12 SB – 71

Second Semester B.Sc. Degree Examination, May/June 2015
(New Syllabus)
Paper – II : PHYSICS
Thermal Physics and Waves

Time : 3 Hours

Max. Marks : 80

Instructions : *1) This paper contains **four** Sections **A, B, C** and **D**.*

*2) Answer **any ten** questions in Section **A any two** in Section **B any five** in Section **C** and **any five** questions in Section **D**.*

*3) Take **necessary** data from tables. Symbols used have their usual meaning.*

*4) Draw the **neat** labeled diagrams **wherever** necessary.*

SECTION – A

1. Answer **any ten** of the following : **(2×10=20)**

a) Define rms and most probable velocity of gas molecule.

b) Calculate the atomicity of monoatomic gas.

c) Compare between heat flow and electrical flow.

d) What is an indicator diagram ? Mention its application.

e) Obtain an expression for work done in a isothermal process.

f) Is there any change in entropy of the universe ? Explain.

g) Draw the experimental setup of adiabatic demagnetization.

h) Write a note on radiation pressure.

i) Mention any four properties of radiation.

j) Define reverberation time and absorption co-efficient.

k) What are sound transducers ? Mention any two characteristics.

l) Sketch the variation of Lissajou's figures with period.

P.T.O.

SECTION – B

Answer **any two** of the following : **(2×5=10)**

2. Obtain an expression for heat flow through a compound bar.
3. Derive Clausiu's – Clapeyron's latent heat equation.
4. Define solar constant. Obtain expression for surface temperature of Sun.

SECTION – C

Answer **any five** of the following : **(6×5=30)**

5. Obtain an expression for Van der Waal's equation of State.
6. Mention the different stages of Carnot's cycle and hence obtain an expression for efficiency.
7. Deduce an expression for change in entropy for a cyclic process.
8. Describe Joule – Thomson porous plug experiment with theory.
9. Derive Wein's displacement law and Rayleigh – Jean's law from Planck's law of radiation.
10. Give the theory of Helmholtz resonator.
11. With a neat diagram obtain an expression for velocity of sound in a rod.

SECTION – D

Answer **any five** of the following : **(4×5=20)**

12. The mean free path of nitrogen molecules at 0° C and at one atmospheric pressure is 0.8×10^{-7} m. At that temperature and pressure there are 2.7×10^{25} m^{-3} molecules. What is the molecular diameter ?
13. A slab of material of area 3600 cm^2 and thickness 10 cm is exposed on the lower surface to steam 100° C. A block of ice at 0° C placed on upper surface of the slab. In 1 hour 4.8 Kg of ice is melted. Calculate thermal conductivity of material. Given latent heat of ice is 3.36×10^5 jk.

14. One litre of air at NTP is suddenly compressed to 1 cc what will be the final pressure ? (Given $\gamma = \frac{5}{3}$)
15. Efficiency of a Carnot's cycle changes from $\frac{1}{6}$ to $\frac{1}{3}$ when source temperature is raised by 100 K. Calculate the temperature of the sink.
16. A body losses the energy at the rate of 40 watt from its surface when its temperature is 1500° K .Calculate the temperature when it is loosing energy at the rate of 2560 watt, assuming the body to be perfectly black.
17. The Van der Waal's constants for hydrogen are a = 0.0247 atmosphere litre^2 mol^{-2}, b = 2.65×10^{-2} Litre Mol^{-1}. Find the temperature of inversion.
18. 10 beats are produced per second with the waves of wavelength 0.10 m and 0.110 m. Calculate the velocity of sound in a gas.
19. A mass of 1 kg is attached to a spiral spring having a force constant 15 N m^{-1}. Calculate damping constant when the oscillation is critically damped.

