JYOTI NIVAS COLLEGE AUTONOMOUS
SYLLABUS FOR 2018 BATCH AND THEREAFTER

Programme: B.Sc. **Semester: II**

PHYSICS PAPER II
PROPERTIES OF MATTER, THERMAL PHYSICS & THERMODYNAMICS

Course Code: 18IIPH2 **No. of Hours: 60**

COURSE OBJECTIVES

- Study the absorption of heat and the effect of this absorption on materials. This will include both temperature and phase changes. The concepts of specific heat and latent heat should both be understood.
- The goal is to use the Second Law of Thermodynamics to explain the operation of heat engines. This also involves the introduction of the concept of entropy and its important implication for physical processes involving heat.
- To describe properties of solids at low temperature and to define liquid helium production methods

LEARNING OUTCOMES

- Students gain knowledge of the thermal and mechanical properties of matter and heat transfer and to develop skills in problem solving using these concepts.
- Discuss real world engine examples (steam, gasoline, diesel, etc) and relate their processes to the basic heat engine cycle.
- They acquire a basic knowledge of superconductivity as well as the methods used to understand the functionality.

UNIT I

Elasticity **11 HRS**

Review of Hooke's law and moduli of elasticity. Poisson's ratio. Derivation of relations connecting elastic constants. Theoretical and practical limits of Poisson's ratio. Work done in stretching a wire. Resilience and elastic aftereffect. Factors affecting elasticity of a body. Problems.

Bending of beams and derivation of expression for bending moment. Theory of single cantilever. I - section girder. Torsion of a cylinder. Expression for couple per unit twist and period of torsional oscillations. Thermal Stress. Theory of Searle's method of determining rigidity and bulk modulus of a material. Problems.

Surface tension **4 HRS**

Review of surface tension, angle of contact and capillarity. Pressure difference across a curved surface: application to spherical and cylindrical drops and bubbles. Interfacial tension. Theory of

drop weight method of determining surface tension and interfacial tension. Factors affecting surface tension. Problems.

UNIT II

Viscosity **4 HRS**

Streamline and turbulent flow. Critical velocity. Reynold's number and its significance. Rate of flow of a liquid in a capillary tube. Derivation of Poiseuille's formula. Factors affecting viscosity. Problems.

Physics of low pressure **4 HRS**

Pirani gauge Production of low pressure: Sorption process, electrical and thermal processes. Exhaust pump and its characteristics. Derivation of Langmuir's equation for the speed of a pump. Measurement of low pressure. Methods of detecting leakage in vacuum system. Mention of different types of vacuum pumps used at different levels of pressure

Thermal Physics **7 HRS**

Review of translatory, vibratory and rotatory degrees of freedom of a gas. Maxwell's law of distribution of molecular velocity (qualitative). Calculation of mean velocity, rms velocity and most probable velocity. Perfect and real gases. Andrew's experiment on carbon dioxide. Van der Waal's equation and critical constants. Problems.

UNIT III

First law of Thermodynamics **7 HRS**

Extensive and intensive thermodynamic variables. Isolated, closed and open systems. Thermal equilibrium and zeroth law of thermodynamics. Thermodynamic equilibrium. Classification of thermodynamic processes into (i) isobaric, (ii) isochoric, (iii) isothermal, (iv) adiabatic process, with examples. Indicator diagram. First law of thermodynamics and its application to isothermal and adiabatic processes. Derivation of PV^{γ} = constant (also in terms of temperature). Work done during isothermal and adiabatic processes. Problems.

Second and third laws of Thermodynamics **8 HRS**

Cyclic, reversible and irreversible processes with examples. Kelvin-Planck and Clausius statements of II law of thermodynamics and their equivalence. Carnot's theorem (qualitative). Clausius theorem, Clausius inequality. II law of thermodynamics in terms of entropy. Entropy of a perfect gas. Entropy of the universe Entropy and Disorder Entropy changes in reversible and irreversible processes. III law of thermodynamics. Heat engine: External and internal combustion engine (qualitative). Refrigerator, its working and coefficient of performance. Derivation of Clausius-Clapeyron equation. Its application to (i) elevation of boiling point and (ii) depression of freezing point. Problems.

UNIT IV

Thermodynamic potentials **7 HRS**

Internal energy, enthalpy, Helmholtz free energy, Gibbs free energy and their significance. Maxwell's thermodynamic relations from thermodynamic potentials. Application to (i) relation between principal specific heats of a real gas (ii) energy equations and (iii) increase of temperature during adiabatic compression. I and II order phase transitionsProblems.

