Q.P. Code : 11121

First Semester B.Sc. Degree Examination,
November/December 2019

(Semester Scheme – CBCS – Freshers & Repeaters – 2018–2019 and onwards)

Physics

Paper I — MECHANICS – 1, HEAT AND THERMODYNAMICS – 1

Time : 3 Hours] *[Max. Marks : 70*

Instructions to Candidates :

1) *Answer **any five** questions from each Part.*

2) *Use of non-programmable scientific calculations/mathematical tables are allowed.*

PART – A

Answer any **FIVE** questions. Each question carries **8** marks : **(5 × 8 = 40)**

1. (a) Define terminal velocity of a body moving in a resistive medium.

   (b) Assuming the resistive force to be proportional to the velocity, obtain an expression for the velocity of a particle moving in a resistive medium under gravity. **(2 + 6)**

2. (a) Define the terms "Kinetic friction" and "angle of repose".

   (b) Derive an expression for radial and transverse component of velocity of a particle moving along a curve in a plane using polar coordinates. **(2 + 6)**

3. (a) State and explain Work-Energy theorem.

   (b) Obtain an expression for linear momentum of a system of particles. **(3 + 5)**

4. (a) Explain with graph, the distribution of energy in Blackbody spectrum.

   (b) State and explain :

   (i) Wien's displacement law and

   (ii) Kirchhoff's law of radiation. **(4 + 4)**

5. (a) Write any two assumptions of kinetic theory of gases.

   (b) Describe with a diagram Andrew's experiments on carbon dioxide. **(2 + 6)**

6. (a) Derive an expression for the coefficient of viscosity of a gas on the basis of kinetic theory of gases.

   (b) Write Van der Waal's equation of state for a real gas. **(7 + 1)**

7. (a) State and explain first law of thermodynamics.

   (b) Show that PV^{γ} = constant, with usual notation. **(2 + 6)**

8. (a) Explain the PV – diagram for Carnot cycle and hence obtain an expression for the net work done.

   (b) Show that, the total change in entropy in a reversible process is always zero. **(5 + 3)**

PART – B

Solve any **FIVE** of the following problems. Each problem carries **4** marks : **(5 × 4 = 20)**

9. Two masses 6 kg and 12 kg are connected at the two ends of a light inextensible string that goes over a frictionless pulley. Find the acceleration of the masses when masses are released.

10. An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of escape velocity from the earth. Calculate the height above the surface of earth at which satellite is moving. Radius of the earth = 6400 km and $g = 9.8\ ms^{-2}$.

11. A force of 4.8 N is applied to a block attached to the free end of a spring to keep the spring stretched from its relaxed length by 12 mm.

    (a) What is the spring constant of spring?

    (b) What force does the spring exert on the block if the spring is stretched by 16 mm?

12. Two bodies of masses 10 kg and 2 kg are moving with velocities $(2\hat{i} - 7\hat{j} + 3\hat{k})$ and $(-10\hat{i} - 35\hat{j} - 3\hat{k})$ respectively. Find the velocity of centre of mass.

13. Calculate the average kinetic energy of a molecule at $27^{\circ}C$ and Avogadro number, given Boltzmann constant $K = 1.38 \times 10^{-23}\ Jk^{-1}$ and gas constant $R = 8.31\ Jk^{-1}\ mole^{-1}$.

14. If the Van der Waals' constant for carbon dioxide are $a = 1.32 \times 10^{4}\ Nm^{4}\ mole^{-2}$ and $b = 3.64 \times 10^{-5}\ m^{3}\ mole^{-1}$. Calculate its critical pressure and critical volume.

15. A refrigerator takes heat from water at $0^{\circ}C$ and rejects heat at room temperature at $27^{\circ}C$. Find the amount of work to be done to convert 100 kg of water at $0^{\circ}C$ to an equal amount of ice at $0^{\circ}C$. Given specific latent heat of ice = 333×10^3 J kg^{-1}.

16. What is the entropy change of 0.20 kg of block of copper when its temperature is increased from $10^{\circ}C$ to $20^{\circ}C$? Given specific heat of copper = 388 J kg^{-1} k^{-1}.

PART – C

Answer any **FIVE** of the following. Each question carries **2** marks : **(5 × 2 = 10)**

17. (a) Action and reaction are equal and opposite. Will they cancel each other? Explain.

(b) Is frictional force a "self adjusting force"? Explain.

(c) Is the force exerted by a spring, conservative or non-conservative force? Explain.

(d) Can a body have energy without momentum? Explain.

(e) Given sample of 1 cm^3 hydrogen and 1 cm^3 of oxygen both are at NTP. Does the number of molecule differ? Explain.

(f) Does the coefficient of viscosity of gas depend on its pressure? Explain.

(g) Does adiabatic expansion produce cooling? Explain.

(h) Can a heat engine have 100% efficiency? Explain.

SS – 319

I Semester B.Sc. Examination, November/December 2018
(CBCS) (F+R) (2016 – 2017 and Onwards)
PHYSICS – I
Mechanics – I, Heat and Thermodynamics – I

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***five*** *questions from each* ***Part.***

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) Define static friction and kinetic friction.

   b) What is the angle of repose ? Derive the relation between the coefficient of static friction and the angle of repose. **(2+6)**

2. a) State Kepler's laws of planetary motion.

   b) Derive an expression for the escape velocity of a body from the surface of the planet. **(3+5)**

3. a) What is centre of mass ? Derive an expression for position vector of centre of mass.

   b) Show that the linear momentum of a system of particles is equal to the product of mass of the system and velocity of the centre of mass. **(4+4)**

4. a) Define solar constant.

   b) Describe the experimental method of determination of solar constant using Angstrom's pyrheliometer. **(2+6)**

5. Obtain an expression for the pressure exerted by gas molecules on the basis of kinetic theory of gases. **8**

6. a) Define critical temperature of a real gas.

   b) Derive the expressions for critical volume and critical temperature of a real gas in terms of the Vander Waal's constants a and b. **(2+6)**

P.T.O.

7. a) State first law of thermodynamics.

   b) Derive an expression for the work done by ideal gas during an adiabatic process. **(2+6)**

8. a) Derive an expression for the change in entropy of an adiabatic process.

   b) Derive an expression for the change in entropy of an isobaric process. **(4+4)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **4** marks. **(5×4=20)**

9. Two masses 2 kg and 8 kg are connected at the two ends of a light in extensible string that goes over a frictionless pulley. Find the acceleration of the masses and tension in the string when the masses are released. Assume g to be 9.8 ms^{-2}.

10. The force of attraction between the two spherical bodies of masses 40 kg and 80 kg is equal to 87 $\times 10^{-8}$ N. If the distance between the centers of spherical bodies is 0.5 m. Calculate the value of G. Given g = 9.8 ms^{-2}.

11. A box of mass 0.4 kg slides across horizontal frictionless counter with a speed of 0.5 ms^{-1}. It compresses a spring of spring constant K = 750 Nm^{-1}. By what distance is the spring compressed when the box is stopped by the spring momentarily ?

12. The temperature of the furnace is 3000 K. Calculate the heat radiated per unit area for one minute from it. Assume σ to be 5.67 $\times 10^{-8}$ wm^{-2} k^{-4}.

13. Calculate the RMS velocity of oxygen molecules at NTP, if the RMS velocity of hydrogen molecules at NTP is 1840 ms^{-1}. Molecular weights of hydrogen and oxygen are 2 and 32 respectively.

14. The average speed of a gas molecule is 400 ms^{-1}. Calculate the coefficient of viscosity of the gas. If its density is 1.25 kg m^{-3} and mean free path of the molecule is 9 $\times 10^{-8}$ m.

15. Calculate the work done when one mole of perfect gas at NTP is compressed adiabatically till the temperature is increased to 150° C. Assume R = 8.31 Jk^{-1} mol^{-1} and r = 1.67.

16. A Carnot engine has same efficiency

1) between 1000 K and 500 K and
2) between TK and 100 K (temperature of the sink). Calculate TK of the source.

PART – C

Answer **any five** of the following. **Each** question carries **2** marks. **(5×2=10)**

17. a) A lighter and heavier fans m, M respectively are running at the same speed. When the switches of both of them are put off which one of them will come to rest first and why ?

b) Does a satellite need fuel to circle round the earth ? Explain.

c) Can kinetic energy of a system be increased without applying any external force on the system.

d) If the temperature of a blackbody is raised from 300 K to 600 K, by what factor, the rate of energy emission will increase ?

e) Why gas laws are not obeyed at low temperature and high pressure ?

f) How permanent are so called permanent gases like hydrogen and nitrogen ?

g) In which state the entropy is maximum, solid, liquid or gas ? Why ?

h) Otto engine is preferred to a Carnot's engine. Explain why.

SN – 327

I Semester B.Sc. Examination, Nov./Dec. 2017
(CBCS) [F + R] [2016-2017 and Onwards]
PHYSICS – I
Mechanics – I, Heat and Thermodynamics – I

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **five** questions from **each** Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks : **(5×8=40)**

1. a) Define Terminal Velocity.
   b) Derive an expression for the velocity and acceleration of a body moving through a resistive medium at low speed under gravity. **(1+7)**
2. Derive an expression for Radial and Transverse Components of velocity and acceleration for a particle moving along a curve. **8**
3. a) State and explain Work-Energy Theorem.
   b) Distinguish between conservative and Non Conservative forces with examples. **(4+4)**
4. a) State Stefan's law of Radiation.
   b) Define solar constant. Estimate the Surface Temperature of Sun. **(2+6)**
5. a) Derive an expression for the mean free path of a gas molecule.
   b) Mention the factors affecting the mean free path of gas molecules. **(6+2)**
6. Describe Andrew's experiment on the isothermals of Carbon dioxide and discuss its results. **8**
7. a) Distinguish between isothermal and adiabatic processes.
   b) Obtain an expression for the amount of work done by the Ideal gas during adiabatic expansion. **(3+5)**

P.T.O.

8. a) What is meant by entropy ?
   b) Calculate the change in entropy during reversible and irreversible processes. **(2+6)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(5×4=20)**

9. A 10 kg block is placed on a horizontal table and is attached to 5 kg block with the help of a string passing over a frictionless massless pulley. Calculate the acceleration produced. Given the coefficient of static friction is 0.2 between block and the table.

10. Calculate the escape velocity at which the planet has to be launched from the surface of earth so that it escapes from earth's gravitational force.

    Given : Radius of earth $R_E = 6400$ km $g = 9.8\ ms^{-2}$.

11. A Rocket of mass 400 kg has 3,600 kg fuel. The exhaust velocity of fuel is 3.2 km/s. Calculate the rate of consumption of fuel so that Rocket may rise from the ground. Also calculate the time taken for the consumption of fuel, if the rate of consumption of fuel is 20 kg/s.

12. Calculate the surface temperature of the sun from the following data :

    Stefans constant $\sigma = 5.7 \times 10^{-8}\ Wm^{-2}\ K^{-4}$ solar constant $S = 1500\ Wm^{-2}$. Radius of the Sun $r = 7 \times 10^8$ m distance between sun and earth is $R = 15 \times 10^{10}$ m.

13. Find the temperature at which root mean square velocity of the molecules of gas would become twice its value at 77°C.

14. For a gas critical pressure is $1.3 \times 10^6\ Nm^{-2}$ and critical volume for a mole of gas is $70 \times 10^{-6}\ m^3$. Calculate van der Waals constants a and b.

15. A Carnots engine with Sink temperature 27°C has 40% efficiency. By how much the temperature of the source has to be changed so as to increase the efficiency to 50%.

16. Calculate the change in entropy when 0.125 kg of ice at 273 K is converted into steam at 373 K.

Given : Specific heat of water = 4200 $JKg^{-1}K^{-1}$ specific latent heat office = 336×10^3 JKg^{-1} specific latent heat of steam is 227×10^4 $J\ Kg^{-1}$.

PART – C

Answer **any five** of the following. **Each** question carries **2** marks : **(5×2=10)**

17. a) Can you stop the Car on a friction less horizontal road by applying brakes ? Explain.

b) No work is done in moving a particle from one point to another on the surface of a smooth spherical shell. Justify.

c) Can a body have energy without momentum ? Explain.

d) Can the centre of mass lie outside the body ? Give an example.

e) Why hydrogen has highest Co-efficient of Thermal Conductivity ?

f) Can a gas in thermal equilibrium conduct heat from one point to another point ? Explain.

g) Entropy of the Universe tends to maximum. Justify.

h) Can the efficiency of Carnot's engine be greater than one ? Explain.

NS – 284

I Semester B.Sc. Examination, November/December 2016
(CBCS Fresh – 2016-17 and Onwards)
PHYSICS – I
Mechanics I, Heat and Thermodynamics – I

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***five*** *questions from* ***each*** *Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) State Newton's second law of motion.

   b) Define terminal velocity of a body falling under gravity in a resistive medium.

   c) Assuming the expression for instantaneous velocity of a body falling under gravity in a resistive medium at low speed, derive the expression for its instantaneous acceleration. **(2+2+4)**

2. a) State Kepler's laws of planetary motion.

   b) Define escape velocity of an object from a planet's surface and derive an expression for the same. **(3+5)**

3. a) State and explain work energy theorem.

   b) Derive an expression for the potential energy of a spring when it is stretched through a distance x from its unstretched position x = 0. **(2+6)**

4. Derive Planck's radiation formula in terms of frequency of radiation . **8**

5. a) Derive an expression for the mean (average) velocity of a gas molecule on the basis of Maxwell's law of distribution of molecular velocities.

   b) Deduce the perfect gas equation from the equation $PV = \frac{1}{3}mnc^2$ where the symbols have their usual meaning. **(4+4)**

P.T.O.

