61121

First Semester B.Sc. Degree Examination, December 2018

(CBCS Scheme – Freshers – 2016-17 and onwards)

Physics

Paper 101 – MECHANICS – 1, HEAT AND THERMODYNAMICS – 1

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

Instructions to Candidates : Answer any five questions from each Part.

PART – A

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

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

   (b) Derive an expression for the velocity of a body moving through a resistive medium at low speed under gravity. **(3 + 5)**

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

   (b) Define orbital velocity and derive an expression for the same. **(3 + 5)**

3. (a) Obtain an expression for the potential energy of a spring when it is stretched through a distance from its equilibrium position.

   (b) What are conservative and non-conservative forces? Give an example for each. **(4 + 4)**

4. (a) State and explain Kirchoff's law of Radiation.

   (b) Derive Wien's law and Rayleigh-Jean's law from Planck's law. **(2 + 6)**

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

   (b) Deduce the perfect gas equation from Kinetic theory of gases. **(4 + 4)**

6. Describe Andrew's experiment on the isothermals of CO_2 and discuss its results. **(8)**

7. (a) State and explain First law of Thermodynamics. What is its significance?

   (b) Derive an expression for work done by a gas during an adiabatic process. **(4 + 4)**

8. (a) What are reversible and irreversible processes?

   (b) Obtain an expression for the change in entropy of a gas in terms of volume and temperature. **(2 + 6)**

PART – B

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

9. A block of wood of mass 2 kg resting on a horizontal table is connected by a horizontal table is connected by a horizontal string passing over a smooth fixed pulley to a mass of 0.5 kg hanging from its free end. If the coefficient of friction between the block and the table is 0.1, calculate the acceleration of the system.

10. What is the orbital velocity and escape velocity of an artificial satellite revolving round the Earth at a height 100 km?

    Given :

    Radius of the Earth is 6400 km and acceleration due to gravity is 9.8 ms^{-2}.

11. A 0.08 kg bullet is accelerated by a rifle barrel 0.6 m long to a speed of 840 ms^{-1}. Calculate the average force exerted on the bullet while it is accelerated using Work-Energy theorem.

12. A 5 kg body and a 8 kg body are moving along the X-axis. At a particular instant the 5 kg body is 1 m from the origin and has a velocity of 3 ms^{-1} and 8 kg body is 2 m from the origin and has a velocity of -1 ms^{-1}. Find the position and velocity of centre of mass.

13. Find (a) the mean free path and (b) collision frequency for N_2 molecules. Assume a molecular diameter of 2×10^{-10} m, given that the average speed of N_2 molecule is 511 ms^{-1} and molecular density is 2.5×10^{25} moles m^{-3}.

14. The critical temperature, pressure 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 the van der Waal's constants of the gas.

15. One litre air at a pressure of 10^5 Nm^{-2} is suddenly compressed to 10^{-3} litre. Find the final pressure. Given : $\gamma = \frac{5}{3}$.

16. A Carnot engine, whose sink is at a temperature of 7°C, has an efficiency of 50%. It is desired to increase the efficiency to 70%. By how many degrees, the temperature of the source be increased.

PART – C

Answer any **FIVE** of the following questions. Each question carries **2** marks :

(5 × 2 = 10)

17. (a) A swimmer pushes water backward while swimming. Why?

(b) "It is easier to make a body roll over a surface than to slide." Justify.

(c) Can a pendulum vibrate in an artificial satellite? Explain.

(d) A light body and a heavy body have the same momentum. Which one has a larger kinetic energy? Explain.

(e) In summer, black clothes are not preferred. Justify.

(f) Why does the temperature of a gas increase when it is suddenly compressed?

(g) Is Carnot's engine reversible? Explain.

(h) A reversible adiabatic change is isentropic. Explain.

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I SEMISTER B.Sc. EXAMINATION, NOVENMBER/DECEMBER 2019
(CBCS SCHEME-FRESHERS 2016-17 ONWARDS)
PHYSICS-I
PAPER-I: MECHANICS-I, HEAT AND THERMODYNAMICS-I
SCHEME OF EVALUATION

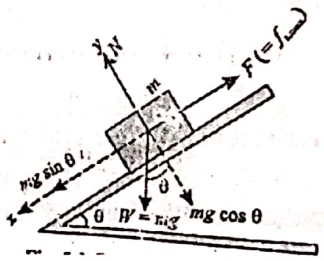
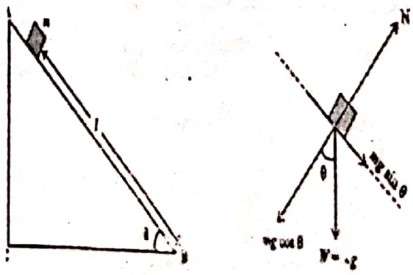
Time: 3hours **Max.Marks:70**

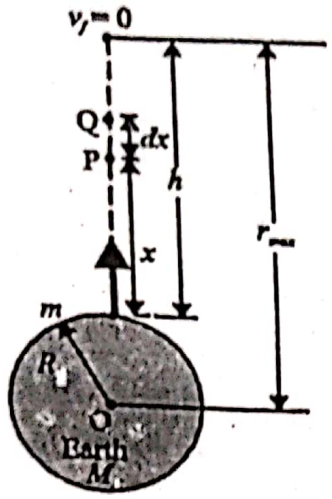
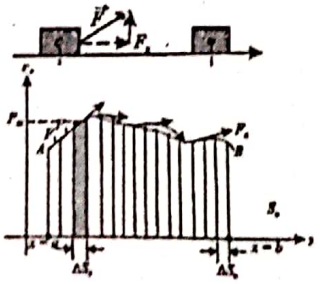
Paper Setter: Dr. ADAVALA VENKATESULU, Assistant Professor, Department of Physics (UG&PG), GFGC-Hoskote, Mob.No.:9449535304

Instruction: Answer any **FIVE** questions from each part

Part-A

Answer any FIVE of the following questions. Each question carries 8 marks. (5X8 =40)