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12 SB – 71

Second Semester B.Sc. Degree Examination, Nov./Dec. 2014
(New Scheme) (New Syllabus)
Paper – II : PHYSICS
Thermal Physics and Waves

Time : 3 Hours Max. Marks : 80

Instructions : *1) The question paper consists **four** Sections **A, B, C** and **D**.*
*2) Section **A** should be answered in the beginning pages **only**.*
*3) Draw **neat** labelled diagrams **wherever** necessary.*
*4) Symbols used have their **usual** meanings.*

SECTION – A

1. Answer **any ten** of the following questions : **(2×10=20)**

a) Define mean free path and write an expression for it.

b) State and explain Wiedeman-Franz Law.

c) Discuss the analogy of heat flow and electrical flow in metals.

d) State and explain zeroth law of thermodynamics.

e) What are significances of T-S diagram ?

f) What is reversible process ? Give an example.

g) Explain Joule-Thomson effect.

h) State and explain Stefan's Law of radiation.

i) Define (a) amplitude and (b) frequency of oscillation.

j) Write and explain Sabine's formula.

k) What are beats ? Mention its application.

l) Distinguish between free and forced vibrations.

P.T.O.

SECTION – B

Answer **any two** of the following questions : **(5×2=10)**

2. State the law of equipartition of energy. Calculate the ratio of specific heats for monoatomic and diatomic gases.
3. Obtain the expression for efficiency of Carnot's heat engine.
4. Derive Planck's law of radiation from the concept of Oscillators.

SECTION – C

Answer **any five** of the following questions : **(6×5=30)**

5. Derive the relation between pressure and volume for an adiabatic change.
6. Derive the Clausius Clayperon latent-heat equation.
7. Derve an expression for inversion temperature.
8. Define solar constant. Estimate the surface temperature of the sun using solar constant.
9. Discuss change in entropy in a reversible and an irreversible process.
10. What are Lissajous figures ? Give the theory of Lissajous figures.
11. Derive an expression for velocity of sound in a rod.

SECTION – D

Answer **any five** of the following questions : **(4×5=20)**

12. A horizontal form of 100 N is required to move a metal plate of area 4 m^2 with a velocity of 0.14 ms^{-1}, when it rests on a layer of a liquid of thickness 4×10^{-3}m. Calculate the coefficient of viscosity of the oil.
13. A Carnot engine whose low temperature reservoir is at 17° C has an efficiency of 50%. It is desired to increase the efficiency to 75%. By how many degrees should the temperature of the high temperature reservoir be increased.

14. Calculate the radiant emittance of a black body at temperature of (i) 400 K (ii) 4000 K (σ is 5.672×10^{-8} MKS units).
15. Calculate the average energy of an oscillator of frequency 0.60×10^{14} sec^{-1} at temperature 1800 K treating it as classical oscillator.
16. Find the pressure at which water would boil at 150° C, if the change in specific volume when 1 Kg of water is converted in to steam is 1.676 m^3. (1 atmosphere = 10^5 Nm^{-2} and latent heat of vapourization of steam = 2.268×10^6 JKg^{-1}).
17. An object is undergoing SHM with period $\frac{\pi}{2}$ sec and amplitude 0.4 m. At t = 0, the object is at x = 0. How far is the object from the equilibrium position when $t = \pi/10$ sec.
18. At what temperature will the velocity of sound in air double of that in air at 0° C ?
19. A bar of length 40 cm and uniform area of cross-section 5 cm^2 consists of two halves AB of copper and BC of iron welded together at B. The end A is maintained at 100° C and the end C at 0° C. The sides of the bar are thermally insulated. Find the rate of flow of heat along the bar, when the study state is reached. Thermal conductivity of copper is 0.9 and thermal conductivity of iron is 0.12 CGC units.