6. a) Define critical temperature of a real gas.

   b) Derive the expressions for critical volume and critical temperature of a real gas in terms of the Vander Waal's constants a and b. **(2+6)**

7. a) State First Law of thermodynamics and apply the same to an isochoric process.

   b) Derive the expression for work done by n moles of an ideal gas in an isothermal process. **(4+4)**

8. a) State Clausius's statement of second law of thermodynamics.

   b) Describe the construction and working of a Carnot's engine. Write the expression for its efficiency in terms of heat absorbed from the source and rejected to the sink. **(2+6)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(5×4=20)**

9. A block of mass 1 kg is placed on a horizontal surface. The coefficient of static friction between the block and the surface is 0.2. If an external force of 3 N is applied on the block parallel to the surface, find the acceleration of the block. Given $g = 10\ ms^{-2}$.

10. Calculate the magnitude of the gravitational intensity due to a solid sphere of mass 5000 kg and radius 0.5 m at a point 1.5 m from its surface.
    Given $G = 6.67 \times 10^{-11}\ Nm^2kg^{-2}$.

11. Two particles of mass 5 kg and 10 kg have position vectors $(3\hat{i} + 6\hat{j} - 3\hat{k})$ m and $(3\hat{i} - 9\hat{j} + 3\hat{k})$ m respectively from the origin of a co-ordinate system. Calculate the position vector and distance of their center of mass from the origin.

12. Calculate the wavelength corresponding to maximum intensity emitted by a black body at 2900 K.
    Given Wien's constant $= 2.9 \times 10^{-3}$ mK.

13. The mean free path of Nitrogen molecule at 273 K and 1 atmosphere pressure is 8×10^{-8} m. If the diameter of nitrogen molecule is 3.2 $\overset{0}{A}$, find the number of Nitrogen molecules per m^3.

14. The rms speed of a gas molecule is 490 ms^{-1}. Calculate the coefficient of viscosity of the gas given the density of the gas is 1.25 kg m^{-3} and the mean free path of the molecule is 8.85×10^{-8}m. Given : $\frac{V_{mean}}{V_{rms}} = 0.92$.

15. An ideal gas adiabatically expands from an initial volume 0.1 m^3 to a final volume 0.149 m^3.If the pressure of the gas decreases from 1Nm^{-2} to 0.57 Nm^{-2}, find the ratio of specific heat capacity at constant pressure to specific heat capacity at constant volume of the gas (γ).

16. Calculate the change in entropy when 0.05 kg of ice at 273 K melts into water and the temperature of water is raised to 300 K. Give entropy change in melting ice at 273 k = 61.5 Jk^{-1} and specific heat capacity of water = 4200 $Jkg^{-1}k^{-1}$.

PART – C

Answer **any five** of the following. **Each** question carries **two** marks. **(5×2=10)**

17. a) Two pieces of paper of equal size one plane and the other crumpled are dropped from rest in air. Which of them reaches the ground first ? Explain.

    b) Does the moon have an atmosphere ? Explain.

    c) A book is moved on a rough table top from one point to another. Does the work done by the external agent in moving the book against friction depend on the path taken by the book ? Explain.

    d) Where is the center of mass of the sun-earth system located ? Explain.

    e) Does a gas confined in a container exhibit the property of viscosity ? Explain.

    f) Can air be liquified at room temperature by the mere application of pressure ? Explain.

    g) Can a refrigerator be considered as a heat engine working in reverse direction ? Explain.

    h) In an adiabatic expansion of a gas how does the internal energy change ? Explain.

Q.P. Code : 11221

Second Semester B.Sc. Degree Examination, May/June 2019

(CBCS Scheme – Freshers)

Physics

Paper II — MECHANICS – 2, HEAT AND THERMODYNAMICS – 2

Time : 3 Hours] *[Max. Marks : 70*

Instructions to Candidates :

1. *Answer any **FIVE** questions from each Part.*
2. *Candidate is permitted to use non-programmable Scientific Calculator.*

PART – A

Answer any **FIVE** questions. Each question carries **8** marks : **(5 × 8 = 40)**

1. (a) Arrive at the expression for the time period of a compound pendulum.

   (b) Explain coupled oscillations. **(6 + 2)**

2. Obtain the relation between the three moduli of elasticity. **(8)**

3. (a) Arrive at the energy equation $\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$ where symbols have their usual meaning.

   (b) Write the expressions for thermodynamic potentials and explain the symbols. **(4 + 4)**

4. (a) Explain porous plug experiment.

   (b) Arrive at an expression for the Joule-Thomson coefficient of a gas. **(3 + 5)**

5. (a) Show that length is an invariant under Galelian transformation for inertial frames.

   (b) Write the Lorentz transformation equations. **(4 + 4)**

6. (a) Explain the concept of time dilation with the necessary equation.

   (b) Derive the expression for the relativistic addition of velocities. **(3 + 5)**

7. (a) Arrive at an expression for the kinetic energy of rotation for a rigid body.

   (b) Obtain an expression for the moment of inertia of a solid sphere about its diameter. **(3 + 5)**

8. (a) State and explain the law of conservation of angular momentum.

   (b) Define group velocity and phase velocity and derive the relation between them. **(2 + 6)**

PART – B

Solve any **FIVE** problems. Each problem carries **4** marks. **(5 × 4 = 20)**

9. A block of mass 2.7×10^{-3} kg is designed to oscillate at a frequency of 25 Hz and amplitude 26 cm. What is the total mechanical energy of the system?

10. A wire of diameter 1.10 mm and 2 m long fixed at one end is stretched by 0.5 mm when a load of 4 kg is attached at the other end. Calculate Young's modulus of the material of the wire. Acceleration due to gravity = 9.8 ms^{-2}.

11. Calculate the change in pressure required to lower the melting point of ice by 0.5 K given

    Latent heat of fusion of ice at 0°C = 3.34×10^5 JKg^{-1}

    Specific volume of water at 0°C = 1.0×10^{-3} m^3 kg^{-1}

    Specific volume of ice at 0°C = 1.1×10^{-3} m^3 kg^{-1}

12. Van der Wall's constants for oxygen are $a = 0.1382$ Nm^4 mol^{-2}, b = 3.2×10^{-5} m^3 mol^{-1}. Calculate the temperature of inversion and critical temperature of oxygen given gas constant $R = 8.3$ $JK^{-1}mol^{-1}$.

13. Calculate the fringe shift in Michelson-Morley experiment if effective length of each path is 8 m. Velocity of earth 3×10^4 ms^{-1} and wavelength of light is 625 nm.

14. A proton of rest mass 1.67×10^{-27} kg is moving with speed 0.92°C. What is its total energy?

15. A circular disc of mass 0.9 kg and radius 6 cm is oscillating about an axis (a) passing through its centre (b) about a diameter. Calculate moment of inertia of the disc in both the cases.

16. Calculate the speed of transverse wave on a wire stretched by a weight of 400 gm given mass per unit length of the wire is 0.0018 kg m^{-1}.

PART – C

Answer any **FIVE** questions. Each question carries **2** marks : **(5 × 2 = 10)**

17. (a) A damped oscillator of mass m has a force constant 'k' and damping coefficient 'b'. Does the decrease in mechanical energy depend on 'k'? Explain.

(b) A hollow shaft is stronger than a solid shaft of same material, mass and length. Explain.

(c) How the internal energy changes during isothermal expansion? Explain.

(d) Does adiabatic demagnetization produce cooling in a specimen? Explain.

(e) To whom does an object seem shorter in length, an observer moving with object or an observer moving relative to object? Explain.

(f) Is law of inertia valid in linearly accelerated frame? Explain.

(g) What happens to the kinetic energy, when a person on turn table out stretches her hands? Explain.

(h) Does the velocity of sound in gaseous medium depend on pressure of the medium at constant temperature? Explain.

SM – 346

II Semester B.Sc. Examination, May/June 2018
(CBCS) (Fresh + Repeaters) (2016-2017 and Onwards)
PHYSICS – II
Mechanics – 2, Heat and Thermodynamics – 2

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***any five*** *questions from* ***each*** *Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. (5×8=40)

1. a) Define simple harmonic motion.
   b) Derive an expression for the time period of oscillations of a simple pendullum for small amplitude. (1+7)

2. a) What is a cantilever ?
   b) Give the theory of single cantilever. (1+7)

3. Derive Maxwell's four thermodynamic relations from thermodynamical potentials. 8

4. Derive clausius clapeyron's latent heat equation. What is the effect of pressure on melting point of ice and boiling point of water ? 8

5. a) Distinguish between inertial and non-inertial frames of reference.
   b) Describe Michelson-Morley experiment and discuss its result. (2+6)

6. a) State the postulates of special theory of relativity.
   b) Deduce Einstein's mass-energy relation $E = mc^2$, where the symbols have their usual meaning. (2+6)

P.T.O.

7. a) Define moment of inertia and radius of gyration.
   b) State and prove parallel axes theorem for two dimensional case. (2+6

8. a) Define group velocity and phase velocity.
   b) Derive an expression for the speed of transverse waves on a uniform stretched string interms of tension and mass per unit length. (2+6

PART – B

Solve **any five** problems. **Each** problem carries **four** marks. (5×4=20)

9. A square lamina of side 0.30 m oscillates in a vertical plane about a horizontal axis perpendicular to its plane. Calculate the minimum time period of oscillations of compound pendulum. Given $K = L/\sqrt{6}$ and $g = 9.8\ m/s^2$.

10. Find the amount of work done in twisting a steel wire of radius 1 mm, length 0.25 m through an angle of 45°. Given the rigidity modulus for steel is $8\times10^{10}\ N/m^2$.

11. Calculate the specific heat of saturated steam given that specific heat of water at 100°C = 4242 JK^{-1} and latent heat of vapourisation decreases with size in temp at the rate of 2688 JK^{-1} latent heat of vapourisation of steam = $540 \times 4200\ JK^{-1}$.

12. Calculate the change in temperature produced by adiabatic throttling process of one gram mole of oxygen when pressure reduced by 60 atmosphere. The initial temperature of the gas is 27°C. Given for oxygen Cp = 29.53 JK^{-1} $mole^{-1}$, R = 8.3 JK^{-1} $mole^{-1}$, a = 0.132 Nm^4 $mole^{-2}$, b = 3.12×10^{-5} m^3 $mole^{-1}$.

13. At what speed the mass of the particle will be 1.25 times its rest mass ? Given the velocity of light is 3×10^8 m/s.

14. A π meson has mean life time of 2.2×10^{-8}s when measured at rest. How far does it travel before decaying into another particle if its sped is 0.99 C.

15. Calculate the angular momentum of a solid sphere of mass 5 kg and its radius 12 cm spinning at 12 revolutions per second.

16. A string of length 0.5 m and mass per unit length is 2×10^{-4} kg/m is stretched with a tension of 12 N. Calculate the velocity and frequency of fundamental note.

PART – C

Answer **any five** questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) In a simple harmonic motion, at which position P.E. and K.E. are maximum.
    b) Springs are made of copper or steel. Why ?
    c) Why C_p is greater than C_v ?
    d) Hydrogen and Helium shows negative Joule-Thomsons effect at room temperature. Explain.
    e) Name any two frame dependent forces.
    f) Is the moving clock go slow or fast ? Explain.
    g) What happens, when a man on turn table out stretches his hands suddenly ?
    h) Can sound waves be polarised. Explain.

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II Semester B.Sc. Examination, May/June 2019

PHYSICS - II

Mechanics-2, Heat and Thermodynamics-2

(CBCS) (Fresh+Repeaters) (2016-17 and onwards)

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***any five*** *questions from each part.*

5x8=40

PART - A

Answer **any five** questions. Each question carries **eight** marks. **2+6**

1. (a) Define simple harmonic motion giving an example.
   (b) What is Compound Pendulum ? Derive expression for its time period and equivalent length of simple pendulum.

2. (a) Define Young's modulus, rigidity modulus and Poisson's ratio. **3+5**
   (b) Obtain an expression for work done in stretching a wire.

3. (a) What is Gibb's Free energy ?
   (b) Write four Maxwell's thermodynamic relations and deduce an expression for difference in molar specific heats for perfect gas. **1+7**

4. (a) What is Joule-Thomson effect ? Derive an expression for Joule-Thomson co-efficient. **6+2**
   (b) Write two differences between Joule-Thomson expansion and Adiabatic expansion.

5. (a) Distinguish between inertial and non inertial frames of reference. **2+6**
   (b) What is Galilean invarience ? Show that the acceleration is invariant under Galilean transformations.

6. (a) What is the inference of negative result of Michelson-Morley experiment ? **2+6**
   (b) Obtain an expression for Lorentz-Fitzgerald length contraction.

7. (a) State and explain law of conservation of angular momentum. **2+6**
   (b) Derive an expression for moment of inertia of circular disc about an axis passing through its centre and perpendicular to its plane.

P.T.O.

8. (a) Define Phase velocity and Group velocity of waves. 2+6

(b) Derive the relation between Group velocity and Phase velocity of waves.

PART - B

Solve **any five** problems. Each problem carries **four** marks. 5x4=20

9. Calculate total energy of simple harmonic oscillator of mass 0.03 kg having an amplitude 0.1m and frequency of oscillation 20 Hz.

10. Poisson's ratio for glass is 0.4 and young's modulus is 2×10^{10} Nm^{-2}. Calculate the rigidity modulus of glass.

11. Calculate the depression in the melting point of ice for an increase of pressure of 2 atmospheres. Specific volume of ice and water at 273K are $1.091 \times 10^{-3} m^3 kg^{-1}$ and $10^{-3} m^3 kg^{-1}$ respectively. Latent heat of ice $= 336 \times 10^3$ $Jkg^{-1}K^{-1}$. 1 atmosphere $= 10^5$ Nm^{-2}.