Q.No	Scheme of Evaluation	Marks
1	**(a) Derive the relation between coefficient of static friction and angle of repose**	
Answer	Figure and Explanation The forces on the block are weight W = mg mg Cosθ = N (normal reaction force) when the block just starts sliding then $mg\cos\theta = F_{s.max} = \mu_S N$ $\Sigma F_x = \mu_s N - mg\sin\theta = 0$ $\Sigma F_y = N - mg\cos\theta = 0$  Arriving final expression $\mu_S = \frac{f_{s.max}}{N} = \frac{\sin\theta}{\cos\theta} = \tan\theta$...	2 Marks 2 Marks
	(b) Obtain an expression for the velocity of the accelerating body moving along an inclined plane without friction	...
	Figure and Explanation mgCosθ = N (Normal force) and a = g Sinθ [∴ mg Sinθ produces acceleration] if 'V' is the velocity of the block at the bottom, then $V^2 - 0 = 2gl\sin\theta$ Arriving final expression $V = \sqrt{2gl\sin\theta}$  	2 Marks 2 Marks
2 Answer	**(a) Define Orbital velocity**	
	Orbital velocity: The minimum velocity required to put a satellite into the orbit, around a central body (planet) is called the orbital velocity	1 Mark

	(b) Obtain an expression for the escape velocity of an object from the earth surface	
	Figure and Explanation and Arriving expression for K.E & P.E of a planet  $K.E = 1/2\ mv_i^2$ & $P.E = -\frac{GMm}{R}$ Total Energy $TE = KE + PE = 1/2\ mv_i^2 - \frac{GMm}{R}$ Condition of maximum altitude, $V = V_f = 0$ & $r = r_f = r_{max}$ Arriving an expression $\frac{GMm}{r_{max}} = \frac{1}{2} mv_i^2 - \frac{GMm}{R}$ And Solving for $V_i^2 = 2GM\left[\frac{1}{R} - \frac{1}{r_{max}}\right]$ Considering the relation for maximum altitude $h = r_{max} - R$ Assuming r_{max} $V_i = V_{esc}$ Arriving final expression $V_{esc}^2 = 2GM/R$ or $V_{esc} = \sqrt{\frac{2GM}{R}}$	2 Marks 2 Marks 1 Mark 2 Marks
3 Answer	**(a) Explain conservative and non-conservative forces with examples**	
	i) Conservation force: If the work done by a force in displacing a particle from one point to another point is independent of the path followed by the particle, is called conservative force Ex: Gravitational force, Elastic force etc. work done in a closed path, W= 0 ii) Non conservative force: If the work done by a force on a path moving between two points depends on the path followed by a particle is called the non-conservative force Ex: Frictional forces, viscous forces etc. & work done in a closed path, $W \neq 0$	2 Marks 2 Marks
Answer	**(b) Derive an expression for work done by a variable force**	
	Figure and Explanation  Arriving the expression total work done $W = \Delta W_1 + \Delta W_2 + \Delta W_3 + \ldots\ldots\ldots\ldots$ $= F_1 \cos\theta_1 \Delta S_1 + F_2 \cos\theta_2 \Delta S_2 + \ldots\ldots$ $= \sum_{i=1}^{n} F_i Cos\theta_i \Delta S_i$ Assuming $\Delta s \rightarrow 0$ & arriving at total work done Expression $W = \int_A^B F\cos\theta ds = \int_A^B \vec{F} \cdot \vec{ds}$ = Area under the curve	2 Marks 1 Mark 1 Mark
4	**Derive Plank's law of radiation for a black body**	
Answer	Assuming the black body consisting of N number of oscillators and distributing of energies for each oscillator to the expressions. $N = N_0 + N_1 + N_2 + \ldots + Nn$, $E = 0 + E + 2E + \ldots + nE$ and Average energy of oscillator $\vec{E} = \frac{E}{N}$ According to Maxwell-Boltzmann distribution $N_n = N_o e^{\frac{-nh\nu}{KT}}$ ..... Applying to above equations &arriving expressions for N & E.	2 Marks 1 Mark

$$N = N_0[1 + e^{\frac{-h\nu}{kt}} + e^{\frac{-2h\nu}{kt}} + \ldots = N_0\left[\frac{1}{1-e^{\frac{-h\nu}{kt}}}\right]$$

$$E = N_0 + N_1 h\nu + N_2 2h\nu + \ldots\ldots N_n nh\nu$$

$$= N_0 e^{\frac{-h\nu}{kt}} \text{ hr } \left[\frac{1}{[1-e_{kt}^{-h\nu}]2}\right]$$

Average energy of the oscillator $\bar{E} = \frac{h\nu}{e_{kt}^{h\nu}-1}$ — **3 Marks**

Assuming the no of oscillator in the frequency range ν & $\nu + d\nu$, $N = \frac{8\pi\nu^2}{c^3}d\nu$ — **1 Mark**

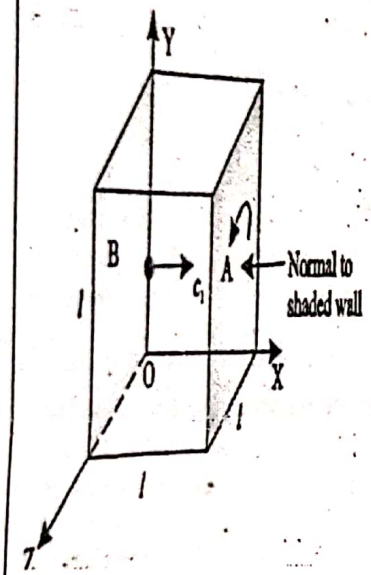
Energy density in a black body radiation $E_\nu d\nu = N \times \bar{E} = \frac{8\pi\nu^2}{c^3}d\nu \times \frac{h\nu}{e_{kt}^{h\nu}-1}$ …

radiation $E_\lambda d\lambda = N \times \bar{E} = \frac{8\pi hc}{\lambda^5} \times \frac{d\lambda}{e_{\lambda kT}^{hc}-1}$ $\left[\because \nu = \frac{c}{\lambda}\ \ d\nu = -\frac{c}{\lambda^2}d\lambda\ ,\ E\nu d\nu = -E\lambda d\lambda\ \right]$ — **1 Mark**

5 Answer

Show that the pressure exerted by a gas PV =1/3 mnc² — **2 Marks**

Figure and Explanation



Change of momentum along the X coordinate for a molecule $= \frac{mu_1^2}{l} = F_1$ ….. — **1 Mark**

Similarly $F_2 = \frac{mu_2^2}{l}$, $F_3 = \frac{mu_3^2}{l}$,

Total force along X direction $F_x = F_1 + F_2 + F_3$. — **1 Mark**

& pressure $P_x = \frac{F_x}{l^2} = \frac{m}{l^3}[\ U_1^2 + U_2^2 + \text{----}]$

Similarly $P_y = \frac{m}{l^3}[\ v_1^2 + v_2^2 + \text{----}]$

Arriving $P_z = \frac{m}{l^3}[\ W_1^2 + W_2^2 + \text{---}]$ …..

