AS – 207

IV Semester B.Sc. Examination, April/May 2012
(Semester Scheme)
PHYSICS – IV
Acoustics, Optics and Lasers

Time : 3 Hours Max. Marks : 60

Instruction : *Answer* ***any five*** *questions from Part* ***A, four*** *questions from Part* ***B, five*** *questions from Part* ***C.***

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. Derive an expression for a stationary wave formed due to the super position of two identical simple harmonic waves travelling in opposite directions along the same line. Explain the formation of nodes and anti nodes. 6

2. a) Mention the different methods of sound recording and reproduction.

   b) Explain with a diagram the construction and working of a carbon microphone. **(2+4)**

3. a) Describe briefly two methods of producing coherent beams.

   b) Derive an expression for the refractive index of a thin transparent plate introduced in the path of any one of the interfering beams coming from two coherent sources. **(2+4)**

4. What are Newton's rings ? Describe an experiment to determine the radius of curvature of a plano convex lens by setting up Newton's rings. 6

5. a) State and explain with a figure, the Rayleigh criterion for resolution.

   b) Derive an expression for the resolving power of a plane diffraction grating. **(2+4)**

P.T.O.

6. Discuss Fraunhofer diffraction at a single slit and obtain expressions for directions of recording maxima and minima. **6**

7. a) What are retarding plates ?

   b) Explain how retarding plates can be used for the production and detection of circularly, elliptically and plane polarized light. **(1+5)**

8. a) What is a laser ?

   b) Derive the relations between the Einstein co-efficients of stimulated emission, spontaneous emission and absorption. **(1+5)**

PART – B

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

9. A brass rod of length 4 m is clamped at its centre. It is made to vibrate longitudinally. Find the Young's modulus of brass if the frequency of the note produced is 450 Hz and the density of brass is 8200 Kg/m^3.

10. Calculate the distance through which the mirror of Michelson interferometer has to be displaced between two consecutive positions of maximum distinctness of fringes for D_1 and D_2 lines of sodium of wavelengths 5896 Å and 5890 Å respectively.

11. In a biprism experiment interference bands are produced in the focal plane of an eye-piece 1 m from the slit. The separation between the images for conjugate positions of a convex lens are 3.17 mm and 1.75 mm. If the width of the fringes is 0.025 cm, find the wavelength of light used.

12. A point source of light of wavelength 589.6 nm is placed at a distance of 1 m from a zone plate. The image of the source is formed at a distance of 2 m on the other side of the zone plate. What is the power of the equivalent lens which can replace the zone plate ? Also find the radius of the second zone of the zone plate.

13. Find the grating constant of a grating whose width is 3 cm and which just resolves the sodium lines of wavelength 589 nm and 589.6 nm in the second order.

14. Determine the concentration of a solution of length 0.2 m which produces a rotation of 30°. The specific rotation of the solution is 0.0697 rad m^2/Kg.

PART – C

15. Answer **any five** of the following : **(5×2=10)**

a) Diffraction is more easily observed in the case of sound waves than in the case of light. Explain.

b) Results of Focault's experiment to determine the velocity of light contradicts the corpuscular theory of light. Explain.

c) Is it possible to produce interference from two independent sources emitting light of same wavelength ? Explain.

d) A thin film of oil on the surface of water appears coloured. Explain.

e) Two gratings A and B have the same width but A has greater number of lines. Which of them have larger 1) dispersive power 2) resolving power ?

f) Circularly polarized light and unpolarized light behave identically when viewed through a rotating nicol prism. Yet they can be distinguished. Explain.

g) Will atoms in a metastable state drop to the ground state spontaneously ? Explain.

h) If a hologram is cut into several pieces, can each piece give the same image as the whole hologram. Explain.

OS – 195

III Semester B.Sc. Examination, October/November 2012
(NS) (2012-2013 and Onwards)
PHYSICS – III
Electricity and Magnetism

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) Derive the relation between electric field and potential.

   b) Derive an expression for electric potential at a point due to an electric dipole. **(4+4)**

2. State and prove Thevenin's theorem. **8**

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

   b) Derive an expression for the force between two parallel current carrying conductors. Hence define ampere. **(3+5)**

4. a) What is toroid ? Using Ampere's circuital law, deduce an expression for the magnetic field inside a toroid carrying current.

   b) State Faraday's laws of electromagnetic induction. What are eddy currents ? Mention any one application of eddy currents. **(4+4)**

5. a) Derive an expression for growth of current in series LR circuit connected to DC source. Indicate the growth of current graphically. Define time constant of the circuit.

   b) State and explain divergence theorem. **(6+2)**

P.T.O.

6. a) Derive Maxwell's field equations :

$$\vec{\nabla}.\vec{D} = 0 \text{ and } \vec{\nabla}\times\vec{E} = -\frac{\partial \vec{B}}{\partial t}.$$

b) Write an expressions for speed of electromagnetic waves in free space and explain the terms in it. **(6+2)**

7. a) Define rms and average values of alternating current.

b) Derive expressions for impedance, current and phase angle of a series LCR circuit connected to ac source by vector method. **(2+6)**