12. Calculate the change in temperature when carbon dioxide gas suffers Joule-Thomson expansion at 300K when the pressure difference on the two sides of the porous plug being $5 \times 10^5 Nm^{-2}$.

Given $a = 0.303$ $Nm^4 mol^{-2}$

$b = 4.24 \times 10^{-5}$ $m^3 mol^{-1}$

$C_p = 36.57$ $Jmol^{-1}K^{-1}$

$R = 8.31$ $Jmol^{-1}K^{-1}$

13. Calculate the expected fringe shift in Michelson-Morley experiment if the distance of each path is 3m and light is of wavelength 6000 Å. Given orbital velocity of earth around the sun is 3×10^4 ms^{-1}. Velocity of light is 3×10^8 ms^{-1}.

14. An electron of rest mass 9.1×10^{-31} kg is moving with speed 0.99 C. What is its total energy ?

15. A solid sphere is of mass 2 kg and radius 0.5 m calculate its moment of inertia (a) about its diameter and (b) about an axis tangential to its surface.

16. The equation of a progressive wave is $y = \sin 2\pi \left[\frac{t}{0.02} - \frac{x}{400}\right]$ with length expressed in metre and time in second.
Find : (a) the wavelengths
(b) amplitude
(c) frequency and
(d) the velocity of the wave.

PART - C

Answer **any five** questions. Each question carries **two** marks. **5x2=10**

17. (a) Can simple pendulum experiment be done inside a satellite ? Explain.
(b) Why bridges are declared unsafe after long use ?
(c) There is always cooling during an adiabatic expansion of gas. Why ?
(d) What does Joule - Thomson co-efficient imply if it is negative ?
(e) Does the mass of a body vary with speed ? Explain.
(f) Is Newton II Law of motion F=ma always valid in relativity ? Explain.
(g) There are two spheres of the same mass and same radius. One is solid and the other is hollow. Which one of them has larger moment of inertia about diameter ? Explain.
(h) A Rope hangs vertically from the ceiling. DO waves on the rope move faster, slower or at same speed as they move from bottom to top.

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US – 331

II Semester B.Sc. Examination, May 2017
(CBCS) (Freshers) (2016-17 and Onwards)
PHYSICS – II
Mechanics – 2, Heat and Thermodynamics – 2

Time : 3 Hours Max. Marks : 70

- ***Instruction :*** *Answer* ***five*** *questions from* ***each*** *Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) What is periodic motion ? Give an example.
   b) What is compound pendulum ? Deduce an expression for its time period. **(2+6)**

2. a) Arrive at the relation between elastic constants $K = \frac{q}{3[1-2\sigma]}$ where symbols have their usual notations.
   b) Write the theoretical and practical limiting values of Poisson's ratio. **(6+2)**

3. a) Give the significance of thermodynamic potentials.
   b) Using Maxwell's thermodynamic relations obtain an expression for the difference in specific heats for a perfect gas. **(2+6)**

4. a) Explain melting and sublimation of a solid.
   b) Deduce an expression for Joule-Thomson coefficient. **(2+6)**

5. a) Distinguish between inertial and non-inertial frames of reference.
   b) Show that acceleration is invariant under Galilean transformations. **(2+6)**

6. a) State the postulates of special theory of relativity.
   b) Obtain Lorentz transformation equations. **(2+6)**

P.T.O.

7. a) Define moment of inertia.

   b) Deduce an expression for moment of inertia of a solid sphere about an axis passing through its diameter. **(2+6)**

8. a) What is wave motion ? Mention the characteristics of a wave.

   b) Derive the equation of a progressive wave. **(4+4)**

PART – B

Answer **any five** problems. **Each** problem carries **4** marks. **(5×4=20)**

9. A particle of mass 0.01 kg, executing SHM makes 30 oscillations in 2s with an amplitude of 0.08 m. Find the maximum velocity of the particle.

10. A sphere is suspended from a wire of length 1 m and radius 0.5×10^{-3} m. If the period of torsional oscillations is 1.23 s and moment of inertia of the sphere about an axis through its diameter is 0.03×10^{-2} kg m^2, calculate rigidity modulus of the material of the wire.

11. Calculate the decrease in the melting point of ice when the pressure changes by 1 atmosphere, specific volume of ice at 273 K is 1.091×10^{-3} m^3 kg^{-1} and that of water at 273 K is 10^{-3} m^3 kg^{-1} and latent heat of ice, $L = 3.36 \times 10^5$ J kg^{-1}, one atmosphere = 10^5 Nm^{-2}.

12. The Van der Waals constant for hydrogen are $a = 0.02\ 47$ Nm^4 mol^{-2}, $b = 2.65 \times 10^{-5}$ m^3 mol^{-1}. R = 8.31 J mol^{-1} K^{-1}. Find the inversion temperature of hydrogen.

13. Calculate the expected fringe shift in Michelson-Morley experiment. If the effective length of each path is 6 m, velocity of the earth round the sun is 3×10^4 ms^{-1} and wave length of monochromatic light used is 5000Å (Velocity of light is 3×10^8 ms^{-1}).

14. Calculate the velocity at which the mass of the electron is $\sqrt{3}$ times its rest mass. (Velocity of light is 3×10^8 ms^{-1}).

15. Calculate the moment of inertia of a uniform disc of mass 0.2 kg and radius 0.05 m about an axis passing through its edge and perpendicular to the plane of the disc.

16. The equation of a progressive wave is $y = 4 \sin 2\pi \left[\frac{t}{0.02} - \frac{x}{400} \right]$ metre. Find its amplitude and velocity.

PART – C

Answer **any five** questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) What should be the time period of a simple pendulum in a freely falling lift ? Explain.

    b) Justify the statement that Poissons ratio cannot be negative.

    c) The melting point of ice decreases and that of wax increases with an increase in pressure. Explain.

    d) Ideal gas does not show Joule-Thomson effect. Why ?

    e) Ether was assigned self contradictory properties. Explain.

    f) Moving clock runs slow. Explain.

    g) There are two spheres of same mass and same radius. One is solid and the other is hollow. Which of them has a larger moment of inertia about an axis through the diameter.

    h) Which properties of the medium are necessary for the propagation of a mechanical wave through it ?

Q.P. Code : 11321

O.C

Third Semester B.Sc. Degree Examination,
November/December 2019

(CBCS – Freshers – Semester Scheme)

Physics

Paper III — ELECTRICITY AND MAGNETISM

Time : 3 Hours] *[Max. Marks : 70*

Instructions to Candidates :

1) *Answer any Five questions from each Part.*

2) *Use of non-programmable Scientific calculator/Mathematical tables are allowed.*

PART – A

Answer any **FIVE** questions. Each question carries **8** marks : **(5 × 8 = 40)**

1. (a) How do you convert the current source into voltage source?

   (b) State and prove super position theorem. **(2 + 6)**

2. (a) Obtain an expression for the self inductance of a solenoid.

   (b) Derive an expression for the growth of charge in series CR circuit connected to a dc source. Represent it graphically. **(3 + 5)**

3. (a) Derive an expression for the force between two parallel current carrying conductors.

   (b) Obtain an expression for magnetic field at a point near a straight conductor carrying current using Biot-Savart's law. **(4 + 4)**

4. (a) Obtain an expression for the magnetic field on the axis of a solenoid carrying current.

   (b) Mention any two conditions for Ballistic Galvanometer to be dead beat. **(6 + 2)**

5. (a) Explain briefly surface integral of a function.

   (b) Derive Maxwell's equation $\nabla . B = 0$ and write its physical significance. **(2 + 6)**

6. (a) Derive the relation between refractive index and permittivity of a medium.

   (b) Show that the electromagnetic waves are transverse in nature. **(2 + 6)**

7. Derive expressions with diagrams for current, phase angle and impedance of series LCR ac circuit by J operator method. **(8)**

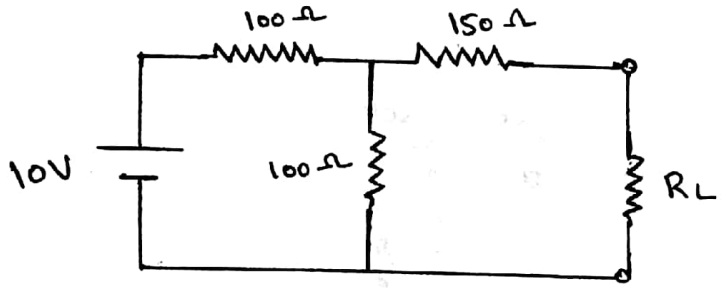
8. (a) Distinguish between Seebeck effect and Thomson effect.

   (b) Apply the principles of thermodynamics and arrive at the relation $\pi = T\left[\frac{dE}{dT}\right]$ where the symbols have their usual meaning. **(3 + 5)**

PART – B

Solve any **FIVE** problems. Each problem carries **4** marks : **(5 × 4 = 20)**

9. For the circuit shown below, calculate the value of R_L to transfer maximum power and also the maximum power.



10. A coil having a resistance of 120 Ω and inductance of 24 H is connected across 24 V battery. Find the current after 0.2 seconds.

11. A capacitor of capacitance 1 μF is discharged through a high resistance of 10 MΩ. Find the time taken for half the charge on the capacitor to leak.

12. Each two coils of a Helmholtz Galvanometer contains 50 turns of wire of mean radius 0.2 m. When a current of 0.1 A is passed through the coil a deflection of 45° is obtained. Calculate the horizontal component of earth's magnetic field. Given $\mu_0 = 4\pi \times 10^{-7}\ \text{Hm}^{-1}$.

13. Find constants (a, b, c) so that the vector

    $A = \hat{i}(x + 2y + az) + \hat{j}(6x - 3y - z) + \hat{k}(4x + cy + 2z)$ is irrotational.

14. Electromagnetic waves are propagating through a conductivity medium made up of aluminium with $\sigma = 38.2 \times 10^6\ Sm^{-1}$. Calculate the skin depth and frequency of wave having a velocity of 650 ms^{-1}. Given $\mu = \mu_0 = 4\pi \times 10^{-7}\ Hm^{-1}$.

15. A condenser of capacity $0.2\ \mu F$ is connected in series with a resistor to a 220 V, 50 Hz ac supply. If the potential drop across the condenser and resistor are equal in magnitude. Calculate the value of resistance and the potential drop across resistor.

16. The emf of a thermocouple of which one junction is at $0°c$ and the other at $50°C$ is 25 μV. The neutral temperature is $100°C$. Find the emf when the junctions are at $0°C$ and $200°C$.

PART – C

17. Answer any **FIVE** of the following. Each question carries **2** marks : **(5 × 2 = 10)**

(a) Can Thevenin's theorem be applied to nonlinear networks? Explain.

(b) What is the effect on frequency of oscillatory discharge in series LCR circuit if an inductor of more number of turns are used? Explain.

(c) Is it possible for a charge to pass through a magnetic field without getting deflected? Explain.

(d) Is the field produced in a toroid uniform? Explain.

(e) Is the displacement current and conduction current being of same magnitude for a given system? Justify.

(f) Is it possible to have only electric wave or magnetic wave alone propagating through space? Explain.

(g) Does current lags the voltage in a pure inductive circuit? Explain.

(h) The thermo emf of a thermocouple is very small – Justify.

No. of Printed Pages : **3**

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III Semester B.Sc. Examination, December - 2019

(CBCS) (Fresher+Repeaters) (2017-18 and Onwards)

PHYSICS - III

Electricity and Magnetism

Time : 3 Hours Max. Marks : 70

Instruction : *Non programmable scientific calculators are permitted.*

PART - A

Answer **any five** questions. Each carries **eight** marks. **5x8=40**

1. State and prove Thevenin's Theorem. **8**

2. (a) Obtain an expression for growth of current in a series LR circuit. Represent it graphically. **6+2**

(b) Define time constant and its significance in LR circuit.

3. (a) Write the expression for force between two long straight parallel conductors carrying current separated by a small distance. Hence define ampere. **2+6**

(b) Derive an expression for magnetic field due to a long straight conductor carrying current using Biot-Savart's Law.

4. (a) State and explain Ampere's circuital law. **2+6**

(b) Obtain with necessary theory an expression for the current through The Helmholtz galvanometer.

5. (a) State and explain Gauss-Divergence Theorem. **2+3+3**

(b) Derive the equation of continuity.

(c) State and explain Poynting's Theorem.

6. (a) Write down Maxwell's field equations. **4+4**

(b) Deduce the electromagnetic wave equation.

P.T.O.

2+6

7. (a) Define rms value and average value of alternating current.

   (b) Write the condition for resonance in series LCR circuit. Obtain the expression for resonance frequency and resonant current. Explain graphically, the current variation with frequency for various resistance values.

2+6

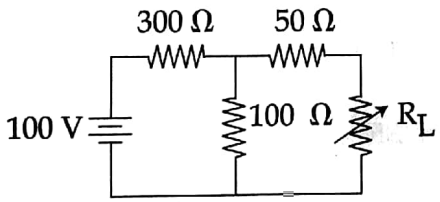
8. (a) What are thermoelectric diagrams ?

   (b) Explain the method of finding Peltier coefficient and Thomson co-efficient using thermo electric diagram.

PART - B

Solve **any five** problems. Each problem carries **four** marks. 5x4=20

9. Find the value of R_L necessary to obtain maximum power. Also calculate the maximum power in R_L in the circuit given below.



10. A capacitor 1μF is charged and discharged through a high resistance. If half the charge leaks in half a minute, calculate the value of high resistance.

11. A rectangular coil of area 40×10^{-4} m^2 consists of 50 turns of wire and carries a current of 20mA. A magnetic field of 0.35T is applied parallel to the plane of the coil. Calculate the torque acting on it.