Total pressure, $P = [\ P_x + P_y + P_z\ ]/3$

$= m/3V\ [\ C_1^2 + C_2^2 + \text{---} + C_n^2]$ — **3 Marks**

$[\because l^3 = V]$

$C^2 = \frac{C_1^2 + C_2^2 + C_3^2 + C_4^2 + \cdots + C_n^2}{n}$

$[\because nC^2 = C_1^2 + C_2^2 + \text{------} + C_n^2]$

$\therefore P = \frac{mn}{3V}C^2$ or $PV = 1/3nmc^2$ — **1 Mark**

6 Answer

(a) Mention the assumptions of kinetic theory of gases

Any four assumptions of K.T of gases …… — **2 Marks**

(b) Deduce the relation for the coefficient of viscosity of a gas on the basis of kinetic theory of gases

Figure and Explanation — **2 marks**

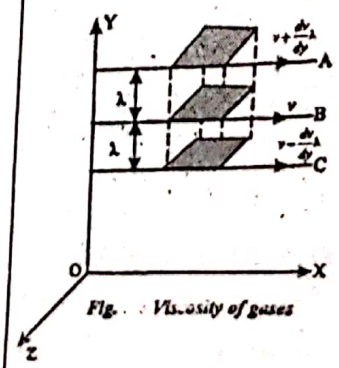


Fig. : Viscosity of gases

Arriving an expression for momentum lost / unit area /sec by an upper layer

$$A = \frac{mn\bar{c}}{6}\left[V + \frac{dv}{dy}\lambda\right]$$

Momentum gained by layer B/unit area /sec — **2 Marks**

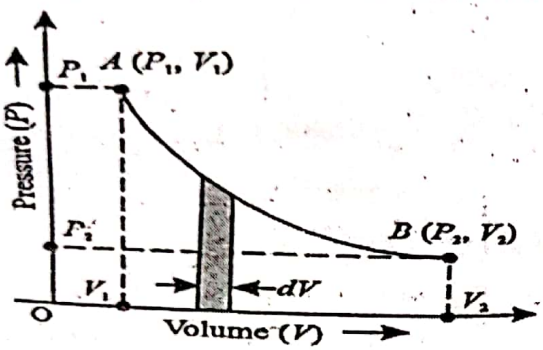
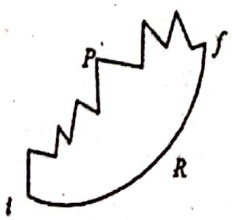
$$B = \frac{mn\bar{c}}{6}\left[V - \frac{dv}{dy}\lambda\right]$$

Net momentum lost by layer A /unit area /sec

$= \frac{1}{3}mn\bar{c}\lambda\frac{dv}{dy}$ …… — **1 Mark**

The back ward dragging force/ area = gain or loss of momentum /unit area

i.e., $\eta \times \frac{dv}{dy} = \frac{1}{3}mn\bar{c}\lambda\frac{dv}{dy}$ & $\eta = \frac{1}{3}mn\bar{c}\lambda$ — **1 Mark**

7	**a) State the first law of thermodynamics and explain its significance**	
Answer	Statement &Expression dQ =du +dw	**1 Mark**
	Significances: 1. This law is a relation between heat &work 2. It signifies that heat can be produced by expanding some other form of energy 3. It introduces the concept of internal energy.....	**2 Marks**
	b) Obtain an expression for the amount of work done by an ideal gas during isothermal process.	
	Figure &Explanation.....	**2 Marks**
		
	Expression for Work done by a gas in expanding from one state to another state, $W = \int_A^B pdv$..... Since PV =RT $\therefore P = \frac{RT}{V}$	**1 Mark**
	Hence $W = \int_A^B \left[\frac{RT}{V}\right]dv = RT \log_e \frac{v_2}{v_1}$ $= 2.303\ RT \log_{10} \frac{v_2}{v_1}$ ...	**2 Marks**
8	**a) State Carnot's theorem. Write the expression for the efficiency of Carnot's heat engine.**	
Answer	i) Statement: "NO heat engine working between two heat reservoirs can be more efficient than a Carnot's reversible engine working between the same two temperatures. i.e., "The efficiency of all reversible engines working between the same two temperatures is the same, irrespective of the working substance ...	**1 Mark**
	ii) $\eta = 1 - Q_2/Q_1$ or $\eta = 1 - T_2/T_1$ ..... With explaining the terms	**2 Marks**
Answer	**b) Derive an expression for change in entropy for a cyclic process**	
	Figure & Explanation	**1 Mark**
	 *Fig. Change in entropy in a cyclic process*	
	According clausious inequality integral over a cyclic path $\oint \frac{dQ}{T} = \int_i^f \left[\frac{dQ}{T}\right]_{\text{irreversible path}} + \int_f^i \left[\frac{dQ}{T}\right]_{\text{reversible path}} \le 0$	
	For reversible path $\int_f^i \left[\frac{dQ}{T}\right] = S(i) - S(f) = dS$	**1 Mark**
	Substituting in above equation we get $\int_i^f \left[\frac{dQ}{T}\right] \le S(f) - S(i)$ or $S(f) - S(i) \ge \int_i^f \left[\frac{dQ}{T}\right]$ ...	**2 Marks**

Part-B

Answer any FIVE of the following problems each problem carries four marks (5 x 4 =20)

9.	**A 2kg block is placed on a horizontal surface. The co-efficient of static friction between the block and the surface is 0.15. If an external force of 5N is applied on the block parallel to the surface. Find the acceleration of the block. Given g=9.8m/sec².**	
Solution	Given: m=2kg , μ_s =0.15 ,F=5n , g=9.8m/sec²	
	Frictional force, $F_r = \mu_s mg$ =0.15 x2x9.8=2.94N Applied force = 5N.	**1 Mark**
	Applied force-limiting frictional force; F- Fr=ma	**1 Mark**
	$\therefore$ acceleration, $a = \frac{F - Fr}{m} = \frac{5 - 2.94}{2} = \frac{2.06}{2} = 1.03 m/s^2$	**2 Marks**