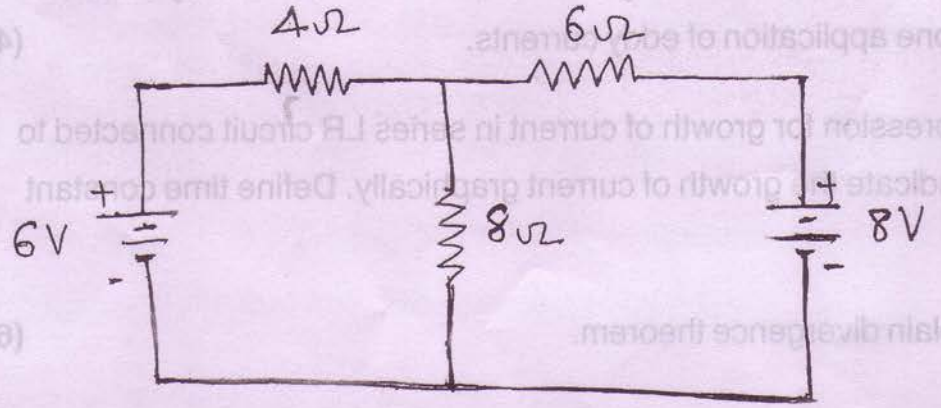
8. a) What are thermo-electric diagrams ? To construct the thermoelectric diagram for any metal, name the second metal for thermo-couple.

b) Explain methods of finding Peltier coefficient and Thomson coefficient using thermo-electric diagrams. **(2+6)**

PART – B

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

9. Find the current through 8 Ω resistance using superposition theorem in the given circuit.



10. A capacitor of capacitance 1 μ F is discharged through a resistance. Time taken for half the charge on the capacitor to leak is found to be 10 seconds. Calculate the value of resistance.

11. A Helmholtz tangent galvanometer has coils of radius 0.077 m each and number of turns 110. Calculate the current through the coils which produces a deflection of 45°, $B_H = 0.34\times10^{-4}$ T.

12. The magnetic flux linked with a coil of resistance 10 Ω at any instant is given by $\phi = 5t^2 + 2t + 3$. Calculate the magnitude of induced emf and current in a time interval of 0.5 seconds.

13. A coil of self-inductance 1 henry and having 100 turns carries a current of 5 ampere. Calculate the induced emf in it if the current changes at the rate of $2As^{-1}$.

14. A plane electromagnetic wave in the visible region is moving along the X-direction. The frequency of the wave is 0.5×10^{15} Hertz and the electric field at any point is varying sinusoidally with time with an amplitude 1 V m^{-1}. Calculate the instantaneous values of the densities of the electric and magnetic fields.

$\varepsilon_0 = 8.854\times10^{-12}$ Fm^{-1} $\quad \mu_0 = 4\pi\times10^{-7}$ Hm^{-1}

15. A resistance of 2 Ω and an inductance of 10 mH are connected in series with an ac source of 50 Hertz. Calculate the power factor of the circuit.

16. The thermo-emf of a thermo-couple in microvolt is given by the equation $e = 16.3\,\theta - 0.021\,\theta^2$ when the junctions are at 0°C and θ°C. Calculate neutral temperature and the temperature of inversion.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks.

(5×2=10)

17. a) Is the electrostatic potential necessarily be zero at a point where the electric field intensity is zero ?

    b) Does electric charge kept near a powerful magnet experience a force ? Explain.

    c) What is the force experienced by a conductor carrying current placed along the magnetic field ? Explain.

    d) Induced emf during break of the circuit is greater than that during make of the circuit. Why ? Explain.

    e) When does an LCR circuit get critically damped ?

    f) Is electromagnetic wave transverse ? Explain.

    g) Why is a choke preferred to a rheostat in controlling the current in an ac circuit ?

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

OS – 195

III Semester B.Sc. Examination, October/November 2012
(OS)(Semester Scheme) (Prior to 2012-2013)
PHYSICS – III
Electricity, Magnetism and Radiation

Time : 3 Hours Max. Marks : 60

Instruction : *Answer* ***five*** *in Part* ***A****,* ***four*** *in Part* ***B*** *and* ***five*** *in Part* ***C****.*

PART – A

Answer **any five** questions. **Each** question carries **six** marks. **(5×6=30)**

1. a) State Thevenin's theorem.

   b) What is dipole moment ? Derive an expression for the dipole moment of a current carrying coil in a magnetic field. **(2+4)**

2. Derive an expression for the charge flowing through a ballistic galvanometer. **6**

3. Obtain an expression for the magnetic field at a point on the axis of a circular coil carrying a current. **6**

4. a) State and explain Gauss's theorem.

   b) Write down Maxwell's equations. **(2+4)**

5. Derive an expression for the growth of current in an L-R circuit connected to a dc source. **6**

6. Derive an expression for resonant frequency in a series R-L-C ac circuit. Why is it called an acceptor circuit ? **6**

7. a) What is Seebeck effect ? Is Seebeck effect reversible ?

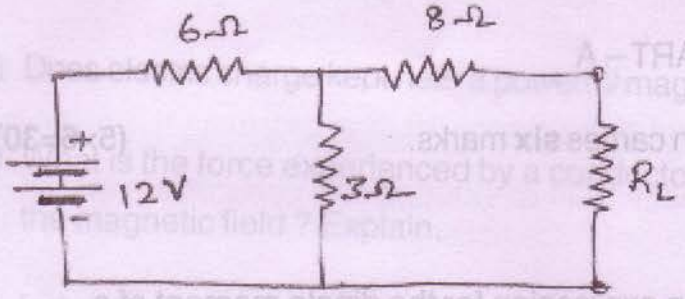
   b) State and explain the two laws of thermoelectricity. **(2+4)**

8. Derive Planck's law of distribution of energy in the spectrum of a black body. **6**

PART – B

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

9. For the network shown in the figure, determine the value of R_{Th} for maximum power to R_L and calculate the power delivered under these conditions. 5



10. A straight conductor 25 cm long carrying a current of 5 A is kept in a uniform magnetic field of 0.05 T. Find the force acting on the conductor when it is at

    a) right angles to the field and

    b) 30° to the field. 5

11. A coil of 50 turns and area 0.02 m^2 is kept in a uniform magnetic field of flux density 10^{-2} T so that the flux passes normally through it. Calculate the emf induced in it when the coil is suddenly removed from the field in 0.1 s. 5