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Second Semester B.Sc. Degree Examination, May/June 2014
(New Syllabus)
Paper – II : PHYSICS
Thermal Physics and Waves

Time : 3 Hours

Max. Marks : 80

Instructions : *1) The paper contains **four** Sections **A, B, C** and **D**.*

*2) Answer **any ten** questions in Section **A** ; **any two** in Section **B** ; **any five** in Section **C** and **any five** questions in Section **D**.*

*3) Take **necessary** date from tables. Symbols used have their usual meaning.*

*4) Draw **neat** and labelled diagrams **wherever** necessary.*

SECTION – A

1. Answer **any ten** of the following (**two** marks **each**). **(2×10=20)**

a) Define the term "Degrees of freedom" of a molecule in a thermal system. How many degrees of freedom does a diatomic molecule processes ?

b) State and explain Maxwell's law of velocity distribution of molecular speeds.

c) State and explain Weidemann-Franz law.

d) Distinguish between isothermal and adiabatic changes.

e) Show that total change in entropy of the working substance in a reversible process is zero.

f) State I law of thermodynamics. Write an expression for work done in an isothermal process.

g) Deduce the relation between temperature of inversion and critical temperature.

h) State Wein's law and Stefan's law of radiation.

i) Write a note on Crooke's radiometer.

j) What are Lissajou's figure ? What is the shape of the Lissajou's figure when the phase difference between S-H-M is $\pi/2$?

k) Mention any two requisites of good acoustics.

l) What are beats ? Define beat frequency.

P.T.O.

SECTION – B

Answer **any two** of the following (**five** marks **each**) : **(5×2=10)**

2. What is mean free path ? Derive an expression for the mean free path of a molecule of a gas.

3. Prove that PV^{γ} = constant in an adiabatic transformation.

4. Derive an expression for velocity of longitudinal vibrations in a rod.

SECTION – C

Answer **any five** of the following (**six** marks **each**). **(6×5=30)**

5. Write down the Vanderwaal's equation of state. Obtain the expressions for critical constants in terms of the constants of the equation.

6. Deduce the efficiency of a Carnot's engine in terms of the temperatures of the source and sink.

7. Derive the Clausiu's-Clapeyron's latent heat equation.

8. What is regenerative cooling ? Explain. What is adiabatic demagnetization ? How is this principle used in producing low temperatures ?

9. Derive an expression for the Planck's radiation law from the concept of oscillators.

10. What are Forced vibrations ? Obtain an expression for the amplitude of forced vibrations and hence give the condition for amplitude resonance.

11. What is reverberation time ? Derive Sabine's formula.

SECTION – D

Answer **any five** of the following (**four** marks **each**). **(4×5=20)**

12. Calculate the temperature at which the r.m.s velocity of a hydrogen molecule will be equal to the speed of the earth's first satellite (i.e. C = 8 Km/Sec.)

13. The bar of length 0.3 m and area of cross-section 0.005 m^2 consists of two halves AB of copper and BC of iron welded together at B. The end A is mainted at 200°C and the end C at 0°C. The sides of the bar are thermally insulated. Find the temperature interface at B. Given thermal conductivity of copper is 0.9 SI units and thermal conductivity of iron is 0.12 SI units.

14. Air is compressed adiabatically to half its volume. Calculate the change in temperature.

15. Calculate the depression of melting point of Ice by one atmosphere increase of pressure, given latent heat of ice = 3.35×10^5 J/Kg and specific volumes of 1Kg of ice and water at 0°C are $1.090\times10^{-3}m^3$ and $10^{-3}m^3$ respectively.

16. The earth receives heat energy 8.4×10^4 joule m^{-2} min^{-1} from Sun. If angular diameter of Sun 32' and it is treated as black body, deduce its surface temperature. Given $\sigma=5.7\times10^{-8}$ watt $m^{-2}K^4$.

17. The Vanderwaal's constants of a gas are a = 1.696×10^3 Nm^4 $mole^{-2}$ and b = $2.18\times10^{-6}m^3$ $mole^{-1}$. Calculate the critical volume and critical pressure of the gas.

18. A particle making S.H.M. has a period 0.001 Sec, amplitude 0.05 m. Show that the acceleration is 7.4×10^4 m/sec^2, when it is 0.002 m away from the mean position of rest and maximum velocity it will attain is $\pi\times10^{+2}$ m/sec.

19. Calculate the velocity of sound in a gas in which the waves of wavelengths 0.50 m and 0.505 m produce 6 beats per second.