10	**Calculate the mass of the earth, given that the gravitational constant=6.67 x10^{-11} Nm^2kg^{-2}, radius of the earth =6.38x10^6m and acceleration due to gravity =9.8m/sec^2**	
Solution	Given: G=6.67x$10^{-11}$$Nm^2kg^{-2}$, R=6.38x$10^6$m & g=9.8m/$sec^2$. According to newton's law of gravitation, $G\frac{Mm}{R^2} = mg \rightarrow \frac{GM}{R^2} = g$ $\therefore M = g\frac{R^2}{G}$... $M = \frac{9.8X(6.38X10^6)^2}{6.67X10^{-11}}$.... M=5.98X$10^{24}$kg..	1 Mark 1 Mark 1 Mark 1 Mark
11	**Calculate the work done in lifting a body of mass 28kgs to a height of 1.5m.**	
Solution	Given: m=28kg ,S=1.5m & $\theta=0^0$ W = F.S.Cos0 = mg.S.Cosθ W = 28 X 9.8X 1.5X Cos 0^0 → W=411.6 J	1 Mark 1 Mark 2 Marks
12	**Determine the temperature at which a blackbody loses thermal energy at the rate of 10^4Wm^{-2}. Given Stefan's constant=5.7X$10^{-8}$$Wm^{-2}K^{-4}$.**	
Solution	Given: E=10^4Wm^{-2}, σ=5.7x$10^{-8}Wm^{-2}K^{-4}$ $E=\sigma T^4$, $T^4=\frac{E}{\sigma}$; $T=(\frac{E}{\sigma})^{1/4}$... $T=\left(\frac{10^4}{5.7X10^{-8}}\right)^{1/4}$ = 648 K	2 Mark 2 Marks
13	**The mean free path of nitrogen molecules at 0°C and one atmosphere is 0.8X10^{-7}m and the number of nitrogen molecules is 2.7X$10^{25}$$m^{-3}$. calculate the molecular diameter of nitrogen molecules**	
Solution	Given: λ=0.8X10^{-7}m, n=2.7X$10^{25}$$m^{-3}$, d=? $\lambda=\frac{1}{\sqrt{2}\pi d^2 n}$; $d^2=\frac{1}{\sqrt{2}\,\pi\lambda n}$; $d=\left[\frac{1}{\sqrt{2}\,\pi\lambda n}\right]^{1/2}$ $d=\left[\frac{1}{\sqrt{2}\ 3.14x0.8x10^{-7}x2.7x10^{25}}\right]^{1/2}$ d=3.228x10^{-10} m	1 Mark 1 Mark 2 Marks
14	**Calculate the van der Waal's constants a and b. Given that critical pressure of the gas is 2.1x10^6 Nm^{-2} and critical volume for a mole of gas is 45X$10^{-6}$$m^3$.**	
Solution	Given: P_c =2.1 X10^6 Nm^{-2}, Vc=45X$10^{-6}$$m^{-3}$, a=? b=? We have $V_c=3b \rightarrow b=\frac{V_c}{3}$ $b = \frac{45X10^{-6}}{3}$ = 15X10^{-6} m^3 $P_c=\frac{a}{27b^2}\rightarrow$ $a = 27P_cb^2$ a=27 X 2.1 X 10^6 X (15X10^{-6})^2 a = 0.0127 Nm^4mol^{-2}	1 Mark 1 Mark 1 Mark 1 Mark
15	**One mole of an ideal gas at 273K is subjected to a reversible adiabatic expansion to double its volume. Calculate the change in temperature of the gas, given γ=1.4.**	
Solution	T_1 =273k , γ=1.4 , $T_2=T_1\left[\frac{V1}{V2}\right]^{\gamma-1}$ $T_2=273\ X\left[\frac{V1}{2V1}\right]^{1.4-1} = 273\ X\left[\frac{1}{2}\right]^{0.4}$ T_2=207k	1 Mark 1 Mark 2 Marks
16	**Calculate the change in entropy when 0.5 kg of ice at 273K melts into water and the temperature of water is raised to 300k. Given entropy change in melting ice at 273k=61.5JK^{-1} and specific heat of water = 4200 $Jkg^{-1}k^{-1}$.**	
	Given: m=0.5 kg, T_1 =273 K, T_2=300 K & $(\Delta S)_{ice\text{-}water}$ =61.5 JK^{-1}	

Solution	$S_w = 4200 Jkg^{-1}k^{-1}$ Change in entropy when water is heated from T_1 to T_2 = $(\Delta S)_{water}$ $(\Delta S)_{water} = m\ S_w \ln\left[\frac{T_2}{T_1}\right]$ $(\Delta S)_{water} = 0.5 \times 4200 \times \ln \frac{300}{273} = 198.1$ Net change in entropy, $(\Delta S)_{net} = (\Delta S)_{ice\text{-}water} + (\Delta S)_{water}$ $\therefore (\Delta S)_{net} = 61.5 + 198.1 = 259.6\ JK^{-1}$	**1 Mark** **1 Mark** **1 Mark** **1 Mark**