12. A current of 30 A is flowing upward through a infinitely long straight vertical wire. Calculate the distance from the conductor at which magfield produced by it neutralises the earth's horizontal component $B_H = 0.3 \times 10^{-4}$ T.

13. If the electric field between a parallel plates of air capacitor of dimension 1.2m × 1.5m changes at the rate of 5.5×10^5 $Vm^{-1}s^{-1}$, calculate displacement current. What is the displacement current if dielectric material of $\epsilon_r = 3.2$ is introduced between the plates of capacitor ?

($\epsilon_0 = 8.854 \times 10^{-12}$ Fm^{-1})

14. Assuming $\mu = \mu_0$ calculate the skin depth in silver of conductivity 6.2×10^7 mho m^{-1}, for the electromagnetic waves of frequency 10^6 Hz.

15. A capacitor of capacity 0.2μF is connected in series with a resistance to a 220V – 50Hz ac supply. If the pd across capacitor and resistance are equal in magnitude calculate the resistance and current in the circuit.

16. The thermo emf of a thermocouple in μV is given by the equation $e = 16.34\theta - 0.021\theta^2$, when the junctions are at 0°C and θ°C. Calculate thermo-electric power and peltier emf at 100°C.

PART - C

Answer **any five** questions. Each question carries **two** marks. **5x2=10**

17. (a) Can we apply superposition theorem to circuits containing active devices ?

(b) When does LCR circuit get critically damped ?

(c) In a BG the moment of inertia of suspension is made large. Why ?

(d) Does the solenoid contract when a current is passed through it ? Explain.

(e) What is the significance of equation $\vec{\nabla} \cdot \vec{B} = 0$?

(f) What is the basic source of electromagnetic waves ? Explain.

(g) Can we use a capacitor in place of inductor to control ac current. Explain.

(h) Is seebeck effect reversible ? Explain.

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SS – 320

III Semester B.Sc. Examination, Nov./Dec. 2018
(CBCS) (2017-18 and Onwards)
(Fresh + Repeaters)
PHYSICS – III
Electricity and Magnetism

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***any five*** *questions from* ***each*** *Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) What is an ideal voltage source ? Represent V-I characteristics of ideal and practical voltage sources.

   b) State and explain Norton's theorem. **(3+5)**

2. a) Derive an expression for the self inductance of a solenoid.

   b) Derive an expression for the growth of current in LR circuit connected to a d.c. source. **(3+5)**

3. a) Mention the conditions for a moving coil galvanometer to be dead beat.

   b) Explain with a neat diagram the experimental determination of high resistance by leakage using ballistic galvanometer. **(3+5)**

4. a) State and prove Ampere's circuital law.

   b) Using Ampere's circuital law obtain an expression for magnetic field at a point inside a long solenoid carrying current. **(4+4)**

5. a) Write the equation of continuity. What is its physical significance ?

   b) Write the four Maxwell's field equations. Derive $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$. **(2+6)**

6. a) Derive $\nabla^2 E = \mu_0 \varepsilon_0 \frac{\partial^2 E}{\partial t^2}$.

   b) State poynting theorem. **(6+2)**

P.T.O.

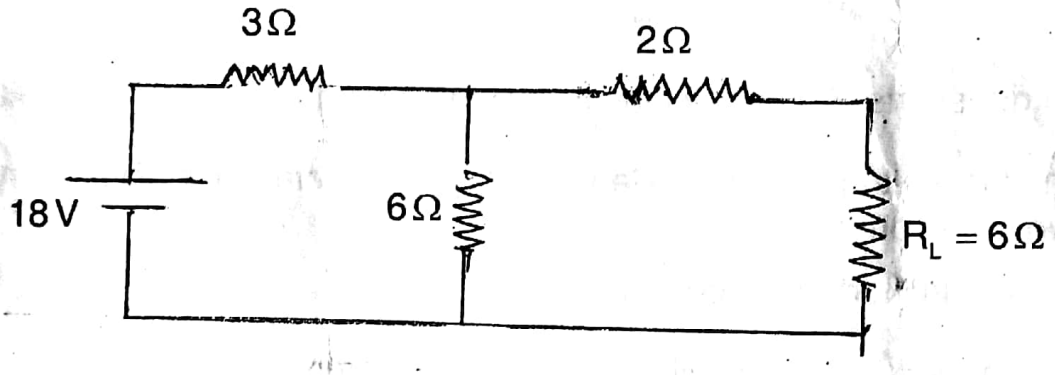
7. Derive expressions with diagram for impedance, current and phase angle of a series CR ac circuit by j operator method. 8

8. a) State and explain the laws of thermo-electricity.
   b) Explain with a neat diagram Thermopile. (4+4)

PART – B

Solve **any five** problems. **Each** problem carries **four** marks. (5×4=20)

9. In the given circuit find the current through R_L using Thevenin's theorem.



10. How many time constants will be taken by a condenser to gain 99% of its steady state charges in a CR circuit ?

11. Two parallel wires each of length 3 m kept 20 cm apart carry currents of 20 A and 30 A respectively in the same direction. Calculate the force acting. What is the nature of this force ? Given $\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}.

12. An electric current I is flowing in a circular wire of radius $\sqrt{3}$ m. At what distance from the centre on the axis of circular wire will the magnetic field be 1/8th of its value at the centre ?

13. Yellow light of frequency 5.09×10^{14} Hz enters diamond. Calculate the wavelength and speed of wave propagation in diamond. At this frequency diamond has $\varepsilon_r = 5.84$ and $\mu_r = 1$. Given $C = 3 \times 10^8 ms^{-1}$.

14. An electromagnetic wave of frequency 2 MHz is propagating in a conducting medium. The medium is silver for which conductivity is 6.8×10^7 Sm^{-1} and $\mu_r = 1$. Calculate the skin depth. Given $\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}.

15. An alternating voltage of 110 V, 50 Hz is applied to a circuit containing a resistance of 200 Ω, an inductance of 5 H and a capacitance of 2 μF connected in series. Calculate the impedance and the current in the circuit.

16. The emf of a certain thermocouple varies with temperature θ of the hot junction when the cold junction is kept at 0°C as $e = 40\,\theta - \frac{\theta^2}{20}$. Find the neutral temperature and the temperature of inversion.

PART – C

17. Answer **any five** questions. **Each** question carries **two** marks. **(5×2=10)**

a) Self inductance is called electrical inertia. Justify.

b) What does a small value of time constant in a LR circuit represent ? Explain.

c) Is the direction of displacement current same as that of conduction current ? Explain.

d) Does a current carrying conductor kept parallel to the direction of a magnetic field get deflected ? Explain.

e) Do magnetic monopoles exist ? Explain.

f) Does the skin depth for a good conductor increase with increasing wave frequency ? Explain.

g) What is a rejector circuit ? Why is it so called ?

h) Is Peltier effect reversible ? Explain.

SN – 329

III Semester B.Sc. Examination, November/December 2017
(CBCS) (2017 – 18 and Onwards) (Fresh)
PHYSICS – III
Electricity and Magnetism

Time : 3 Hours Max. Marks : 70

Instructions *: Answer* ***any five*** *questions from* ***each*** *Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) Define an ideal voltage source and current source.
   b) State and prove maximum power transfer theorem. **(2+6)**

2. Obtain an expression for decay of charge in series LCR circuit and mention its special cases. **8**

3. a) State and explain Biot – Savart's law.
   b) Obtain an expression for the field on the axis of a Solenoid carrying current. **(3+5)**

4. a) Obtain with necessary theory an expression for the current through the Helmholtz galvanometer.
   b) Using Ampere's circuitar law obtain an expression for the magnetic field due to a straight conductor carrying conductor. **(5+3)**

5. a) State and explain Divergence theorem.
   b) Derive Maxwell's Equation $\nabla.D = \rho$ and discuss its physical significance. **(2+6)**

6. a) Obtain an expression for velocity of electromagnetic waves in free space.
   b) State poynting theorem. **(6+2)**

7. a) Derive with a diagram an expression for self inductance of a coil using Maxwell's Bridge.

   b) What is Q-factor ? Explain its significance. **(5+3)**

8. a) Distinguish between Seebeck effect and Peltier effect.

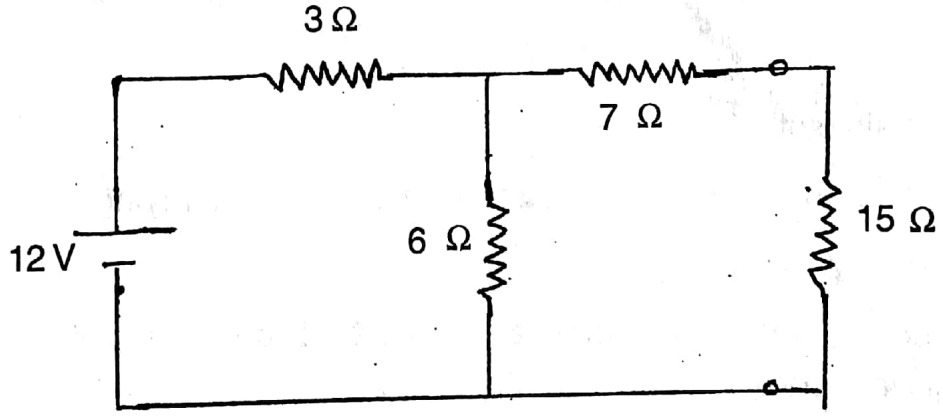
   b) What is meant by Thermo electric diagrams ? Discuss in detail any two of its applications. **(2+6)**

PART – B

Solve **any five** problem. **Each** problem carries **four** marks. **(5×4=20)**

[Permeability of free space $\mu_0 = 4\pi \times 10^{-7} H\, m^{-1}$
Permittivity of free space $t_0 = 8.8 \times 10^{-12} Fm^{-1}$]

9. Using Thevenin's theorem calculate the power delivered across 15 Ω .



10. A 0.5 m long solenoid having 500 turns and radius 0.02 m is wound on an iron core of relative permeability 800. What will be the average emf induced in the solenoid if the current in it changes from 0 to 2 amp. in 0.05 sec.

    Given $\mu_0 = 4\pi \times 10^{-7} H\, m^{-1}$.

11. A uniform magnetic field of magnitude 1.5 Tesla points horizontally from south to north. A proton of energy 5 MeV moves vertically downward through this field. Calculate the force on it.

    Given mass of proton = 1.7×10^{-27} kg

    Charge = 1.6×10^{-19} C.

12. A condenser of 1000 PF is charged to a potential difference of 1 volt and then discharged through a BG. The first throw on a scale placed away is 0.62 m. If the time period is 10 sec and logarithmic decrement is 0.02, calculate the ballistic constant of the galvanometer.

13. An ac voltage is applied directly across a 10 μ F capacitor. The frequency of the source is 3 kHz and the voltage amplitude is 30 V. Find the displacement current between the plates of the capacitor.

14. Calculate the skin depth in copper of conductivity 5.8×10^7 S m^{-1} for the electromagnetic waves of frequency 1 m Hz.

    Given $\mu = \mu_0 = 4\pi \times 10^{-7}$ H m^{-1}

15. A circuit consists of a non inductive resistance of 50 Ω , an inductance of 0.3 H and resistance of 2 Ω , a capacitor of 40 μF in series and is supplied with 200 V at 50 Hz. Find the impedance, I_{rms} and I_{max} in the circuit.

16. Calculate the neutral temperature, temperature of inversion and the total emf of a thermo couple between 0°C and 100°C for which the Seebeck coefficients are a = 10 μv/°C and b = – 0.025 μv/°C^2.

PART – C

17. Answer **any five** questions. **Each** question carries **two** marks. **(5×2=10)**

    a) Can super position theorem be applied to non linear networks ? Explain.

    b) Is there any loss of energy due to the production of back emf in an LR circuit ? Explain.

    c) Does a current loop behave as a magnetic dipole ? Explain.

    d) Is the field produced in a toroid uniform ? Explain.

    e) Do magnetic monopoles exist ? Explain.

    f) Is it possible to have only electric wave or magnetic wave alone propagating through space ? Explain.

    g) What is the phase difference between the applied voltage and current in an LCR series ac circuit at resonance ? Explain.

    h) Does thermoelectric effect obey the law of conservation of energy ? Explain.

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SN – 330

III Semester B.Sc. Examination, November/December 2017
(R) (CBCS/NS) (2012-2013 and Onwards) (Prior to 2017-18)
PHYSICS – III
Electricity and Magnetism

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***any five*** *questions from* ***each*** *Part.*

PART – A

I. Answer **any five** questions. **Each** question carries **eight** marks. **(5×8=40)**

1) State and prove Thevenim theorem. **8**

2) With the necessary theory explain construction and working of ballistic galvanometer. **8**

3) a) State and explain Biot-Savart's law.

b) Derive an expression for magnetic field at a point on the axis of current carrying circular loop. **(3+5)**

4) a) Derive an expression for force between two parallel current carrying conductors.

b) Define ampere. **(6+2)**

5) Obtain an expression for growth of current in series L-R circuit and represent graphically. Define time constant of the circuit. **8**

6) Derive Maxwells equation :

i) $\vec{\nabla} . \vec{D} = \rho$

ii) $\vec{\nabla} . \vec{B} = 0$. **8**

7) Derive an expression for impedance and current in LCR series circuit by vector method. **8**

8) a) Define Peltier and Thomson coefficient.

b) Show that $\frac{dE}{dT} = \frac{d\pi}{dT} - (\sigma_A - \sigma_B)$. **(2+6)**

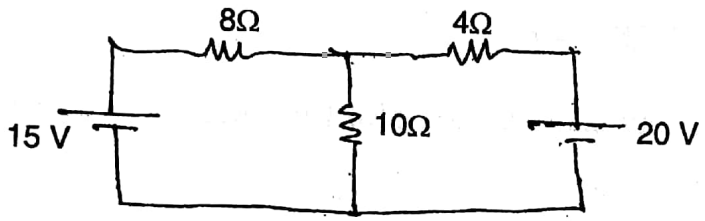
P.T.O.

