and find the value of resistances
7. Study of different parts of BG
8. Determine time period of BG
9. Shouldering of electrical circuits using different components
10. Measurement of DC and AC voltage and current by digital multimeter



## **B.Sc. II Physics Lab Work (Practical)**

### **Group I (Thermal Physics)**

1. Determination of thermal conductivity of bad conductor by Lee's Method
2. Determination of thermal conductivity of good conductor by Forbes's Method.
3. Temperature of Flame
4. To determine the temperature coefficient of resistance of platinum resistance thermometer
5. Measurement of Planck's constant using black body radiation
6. Variation of thermo emf across two junctions of thermocouple with temperature
7. Verification of Stefan's 4<sup>th</sup> power law
8. Mechanical equivalent of heat 'J' by Callendar and Barnes's method

### **Group II (Waves, Oscillation and Sound)**

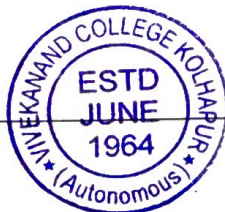
1. Viscosity of liquid by Poiseuille's Method
2. Viscosity of liquid by Searle's viscometer
3. Velocity of sound in air using resonating bottle
4. Velocity of sound in air using Kundt's tube
5. Study of Lissajous figures using CRO
6. To investigate the motion of coupled oscillators
7. Determination of frequency of an electrically maintained tuning fork by Melde's experiment and to verify  $\lambda^2$ -T law
8. Colpitts's oscillator

### **Group III (Optics)**

1. Goniometer I (Cardinal Points)
2. Goniometer II (Equivalent Focal Length)
3. Resolving Power of Prism
4. Determination of Cauchy's constant
5. Resolving power of grating
6. Determination of wavelength of light using Newton's ring
7. Determination of thickness of thin film using interference of wedge shaped thin film
8. Polarimeter

### **Group IV (Electricity and Electronics)**

1. Transistor characteristics (C.E. mode)
2. Transistor as regulated power supply unit
3. Bridge rectifier with  $\pi$  filter circuit
4. A.C. / D.C. sensitivity of CRO
5. Calibration of bridge wire by Griffith's method
6. Constants of B.G.
7. Resistance of B.G. by half deflection method
8. High resistance by Leakage method



## **Skill Enhanced Course (SEC) II**

### **(General Physics, Electricity and Magnetism and Electronics)**

#### **B.Sc. II (Credit 2)**

1. Determination of elastic constants of given material
  - a) Young's Modulus
  - b) Bulk Modulus
  - c) Poisson's Ratio
  - d) Modulus of rigidity
2. Study of errors in measurements
  - a) Determination of mean
  - b) Determination of deviation
  - c) Probable error
3. Study of measuring instruments
  - a) Stop watch
  - b) Traveling microscope
  - c) Vernier caliper
  - d) Screw Gauge
  - e) Spherometer etc.
4. Study of types of radiations
  - a) Ultra-violet
  - b) Visible
  - c) Infrared
  - d) Microwave etc.
5. Use of CRO to measure frequency of ac mains
6. Study of colour code and find the value of resistances
7. Study of different parts of BG
8. Determine time period of BG
9. Shouldering of electrical circuits using different components
10. Measurement of DC and AC voltage and current by digital multimeter





- There will be internal evaluation of 15 marks for each paper.
- There will be end semester theory examination of 35 marks for each paper.
- The total marks for each paper will be 50.
- There will be separate passing for internal evaluation, end semester theory examination, practical examination and Skill Enhancement Courses

Paper No.	Internal evaluation	End Semester Theory Examination	Total
V	15	35	50
VI	15	35	50
VII	15	35	50
VIII	15	35	50

- There will be practical examination of 100 marks at the end of semester IV
- Distribution of 100 marks of practical is as below

Group I	22
Group II	22
Group III	22
Group IV	22
Journal	12
<b>Total</b>	<b>100</b>

- There will be separate examination of 100 marks for Skill Enhancement Courses (SEC's) of all three subjects together of B.Sc. II at the end of semester IV (Conducted by College Examination Cell)

### Nature of Question Paper (End Semester Examination)

#### Instructions:

- 1) All the questions are **compulsory**.
- 2). Figures to the right indicate **full** marks.
- 3) Draw neat labeled diagrams **wherever** necessary.

**Time : 2 hours**

**Total Marks: 35**

#### Paper V

Q:1] Chose correct alternative

A] **FIVE** Multiple Choice Questions

5 Marks

B] **TWO** fill in the blanks

2 Marks