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Second Semester B.Sc. Degree Examination, November/December 2013
New Syllabus (New Scheme)
PHYSICS – Paper II
Thermal Physics and Waves

Time : 3 Hours

Max. Marks : 80

Instructions : *1) The question paper contains four Sections **A, B, C** and **D**.*
*2) Section **A** should be answered in the beginning pages only.*
*3) Draw neat and labelled diagrams **wherever** necessary.*
*4) Symbols used have their **usual** meanings.*

SECTION – A

1. Answer **any ten** of the following : **(2×10=20)**

a) Explain the Maxwell's law of velocity distribution.

b) Explain thermal conductivity in the earth's crust.

c) State and explain Widemann-Franz law.

d) Write a note on first law of thermodynamics.

e) Derive an expression for work done during an isothermal process.

f) Give the concept of entropy.

g) What is adiabetic demagnetization ?

h) State and explain Wein's displacement law.

i) What is inversion temperature of a gas ?

j) Explain reverberation time.

k) What are forced vibrations ?

l) Mention any four requisites for good acoustics.

P.T.O.

SECTION – B

Answer **any two** of the following : **(5×2=10)**

2. Derive an expression for a mean free path of a gas molecule.
3. Explain change in entropy during reversible process.
4. Derive Planck's law of radiation from the concept of oscillators.

SECTION – C

Answer **any five** of the following : **(6×5=30)**

5. Derive Vander Waal's equation of state of a gas.
6. What is Carnot's engine ? Derive an efficiency of Carnot's engine.
7. Derive Classius-Clapeyron equation.
8. What is Joule-Thomson effect ? Explain Joule-Thomson's porous plug experiment with results.
9. What is solar constant ? Estimate the surface temperature of sun using solar constant.
10. What are beats ? Give the theory of beats.
11. What are Lissajou's figures ? Obtain an expression for the resultant of two SHM's of equal time period, when they act at right angle to each other and when phase difference is (i) zero and (ii) $\pi/2$.

SECTION – D

Answer **any five** of the following : **(4×5=20)**

12. Calculate the mean free path of a molecule, given that molecular diameter is 4 Å and number of molecules per unit volume is $1.5 \times 10^{25}/m^3$.
13. The Vander Waals constants of a gas are $a = 1.32 \times 10^4 M^4 mole^{-2}$, $b = 3.64 \times 10^{-5} m^3 mole^{-1}$ and universal gas constant is $8.14 \times 10^5 JK^{-1} mole^{-1}$. Calculate the critical temperature of gas.

14. A certain volume of air at 300 K expands adiabatically until its volume is doubled. Find the resulting fall in temperature, if γ for air is 1.4.
15. Calculate the change in entropy when 15 kg of water at 100°C is converted into steam at the same temperature (Latent heat of steam = 540 cal/gm).
16. Calculate the temperature of inversion of Hydrogen with the following constants $a = 0.2444$ (litre)^2.atm/(mole)^2 and $b = 0.2661$ litre/mole ($R = 0.0821$ litre × atm/mole/°K.)
17. If the sun's surface radiates heat 6.3×10^7 watt/m^2 calculate the temperature of the sun (Given constant $\sigma = 5.7 \times 10^{-8}$ watt/m^2/K^4).
18. Find the maximum amplitude at resonance of a particle of mass 0.02 kg executing forced vibration by an applied force 10 sin 2t. (Damping constant, $b = 0.01$).
19. Calculate the velocity of longitudional sound waves through a metal rod. Given that Young's modulus of the material of the rod is 18×10^{10} N/m^2 and density is 7.8×10^3 kg/m^3.