12. A capacitor of 1 μ F is connected to a battery of 2 V through a resistance of 10 kΩ . Calculate the initial current and current after 0.02 s. 5

13. A 100 μ F capacitor in series with a 40 Ω resistance is connected to a 100 V, 60 Hz supply. What is the maximum current in the circuit ? 5

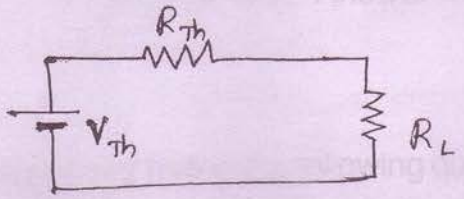
14. Calculate the surface temperature of the sun from the following data :

    $S = 1.330\ Js^{-1}\ m^{-2}$, $\sigma = 5.67 \times 10^{-8}\ Wm^{-2}\ K^{-2}$, radius of the sun = 6.95×10^5 km and distance of the sun from the earth = 1.5×10^8 km. 5

PART – C

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

a) Is current in the circuit shown below maximum or minimum when the load resistance is short-circuited ? Explain.



b) An electrical charge is kept near a magnet. Will it experience a force ? Explain.

c) A solenoid tends to contract when a current is passed through it. Why ?

d) A metal container is filled with water and is placed in a variable magnetic field. Can the water boil ? Explain.

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

f) Does the resonant frequency of a series R-L-C circuit depend on the resistance ? Explain.

g) Mention the factors on which the temperature of inversion depends.

h) The bottom of a cooking vessel should be dark and rough. Explain.

OS – 194

I Semester B.Sc. Examination, October/November 2012
(Semester Scheme) (NS) (2011-12 & Onwards)
PHYSICS – I
Mechanics, Oscillations and Properties of Matter

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 (i) coefficient of static friction (ii) angle of repose.

   b) Derive an expression for the accelaration of a body sliding down an inclined plane assuming coefficient of kinetic friction between the body and the surface of the inclined plane to be μ_k. **(2+6)**

2. a) State the postulates of special theory of relativity.

   b) Derive Einstein's mass energy equivalence relation. **(2+6)**

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

   b) What is meant by geostationary satellite ?

   c) Arrive at an expression for the time period of a satellite orbiting close to the surface of earth in terms of radius of earth and acceleration due to gravity. **(3+1+4)**

4. a) State work-energy theorem.

   b) Define surface tension in terms of surface energy.

   c) Arrive at an expression for the pressure difference across a curved surface of a liquid. **(2+2+4)**

P.T.O.

5. a) What is meant by collision ? What are elastic and inelastic collision ?

   b) Show $v = v_0 + u\ln\left(\frac{M_0}{M}\right)$ where v is the velocity of the rocket, u is the velocity of the exhaust relative to the rocket, M_0 is the initial mass of the rocket and M is the mass of the rocket at an instant of time. **(3+5)**

6. a) State and explain conservation of angular momentum.

   b) Derive an expression for the moment of inertia of a circular disc about an axis passing through its centre and perpendicular to its centre. **(3+5)**

7. a) Define simple harmonic motion. **(a+b=8)**

   b) Obtain differential equation for a simple harmonic motion and write down the expression for the angular velocity and time period of simple harmonic motion.

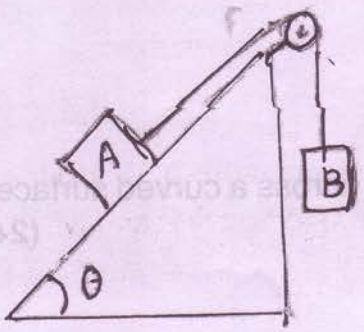
8. a) Define (i) neutral axis (ii) neutral surface of an elastic beam.

   b) Derive an expression for the depression of a cantilever. **(a+b=8)**

PART – B

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

9. Two blocks are connected by a string that passes over a frictionless pulley as shown in the figure given below. The mass of the block A is 20 kg and the coefficient of kinetic friction between block A and the inclined plane is 0.4. Block A slides down the inclined plane at constant velocity. Find the mass of block B in kg. $\theta = 30°$ and $g = 9.8\ ms^{-2}$.



10. A space craft is moving relative to the earth. An observer on the earth finds that according to his clock 3601 s had elapsed between 1 pm and 2 pm of the spacecraft's clock. What is the spacecraft's speed relative to the earth ? Velocity of light in vacuum is 3×10^{8} ms^{-1}.

11. A planet orbits the sun in a nearly circular orbit. The orbital radius is 1.1×10^{11} m and the time period of the planet around the sun is 232 days. Calculate the speed of the planet around the sun. Hence calculate the mass of the sun. $G = 6.67\times10^{-11}$ $NM^{2}kg^{-2}$.

12. What is the pressure inside a small spherical air bubble of 0.4 mm in diameter situated just below the surface of water. Surface tension of water is 0.075 Nm^{-1} and atmospheric pressure is 1.013×10^{5} pascal ?

13. A vehicle of mass 100 kg moving at a speed of 36 kmh^{-1} hits a lighter vehicle of mass 50 kg moving towards it at a speed of 18 kmh^{-1}. The two vehicles cling to each other. Find the speed of the combined mass after collision.

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

15. A uniform rod 1.5 m in length oscillates about a horizontal axis at one end, perpendicular to its length. (a) Find the position of a point about which the time period is minimum. (b) Find the minimum time period. $g = 9.8$ ms^{-2}.

16. Find the work done in stretching a wire of cross-section 2 mm^{2} (sq.mm) and length 4 m through 0.2 mm. Young's modulus of the material of the wire is 20×10^{10} NM^{-2}.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks.