Part – C

Answer any five of the following. Each question carries two marks **(5X2=10)**

17. (a) Answer	**Why it is difficult to run fast on sand?** When we run on sand, the irregularities formed are deeper.so that friction is increased. hence it is difficult to run fast on sand	**2 Marks**
(b) Answer:	**Is it possible to shield a body from gravitational effects? Explain** **No;** Gravitational force does not depend upon the nature of intervening medium.	**1 Mark** **1 Mark**
(c) Answer:	**Does the momentum of system of a particles always conserved? Justify** **No.** Momentum of a system of particles is conserved only if the external force on the system is zero.	**1 Mark** **1 Mark**
(d) Answer:	**Why does the good absorber of radiant energy appear black?** A good absorbing surface removes all visible colors when it converts all the radiant energy incident upon it to heat, it cannot both absorb and reflect the same wave length at the same time.	**2 Marks**
(e) Answer:	**Does the temperature of the gas increase when it is compressed suddenly? Explain** **Yes,** Work has to be done to compress a gas, this work is converted into heat and hence the temperature of the gas increases.	**1 Mark** **1 Mark**
(f) Answer:	**What are the factors on which the Vander Waals correction for the pressure depends?** 1) Number of molecules striking per second per unit area of the walls of the container. 2) The number of molecules in a given volume.	**1 Mark** **1 Mark**
(g) Answer:	**Does the internal energy of a substance is a state function? Justify** **Yes,** Change in internal energy of a system is independent of the path between the two states.	**1 Mark** **1 Mark**
(h) Answer:	**Can the efficiency of Carnot's engine 100%? Explain.** **No,** Efficiency of ideal engine, $\eta = 1 - \frac{T_2}{T_1}$. For 100% efficiency, i.e. $\eta = 1$, T_2 must be zero. but practically it is not possible to have $T_2 = 0$ K. $\therefore$ efficiency of Carnot's Engine is always less than 100%	**1 Mark** **1 Mark**

BANGALORE UNIVERSITY PHYSICS TEACHERS' FORUM

I SEMESTER B.Sc. MODEL QUESTION PAPER
SUBJECT: PHYSICS
PAPER: MECHANICS -1, HEAT AND THERMODYNAMICS -1
(PHY T 101)

TIME : 3 HOURS MAX. MARKS : 70

PART –A

I. Answer any FIVE of the following : 5x 8=40

1. a) State Newton's third law of motion and mention one example.
   b) Derive an expression for the velocity of a body falling under gravity through a resistive medium at low speed. Represent the variation of velocity with time graphically. (2+6)

2. a) Define gravitational field and gravitational potential energy.
   b) What is escape velocity? Derive an expression for the escape velocity. (2+6)

3. a) Explain the concept of center of mass of a system of particles.
   b) Derive an expression for the velocity of a rocket. (2+6)

4. a) State any two postulates of Planck's quantum hypothesis.
   b) Derive Planck's law of radiation and hence deduce Wien's displacement law. (2+6)

5. a) Mention any three assumptions of kinetic theory of gases.
   b) What is molar specific of a gas at constant volume? Derive an expression for the specific heat of an ideal gas at constant volume . (3+5)

6. a) Describe Andrew's experiment on carbon-dioxide and mention the results. (8)

7. a) Distinguish between intensive and extensive variables.
   b) What is an adiabatic process . Derive an expression for work done in an adiabatic process. (2+6)

8. a) Explain the Carnot's cycle and derive an expression for its efficiency in terms of the temperatures of the source and sink. (8)

PART B

II. Answer any five of the following $(5 \times 4 = 20)$

9) A block of mass 2 kg is placed on an inclined plane which makes an angle 30° with the horizontal. The coefficient of friction between the block and surface is $\frac{\sqrt{3}}{2}$. What force should be applied to the block along the incline so that the block moves down without any acceleration?

10) Calculate the time period of satellite at 4000km above the earth surface given radius of the earth = 6400Km, R_E=6400km, $G=6.67X10^{-11}Nm^2Kg^{-2}$, $M_E=5.97\times10^{24}Kg$.

11) A 80g bullet is accelerated by a riffle barrel 60cm long to a speed of $640ms^{-1}$.Calculate the average force exerted on the bullet while it is accelerated.

12) Calculate the maximum amount of heat which may be lost per second by radiation by a sphere 18cm in diameter at a temperature of 227^0C, when placed in an enclosure at 27^0C. Stefan's constant = $5.67x10^{-8}Wm^{-2}K^{-4}$.

13) Calculate the mean free path and thermal conductivity of air molecules at STP given that viscosity $=1.7\times10^{-5}$ N s m^{-2}, mean velocity=$4.5\times10^2ms^{-1}$,density=1.29 kg m^{-3} and specific heat at constant volume = 21 $Jmol^{-1}K^{-1}$.

14) The critical pressure, temperature and volume of the gas are $1.316\times10^{11}Nm^{-1}$, 33.1K and $6.56\times10^{-5}m^3$ per mole respectively calculate the van der Waals constants of the gas.

15) A Carnot engine with low temperature reservoir at 7^0C has an efficiency of 45%.By how much should the temperature of the high temperature reservoir be changed to increase the efficiency to 70%.

16) Determine the change in entropy when 1Kg of water is heated from 20^0C to 95^0C.Given specific heat of water $=4.2\times10^3J\ kg^{-1}K^{-1}$.

PART C

III. Answer any Five of the following $5\times2=10$

17 a) It is easier to roll than to pull a barrel along a road. Explain.
b) A player lowers his hands while catching a hard cricket ball. Justify
c) Is the collision between two rubber balls elastic? Explain.
d) The temperature of a black body is 6000K and emits radiation of wavelength $5500A^0$ .If its temperature is 5500K, how would the wavelength vary?
e) Two different gases are at the same temperature .Does it imply that the molecules have the same rms velocity? Explain.

f) C_p greater than C_v .Justify.

g) The efficiency of a Carnot's engine cannot be greater than one. Why?

h) Which of the two has lower entropy - 1kg of ice or 1Kg of water ? Explain.

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I SEMESTER B.Sc. MODEL PAPER

(2016 – 17 and onwards)

PHYSICS (Paper –I : 101)

MECHANICS – 1, Heat and THERMODYNAMICS – 1

Time : 3 hours Max. Marks : 70

Instructions : Answer 5 questions from Part – A, 5 questions from Part – B and 5 questions from Part – C

PART – A

I. Answer any FIVE of the following. Each question carries Eight marks. $(5 \times 8 = 40)$

1. a. Define drag force and terminal velocity. Obtain an expression for instantaneous velocity and instantaneous position of a body falling freely under gravity where resistance varies directly as the velocity of the body.
   b. Distinguish between static friction and kinetic friction. (2 + 4 + 2)

2. a. Obtain expressions for radial and transverse components of velocity and acceleration of a particle moving in a plane.
   b. Show that the areal velocity of a planet is a constant (6 + 2)

3. a. State and explain work – energy theorem. Hence deduce an expression for work done by a variable force.
   b. What are conservative forces? Show that the work done by conservative forces are path independent. (5 + 3)