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Second Semester B.Sc. Degree Examination, April/May 2013
(New Scheme) (New Syllabus)
Paper – II : PHYSICS
Thermal Physics and Waves

Time : 3 Hours Max. Marks : 80

Instructions : *1) The question paper consists of **four** Sections **A**, **B**, **C** and **D**.*
*2) Section **A** should be answered in the **beginning** pages only.*
*3) Draw **neat**, labelled diagrams **wherever** necessary.*
*4) Symbols used have their **usual** meanings.*

SECTION – A

1. Answer **any ten** of the following questions : **(2×10=20)**

a) Explain Maxwell's law of velocity distribution with the help of a graph.

b) Explain degrees of freedom for a gas molecule.

c) Explain the analogy between heat flow and electrical flow.

d) Write with neat diagram an expression for heat flow through a compound bar.

e) State and explain Wiedemann-Franz law.

f) Distinguish between isothermal and adiabatic processes.

g) Write the relation between Boyle temperature, inversion temperature and critical temperature of a gas and explain the terms.

h) Deduce Wien's law from Planck's law.

i) What are undamped, damped and forced vibrations ?

j) What are transducers ? Give an example.

k) Mention the requisites of good acoustics for an auditorium.

l) Show that the entropy remain constant during reversible process.

P.T.O.

SECTION – B

Answer **any two** of the following questions : **(5×2=10)**

2. Define mean free path. Derive an expression for mean free path of a gas molecule.
3. Obtain an expression for work done during isothermal changes.
4. Define S.H.M. set up differential equation for S.H.M.

SECTION – C

Answer **any five** of the following questions : **(6×5=30)**

5. Deduce expressions for critical constants P_c, V_c and T_c by using Vander Waal's equation of state.
6. Derive the Clausius Clayperon latent heat equation and discuss its application to boiling point of liquid.
7. Describe Joule-Thomson porous plug experiment and discuss the experimental results.
8. Explain the liquefaction of a gas by cascade process with a neat diagram.
9. Derive Planck's law of radiation from the concept of oscillators.
10. What are Lissajous figures ? Give the theory of Lissajous figures.
11. Derive an expression for velocity of sound in a rod.

SECTION – D

Answer **any five** of the following questions : **(4×5=20)**

12. Calculate the rms velocity of oxygen molecules at 27°C. Given density of oxygen at NTP = 1.43 Kgm^{-3}.
13. A copper rod of length 0.75 m and a steel rod of length 1.25m are joined together end to end. Both are of circular cross section with a diameter of 0.02m. The free ends of copper and steel are maintained at 373k and 273k respectively. The surface of the bars is thermally insulated. What is the temperature of copper-steel junction. Given k of copper = 385 $Wm^{-1}k^{-1}$ and k of steel = 150 $Wm^{-1}k^{-1}$.

14. The efficiency of a Carnot's engine is 20% when the temperature of the sink is reduced by 100°C efficiency increases to 40%. Find the intial temperature of the source and sink.
15. Calculate the change entropy when 50×10^{-3} kg of water at 5°C is mixed with 80×10^{-3} kg of water at 40° C. Given specific heat of water is 4200$Jkg^{-1}k^{-1}$.
16. Calculate the change in temperature when helium gas suffers Joule-Thomson expansion at –100° C the pressure difference on the two sides of the porous plug is 50 atmospheres. Given R = 8.3 $Jk^{-1}mol^{-1}$vander Waals constants $a = 3.41\times10^{-3}$ Nm^4mol^{-2}, $f = 2.37\times10^{-5}m^3mol^{-1}$ and $c_p = 20.75$ Jk^{-1}
17. Calculate the black body temperature of the sun from the following data. Stefan's constant $\sigma = 5.67\times10^{-8}wm^{-2}k^{-4}$. Solar constant $s = 1.35\times10^3wm^{-2}$ radius of the sun $r = 7\times10^8$ km, mean distance between sun and earth = $R = 1.5\times10^8$km.
18. A simple harmonic wave train of amplitude of km and frequency of 100 vibrations is travelling in +ve x-direction with velocity $15ms^{-1}$. Calculate displacement and particle velocity from origin at t = 5 sec.
19. Calculate the velocity of longitudinal sound waves through a metal rod. Given that youngs modulus of the rod is $18\times10^{10}Nm^{-2}$ and density is $7.8\times10^3kg\ m^{-3}$.