(5×2=10)

17. a) Two identical fans of different masses are running at same speed. When the switches of both are put off, which one of them will come to rest first and why ?

    b) Moving clock ticks more slowly than a clock at rest. Comment.

c) What is the maximum value of gravitational potential ? and where is it maximum ?

d) Can the work done be negative ? Justify.

e) Can a body have (i) energy without having momentum ? (ii) momentum without energy ?

f) If the angular momentum is conserved in a system whose moment of inertia is decreased, will its rotational kinetic energy be also decreased ? Explain.

g) Are all periodic motion oscillatory ? Give one example of a periodic motion which is not oscillatory.

h) Justify the statement that Poisson's ratio cannot be negative.

OS – 194

I Semester B.Sc. Examination, October/November 2012
(Semester Scheme)
(OS) (Prior to 2011-12)
PHYSICS – I
Mechanics, Oscillations and Waves

Time : 3 Hours Max. Marks : 60

Instruction : *Answer* ***any five*** *from Part* ***A,*** *any* ***4*** *from Part* ***B*** *and* ***any five*** *from Part* ***C.***

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. Derive expressions for velocity and acceleration of a particle projected horizontally through a resistive medium, assuming the resistive force to be proportional to the velocity. **6**
2. Using a free-body diagram derive an expression for acceleration of a block of mass M sliding down an inclined plane. **6**
3. a) State and explain Newton's law of gravitation. Express gravitational force in vector form.

   b) Assuming the radial and transverse components of acceleration, show that areal velocity of the planet is constant. **(2+4)**
4. a) Define work and energy.

   b) Derive expression for the work done by a gravitational force. **(2+4)**
5. a) Define centre of mass of system of particles and state the law of conservation of linear momentum for a system of particles.

   b) What are elastic and inelastic collisions ? Give an example in each case. **(2+4)**
6. Define moment of inertia. State and prove parallel axes theorem. **6**

7. a) What is a torque ? Write an expression for it.

   b) Explain with an example the principle of conservation of angular momentum. **(2+4)**

8. a) Arrive at expression for velocity of the particle executing simple harmonic motion.

   b) Explain how two simple harmonic motions combine to give a resultant circular motion. **(3+3)**

PART – B

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

9. A force of 100 N acting on a body for 2 seconds imparts it a velocity of 40 ms^{-1}. What is the mass of the body ? What is the momentum of the body at the end of 2 seconds ?

10. If a body is moving with a speed of 15 ms^{-1} and coefficient of friction between the ground and the body is 0.3, find the distance travelled before it comes to rest.

11. A rocket of mass 30 kg has fuel 200 kg. The exhaust velocity of the fuel is 2.1 kms^{-1}. Calculate ultimate vertical speed gained by the rocket when the rate of consumption of the fuel is 2.5 kg s^{-1}. Also calculate the time for which the rocket lasts.

12. A body of mass 20 kg moving with a constant velocity of 5 ms^{-1} on a smooth surface is brought to rest by compressing a spring of spring constant 4×10^3 Nm^{-1}. What is the compression produced in the spring ?

13. A circular disc of mass 1 kg and radius 0.2 m is making 120 revolutions per minute about its diameter. Calculate the moment of inertia and kinetic energy of rotation.

14. Calculate the power required to run a vibrator, vibrating at a frequency of 100 Hz causing a harmonic wave of wavelength 4 m and an amplitude of 0.25 m to travel along a string of linear density 0.5×10^{-3} kg m^{-1}.

PART – C

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

15. a) Can a body remain at rest even though forces are acting on it ? Explain.

b) When a body is dropped into a tall jar containing liquid it moves with a constant velocity after some time Why ? Explain.

c) "Work done by a frictional force is negative". Explain.

d) "Electron revoling round the nucleus does no work". Justify.

e) Is angular momentum of a planet in elliptical orbit conserved ? Explain.

f) What is torque acting on a body when force applied is in the direction of radius vector ? Justify your answer.

g) A pendulum clock is taken to moon. Will it loose or gain time ?

h) Light waves are not mechanical. Explain.

AS – 206

II Semester B.Sc. Examination, April/May 2012
(Semester (NS) Scheme) (2011 and 2012 Onwards)
PHYSICS – II
Thermal Physics and Statistical Mechanics

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 root mean square velocity of molecule of a gas and derive an expression for the same.

   b) State and explain the principle of equipartition of energy. **(5+3)**

2. Derive equations for critical constants in terms of van der Waal's constants. **8**

3. a) Distinguish between isothermal and adiabatic processes.

   b) Deduce the relation between pressure and volume of an ideal gas undergoing adiabatic process. **(3+5)**

4. a) What are reversible and irreversible processes ? Explain with one example each.

   b) State and prove Carnots theorem. **(4+4)**

5. a) Explain the terms enthalpy and Gibs tree energy.

   b) Write four Maxwell's thermodynamic equations and hence deduce an expression for difference in molar specific heats of a gas and calculate it in the care of a real gas. **(2+6)**

P.T.O.

6. a) Explain the terms melting, vapourization and sublimation.

   b) Deduce the relation between entropy and thermodynamic probability. **(3+5)**

7. a) Define Joule-Thomson co-efficient and derive an expression for the same.

   b) Write a note on adiabatic demagnetisation. **(6+2)**

8. a) State and explain Kirchoff's law of radiation.

   b) Define solar constant and describe an experiment to determine the solar constant. **(3+5)**

PART – B

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

9. Average speed of a gas molecule is 400 ms^{-1} calculate co-efficient of viscosity of gas. Given that density of gas = 1.25 kg m^{-3} and mean free path = 8.85×10^{-8} m.

10. Critical temperature, pressuse and volume of a gas are 33.1 K, 1.316×10^{11} Nm^{-2} and 6.56×10^{-5} m^3 per mole respectively. Calculate van der Waal's constants of the gas.

11. A reversible engine converts $\frac{1}{6}^{th}$ of heat into work, when temperature of the sink is reduced by 62 K its efficiency is doubled find the temperatures of source and sink.