PART – B

II. Solve **any five** problem. **Each** problem carries **four** marks. **(5×4=20)**

9) Two point charges $+10\mu c$ and $-10\mu c$ are placed 4 mm apart. Calculate the electric field at a point 0.15 m from the mid point of two charges along their axis.

10) Using super position theorem determine the current through 10Ω resistor in the given circuit.



11) A HTG has coils of radius 0.08 m each of 50 turns. Calculate the current through the coils which produces deflection of 50°.

(Given $B_H = 0.36 \times 10^{-4} T$ $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$)

12) A coil of area 300×10^{-4} m^2 having 100 turns placed at right angle to magnetic field of 2.5 tesla is removed from the field in 0.5 s. Calculate the emf induced in the coil.

13) A capacitor of 15 μc is charged and then discharged through a resistance of 10 $M\Omega$. Calculate the time taken in which charge on the capacitor decreases to half of its initial value.

14) If the electric field vector is given by

$\vec{E} = x^2 z\hat{i} - 2y^2 z^2 \hat{j} + xy^2 \hat{k}$.

Find the divergence of the field vector at a point (1, –1, 1).

15) A resistance of 20Ω and capacitor of $20\mu F$ are connected in series with a.c. source of 220 V and 50 Hz. Calculate impedance and current through the circuit.

16) Calculate the thermo e.m.f. and neutral temperature of thermocouple between 0°C and 80°C for which seebeck coefficients $a = 12\,\mu v/°c$ and $b = -0.026\,\mu v/°c^2$.

PART – C

III. Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17) a) An electric charge is kept stationary in a magnetic field. Will it experience force ? Explain.

b) The moment of inertia of the suspension coil in BG is made large. Why ?

c) Does Lenz's law in accordance with law of conservation of energy ? Explain.

d) Does the solenoid contract when current passed through it ? Explain.

e) Is there any loss of energy due to the production of back emf in an L-R circuit ? Explain.

f) Is it possible to have only electric wave or magnetic wave alone propagate through space ? Explain.

g) Does power dissipated by pure inductor is zero ? Explain.

h) Is seebeck effect reversible ? Explain.

No. of Printed Pages : **3**

GS-298

IV Semester B.Sc. Examination, May/June - 2019
(CBCS) (Freshers+Repeaters) (2017-18 & onwards)

PHYSICS - IV

Optics and Fourier Series

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **any five** questions from each part.*

PART - A

Answer **any five** questions. Each question carries **eight** marks. **5x8=40**

1. (a) Explain Huygens principle and deduce the law of refraction for a spherical wave on a plane refracting surface. **5+3**

(b) What are coherent sources ? Describe any one method of producing the coherent sources.

2. (a) Obtain an expression for the displacement of fringes when a thin transparent film is introduced in the path of one of the interfering beams in biprism. **4+4**

(b) Write an expression for path difference in the reflected light from the air wedge. Hence derive an expression for fringe width.

3. (a) Explain Fresnel's diffraction at a straight edge and obtain the conditions for secondary maxima and minima. **6+2**

(b) Write any two differences between Fresnel's and Fraunhofer's diffraction.

4. (a) Define resolving power and dispersive power of a grating. **2+6**

(b) Describe with mathematical theory of diffraction grating at minimum deviation.

5. (a) What are retarding plates ? Write the expression for the thickness of quarter wave plate. **2+6**

(b) Explain how retarding plates can be used for the production and detection of circularly, elliptically and plane polarized light.

6. (a) What are spontaneous and stimulated emission of radiation ? **2+3+3**

(b) Write the characteristics of laser.

(c) Mention any three applications of laser.

P.T.O.

7. (a) State Fourier's theorem.
   (b) Analyse the sawtooth wave using Fourier's theorem. 2+6

8. (a) Explain (i)Numerical aperture, (ii) Acceptance angle of an optical fibre.
   (b) Derive an expression for numerical aperture of an optical fibre. 4+4

PART - B

Solve **any five** problems. Each problem carries **four** marks. 5x4=20

9. In the Fresnel's biprism experiment the distance between slit and screen is 0.82m, the wavelength of light used is 650nm and the tringe width is 1.62×10^{-3} m. Find the distance between two virtual sources.

10. Newton's rings are obtained by using monochromatic light of wavelength 600nm. The radius of curvature of the surface of the lens used is 1m. Calculate the diameter of the 10^{th} dark ring.

11. A point source of light of wavelength 589.6 nm in placed at a distance of 1m from zone plate. The image of the source is formed at a distance of 2m on the other side of the zone plate. What is the focal length of the zone plate? Also find the radius of the second zone.

12. A diffraction grating having 450000 lines per metre is illuminated normally by a parallel beam of monochromatic light and second order spectral line is observed to be deviated through 30°. Calculate the wavelength of the spectral line.

13. Calculate the concentration of the sugar solution if the plane of polarization is rotated through an angle of 26.4° while travelling through 0.2m length of the solution. Given specific rotation of sugar solution is 0.011 rad m^2 kg^{-1}.

14. Calculate the energy difference in eV between the two energy levels of the neon atoms of He-Ne gas laser, the transitions between which results in the emission of light of wavelength 630nm. Also calculate the number of photons emitted per second, if the optical power output is 2×10^{-3} w.

15. Prove that Fourier transform of a function $\exp\left(-\frac{t^2}{2}\right)$ is $\sqrt{2\pi}\, e^{\frac{-w^2}{2}}$.

16. An optical fiber has numerical aperture of 0.32. The refractive index of cladding is 1.48. Calculate the refractive index of the core, the acceptance angle of the fiber and the fractional index change.

PART - C

17. Answer **any five** questions. Each question carries **two** marks. **5x2=10**

(a) What type of fringes are observed in a biprism experiment with a white light source ?

(b) Why does an extremely thin film appears dark in reflected light ? Explain.

(c) Why are Fresnel's half period zones so called ? Explain.

(d) When red light is replaced by violet light, how does resolving power of the telescope change ? Explain.

(e) Is the longitudinal wave be polarized ? Explain.

(f) Can a two level system is suitable for lasing ? Explain.

(g) Can Fourier's theorem be used for analysing sound waves ? Explain.

(h) What is meant by pulse dispersion in optical fibres ?

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No. of Printed Pages : 3

GS-302

IV Semester B.Sc. Examination, May/June - 2019
(NS - 2012-13 & onwards) (CBCS - 2015-16 & onwards)
(Repeaters) (Prior to 2017-18)

PHYSICS - IV

Physical Optics, Lasers and Fibre Optics

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **five** questions from Part - A, **five** questions from Part - B and **five** questions from Part - C.*

PART - A

Answer **any five** questions. Each question carries **eight** marks. **5x8=40**

1. (a) State and explain Huygen's principle. **3+5**
(b) Verify the law of refraction for a spherical wavefront at a plane surface using Huygen's wave theory.

2. (a) What are coherent sources ? Mention any one method of producing coherent sources. **3+5**
(b) Give the theory of Fresnel's biprism and obtain the expression for width of interference fringes.

3. (a) Describe how a plane wavefront can be divided into Fresnel's half period zones of radii proportional to square root of natural numbers. **5+3**
(b) Mention any three differences between a Zone-plate and a Convex lens.

4. (a) Define dispersive power and resolving power of a grating. **2+6**
(b) Obtain an expression for the resolving power of a plane transmission grating.

5. What are retarding plates ? Give the theory of retarding plates. **8**

6. (a) Write two characteristics of laser beam. **2+6**
(b) Describe the construction and working of Helium-Neon laser with its energy level diagram.

7. (a) Explain : (i) Numerical aperture **4+4**
(ii) Acceptance angle of an optical fibre
(b) Derive an expression for Numerical aperture.

P.T.O.

8. (a) What are coherent and incoherent bundles ? 2+6

(b) Derive an expression for the internodal dispersion in a step index multimode fibre.

PART - B

Solve **any five** problems. Each problem carries **four** marks. 5x4=20

9. When a thin sheet of transparent material of refractive index 1.52 is introduced in the path of one of the interference beams, the central fringe shifts to a position occupied by the tenth bright fringe. If the wavelength of light used is 548.1 nm, calculate the thickness of the material.

10. In Newton's rings experiment the diameters of third and ninth rings are 0.3 cm and 0.5 cm respectively. Calculate the diameter of fifteenth ring.

11. If the diameter of the central zone is 2.8 mm and a point source of light of wavelength 660 nm is placed 6 m away from the zone plate, find the position of the primary image.

12. A diffraction grating with 7000 lines per cm is set at normal incidence. Calculate the dispersive power of the grating in the second order spectrum if the wavelength of light is 600 nm.

13. Determine the concentration of a solution of length 0.25 m. which produces an optical rotation of 30°. The specific rotation of the solution is 0.0209 rad m^2 kg^{-1}.

14. A laser beam with power per pulse 2 mW lasts 10 ns, contains 7.5×10^7 photons per pulse. Calculate the wavelength of laser light.

15. Numerical aperture and fractional index difference of an optical fibre are 0.35 and 0.01 respectively. Calculate the refractive index of core and that of cladding.

16. What is the total number of modes when the wavelength of light is 1300 nm ? Given the core diameter as 50×10^{-6} m and numerical aperture of the fibre is 0.42.

PART - C

17. Answer **any five** of the following questions. Each question carries **two** marks. **5x2=10**

(a) The interference patterns of the reflected rays and transmitted rays in thin film are complimentary. What does this mean ?

(b) Thin films of oil on water appear coloured when seen under sunlight. Why ?

(c) It is easy to observe diffraction effect in sound than in light. Explain.

(d) If the number of rulings in a grating is increased, what is its effect on the resolving power of grating ?

(e) A two level system is not suitable for laser action. Justify.

(f) What is the principle underlying in holography ?

(g) Light travels in straight lines, how it is yet transmitted through a curved optical fibre ?

(h) Are fibre optic sensors transducers ? Explain.

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SM – 347

IV Semester B.Sc. Examination, May/June 2018
(CBCS) (Freshers) (2017-18 and Onwards)
PHYSICS – IV
Optics and Fourier Series

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***any five*** *questions from* ***each*** *Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) Verify the law of reflection for a spherical wave front incident on a plane surface using Huygen's wave theory.
   b) Obtain an expression for the displacement of fringes when a thin transparent film is introduced in the path of one of the interfering beams in biprism. **(4+4)**

2. a) Describe with theory the formation of bright and dark interference fringes in the light reflected from a thin film.
   b) What are Newton's rings ? Explain. **(6+2)**

3. a) Derive an expression for the focal length of a zone plate.
   b) Mention any three differences between a zone plate and a convex lens. **(5+3)**

4. Explain Fyaunhofer diffraction at a single slit. Deduce the expressions for positions of central maximum, secondary maxima and minima. **8**

5. What are retarding plates ? Give the theory of retarding plates. **8**

6. a) What is meant by spontaneous and stimulated emissions ?
   b) Describe with energy level diagram the construction and working of Ruby laser. **(3+5)**

7. a) State Fourier's theorem.
   b) Analyse the triangular wave by Fourier theorem. **(2+6)**

P.T.O.

8. a) Define Numerical aperture. Derive an expression for numerical aperture of an optical fibre.

   b) Write a note on attenuation in an optical fibre due to bending losses. **(5+3)**

PART – B

Solve **any five** problem. **Each** problem carries **four** marks. **(5×4=20)**

(Velocity of light $C = 3 \times 10^8 ms^{-1}$)

(Boltzmann constant $k = 1.38 \times 10^{-23} JK^{-1}$)

9. In a Biprism experiment bands of width 0.02×10^{-2}m are observed at 1 m from the slit. On introducing a convex lens 0.3 m away from the slit, two images of the slit are seen 0.7×10^{-2}m apart at 1 m distance from the slit. Calculate the wavelength of light used.

10. A beam of monochromatic light of wavelength 582 nm falls normally on a glass wedge with the wedge angle of 20 seconds of an arc. If the refractive index of glass is 1.5, find the number of dark fringes per cm of the wedge length.

11. A narrow slit illuminated with monochromatic light of wavelength 589 nm is placed at a distance of 0.1 m from a straight edge. If the distance between the straight edge and the screen is 1.9 m, calculate the distance between the first and the fourth dark bands.

12. A diffraction grating containing 6×10^5 lines/m is used at normal incidence. Calculate the dispersive power of the grating in the second order spectrum of wavelength 500 nm.

13. A certain length of 5% solution causes, the optical rotation of 20°. How much length of 10% solution of the same substance will cause 35° rotation ?

14. Light from a 2.5 mW laser source of aperture diameter 1.8×10^{-2}m and wavelength 500 nm is focussed by a lens of focal length 0.20 m. Compute :

   a) the area and

   b) the intensity of the image.

15. Obtain a Fourier expression for $f(x) = x^3$ for $-\pi < x < \pi$.

16. A step index fibre is with a core of refractive index 1.55 and cladding of refractive index 1.51. Compute the intermodal dispersion per kilometer of length of the fibre and the total intermodal dispersion in a 15 km length of the fibre.

PART – C

17. Answer **any five** questions. **Each** question carries **two** marks. **(5×2=10)**

a) Can we observe the interference pattern when the two coherent sources are too far apart ? Explain.

b) Why Newton's rings are circular but air wedge fringes are straight ?

c) Is coloured spectrum seen when we look at a white source of light through a muslin cloth ? Explain.

d) Is telescope with large diameter of the objective preferred to observe heavenly bodies ? Explain.

e) Is there any change in the intensity of light after polarization ? Explain.

f) Under thermodynamic equilibrium is population inversion a negative temperature state ? Justify.

g) Can we express any function in the form of a Fourier series ? Explain.

h) Are there any basic conditions to be satisfied for the transmission of light through an optical fibre ? Explain.