4. (a) Show that the linear momentum of a system of particles is equal to the linear momentum of the centre of mass of the system.
   (b) Deduce Wien's displacement law and Rayleigh-Jeans law from Planck's law. (4 + 4)

5. a. Using a suitable graph, explain the Maxwell's law of distribution of molecular velocities in a gas at different temperature.
   b. Obtain an expression for the coefficient of thermal conductivity K of a gas in terms of the mean free path of its molecule. (4 + 4)

6. a. Compare and contrast Andrew's and van der Waals isotherms.
   b. Derive the expressions for critical constants Pc, Vc and Tc in terms of the van der Waals constants *a and b.* (3 + 5)

7. a. Show that work done in a thermodynamic process is equal to the area under a PV diagram.
   b. Obtain an expression for work done in an isothermal process

[4 + 4]

8. (a) Obtain an expression for change of entropy during the free expansion of an ideal gas.
   (b) Show that the entropy remains constant in a cyclic process

[4 + 4]

PART B

II. Answer any **FIVE** of the following. Each question carries **FOUR** marks. $(5 \times 4 = 20)$

9. A sphere of 0.02 kg falls through a resistive medium under the action of gravity. If the drag coefficient is 0.5, calculate the terminal velocity when the resistive force is proportional to the square of velocity

10. An asteroid of mass 2×10^{-4} times the mass of earth revolves in a circular orbit around the Sun at a distance that is twice Earth's distance from the Sun. (a) Calculate the period of revolution of the asteroid in years. (b) What is the kinetic energy of the asteroid revolving about the Sun?

11. The mass of the Moon is 1.2% of the mass of the earth, The distance between the centre of the earth and the Moon is 386.4×10^6 m. Find the centre of mass of the Earth-Moon system.

12. A cavity at 6000K has an energy distribution corresponding to a black body. Calculate the total power radiated through a hole of 1mm diameter made through the black body.

13. If the rms velocity of hydrogen molecule at NTP is 1.84 kms^{-1}, find the rms velocity of oxygen molecule at NTP. Molecular weights of hydrogen and oxygen are 2 and 32 respectively.

14. For a gas, critical pressure is 12.8 atm. And critical volume for a mole is 70×10^{-6} m^3. Calculate the van der waals constants and the critical temperature.

15. A cylinder of ideal gas is closed by an 8 kg moveable piston of area 60 cm^2. The atmospheric pressure is 100 kPa. When the gas is heated from 30°C *to* 100°C the piston rises 20 cm. The piston is then fastened in the place and the gas is cooled to 30°C. If ΔQ_1 is the heat added to the gas during heating and ΔQ_2 is the heat lost during cooling, find the difference.

16. Consider a system of water that consists of two parts: 1 kg initially at 90°C and another 1.5 kg initially at 10°C. Suppose the two are mixed together in an insulated container and come to equilibrium. Calculate the change in entropy of the system. $(Given: C_P = 4200\, J\, kg^{-1}K^{-1})$

PART C

III. Answer any **FIVE** of the following. Each question carries **TWO** marks. $(5 \times 2 = 10)$

a. Is a large brake on a bicycle more effective than a small one?
b. A satellite does not need fuel to circle around the earth. Why?
c. A car and a bus moving with the same linear momentum are brought to rest by applying equal retarding forces. Which body comes to rest in a shorter distance?
d. Earth is constantly receiving heat radiation from the Sun, yet it does not become as hot as the Sun. Explain
e. At very low pressures the viscosity of a gas is directly proportional to the pressure. Explain
f. What is the essential reason for the isotherms of real gases to deviate from 'ideal' gas behaviour below its critical temperature?
g. For an ideal gas, an adiabatic expansion curve is always steeper than the isothermal curve in a PV diagram for the same change in pressure and volume. Explain.
h. An ideal gas undergoes an isothermal expansion at 77°C increasing its volume from 1.3 L to 3.4 L. The entropy change of the gas is 24 J K^{-1}. How many moles of the gas are present?

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BANGALORE UNIVERSITY PHYSICS TEACHERS' FORUM

I SEMESTER B.Sc. MODEL PAPER

(2016 – 17 and onwards)

PHYSICS (Paper –I : 101)

MECHANICS – 1, Heat and THERMODYNAMICS – 1

Time : 3 hours **Max. Marks : 70**

Instructions : Answer 5 questions from Part – A, 5 questions from Part – B and 5 questions from Part – C

PART – A

I. Answer any FIVE of the following. Each question carries Eight marks. $(5 \times 8 = 40)$

1. (a) Obtain an expression for acceleration of a body sliding down a rough inclined plane.
   (b) Using free body diagram, obtain expressions for acceleration of masses and the contact force acting between two bodies in contact
   (5 + 3)
2. (a) Obtain an expression for the gravitational potential at a point outside a solid sphere
   (b) Arrive at the expression for instantaneous velocity of a body falling through a resistive medium under the action of gravity. Assume that the resistive force to vary directly as square of velocity of the body.
   (4 + 4)
3. (a) Distinguish between conservative and non – conservative forces.
   (b) Derive an expression for the velocity of a rocket using free diagram (4 + 4)
4. (a) Mention the assumptions of Planck's theory of radiation
   (b) Derive the expression for energy density in terms of frequency
   (2+6)
5. Derive the kinetic equation $pV = \frac{1}{3} mnc^2$
6. Obtain the correction for Volume and pressure in the ideal gas equation to arrive at the van der waals equation of state for a real gas. How would you justify the correction?
7. (a) Show that thermodynamic work done is a path dependent function.
   (b) Show that the Kelvin – Planck and the Clausius statements of second law of thermodynamics are equivalent.
   (4 + 4)

8. (a) Explain using a PV diagram the practical four – stroke Otto cycle. Mention the expression for its efficiency.

   (b) Show that the entropy is a measure of unavailability of energy in a system

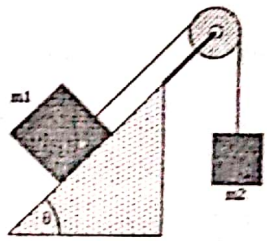
(5 + 3)

PART B

II. Answer any **FIVE** of the following. Each question carries **FOUR** marks. $(5 \times 4 = 20)$

9. What is the velocity of a sphere falling in a resistive medium under gravity at a time of 8 ms, if its terminal velocity is 0.05 ms^{-1} assuming the force to be proportional to velocity? The time constant is 1.61 s.