12. One mole of oxygen at NTP is compressed isothermally to $\frac{1}{5}^{th}$ of its original volume calculate change in entropy during the process. Given that R = 8.31 JK^{-1} $mole^{-1}$.

13. Calculate the depression in the melting point of ice for an increase in the external pressure of 2 atmosphere. Specific volumes of ice and water at 0°C are 1.01×10^{-3} m^3 kg^{-1} and 1×10^{-3} m^3 Kg^{-1} respectively. Latent heat of fusion of ice = 3.36×10^5 J Kg^{-1} k^{-1} and 1 atmosphere pressure = 10^5 Nm^{-2}.

14. Calculate the percentage error in finding $\log_e 4!$ using Stirling's formula.

15. Calculate the change in temperature when helium gas Suffer's Joule-Thomson expansion at – 173°C pressure difference on both sides of porous plug being 20 atmosphere. van der Waal's constants for the gas are a = 0.00 34 $Nm^4 mole^{-2}$, b = 0.0000234 $m^3 mole^{-1}$ and R = 8.3 J K^{-1}.

16. Assuming the Sun to be a black body of temperature 5800 K. Calculate the rate at which each square metre of the Sun's surface is radiating energy. Stefan's constant = 5.7×10^{-8} $Wm^{-2} K^{-4}$.

PART – C

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

17. a) An ascending balloon filled with hydrogen bursts. Explain.

    b) Air can not be liquified by the increase of pressure alone at room temperature, why ?

    c) How work is related to internal energy in an adiabatic process ? Explain.

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

    e) The fusion line has negative slope for ice and positive for carbon dioxide, what is the implication ?

    f) Two coins of face value 1 rupee are tossed simultaneously, what is the probability of getting head up in both the coins.

    g) Why an ideal gas donot show Joule-Thomson effect ?

    h) White cloths are preferred in summer. While coloured Cloth's in winter, why ?

AS – 206

II Semester B.Sc. Examination, April/May 2012
(Old) (Semester Scheme)
Prior to 2011 – 2012
PHYSICS – II
Properties of Matter, Heat and Thermodynamics

Time : 3 Hours | Max. Marks : 60

Instructions : *Answer any* ***five*** *questions from Part –* ***A****,* ***four*** *questions from Part –* ***B*** *and* ***five*** *questions from Part –* ***C****.*

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks : **(5×6=30)**

1. a) Define Young's modulus of the material.

   b) Obtain the relation connecting Young's modulus, rigidity modulus and Poisson's ratio. **(1+5)**

2. a) State Bernoulli's theorem.

   b) With necessary theory, describe Stoke's method of determining coefficient of viscosity of a highly viscous liquid. **(1+5)**

3. a) Define surface tension of a liquid.

   b) Obtain an expression for the pressure difference across a curved liquid surface. **(1+5)**

4. Draw the Andrew's curves on carbon dioxide at different temperatures and discuss the results obtained. **6**

5. a) What are isothermal and adiabatic processes ?

   b) Obtain an expression for the work done during adiabatic process. **(2+4)**

6. With the help of a PV-diagram, obtain an expression for the efficiency of a Carnot's engine. 6

7. a) Write any two Maxwell's thermodynamic relations.

   b) Derive Clausius-Clayperon equation using Maxwell's thermodynamic relation. (2+4)

8. Deduce an expression for Joule-Thomson coefficient. 6

PART – B

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

9. A steel wire of 1 mm radius is bent in the form of a circular arc of radius 50 cm. calculate

   a) The bending moment and

   b) The maximum stress.

10. Calculate the radius of capillary tube in which water rises to a height of 6 cm.

    Given

    Surface tension of water = 70×10^{-2} Nm^{-1}.

    Angle of contact = 0°

    Density of water = 10^3 kg m^{-3}

    Acceleration due to gravity = 10 ms^{-2}.

11. At what temperature the average speed of molecules of hydrogen gas will be double the average speed of Oxygen molecules at 300 K ?

12. A heat engine performs 2200 J of mechanical work and rejects 2000 J of heat in each cycle. Calculate

    a) heat supplied to the engine in each cycle and

    b) efficiency of the heat engine.

13. Calculate the depression in the melting point of ice for an increase of pressure of 2 atmosphere.

    Specific volume of ice at 0°C = 1.091×10^{-3} m^3 Kg^{-1}

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

    Latent heat of ice = 3.36×10^5 J Kg^{-1} K^{-1}

    1 atmosphere = 10^5 N M^{-2}.

14. The van der Waal's constants for hydrogen are a = 0.0247 Nm^4 $mole^{-2}$ b= 2.65×10^{-5} m^3 $mole^{-1}$. Calculate

    a) The temperature of inversion

    b) Joule-Thomson cooling for 2 atmosphere fall of pressure, the initial temperature being 100 K. R = 8.31 J $mole^{-1}$ k^{-1}.

PART – C

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

    a) Steel gliders are made in the form of I section. Explain.

    b) A small solid sphere dropped into a vertical column of liquid moves down with uniform velocity, where as an air bubble inside the column rises up with uniform velocity. Explain.

c) Rain drops are spherical in shape. Explain.

d) How permanent are the so called permanent gases ?

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

f) An ascending balloon filled with hydrogen bursts. Explain.

g) Gibb's free energy is called thermodynamic potential at constant pressure and temperature. Explain.

h) In which state of matter the entropy is maximum ? Explain.