US – 333

IV Semester B.Sc. Examination, May 2017
(F+R) (NS – 2012-13 and Onwards)
(CBCS-2015-16 and Onwards)
PHYSICS – IV
Physical Optics, Laser and Fibre Optics

Time : 3 Hours Max. Marks : 70

***Instruction** : Answer **any five** questions from **each** Part.*

PART – A

Answer **any five** questions. **Each** question carries **eight** marks. **(8×5=40)**

1. a) Mention two methods of obtaining coherent sources.
   b) Give the theory of Fresnel's biprism and obtain an expression for the bandwidth of interference fringes. **(2+6)**

2. a) Why does the centre of Newton's ring pattern appear dark in reflected light ?
   b) Explain with a diagram and necessary theory, the interference in a wedge shaped thin film. Obtain an expression for the fringe width. **(2+6)**

3. a) Distinguish between Fresnel and Fraunhoffer diffraction.
   b) Describe how a plane wavefront can be divided into Fresnel's half period zones of radii proportional to square root of natural numbers. **(2+6)**

4. a) Define dispersive power and resolving power of a grating.
   b) Obtain an expression for the resolving power of a plane transmission grating. **(2+6)**

5. a) Mention three important characteristic properties of laser light.
   b) Derive a relation between Einstein's coefficients A_{21} and B_{21}, where the symbols have their usual meaning. **(3+5)**

6. a) Define optical activity. What are dextro and leavorotatory substances ?
   b) What are retarding plates ? How can circularly polarized light be produced and detected ? **(3+5)**

P.T.O.

7. a) What is an optical fibre ? Explain the principle involved in its working.
   b) Define numerical aperture. Obtain an expression for the same. (3+5)

8. a) Define (i) Modes in fibre (ii) Cut-off wavelength.
   b) Explain different types of losses in an optical fibre.
   c) Write any two applications of optical fibres. (2+4+2)

PART – B

Solve **any five** problems. **Each** problem carries **four** marks. (5×4=20)

9. When a thin sheet of transparent material of refractive index 1.60 is introduced in the path of one of the interfering beams of biprism, the central fringe shifts to a position occupied by the 8^{th} bright fringe. If the wavelength of light used is 550 nm, calculate the thickness of the material.

10. In Newton's ring experiment, the diameters of the 4^{th} and 10^{th} dark rings are 0.40 cm and 0.70 cm respectively. Find the diameter of the 16^{th} dark ring.

11. In an experiment on diffraction of light at straight edge, the distance between the slit and the straight edge is 1.5 m and that between the straight edge and screen is 3.2 m. Find the separation between the 1^{st} and 4^{th} dark fringes. The wavelength of light used is 560 nm.

12. A diffraction grating with 7×10^5 lines per meter is set at normal incidence. Calculate the dispersive power of the grating in the second order spectrum if the wavelength of light is 600 nm.

13. A laser beam with power per pulse 2.2 mW lasts 10 ns and contains 8×10^7 photons per pulse. Calculate the wavelength of laser light.

14. 0.01 Kg of an optically active substance is dissolved in 10^{-4} m^3 of water. The solution is placed in a polarimeter tube of length 0.2 m. Calculate the specific rotation of the substance if the angle of rotation of plane of vibration produced by the solution is 20°.

15. Numerical aperture and fractional index difference of an optical fibre are 0.30 and 0.02 respectively. Calculate the refractive index of the core and the cladding.

16. What is the total number of modes when the wavelength of light is 1.35 μm ? Given : Core diameter to be 45 μm and the numerical aperture to be 0.40.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) The interference patterns of the reflected rays and transmitted rays in thin film are complementary. What does this mean ?

b) Can interference be obtained by using two independent sources ? Explain.

c) Why does a zone plate exhibit the defect of chromatic aberration ? Explain.

d) How does the width of the central maximum change when the width of the slit is increased in a single slit Fraunhoffer diffraction ?

e) What is the principle of holography ?

f) What is the nature of polarization of light incident on a polarizer when, on rotating the polarizer, the intensity varies but never reduces to zero ?

g) What is meant by TE mode and TM mode ?

h) What is meant by pulse dispersion in optical fibres ?

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GN-220

V Semester B.Sc. Examination, December - 2019
(CBCS Repeaters) (Prior to 2018-19/2016-17 and Onwards)

PHYSICS - V

Quantum Statistical Physics,
Quantum Mechanics I and II

Time : 3 Hours

Max. Marks : 70

Instructions : *(i) Answer **any five** questions from each Part.*
(ii) Use of Non - Programmable Scientific Calculators are permitted.

PART - A

Answer **any five** questions. Each question carries **eight** marks. **5x8=40**

1. State the postulates of statistical mechanics. Obtain an expression for the distribution of particles governed by Maxwell-Boltzmann statistics. **8**

2. (a) Obtain an expression for the distribution function for particles obeying Bose-Einstein statistics. **6+2**
(b) Define Fermi energy and write the expression for it.

3. Explain briefly the failure of classical mechanics to explain : **4+4**
(a) Atomic spectra
(b) Specific heat of solid

4. Describe with necessary theory G.P. Thomson experiment for establishing the wave nature of electron. **8**

5. (a) State and explain Heisenberg's uncertainty principle. **4+4**
(b) Show how electron cannot be inside the nucleus using Heisenberg uncertainty relation ?

6. Mention the conditions that a wave function must satisfy. Arrive at the time independent Schrodinger wave equation. **8**

7. (a) What is an operator ? Obtain expression for (i) Linear momentum operator (ii) Energy operator. **5+3**
(b) Explain Born interpretation of wave function.

8. Obtain an expression for the energy of a particle confined to move in one dimensional box of finite length. Draw the first three energy level diagrams. **8**

P.T.O.

PART - B

Solve **any five** of the following problems. Each problem carries **four** marks. **5x4=20**

9. Consider two particle system which can exist in states E_1, E_2 and E_3. What are possible states if particles are (i) Bosons (ii) Fermions ?

10. If the probability of finding an electron of energy 6 eV in an electron gas at 1250 K is 0.01105%, calculate the Fermi energy of the gas.

11. Wavelength corresponding to maximum energy of radiation emitted by a blackbody is 525 nm. Find the temperature corresponding to this value. Wien's constant $=2.9\times10^{-3}$ m-K.

12. Calculate the de-Broglie wavelength of an electron, if it is accelerated through a potential difference of 4 kV. Planck constant $h=6.62\times10^{-34}$ J-s. Charge on electron $=1.6\times10^{-19}$ C and mass of the electron $=9.11\times10^{-31}$ kg.

13. Calculate the uncertainty in momentum of an electron confined to a box of length 0.09 nm. Planck constant $h=6.62\times10^{-34}$ J-s.

14. A particle is moving in a one-dimensional box of width 10 nm. Calculate the probability of finding the particle at the centre of the box.

15. Calculate the first and second excited energy of a linear harmonic oscillator vibrating with frequency 3.5×10^{15} Hz.

16. Determine the normalisation constant of one dimensional wave function $\psi = Ae^{-ikx}$ ('k' is propagation constant) between the limits 0 to 1.

PART - C

Answer **any five** sub-questions. Each sub-question carries **two** marks. **5x2=10**

17. (a) Is Maxwell-Boltzmann statistics applicable to electron gas ? Explain.
(b) A six faced dice is thrown. What is the probability that its face shows 5 ?
(c) What is the probability of finding an electron with its energy equal to Fermi energy at any temperature ? Explain.
(d) Is group velocity less than phase velocity of de-Broglie wave ? Explain.
(e) Is Compton shift same for X-rays and visible light at a given angle ? Explain.
(f) Does a free particle have definite energy and momentum ? Explain.
(g) Are the energy levels of a linear harmonic oscillator equally spaced ? Explain.
(h) The wave function of hydrogen atom depends on which quantum numbers ?

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No. of Printed Pages : 3

GN-216

104261

V Semester B.Sc. Examination, December - 2019
(CBCS) (F+R) (2018-19 and Onwards)

PHYSICS - V

Statistical Physics, Quantum Mechanics-I, Atmospheric Physics And Nano-material

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***any five*** *questions from* ***each*** *Part.*

PART - A

Answer **any five** of the following. Each question carries **8** marks. **5x8=40**

Note : Non-programmable scientific calculators are permitted.

1. (a) Define the terms microstate and phase-space for a thermodynamic system. **2+6**

(b) Derive the Maxwell-Boltzmann distribution law $n_i = g_i e - (\alpha + \beta^{Ei})$.

2. What are bosons ? Derive Bose-Einstein's distribution law. **1+7**

3. Give an account of the failure of classical physics to explain : **4+4**

(a) Photoelectric effect and

(b) Atomic spectra

4. (a) From Planck's law of radiation, arrive at Rayleigh-Jean's law for energy distribution in the blackbody spectrum. **3+5**

(b) Derive expression for the de Broglie wavelength in terms of energy of a non-relativistic particle.

5. Explain the construction and theory of Thomson's experiment, with a neat diagram. What is the significance of the result ? **7+1**

6. (a) Define the terms group velocity and phase velocity. Derive relation between them. **5+3**

(b) Give any two mathematical forms of the Heisenberg's uncertainty principle. What is the physical significance of the principle ?

P.T.O.

7. Based on the vertical distribution of temperature, explain the formation of different layers in earth's atmosphere.

8. (a) What is "greenhouse effect" ? Mention any two greenhouse gases.
   (b) Write a short note on Carbon nano-tube and Graphene.

PART - B

Answer **any five** of the following. Each question carries **4** marks. **5x4=20**

Common data :
$h = 6.625 \times 10^{-34}$ Js, $C = 3 \times 10^{8}$ ms^{-1}, $m_e = 9.1 \times 10^{-31}$ kg, $m_n = 1.67 \times 10^{-27}$ kg, $m_p = 1.67 \times 10^{-27}$ kg

9. A system has two particles 'x' and 'y'. Using appropriate diagram, show how they can be arranged in three quantum states according to : **2+2**
   (a) M B distribution and
   (b) F D distribution

10. The free electron density of silver and aluminium are 5.85×10^{28} m^{-3} and 1.8×10^{29} m^{-3}, respectively. Find the Fermi energy of silver, given fermi energy of aluminium is 11.63 eV.

11. Five bosons have to be distributed in two compartments having 3 and 4 cells respectively. Find the thermodynamic probability for the macro state (4, 1) and (5, 0). **2+2**

12. UV radiation has wavelength 234 nm. Find its frequency and energy (eV). **2+2**

13. For proton and electron to have same de Broglie wavelength, compare their speeds.

14. Calculate the earth's atmospheric pressure at an altitude of 1 km. Given $R = 8.31$ Jmol^{-1}K^{-1}, $g = 9.8$ ms^{-2}, $t = 12°C$, Mean molar mass of air $= \mu = 29$ g/mol and 1 atm pressure $= 1.013 \times 10^5$ Pa.

15. A layer in the earth's atmosphere has thickness 225 m, density 0.15 kg m^{-3} on which radiation is incident at angle 65°. Calculate the absorbance and the optical thickness of the layer.

16. Find the total mass of air present in the earth's atmosphere. Assume pressure of air at mean sea level $= 1.013 \times 10^5$ Pa, $g = 9.8$ ms^{-2} and the radius of earth $= 6400$ km.

PART - C

Answer **any five** of the following. Each question carries **2** marks. **5x2=10**

17. (a) The isotopes $_2He^3$ and $_2He^4$ obey which distribution law at low temperature ?

(b) In metals, what is the occupation index :

(i) Below Fermi energy and

(ii) Above Fermi energy.

NO (c) Can we use M-B statistics to explain the properties of photon gas ?

(d) Two particles have same mass and speed, with one of them charged and the other neutral. Can they have same de Broglie wavelength ? Justify your answer.

(e) Wave nature of matter is not observed in bulk bodies. Why ?

(f) 'Quantum dot is zero dimensional'. Justify.

(g) Electrically and thermally, what is remarkable about Graphene ?

(h) Is nano gold yellow in colour ? Justify.

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SS – 326

V Semester B.Sc. Examination Nov./Dec. 2018
(CBCS – NS – Repeaters)
(Prior to 2018-19/2013-2014 and Onwards)
PHYSICS – VI
Astrophysics, Solid State Physics and Semi Conductor Physics

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **five** questions from **each** part.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) Define luminosity of a star. How does luminosity of a star vary with its mass ?
   b) Distinguish between average temperature and core temperature of a star.
   c) Obtain an expression for the average temperature of a star based on a Linear Density Model. **(2+2+4)**

2. a) Write a note on H-R diagram.
   b) Derive an expression for the radius of a neutron star. Express it in terms of solar mass. **(2+6)**

3. Give the theory of Compton effect.. **8**

4. a) Explain the phenomenon of super-conductivity.
   b) Explain the Type I and Type II superconductors. **(4+4)**

5. a) State Wiedemann-Franz law.
   b) Derive an expression for electrical conductivity of a metal based on Free Electron Theory. **(1+7)**

6. Obtain an expression for electron concentration in conduction band of intrinsic semiconductor. **8**

P.T.O.

7. a) Describe a Zener diode as voltage regulator and explain load regulation.

   b) Write a note on LED. **(4+4)**

8. a) Explain input and output characteristics of a Transistor.

   b) Obtain an expression for input impedence using h-parameter. **(4+4)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(5×4=20)**

9. Calculate the temperature of the sun at a distance of 3×10^{8} m from the centre. Given $T_C = 10^{7}$k. and $R_\odot = 6.9\times10^{8}$ m.