Low temperature Physics **8 HRS**

Liquefaction of gases. Methods of producing low temperatures: Regenerative cooling, Joule-Thomson porous plug experiment, Joule-Thomson coefficient for real and ideal gases. Inversion temperature. Comparison between adiabatic and Joule-Thomson cooling. Cooling by adiabatic demagnetization (qualitative). Linde's air liquefier. Liquefaction of Helium. He I and II. Properties of Helium II. λ point. Principles of measurement of low temperature. Use of platinum Resistance Thermometer at low temperatures Problems.

REFERENCE BOOKS

1. Properties of Matter, *Brijlal and N Subramanyam*, S. Chand and Co., Delhi, 1982.
2. Mechanics, *G Mittal, W D Knight, H A Rudramann*, Berkley Physics Course.
3. Elements of Properties of Matter, *D S Mathur*, Shamlal Charitable Trust, Delhi, 1996.
4. Heat & Thermodynamics, *Brijlal and N Subramanyam*, S Chand & Co., New Delhi, 1985.
5. Heat and Thermodynamics, *D S Mathur*, S Chand and Co., Delhi, 5th Edition (2004).
6. Mechanics and Thermodynamics, *G Basavaraju and Dipan Gosh*, TMH, New Delhi, 1984.
7. University Physics, *Sears and M W Zemansky*, Addition Wesley, London, 1963.
8. Fundamentals of Statistical and Thermal Physics, Vol. V, *Frederick Reif*, TMH, 1989
9. Heat and Thermodynamics, *M M Zemansky & R H Dittman*, TMH, 5th Print, 1986
10. Perspectives of Modern Physics, *Arthur Beiser*, TMH, 4th Edition, 1987
11. Fundamentals of Physics, *R Resnick and D Halliday*, Wiley, 2001
12. Classical Mechanics, *K N Sreenivasa Rao*, University Press, 2001
13. Oscillations and Waves, *D P Khandelwal*, Himalaya Publishing House, 5th Edition
14. Newtonian Mechanics, *A P French*, Nelson & Sons, UK, 1971
15. Waves & Oscillations, *P K Mittal & Jai Dev Anand*, Hari Anand Publications, 1994
16. Physics by examples, *W G Rees*, Cambridge University Press, 2010

PHYSICS PRACTICAL-2

General guidelines for using measuring instruments: (i) Slide Calipers, (ii) Screw Gauge and (iii) Travelling Microscope.

1. Determination of young's modulus of the material of a single cantilever.
2. Determination of young's modulus of the material of a bar by uniform bending.
3. Determination of rigidity modulus of the material of a wire by dynamic method.
4. Determination of bulk modulus of rubber.
5. Determination of elastic constants of the material of a wire using Searle's double bar.
6. Determination of thermal conductivity of a bad conductor by Lee and Charlton's method.
7. Determination of thermal conductivity of rubber.
8. Determination of thermal conductivity of aluminium by Forbe's method.
9. Determination of surface tension and interfacial tension by drop-weight method with error calculation.
10. Determination of coefficient of viscosity of a liquid by Poiseuille's method.
11. Determination of specific heat of a liquid by Newton's law of cooling.
12. Determination of young's modulus of elasticity of glass by setting up Cornu's fringes.

Note: (i) A minimum of **eight** experiments are performed.
(ii) Laboratory manual is prepared by the teaching faculty of Physics department

REFERENCE BOOKS

1. Physics through Experiments, *B Saraf*, Vikas Publications.
2. A Laboratory manual of Physics for Undergraduate Classes, *D P Khandelwal*, Vani Publications, New Delhi.
3. Advanced Practical Physics, *B L Worsnop and H T Flint*, Asia Publishing House, New Delhi.
4. B.Sc. Practical Physics, *C L Arora*, S Chand and Co., New Delhi, 2007, Revised edition.
5. An Advanced Course in Practical Physics, *D Chattopadhya, P C Rakshit, B Saha,* Central Book Agency (P) Limited, Kolkata, 6th Revised Edition.
6. Advanced Level Practical Physics, *M Nelkon & J Ogborn*, Heinemann Educational Publishers, 3rd Revised Edition, 1970
7. Practical Physics, *G L Squires,* Cambridge University Press, 2001