AS – 208

VI Semester B.Sc. Examination, April/May 2012
(Semester Scheme)
PHYSICS (Paper – VII)
Statistical and Solid State Physics

Time : 3 Hours Max. Marks : 60

Instructions : *Answer **5** questions from Part – **A**, **4** questions from Part – **B**, **5** questions from Part – **C**.*

PART – A

I. Answer **any five** of the following. **Each** question carries **six** marks. **(5×6=30)**

1) Derive Fermi-Dirac distribution law for an assembly of Fermions. **6**

2) a) Obtain an expression for the thermal conductivity of metals based on free electron theory.

b) State Wiedamann – Franz law. **(5+1)**

3) a) What are static and dynamic materials ? Explain with one example each.

b) Discuss Nanoscale bio structures. **(4+2)**

4) a) What are X– rays ? Describe the method of producing X – rays using Coolidge tube.

b) How does Moseley Law explain the arrangement of atoms in the periodic table ? **(4+2)**

5) a) Explain with theory, the powder method of X – ray diffraction.

b) Why liquid crystals do not exhibit X – ray diffraction ? **(5+1)**

6) Derive an expression for electron concentration in an intrinsic semiconductor. **6**

7) a) Obtain an expression for the Hall coefficient in metals.

b) Write a note on Photoconductivity. **(4+2)**

8) a) What is Meissner effect ? Show that the magnetic susceptibility of a super conductor is – 1.

b) Explain with suitable equation, how penetration depth varies with temperature. **(4+2)**

P.T.O.

PART – B

II. Answer **any four** questions in the following. **(4×5=20)**

9) The conductivity of copper is 6×10^7 Sm^{-1}, its atomic mass is 63.5 and density 8940 $Kg\,m^{-3}$. Calculate the relaxation time of electrons. Effective mass of electrons = 9.1×10^{-31}Kg.

10) Calculate the mean free path of potassium if its Fermi energy is 2.1 eV and the electrical conductivity is 1.5×10^7 Sm^{-1}.

11) Calculate the interplanar spacing for a (321) plane in a simple cubic crystal whose lattice constant is 4.2 Å. What is the wavelength of the incident X – radiation when first order reflecting angle is $5^o.58^1$?

12) X – rays of wavelength 1 Å are scattered by a carbon target. Calculate the wavelength of scattered X – rays at 90° and the energy of the scattered X – radiation.

13) In a semiconductor the effective mass of an electron is $0.07m_o$ and that of a hole is $0.4\ m_o$. Assuming that the average relaxation time for the holes is half that for the electrons. Calculate mobility of holes when the mobility of electrons is $0.8m^2\ V^{-1}\ S^{-1}$.

14) An electric field of $100Vm^{-1}$ is applied to a sample of n – type semiconductor whose Hall coefficient is – 0.0125 m^3/coulomb. Find the current density. Given $\mu_n = 0.36\,m^2\ V^{-1}\ S^{-1}$.

PART – C

III. Answer **any five** of the following. **(5×2=10)**

a) Is neutron a boson ? Why ?

b) Do the order parameter of a liquid crystal decrease with increase in temperature. Explain.

c) "Photoelectric Phenomenon is the converse of X – ray production". Explain.

d) Super conductor is an ideal diamagnetic material. Explain.

e) The effective mass is different from the free mass of an electron. Explain.

f) Does a paramagnetic substance has a net magnetisation in the absence of external magnetic field . Explain.

MS – 285

VI Semester B.Sc. Examination, May/June 2013
(Semester Scheme)
PHYSICS – VIII
Relativity, Astrophysics and Nuclear Physics

Time : 3 Hours Max. Marks : 60

Instructions : *1) Part – **A**, answer **any five** of the following **(5×6=30)**.*
*2) Part – **B**, answer **any four** of the following **(4×5=20)**.*
*3) Part – **C**, answer **any five** of the following **(2×5=10)**.*

PART – A

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

1. a) What is proper time ? Write an expression for proper time in terms of relativistic time and velocities.

   b) Derive Einstein's mass-energy relation. **(2+4)**

2. Describe with a diagram the Michelson-Morley experiment and explain the physical significance of negative results. Derive an expression for fringe shift. **6**

3. State and prove Virial theorem. **6**

4. a) What is photon diffusion time ?

   b) Derive an expression for gravitational potential energy of a star. **(1+5)**

5. a) What are the probable end stages in the life time of a star ?

   b) Show that luminosity of a star is directly proportional to cube of its mass. **(2+4)**

6. Assuming the relation between impact parameter and scattering angle derive Rutherford's formula. **6**

7. a) Write the conditions for alpha decay.

   b) State Geiger-Nuttal law.

   c) Write a note on Pauli's neutrino hypothesis. **(2+1+3)**

8. Explain with a diagram, the principle, construction and working of a cyclotron. Obtain an expression for the maximum energy of a particle coming out of a cyclotron. **6**

P.T.O.

PART – B

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

9. The star nearest to the earth is at a distance of 4.32 light years. If a space traveller were to make a trip from the earth to the star at a uniform speed of 0.9 c how long would it take according to an earth clock ? How long would it take according to the space traveller's clock ?

10. An electron at rest mass 9.1×10^{-31} kg is moving with a speed of 0.99 c. What is total energy ? Find the ratio of Newtonian kinetic energy to the relativistic energy.

11. If the apparent and absolute magnitudes of the star white dwarf-sirius B are +8.6 and +11.4 respectively, calculate its distance from the earth.

12. The luminosity of a star is 10^4 times that of the sun and its surface temperature is 3000 K. How much larger is the radius of the star compared to that of the sun ?

13. Find the kinetic energy of the alpha particle emitted in the alpha-decay of Ra^{226}. Given $m(Ra^{226}) = 226.0254064$ u, $m(Rn^{222}) = 222.017574$ u.

14. The Q value of the Na^{23} (n, α) F^{20} reaction is – 6.4 MEV. Determine the threshold energy of the neutrons for this reaction. Given $m_i = 1.008665$ u, $m_t = 22.9898$ u.