10. If the apparent and absolute magnitude of a star are + 0.87 and – 0.63 respectively. Calculate its distance from the earth.

11. If the distance modulus of the star Altair is – 1.44. Calculate its distance from the earth.

12. Sodium has 2.5×10^{28} free electrons per m^3. Calculate the Fermi energy and Fermi velocity, where m_o is the rest mass of electron = 9.1×10^{-31} Kg.

13. Calculate the Hall voltage developed in a Germanium crystal of thickness 0.25×10^{-3} m. When a magnetic field of 0.5 tesla is applied, the current density is 200 Am^{-2} and the electron density is 2×10^{23} m^{-3}.

14. For an intrinsic semi conductor with gap width $E_g = 0.7$ eV calculate concentration of intrinsic charge carries at 300K. Assuming $m_e = m_o$ rest mass of electron.

15. A certain regulator has a no-load output voltage of 18V and has a full load output of 17.6V. What is the load regulation expressed as a percentage ?

16. Calculate I_C and I_E for a Transistor that has $\alpha_{dc} = 0.98$ and $I_B = 100\ \mu A$. Determine the value of β_{dc}.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10**

17. a) Can a black hole be seen ? Explain.

    b) What kind of stars become supernovas ?

    c) Is Bloch theorem applicable to constant potential ? Explain.

    d) Hall coefficient is negative for metals ? Why ?

    e) Does characteristic spectrum of X-rays depend on the applied voltage ?

    f) Why are p-type and n-type materials electrically neutral ?

    g) Why are hybrid parameters called so ?

    h) Is solar cell a photovoltaic cell ? Explain.

SS – 321

V Semester B.Sc. Examination, Nov./Dec. 2018
(CBCS) (Fresh) (2018-19 and Onwards)
PHYSICS – Paper – V
Statistical Physics, Quantum Mechanics – I, Atmospheric Physics and Nanomaterials

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **five** questions from **each** Part.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. What is photon gas ? Derive Planck's law of blackbody radiation starting from Bose-Einstein distribution law. **(2+6)**

2. a) Write the expression for Fermi-Dirac distribution function. Explain the variation of f(E) versus E with respect to temperature.

   b) Explain the contribution of free electrons to specific heat of metals. **(5+3)**

3. a) Explain phase velocity and group velocity for a matter wave.

   b) Establish the relation between the phase and group velocity of a non relativistic free particle. **(4+4)**

4. With relevant theory, explain Davisson-Germer experiment to demonstrate de-Broglie hypothesis. **8**

5. a) Explain hydrostatic Balance.

   b) Obtain an expression for hydrostatic balance and hence an expression for the variation of pressure with height. **(2+6)**

6. Explain four distinct properties of nanomaterials. Mention any four applications of nano materials. **8**

7. a) What are macro and micro states ? Define thermodynamic probability. Express Entropy in terms of thermodynamic probability.

   b) Describe how classical physics fails and quantum theory helps in explaining Compton effect. **(4+4)**

8. a) Write a note on :
      i) River bank erosion and
      ii) Cyclones.

   b) What are one and two dimensional nanosystems ? **(6+2)**

PART – B

Answer **any five** of the following questions. **Each** question carries **four** marks. **(5×4=20)**

[$h = 6.625 \times 10^{-34}$ JS, $k = 1.38 \times 10^{-23}$ J/K,

$e = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg,

$m_n = 1.67 \times 10^{-27}$ kg, $m_p = 1.67 \times 10^{-27}$ kg]

9. Five Bosons are distributed in two compartments. First having 3 cells and the second 4. Find the thermodynamic probability for macro-state

   a) (5, 10)

   b) (4, 1)

10. Estimate the fraction of electrons excited above the Fermi level at room temperature for copper. Given the Fermi energy of copper is 5 eV.

11. Calculate the maximum velocity of photoelectrons, if ultraviolet radiation of 260 nm is incident on silver whose threshold wavelength is 380 nm.

12. Calculate the de-Broglie wavelength of neutron of energy 28.8 eV. Given mass of neutron is 1.67×10^{-27} kg.

13. The pressure at Station A is 1×10^5 Pa and that at Station B is 1.05×10^5 Pa. The distance between Stations A and B is 100 km. If the density of air is 1.23 kg m^{-3}, calculate the pressure gradient force per unit mass.

14. Find the Coriolis force per unit mass at a hill station at 30° N having a Zonal wind speed of 15 ms^{-1}.

15. A proton has a kinetic energy of 100 eV. Calculate the group and phase velocities. Given mass of proton is 1.67×10^{-27} kg.

16. The position uncertainty of an electron having a kinetic energy of 0.3 keV is 0.3 nm. What is the percentage uncertainty in its momentum ?

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) Can Maxwell-Boltzmann statistics be applied to electron gas ? Explain.

b) Do particles like electron, proton and neutron obey Pauli's exclusion principle ? Explain.

c) Even though monochromatic X-rays are used, the Compton spectrum contains more than one line. Explain.

d) Does the concept of Bohr's orbit violate uncertainty principle ? Explain.

e) Is water vapor a green house gas ? Explain.

f) In which layer of the atmosphere satellites are placed and why ?

g) Is helium a liquid even at absolute zero temperature ? Why ?

h) Graphene is the strongest nano-material. Justify.

SM – 350

VI Semester B.Sc. Examination, May/June 2018
(F + R)
(CBCS – 2016-17 and Onwards/NS-Repeaters – 2013-14 and Onwards)
PHYSICS – VII
Atomic Physics, Nuclear Physics and Material Science

Time : 3 Hours Max. Marks :70

***Instruction** : Answer **five** questions from **each** Part.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks : **(5×8=40)**

1. a) Explain Sommerfeld's atom model.
   b) Give an account of the spinning electron hypothesis. **(5+3)**
2. What is Zeeman effect ? Give the quantum theory of normal Zeeman effect. **8**
3. Explain molecular spectra. Obtain an expression for the rotational energy levels of diatomic molecule and the frequency of the rotational spectra. **8**
4. a) State the assumptions of Rutherford's α-ray scattering.
   b) Obtain the relation between the impact parameter and scattering angle in α-ray scattering experiment. **(2+6)**
5. With a neat diagram, explain the variation of ionization current with applied voltage in gas ionization detectors. **8**
6. What is a Q-value of a reaction ? Explain endothermic and exothermic reaction. Obtain an expression for the threshold energy of an endoergic reaction. **8**
7. a) Explain any three distinct properties of nano materials.
   b) Mention any two applications of nanomaterials. **(6+2)**
8. a) Deduce an expression for Lorentz field.
   b) Explain any two properties of liquid crystals. **(4+4)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks : **(5×4=20)**

9. The experimental value of Bohr magneton is 9.21×10^{-24} JT^{-1} and Planck's constant $h = 6.625 \times 10^{-34}$ J-S. Calculate the specific charge.

P.T.O.

10. In the Stern-Gerlach experiment silver atoms traverses a distance of 0.1 m in a non-homogeneous magnetic field of field gradient 55 Tm^{-1}. If the velocity of the silver atoms is 450 ms^{-1}. Calculate the separation between the two trace on the collector plate 0.5 m from the pole pieces.
Mass of silver atom = 1.79×10^{-25} kg.
$\mu_B = 9.2 \times 10^{-24}$ JT^{-1}.

11. In an experiment in the study of Raman effect using Hg green radiation of wavelength 5461 Å, a stokes line of wavelength 5543 Å was observed. Find the Raman shift and wavelength corresponding to Antistoke's line.

12. Neptunium – 237($_{93}Np^{237}$) emits alpha particles of energy 4.19 MeV. Calculate the alpha disintegration energy.

13. The Q-value of Na^{23} (n, α)F^{20} reaction is – 5.4 MeV. Determine the threshold energy of the neutrons for this reaction. Given mass of neutron = 1.00866 a.m.u. and mass of Na^{23} = 22.99097 a.m.u.

14. Determine the radial electric field and life of a GM counter tube operating at 1900V with radii of anode and cathode being 0.09 mm and 1.5 cm respectively. The GM tube has guaranteed life counts of 10^{10} and operates 20 hrs. per day at 2500 counts per minute.

15. Assuming that there are 10^{27} molecules per m^3 in HCl vapour, calculate the orientational polarization at 27°C, if the vapour is subjected to an electric field of 10^6 Vm^{-1}. The dipole moment of HCl molecule is 3.46×10^{-30} cm.

16. The atomic weight and density of sulphur are 32 and 2.08×10^3 kg m^{-3} respectively. The electronic polarizability of the atom is 3.28×10^{-40} Fm^{+2}. If sulphur solid has cubic structure, calculate the dielectric constant.

PART – C

17. Answer **any five** of the following questions. **Each** question carries **two** marks : **(5×2=10)**

a) Is the energy of the electron in the n^{th} orbit in hydrogen atom is negative. Explain.
b) What is the direction of magnetic moment of an electron with respect to its orbital angular momentum ? Explain.
c) Are Raman scattering and Rayleigh scattering similar ? Explain.
d) Is quenching necessary in a GM-counter ? Explain.
e) Can a non-radioactive element be changed into a radioactive form ? Explain.
f) Can a photon be used as a projectile in a nuclear reaction ? Justify your answer.
g) Is silver the best "swimming pool" water purifier ?
h) Does the pitch of a chiral nematic liquid crystal get affected by temperature and pressure ?

SN – 331

V Semester B.Sc. Examination, November/December 2017
(F+R) (CBCS/NS – Repeaters 2013-14 and Onwards)
PHYSICS – V
Quantum Statistical Physics, Quantum Mechanics – I and II

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***five*** *questions from* ***each*** *Part.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. Derive Maxwell-Boltzmann distribution law. **8**

2. a) What are fermions and bosons ?
   b) Show that Bose-Einstein and Fermi-Dirac statistics approach to M – B statistics. **(2+6)**

3. Explain briefly the failure of classical theory in the explanation of :
   i) Balck body radiation
   ii) Photoelectric effect. **(4+4)**

4. a) What are matter waves ? Give any two characteristics.
   b) Deduce an expression for de Broglie wavelength. Hence, express it in terms of energy and temperature. **(3+5)**

5. Explain with a diagram Davisson and Germer experiment in the study of diffraction of electrons. Mention the result of the experiment. **8**

6. a) State and explain the three forms of Heisenberg's uncertainty principle.
   b) Show that electrons cannot remain inside a nucleus using uncertainty principle. **(6+2)**

7. a) Explain the term probability density.
   b) Arrive at Schrodinger's time dependent equation for a free particle in one dimension. Write the equation for three dimensions. **(2+6)**

8. Establish Schrodinger's equation for a linear harmonic oscillator. Mention the energy eigen value expression. Show that energy levels are equally spaced in harmonic oscillator. **8**

P.T.O.

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(5×4=20)**

9. Consider two identical particles. Each particle can be in one of the three possible quantum states 0, E and 2E. Find the number of micro states of the system for M – B, B – E and F – D statistics. Also find the ratio of the probability that the two particles are found in different states in each of the three cases.

10. Consider a two particle system each of which exist in three states E_1, E_2 and E_3. What are the possible states if the particles are i) bosons and ii) fermions ?

11. The number of free electrons per C.C is 24.2×10^{22} in Beryllium and 0.91×10^{22} in Cesium. If the fermi energy of conduction electrons in Be is 14.44 eV, Calculate that in cesium.

12. A particle of mass $\frac{0.5}{C^2}$ SI units has a K.E. of 100eV. Calculate its de Broglie wavelength.

13. The de Broglie wavelength of a non-relativistic electron is 1.5 Å. Calculate its phase and group velocity.

14. An electron is confined to a box of length 10^{-8} m. Calculate the minimum uncertainty in its velocity and comment on the result. ($m_e = 9.1 \times 10^{-31}$ kg).

15. An electron is trapped inside a box of side 1nm. Calculate the first three eigen values in eV.

16. The energy of a linear harmonic oscillator in its third excited state is 0.1 eV. Calculate its frequency.

PART – C

Solve **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) Why do bosons and fermions have different distribution functions ? Explain.
    b) What is ultraviolet catastrophe ? Explain.
    c) Does the Bose temperature depend on number of particles ? Explain.
    d) Are de Broglie waves monochromatic in nature ? Explain.
    e) Can matter waves travel faster than light ? Explain.
    f) Why do we normalise a wave function ?
    g) Is zero point energy of a harmonic oscillator zero ? Explain.
    h) An electron and a neutron have the same de Broglie wave length. Which one will move faster ? Explain.

No. of Printed Pages : **3**

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GN-217

V Semester B.Sc.Examination, December - 2019
(CBCS) (Fresh+Repeaters) (2018-19 and Onwards)

PHYSICS - VI

Astrophysics, Solid State Physics and Semiconductor Physics

Time : 3 Hours

Max. Marks : 70

Instructions : *(i) Answer **any five** questions from each Part.*
(ii) Non-programmable scientific calculators are allowed.

PART - A

Answer **any five** questions. Each question carries **8** marks. **5x8=40**

1. Define gravitational potential energy of a star. Using linear density model derive an expression for gravitational potential energy of a star. **8**

2. (a) Write any four General characteristics of Main Sequence Stars. **4+4**
(b) State and explain Virial theorem.

3. (a) What are Miller Indices ? Explain the steps followed in assigning Miller indices for a set of planes with an example. **4+4**
(b) With a neat diagram, derive Bragg's law of X-ray diffraction.

4. (a) Write assumptions of classical free electron theory of metals. **4+4**
(b) Based on free electron theory of metals, obtain an expression for average kinetic energy of a free electron at absolute zero.

5. (a) What is Hall effect in metals ? Arrive at expression for Hall Coefficient. **4+4**
(b) Distinguish between Type I and Type II Superconductors.