10. Two blocks are connected over a massless pulley as shown. The mass of block 1 is 10 kg and the coefficient of kinetic friction is 0.2. Block A slides down the incline at constant speed. Find the mass of block 2. $(\theta = .30^0)$



11. To push a 25 kg crate up a 27^0 incline, a worker exerts a force of 120 N, parallel to the incline. As the crate slides 3.6 m, how much work is done on the crate by (a) the worker, (b) the force of gravity, and (c) the normal force on the incline?

12. Centre of mass of three bodies 10 g, 20 g and 25 g is at $(1, -2, 1)$. Where should another 30 g body be placed such that the c.m is at (1,1,1).

13. The mean kinetic energy of a molecule in hydrogen gas at 0^0C is 5.62×10^{-21} J. The molar gas constant is 8.31 J K^{-1} mol^{-1}. Calculate the Avogadro number.

14. The viscosity of nitrogen at 27^0C is $\eta = 1.7 \times 10^{-5} Nsm^{-2}$. Calculate the diameter of the molecule of the gas given $k = 1.38 \times 10^{-23} JK^{-1}, n = 6.023 \times 10^{23} mol^{-1}$ and the molecular weight is 28.

15. During an isobaric process the work done by the oxygen gas is 5 J. Calculate the amount of heat transferred to the gas. ($\gamma = 1.4$).

16. A Carnot's engine working as a refrigerator between 350 K and 250 K received 2000J of heat from the reservoir at lower temperature. Calculate the amount of heat rejected to the reservoir at higher temperature and also the work done in each cycle.

BANGALORE UNIVERSITY PHYSICS TEACHERS' FORUM

PART C

III. Answer any **FIVE** of the following. Each question carries **TWO** marks. $(5 \times 2 = 10)$

a. A skydiver is falling at his terminal speed. Immediately after he opens his parachute, what happens to the speed?

b. Can you stop a car on a frictionless horizontal road by applying brakes? Explain

c. A car is moving on a straight smooth level horizontal surface at a constant velocity. What is the work done? Justify

d. A projectile is fired into the air and suddenly explodes into several fragments. What is the path followed of the centre of mass of the fragments in absence of air resistance? Explain.

e. Why does the coefficient of viscosity of a gas increase more rapidly than $\sqrt{T}$ at very high temperatures?

f. No gas appears to obey van der Waals equation of state near the critical point. Justify the statement.

g. How is the work done in an adiabatic process related to the internal energy? Explain.

h. A mass of gas is first expanded isothermally and then compressed adiabatically to its original volume. What single process is required to restore the system to its original state? Explain

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I SEM B.Sc. PHYSICS (101)
(New Syllabus effective from the academic year 2016 – 17)
Model Paper

Time : 3 hours Max. Marks : 70

Part A

I. Answer any FIVE of the following 5 x 8 = 40

1. a. Define drag force and terminal velocity. Obtain an expression for instantaneous velocity and instantaneous position of a body falling freely under gravity where resistance varies directly as the velocity of the body.
   b. Distinguish between static friction and kinetic friction. (6 + 2)

2. a. Obtain expressions for radial and transverse velocity and acceleration of a particle moving in a plane.
   b. State Kepler's laws of planetary motion (5 + 3)

3. a. Give the relation between conservative force and potential energy difference. Hence, derive an expression for the potential energy of spring when it is stretched through a distance x from the un-stretched condition($x = 0$).
   b. Derive Newton's second law of motion for a system of particles. (4 + 4)

4. Derive Planck's law of radiation and hence deduce Wien's Law & Rayleigh – Jeans Law.

5. a. Obtain the expression for the pressure exerted by a gas on the basis of kinetic theory.
   b. State the law of equipartition of energy. (6 + 2)

6. a. Describe with a diagram Andrews experiments on Carbon dioxide
   b. What are the critical constants of a gas? Name them. (6 + 2)

7. a. Derive the relation between the pressure and volume of a gas undergoing an adiabatic process.
   b. Explain why the adiabatic PV curve is steeper than the isothermal curve. (6 + 2)

8. a. Explain with a diagram the working of a Carnot's engine.
   b. State the second law of thermodynamics in terms of entropy. (6 + 2)

BANGALORE UNIVERSITY PHYSICS TEACHERS' FORUM

PART B

II. Answer any FIVE of the following. $5 \times 4 = 20$

9. Two blocks are connected by a cord of negligible mass that passes over a frictionless pulley. One block has mass 1.30 kg and the other 2.5 kg. Using free body diagram calculate the (i) magnitude of acceleration of the blocks and (ii) tension in the cord.

10. A space transportation vehicle releases a 470 kg communications satellite while in an orbit 280 km above the surface of the Earth. A rocket engine on the satellite boosts it into a geosynchronous orbit. How much energy does the engine have to provide? (Assume the height of geosynchronous satellite to be 36,000 km above the surface of Earth)

11. Two particles of masses 5 kg and 10 kg have position vectors $(3i + 2j - k)$ and $(i - j + 3k)$ respectively. Calculate the position vector and the distance of centre of mass from the origin.

12. A body of mass 1 kg initially at rest explodes into 3 pieces of masses in the ratio 1:1:3. Two pieces of equal masses fly off perpendicular to each other with a speed of 30 ms^{-1}. Find the velocity of the heavier mass.

13. Calculate the mean free path of oxygen molecules at STP given their diameter is 3×10^{-10} m.

14. The critical temperature, pressure 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 the Van der Waals' constants of the gas.

15. Two moles of an ideal gas at 27^0 C expands adiabatically till the volume is doubled. Calculate the resulting temperature and the work done by the gas.

16. Efficiency of a Carnot engine changes from 1/6 to 1/3 when the source temperature is increased by 100 K. Find the temperature of the sink.

PART C

17. Answer any FIVE of the following. **5 x 2 = 10**

a. If a car collides head on with a massive truck, which vehicle experiences the (a) greater force (b) greater acceleration?

b. A comet moves in an elliptical orbit around the sun. Which point in its orbit represents the highest value of (a) speed of the comet (b) total energy of the sun-comet system?

c. Bullet 2 has twice the mass of bullet 1. Both are fired so that they have the same speed. If the kinetic energy of bullet 1 is K then what is the kinetic energy of bullet 2?

d. Why are the outer walls of a thermos flask made shining?

e. Why is C_P greater than C_V? Explain.

f. Explain why the coefficient of viscosity of a gas is independent of pressure.

g. Will the internal energy change when an ideal gas is compressed isothermally? Explain.

h. What is the change in entropy in a reversible process? Explain.