PART – C

15. Answer **any five** of the following : **(5×2=10)**

    a) A moving clock ticks more slowly than a clock at rest. Justify.

    b) Can massless particle exist ? Comment.

    c) Can a material particle move with a velocity equal to c ? Explain.

    d) Is apparent magnitude of a star smaller or larger than its absolute magnitude if it is closer than 10 par secs ? Explain.

    e) Greater the mass of a star, shorter its lifetime. Justify.

    f) Why is Aston's mass spectrograph called a velocity focussing mass spectrograph ?

    g) Why is quenching necessay in a GM counter ? Explain.

    h) Not all nuclei are radioactive. Comment.

OS – 196

V Semester B.Sc. Examination, October/November 2012
(Semester Scheme)
PHYSICS – V
Gravitation, Space Physics and Electronics

Time : 3 Hours Max. Marks : 60

Instruction : *Answer* ***any five*** *questions in Part* ***A****,* ***any four*** *in Part* ***B*** *and* ***five*** *in Part* ***C****.*

PART – A

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

1. a) Define gravitational potential at a point.

   b) Obtain an expression for the gravitational potential due to a uniform solid sphere at a point outside the sphere. **(1+5)**

2. a) What is escape velocity ? Explain.

   b) Derive an expression for the escape velocity of a body on the earth. **(2+4)**

3. a) What is relative humidity ?

   b) Outline the vertical structure of the atmosphere. **(1+5)**

4. a) What are hybrid parameters of a transistor ?

   b) Draw an AC equivalent circuit of a CE transistor amplifier and derive expressions for voltage gain and current gain using h-parameters. **(1+5)**

5. a) Define any two JFET parameters.

   b) With the help of a circuit diagram describe the action of a zener diode as a voltage regulator. **(2+4)**

6. a) What is an operational amplifier ? Why is it called so ?

   b) Explain with circuit diagram, how an op-Amp can be used as an integrator. Obtain expression for its output voltage. **(2+4)**

P.T.O.

7. a) What are the essential parts of an oscillator ?

   b) Explain with circuit diagram, the working of a Hartley oscillator. Write the expression for its frequency. **(2+4)**

8. a) What is NOR gate ? Write the truth table for NOR.

   b) With the help of a circuit diagram and truth table, explain the working of a half adder circuit using logic gates. **(2+4)**

PART – B

Solve **any four** problems : **(4×5=20)**

9. A satellite is circling round the earth at a height of 1000 Km above the earth's surface. Calculate the orbital velocity and period of revolution. Given, Radius of the earth = 6,400 Km; g = 9.8 ms^{-2}.

10. In a transistor the base current and the collector current are 100 μA and 2mA respectively. Calculate I_E, α and β of the transistor.

11. In a Colpitt's oscillator, the inductance and capacitances in the tuned circuit are 16 mH, 0.016 μF and 0.018 μF . Calculate the frequency of the oscillator.

12. a) Convert $[675]_8$ to binary.

    b) Convert $[AF.2F]_{16}$ to decimal and binary equivalents. **(2+3)**

13. Prove that

$$(A+B)(\overline{A}\,\overline{C}+C)\overline{(\overline{B}+AC)}=\overline{A}\,B$$

Draw the logic circuit for the output.

14) Find the output of a three input summing op-Amp given the following data

$V_1 = 2V$, $V_2 = 3V$, $V_3 = -1V$

$R_1 = 15\ K\Omega$, $R_2 = 60\ K\Omega$, $R_3 = 600\ K\Omega$, $R_f = 60\ K\Omega$.

Draw the diagram.

PART – C

(5×2=10)

Answer **any five** of the following :

15. a) Saturn is about sixtimes farther from the sun than the Mars. Which of the two planets has (a) longer period of revolution (b) larger orbital speed ?

b) A junction transistor is called a bipolar transistor. Why ?

c) Explain the concept of virtual ground in op-amp circuit.

d) An oscillator is an amplifier with infinite gain. Justify.

e) Does electric field exist across the depletion layer of a semiconductor diode ? Explain.

f) A NAND gate is called a universal gate. Justify.

g) Do gravity waves appear only in water ? Explain.

h) A zener diode is a constant voltage source. Explain.

OS – 197

V Semester B.Sc. Examination, October/November 2012
(Semester Scheme)
PHYSICS – VI
Quantum Mechanics, Atomic and Molecular Physics

Time : 3 Hours Max. Marks : 60

***Instruction**: Answer **any five** questions in Part **A**, **any four** questions in Part **B** and **any five** in Part **C**.*

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. Account for the partial success of classical mechanics in explaining Blackbody radiation. Explain, based on Quantum mechanics, the Plank's distribution law. **6**

2. Give the necessary theory and explain Davisson-Germer's experiment to substantiate de Broglie matter wave. **6**

3. Derive the eigenvalues of a particle in a one-dimensional box. **6**

4. Obtain Schrödinger's time dependent equation for a particle in a box of one-dimension. Write the modified Schrödinger's time dependant equation in three-dimension. **(5+1)**

5. a) Write the Schrödinger's equation for a one dimensional harmonic oscillator.

   b) Write the energy eigen values of the harmonic oscillator in terms of frequency. What is the energy difference between two consecutive levels ?

   c) What are the operators for momentum and energy ? **(2+2+2)**

6. What is the effect of finite nuclear mass on Rydberg constant ? Plot a schematic diagram of R versus mass of the nucleus. **6**

7. There are in all four quantum numbers that fully describe an electron in an atom. Name them and give at least two of their characteristics. **6**

P.T.O.