6. Obtain an expression for Concentration of holes in an intrinsic semiconductor. **8**

7. (a) Explain the working of a pn-diode in reverse biased condition. **4+4**
(b) Distinguish between ordinary diode and a zener diode.

8. What are hybrid parameters ? Write expressions for hybrid parameters. With the help of a hybrid equivalent circuit of a CE-transistor amplifier derive expressions for (i) Voltage gain (ii) Input impedance. **6+2=8**

P.T.O.

PART - B

Solve **any five** problems. Each problem carries **four** marks. **5x4=20**

9. If the luminosity and surface temperature of a star are 25 L⊙ and 1.12×10^4 K respectively, Calculate its radius. Given that Stefan-Boltzmann constant $(\sigma) = 6 \times 10^{-8}$ Wm^2K^{-4} and luminosity of Sun (L⊙) to be 4×10^{26} W. **4**

10. A Star whose apparent magnitude is observed to be 7 has a parallax of 0.015″. Calculate its absolute magnitude. Also compare the luminosity of the given star with that of the Sun. Given that absolute magnitude of Sun (M⊙) = 5. **4**

11. Calculate the core pressure of the Sun. Given $G = 6.673 \times 10^{-11}$ Nm^2/kg^2 and $R\odot = 6.96 \times 10^8$ m, $M\odot = 2 \times 10^{30}$ kg. **4**

12. X-rays with $\lambda = 1$ Å are scattered from a carbon block. The scattered radiation is viewed at 90° to the incident beam. **4**

(i) What is the Compton Shift ?

(ii) How much kinetic energy is imparted to the recoiling electron ?

13. Following are the Miller indices for four different sets of parallel planes for a cubic crystal. **4**

(i) (100) (ii) (010) (iii) (111) (iv) (011)

Represent or draw the corresponding lattice planes on a cubic structure.

14. Calculate the Fermi energy and Fermi velocity for Lithium. The density and atomic weight of Lithium are 534 kg/m^3 and 6.931 amu respectively. **4**

15. A 25 V, 550 mW zener diode is to be used for providing a 25 V stabilized supply to a variable load. If the input voltage is 35 V. Calculate the value of Series Resistance (R_s). **4**

16. For a silicon transistor connected in CE-Configuration, find I_B, I_C and V_{CE}. Given that $\beta = 150$, $V_{BE} = 0.7$ V, $V_{CC} = 15$ V and $V_{BB} = 9$ V, $R_C = 5$ kΩ and $R_B = 1$ MΩ. **4**

PART - C

Answer **any five** questions. Each question carries **2** marks. **5x2=10**

17. (a) Which two forces must be balanced to keep a white dwarf stable ?

(b) Star A has a magnitude of $+1$ and Star B has a magnitude of -1, which star is brighter ? Explain.

(c) Is an unit cell of fcc structure, a primitive cell ? Explain.

(d) In a semiconductor what is the effect of doping on the position of the Fermi level ?

(e) Can we apply classical model to study Hall effect in semiconductors ? Explain.

(f) Is solar cell a photovoltaic cell ? Explain.

(g) What is the basic biasing condition for the proper functioning of a transistor as an amplifier ?

(h) Why the collector region in a transistor is made wider than the emitter and base regions ?

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No. of Printed Pages : **3**

100048

GN-221

V Semester B.Sc. Examination, December - 2019
(CBCS-Repeaters) (Prior to 2018-19/2016-17 and Onwards)

PHYSICS - VI

Astrophysics, Solid State Physics and Semi-Conductor Physics

Max. Marks : 70

Time : 3 Hours

Instruction : *(i) Answer **five** questions from each part.*
(ii) Non-Programmable scientific calculators are allowed.

PART - A

Answer **any five** of the following questions. Each question carries **eight** marks. **5x8=40**

1. (a) Define apparent and absolute magnitudes of a star. **2+6**
(b) Obtain an expression for gravitational potential energy of a star.

2. (a) Explain photon diffusion time. **2+6**
(b) Derive the relation between mass and luminosity of a main sequence star.

3. (a) What is Supernova ? Explain Supernova explosion. **4+4**
(b) Distinguish between type-I and type-II supernova.

4. What is Compton effect ? Derive an expression for Compton shift. **1+7**

5. Define fermi energy and obtain an expression for it based on free electron theory of metals. **8**

6. (a) What is superconductivity and define critical temperature. **2+6**
(b) Explain Meissner effect and critical magnetic field.

7. What is Zener diode ? Explain with a circuit diagram the action of Zener diode as a voltage regulator. **1+7**

8. With relevant circuit diagram, explain the characteristics of n-p-n transistor in common emitter mode. **8**

P.T.O.

PART - B

Solve **any five** of the following problems. Each problem carries **four** marks. **5x4=20**

9. The apparent magnitude of a star Sirius A is -1.44 and that of another star Regulus is $+1.36$ on the magnitude scale of stars. Calculate the relative brightness of the star Sirius A with respect to Regulus.

10. Calculate the radius of the star whose luminosity is 10^4 times the Sun and its surface temperature is 2000 K. Given $T_\odot = 6000$ K and $R_\odot = 7 \times 10^8$ m.

11. Lead is face centered cubic with an atomic radius $r = 1.746$ Å. Find the spacing of (i) (200) plane (ii) (220) plane and (iii) (111) plane.

12. Monochromatic X-rays of wavelength 1.5 Å are incident on a crystal face having an interplanar spacing of 1.6 Å. Find the various orders in which Bragg's reflections take place.

13. A current of 50 A is established in a copper slab of 0.5×10^{-2} m thick and 0.2×10^{-2} m wide. The slab is placed in a magnetic field of 1.5 T. The magnetic field is perpendicular to the plane of the slab and to the current. The free electron concentration in copper is 8.48×10^{28} electron/m^3. Calculate the magnitude of Hall voltage.

14. Mobilities of electrons and holes in a sample of intrinsic germanium at room temperature are 0.54 m^2/V-s and 0.18 m^2/V-s respectively. Calculate the conductivity of germanium. Assume the densities of holes and electrons each are equal to 3.6×10^{19} m^{-3}.

15. Calculate the values of β_{dc}, I_C and I_E for a transistor that has $\alpha_{dc} = 0.98$ and $I_B = 100$ μA.

16. The transistor is connected as a C-E amplifier and the h parameters are given below. If $R_L = R_S = 1000$ Ω, find the current gain, input impedance and voltage gain.

Given $h_{ie} = 1100$ Ω, $h_{fe} = 50$, $h_{oe} = 25$ μs , and $h_{re} = 2.5 \times 10^{-4}$

PART - C

Answer **any five** of the following questions. Each question carries **two** marks. **5x2=10**

17. (a) Is the brightness of a star is a good indicator of its distance ? Why ?

(b) Does the luminosity of a star depend on its mass ? Explain.

(c) Is cooling system required for an X-ray tube ? Justify.

(d) Does the ratio of thermal conductivity to the electrical conductivity of a metal depend only on temperature ? Justify.

(e) Hall coefficient is negative for metals and positive for P-type semiconductors. Why ?

(f) The conductivity of an intrinsic semiconductor is very low. Why ?

(g) Does the width of the depletion region of a p-n junction depend on the doping concentration ? If yes how ?

(h) Can emitter and collector regions of a transistor be interchanged ? Justify.

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SS – 326

V Semester B.Sc. Examination Nov./Dec. 2018
(CBCS – NS – Repeaters)
(Prior to 2018-19/2013-2014 and Onwards)
PHYSICS – VI
Astrophysics, Solid State Physics and Semi Conductor Physics

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **five** questions from **each** part.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) Define luminosity of a star. How does luminosity of a star vary with its mass ?

   b) Distinguish between average temperature and core temperature of a star.

   c) Obtain an expression for the average temperature of a star based on a Linear Density Model. **(2+2+4)**

2. a) Write a note on H-R diagram.

   b) Derive an expression for the radius of a neutron star. Express it in terms of solar mass. **(2+6)**

3. Give the theory of Compton effect.. **8**

4. a) Explain the phenomenon of super-conductivity.

   b) Explain the Type I and Type II superconductors. **(4+4)**

5. a) State Wiedemann-Franz law.

   b) Derive an expression for electrical conductivity of a metal based on Free Electron Theory. **(1+7)**

6. Obtain an expression for electron concentration in conduction band of intrinsic semiconductor. **8**

P.T.O.

7. a) Describe a Zener diode as voltage regulator and explain load regulation.

   b) Write a note on LED. **(4+4)**

8. a) Explain input and output characteristics of a Transistor.

   b) Obtain an expression for input impedence using h-parameter. **(4+4)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(5×4=20)**

9. Calculate the temperature of the sun at a distance of 3×10^{8} m from the centre. Given $T_C = 10^7$k. and $R_\odot = 6.9\times10^{8}$ m.

10. If the apparent and absolute magnitude of a star are + 0.87 and – 0.63 respectively. Calculate its distance from the earth.

11. If the distance modulus of the star Altair is – 1.44. Calculate its distance from the earth.

12. Sodium has 2.5×10^{28} free electrons per m^3. Calculate the Fermi energy and Fermi velocity, where m_o is the rest mass of electron = 9.1×10^{-31} Kg.

13. Calculate the Hall voltage developed in a Germanium crystal of thickness 0.25×10^{-3} m. When a magnetic field of 0.5 tesla is applied, the current density is 200 Am^{-2} and the electron density is 2×10^{23} m^{-3}.

14. For an intrinsic semi conductor with gap width $E_g = 0.7$ eV calculate concentration of intrinsic charge carries at 300K. Assuming $m_e = m_o$ rest mass of electron.

15. A certain regulator has a no-load output voltage of 18V and has a full load output of 17.6V. What is the load regulation expressed as a percentage ?

16. Calculate I_C and I_E for a Transistor that has $\alpha_{dc} = 0.98$ and $I_B = 100\ \mu A$. Determine the value of β_{dc}.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) Can a black hole be seen ? Explain.

    b) What kind of stars become supernovas ?

    c) Is Bloch theorem applicable to constant potential ? Explain.

    d) Hall coefficient is negative for metals ? Why ?

    e) Does characteristic spectrum of X-rays depend on the applied voltage ?

    f) Why are p-type and n-type materials electrically neutral ?

    g) Why are hybrid parameters called so ?

    h) Is solar cell a photovoltaic cell ? Explain.

SN – 332

V Semester B.Sc. Examination, November/December 2017
(2013 – 2014 and Onwards)
(CBCS – F+R/NS – Repeaters)
PHYSICS – VI
Astrophysics, Solid State Physics and Semiconductor Physics

Time : 3 Hours Max. Marks : 70

***Instruction** : Answer **five** questions from **each** Part.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. Derive an expression for gravitational potential energy of a star. **8**

2. a) Write a note on H-R diagram.

   b) Derive an expression for the radius of a neutron star. Express it in terms of solar mass. **(3+5)**

3. Give the theory of compton effect. **8**

4. Deduce an expression for the electrical conductivity of a metal based on free electron theory. Hence arrive at Ohm's law. **8**

5. Give a detailed account of any four properties of superconductivity. **8**

6. Derive an expression for the hole concentration in the conduction band of intrinsic semiconductor. **8**

7. a) Explain the principle and working of a solar cell.

   b) With a circuit diagram, explain the working of zener diode as a voltage regulator. **(4+4)**

8. With a neat circuit diagram, explain the working of a CE amplifier. Explain the method of drawing a.c. load line. **8**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(4×5=20)**

9. If the apparent and absolute magnitude of Aldebaran are + 0.87 and – 0.63 respectively, calculate its distance from the earth.
   Given : 1 Parsec = 3.2616 light years.

P.T.O.

10. Calculate the average pressure of the sun. Given : $R_\odot = 6.96 \times 10^8$m, $M_\odot = 1.989 \times 10^{30}$ kg and $G = 6.67 \times 10^{-11} Nm^2kg^{-2}$.

11. In the orion constellation the luminosity of the star is 10000 times that of sun and its surface temperature is about 3000K. How much larger is the radius of the star compared to that of the sun ? Given : Temperature of the sun is 6000K.

12. Find the interplanar spacing for the lattice planes of Miller indices (3 2 1), (2 1 0) and (1 1 1) for cubic lattice (a = 5.62Å).

13. Fermi energy for gold and silver are 5.54 eV and 5.51 eV respectively. Calculate their Fermi temperatures. Given : $K = 1.38 \times 10^{-23} JK^{-1}$.

14. A magnetic field of 0.7 T is applied on a germanium crystal of 0.5 mm thick. Calculate the Hall voltage developed, if the current density is 250 Am^{-2} and electron density 2×10^{23} m^{-3}

15. Calculate the drift velocity of free electrons in a metal of area of cross section 2×10^{-4} m^2 in which a current of 100 A is flowing. The density of free electrons in a metal is 7.23×10^{28} m^{-3}.

16. For a transistor amplifier in CE – mode, $R_S = R_L = 1$ KΩ, $h_{ie} = 1.1$KΩ, $h_{re} = 2.5 \times 10^{-4}$, $h_{fe} = 50$ and $h_{oe} = 25 \times 10^{-6}$ mhos. Calculate (i) Current gain and (ii) Voltage gain.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) The more massive a star, the shorter its life time. Justify.

    b) What is the order of the density of a neutron star ? What happens if it continues to contract further ?

    c) A hot star has radiations of shorter wavelength compared to that of a cooler star. Why ?

    d) Visible light is not preferred for crystal diffraction. Why ?

    e) In metals, as the temperature increases, the conductivity decreases. Explain.

    f) Why is $\beta > \alpha$ in a transistor ?

    g) Pure germanium and silicon at 0°K are insulators. Why ?

    h) Does the rate of generation of electron-hole pair is equal to the rate of recombination at a given temperature ? Explain.