

B.Sc. II Semester Degree Examination, April/May - 2019

PHYSICS

Heat, Thermodynamics and Waves and Oscillations

PAPER - 2.1

(Old)

Time : 3 Hours

Maximum Marks :80

*Instructions to Candidates:*

1. Section -I is compulsory.
2. Answer any **Four** questions each from Section -II and from Section - III.

**SECTION - I**

1. Answer any **twelve** of the following:

(12×1=12)

A. Choose the correct answer:

- i) At what temperature is the r.m.s speed of molecules of hydrogen is twice that at S.T.P?
 

a) 273K	b) 546K
c) 819K	d) 1092K
  
- ii) Which of the following is a sudden process.
 

a) Isothermal	b) Adiabatic
c) Isobaric	d) Isochoric
  
- iii) The temperature at which Joule-Thomson effect is zero is called.
 

a) Critical temperature	b) Neutral temperature
c) Temperature of inversion	d) None of these.
  
- iv) At resonance, the intensity of the resultant sound is.
 

a) Zero	b) Minimum
c) Maximum	d) Unpredictable

[P.T.O.]

B. Fill in the blanks:

- i) Entropy remains constant in all -----
- ii) Air can be liquefied by ----- process.
- iii) When the temperature of a black body is doubled the total radiation emitted by the black body increases by ----- times initial value.
- iv) Microphone works on the principle of -----

C. State True or False:

- i) Maxwell's law of distribution of velocities gives probability of velocity of molecules.
- ii) Wien's law of radiation holds good in the shorter wavelength region of the spectrum.
- iii) Energy is transferred by stationary waves.

D. Answer the following in one or two sentences:

- i) State Carnot's theorem.
- ii) What is the perfect black body?
- iii) What are beats?
- iv) What are sound transducers?



## SECTION -II

(4×4=16)

2. What is mean free path? Obtain an expression for it.
3. Obtain an expression for work done in an isothermal process.
4. Explain adiabatic demagnetisation process.
5. Explain the distribution of energy in the spectrum of black body radiation.
6. What are free, damped and forced vibrations.
7. Explain briefly the working of microphone with diagram.

## SECTION -III

(4×13=52)

8. a) State the law of equipartition of energy of a dynamical system. Calculate  $\gamma$  (gamma) the ratio of specific heat at constant pressure to constant volume for a monoatomic, diatomic and triatomic gas. (9)
- b)  $10^{-3} \text{ m}^3$  of hydrogen at  $27^\circ\text{C}$  expands isothermally until its volume is doubled, find the work done. Given  $R=8.314 \text{ JK}^{-1} \text{ Mol}^{-1}$ . (4)
9. a) Deduce Clausius and Claypeyrons equation. Explain the effect of pressure on boiling point and melting point. (9)
- b) Calculate the increase in entropy when 0.01 Kg of ice melts into water without change of temperature. Assume specific latent heat of water is  $3.36 \times 10^5 \text{ JKg}^{-1}$ . (4)

[P.T.O.]



10. a) Describe Joule-Thomson porous plug experiment. Out line the theory of Joule-Thomson effect. (9)
- b) Vander waals constant for a gas are  $a=0.0245 \text{ m}^4 \text{ N mole}^{-2}$ ;  $b=2.67 \times 10^{-5} \text{ m}^3 \text{ mole}^{-1}$ .  $R=8.4 \text{ J mole}^{-1} \text{ K}^{-1}$  calculate the temperature of inversion. (4)
11. a) State and prove stefan's law of radiation, write a note on wien's displacement law. (9)
- b) Calculate the energy radiated per minute from the filament of an incandescent lamp at 2000 kelvin if the surface area is  $5 \times 10^{-5} \text{ m}^2$  and its relative emittance is 0.85. (4)
12. a) Derive Newton-Laplace formula for velocity of sound in a medium. Discuss the effect of pressure and density on the velocity of sound. (9)
- b) The velocity of sound in air at NTP is  $330 \text{ ms}^{-1}$ . At what temperature will the velocity be  $418 \text{ ms}^{-1}$ . (4)
13. a) Obtain the relation Intensity and amplitude of sound wave. (5)
- b) Derive the expression for progressive wave in one dimension. (4)
- c) The equation of progressive wave is given by  
 $y = 5 \sin(10\pi t - 0.1\pi x)$  where x and y are in metre and t in second. Calculate amplitude, frequency, time period and velocity of the wave. (4)



27221(New)

B.Sc II Semester Degree Examination, April /May- 2019

PHYSICS

Heat, Thermodynamics and Waves and Oscillations

PAPER - 2.1

(New)

Time : 3 Hours

Maximum Marks : 60

*Instructions to Candidates:*

- 1) Part A : Answer all questions
- 2) Part B : Answer any FIVE questions

**PART-A**

1. Answer the following questions. (10×1=10)
  - a) Define mean free path .
  - b) State first law of thermodynamics.
  - c) State carnot's theorem .
  - d) Define entropy.
  - e) Define temperature of inversion.
  - f) What is a black body ?
  - g) What is a free-free rod ?
  - h) What is progressive wave ?

[P.T.O.]



- i). Define resonance.
- j) What are beats?

**PART-B**

(5×10=50)

- 2. a) State and prove the principle of equipartition of energy.
- b) Calculate the rms velocity of oxygen molecules at 27°C. Pressure of oxygen at NTP =  $1.0129 \times 10^5 \text{ N/m}^2$  and density of oxygen at NTP =  $1.43 \text{ kg/m}^3$ . (7+3)
- a) What is heat engine? Derive an expression for the efficiency of heat engine in terms of temperature of source and sink.
- b) The efficiency of carnot engine is 50% when the temperature of the sink is 400k. Find the temperature of the source. (7+3)
- a) Derive clausius - claypeyron's latent heat equation.
- b) Find the increase in boiling point of water at 100°C. When pressure is increased by one atmosphere. Given density of water =  $1 \text{ kg/m}^3$  and latent heat of vapourisation =  $2.268 \times 10^6 \text{ J kg}$ . (7+3)
- 1) Explain production of low temperature by adiabatic demagnetisation.
- ) Explain in brief regenerative cooling (7+3)

Derive plank's law of radiation and deduce weins displacement law from it.

A perfectly black body of surface area  $0.04 \text{ m}^2$  is at  $427^\circ \text{C}$  and is placed inside an encloser at  $27^\circ \text{C}$ . what is the rate of loss of heat. Assume  $\sigma = 5.7 \times 10^{-8} \text{ wm}^{-2} \text{ k}^{-4}$ . (7+3)

Derive Newton's formula for velocity of sound in air.

Velocity of sound in air at  $14^\circ \text{C}$  is  $340 \text{ m/sec}$  what will be the velocity of sound when pressure of the gas is doubled and its temperature is raised to  $200^\circ \text{C}$ ? (7+3)



8. a) Derive the Sabine's formula for reverberation time.
- b) A 4m long String of mass per unit length  $0.75 \times 10^{-3}$  kg/m is tied at one end. A tension of 20 Newton is applied at another end. What will be the velocity of transverse waves along the string. (7+3)
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