8. a) From the expression for the rotational energy $E = \frac{\hbar^2}{2I} J(J+1)$ of a diatomic molecule explain the energy level diagram. The symbols in the expression for energy have their usual meaning.

   b) What is the selection rule for the transitions among the rotational energy levels ? **(5+1)**

PART – B

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

$h = 6.63 \times 10^{-34}$ Js, $m_e = 9.1 \times 10^{-31}$ kg ; $e = 1.6 \times 10^{-19}$ C. $c = 3 \times 10^8$ ms^{-1}

9. Calculate the frequency and energy (in eV) of a photon of wavelength 4000Å.

10. Calculate the momentum and wavelength of an electron of total energy 20 keV.

11. Calculate the uncertainty in the position of an electron moving with an uncertainty of 3×10^7 ms^{-1}. What is the minimum Kinetic energy of the free electron.

    [Use $\Delta \times \Delta p_x \sim \hbar$]

12. The energy of a linear harmonic oscillator is 0.20 eV in the n = 4 state. Calculate its frequency. Find the zero point energy of the oscillator.

13. Calculate the Zeeman shift observed in the normal Zeeman effect when a spectral line of wavelength 500 nm is subjected to a magnetic field 0.5 T. Given $\frac{e}{m} = 1.76 \times 10^{11}$ Ckg^{-1}.

14. In an experiment on Raman effect, using Mercury green radiation with wavelength 546.1 nm, a Stoke's line of wavelength 554.3 nm was observed. Find the Raman shift and wavelength corresponding to anti-stokes line.

PART – C

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

15. a) Hydrogen gas in a discharge tube emits line spectrum in the visible region. Ionised Hydrogen in the sun emits a continuous spectra in the visible region. Why this difference ?

    b) Does the concept of Bohr orbit violate the uncertainty principle ? Explain.

    c) Why is the wave nature of matter not apparent in our daily observations ?

    d) Distinguish between a free particle and a particle in a box.

    e) Give the energy equation in the operator format.

    f) Generally, Norman Zeeman effect occurs in atoms with even number of electrons while anamalous Zeeman effect is observed with odd number of electrons. Explain.

    g) How do you distinguish an atomic spectra from a molecular spectra by a casual observation ?

    h) Which branch is missing in a rotation-vibration spectra ?

OS – 196

V Semester B.Sc. Examination, October/November 2012
(Semester Scheme)
PHYSICS – V
Gravitation, Space Physics and Electronics

Time : 3 Hours Max. Marks : 60

Instruction : *Answer* ***any five*** *questions in Part* ***A****,* ***any four*** *in Part* ***B*** *and* ***five*** *in Part* ***C****.*

PART – A

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

1. a) Define gravitational potential at a point.

   b) Obtain an expression for the gravitational potential due to a uniform solid sphere at a point outside the sphere. **(1+5)**

2. a) What is escape velocity ? Explain.

   b) Derive an expression for the escape velocity of a body on the earth. **(2+4)**

3. a) What is relative humidity ?

   b) Outline the vertical structure of the atmosphere. **(1+5)**

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   b) With the help of a circuit diagram and truth table, explain the working of a half adder circuit using logic gates. **(2+4)**

PART – B

Solve **any four** problems : **(4×5=20)**

9. A satellite is circling round the earth at a height of 1000 Km above the earth's surface. Calculate the orbital velocity and period of revolution. Given, Radius of the earth = 6,400 Km; g = 9.8 ms^{-2}.

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Draw the diagram.

PART – C

(5×2=10)

Answer **any five** of the following :

15. a) Saturn is about sixtimes farther from the sun than the Mars. Which of the two planets has (a) longer period of revolution (b) larger orbital speed ?

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e) Does electric field exist across the depletion layer of a semiconductor diode ? Explain.

f) A NAND gate is called a universal gate. Justify.

g) Do gravity waves appear only in water ? Explain.

h) A zener diode is a constant voltage source. Explain.

OS – 197

V Semester B.Sc. Examination, October/November 2012
(Semester Scheme)
PHYSICS – VI
Quantum Mechanics, Atomic and Molecular Physics

Time : 3 Hours Max. Marks : 60

***Instruction**: Answer **any five** questions in Part **A**, **any four** questions in Part **B** and **any five** in Part **C**.*

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. Account for the partial success of classical mechanics in explaining Blackbody radiation. Explain, based on Quantum mechanics, the Plank's distribution law. **6**

2. Give the necessary theory and explain Davisson-Germer's experiment to substantiate de Broglie matter wave. **6**

3. Derive the eigenvalues of a particle in a one-dimensional box. **6**

4. Obtain Schrödinger's time dependent equation for a particle in a box of one-dimension. Write the modified Schrödinger's time dependant equation in three-dimension. **(5+1)**

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7. There are in all four quantum numbers that fully describe an electron in an atom. Name them and give at least two of their characteristics. **6**

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8. a) From the expression for the rotational energy $E = \frac{\hbar^2}{2I} J(J+1)$ of a diatomic molecule explain the energy level diagram. The symbols in the expression for energy have their usual meaning.

   b) What is the selection rule for the transitions among the rotational energy levels ? **(5+1)**

PART – B

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

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10. Calculate the momentum and wavelength of an electron of total energy 20 keV.

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13. Calculate the Zeeman shift observed in the normal Zeeman effect when a spectral line of wavelength 500 nm is subjected to a magnetic field 0.5 T. Given $\frac{e}{m} = 1.76 \times 10^{11}$ Ckg^{-1}.

14. In an experiment on Raman effect, using Mercury green radiation with wavelength 546.1 nm, a Stoke's line of wavelength 554.3 nm was observed. Find the Raman shift and wavelength corresponding to anti-stokes line.

PART – C

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

15. a) Hydrogen gas in a discharge tube emits line spectrum in the visible region. Ionised Hydrogen in the sun emits a continuous spectra in the visible region. Why this difference ?

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    g) How do you distinguish an atomic spectra from a molecular spectra by a casual observation ?

    h) Which branch is missing in a rotation-vibration spectra ?