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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 $\mathring{A}$, 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.

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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

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+

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 × 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.

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 ?

61221

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

(CBCS Scheme – Freshers + Repeaters – 2016-17 and onwards)

Physics

Paper 201 – MECHANICS – 2, HEAT AND THERMODYNAMICS – 2

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

Instructions to Candidates : Answer any five questions from each Part.

PART – A

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

1. (a) What is simple harmonic motion? Give an example.

(b) Obtain an expression for the velocity of a body executing SHM. **(2 + 6)**

2. What is a cantiliver? Obtain an expression for the depression at the free end of thin light beam clamped horizontally at one end and loaded at the other end. **(8)**

3. (a) What is meant by Helmholtz free energy?

(b) Deduce the following Maxwell's relations. **(2 + 6)**

(i) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(ii) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$

4. (a) What is meant by triple point of water?

(b) Deduce Clausius-Clapeyron's Latent heat equation. What is the effect of pressure on boiling point of water? **(1 + 7)**

5. Show that under Galilean transformations, velocity is variant and acceleration is invariant. **(8)**

6. (a) Define :

(i) Proper length and

(ii) Proper time

(b) Deduce the mass energy relation according to the theory of relativity. **(2 + 6)**

7. (a) State and prove the perpendicular axes theorem.

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

8. (a) What are transverse and longitudinal wave motions? Give an example for each.

(b) Derive the relation between group velocity and phase velocity. **(4 + 4)**

PART – B

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

9. If the potential energy of a particle performing SHM is 2.5 J, when displacement is half of amplitude, find the total energy.

10. One end of a steel wire of length 0.25 m and radius 2×10^{-3} m is fixed. If the rigidity modulus of the steel is $8 \times 10^{10} Nm^{-2}$, find the work done in twisting the free end of the wire through 45°.

11. The Vander Waal's constants for hydrogen are

$a = 0.00247\ Nm^4 mole^{-2}$

$b = 2.65 \times 10^{-5} m^3 mole^{-1}$

Find :

(a) the temperature of inversion

(b) Joule -Thomson cooling for $5 \times 10^5 Nm^{-2}$ fall of pressure, initial temperature being 100 K.

Given R = 8.3 JK^{-1} $mole^{-1}$.

12. When lead is melted at atmospheric pressure (the melting point is 600 K) the density decreases from 11010 to 10650 kgm^{-3} and the latent heat of fusion is 24500 Jkg^{-1}. What is the melting point at a pressure of 200 atmosphere?

Given : 1 atmosphere = $10^5 Nm^{-2}$.

13. A rod stationary relative to the earth is found to be 20 m long by an observer on the earth. With what velocity should it move parallel to its length so that its apparent length relative to the observer is reduced to 5 m? Given $C = 3 \times 10^8 ms^{-1}$.

14. Find the fringe shift when effective length of earth arm is 25 m, Orbital velocity of earth about sun is $3 \times 10^4 ms^{-1}$ and wavelength of light used is 5000 Å. Given velocity of light is $3 \times 10^8 ms^{-1}$.

15. A circular disc of mass 1 kg and radius 0.2 m is making 120 rpm about its diameter. Calculate the moment of inertia and energy.

16. The equation of a progressive wave is $y = 20 \sin(100 \pi t - 0.08 \pi x)$ cm. Find the amplitude, frequency, wavelength and velocity of the wave.

PART – C

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

17. (a) Is the motion of a simple pendulum strictly simple harmonic? Explain.

(b) A spring is made of steel and not of copper. Justify.

(c) Does the internal energy of an ideal gas depend on mass of the gas? Explain.

(d) Why the boiling point of water is less than 100° C in the laboratories?

(e) Is Earth an inertial frame? Explain.

(f) Is the moving clock moves slow or fast? Explain.

(g) How a swimmer jumping from a height is able to increase the number of loops made in the air?

(h) Can sound waves be polarised? Explain.

NS – 286

III Semester B.Sc. Examination, November/December 2016
(CBCS/NS) (2012-13 & Onwards) (Freshers & Repeaters)
Physics – III
ELECTRICITY & 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) a) Write an expression for electric field at a point due to a short dipole. Hence find the electric field at a point on the equatorial line of the dipole.

b) State Thevenin's theorem. With a suitable network of resistances, explain the determination of Thevenin voltage and Thevenin resistance. **(3+5)**

2) a) Explain the theory of working of a moving coil ballistic galvanometer.

b) Mention the conditions for a ballistic galvanometer to be dead beat. **(5+3)**

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

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

4) a) Write the expression for magnetic field at a point due to an infinitely long straight conductor carrying current. State the Maxwell's cork screw rule to find the direction of the magnetic field.

b) Obtain an expression for force between two long straight parallel conductors separated by a small distance. Hence, define Ampere. What is the nature of the force between the conductors when they carry currents in same direction and in opposite direction ? **(2+6)**

P.T.O.

5) a) Derive an expression for growth of charge in an RC circuit. Represent graphically the variation of charge with time. Define time constant of RC circuit.

b) Mention the conditions to start or stop oscillations in a series LCR circuit. (6+2)

6) a) Obtain an expression for velocity of electromagnetic waves in free space using Maxwell's field equations.

b) Mention the factors on which the refractive index of a material medium depend. (6+2)

7) a) Obtain an expression for impedance of series LCR circuit using phasor diagram. Also obtain an expression for the phase difference between voltage and current.

b) What is resonance of series LCR circuit ? Mention the condition for resonance and write the expression for frequency at resonance. (5+3)

8) a) State the laws of thermoelectricity.

b) Describe the determination of Thomson coefficient using thermoelectric diagram. (4+4)

PART – B

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

9) Two point charges of $+2\mu c$ and $-2\ \mu c$ are placed at the two corners of an equilateral triangle of side 20 cm. Find the direction and magnitude of the electric field at the third corner.

10) A capacitor of capacitance $10\mu F$ is discharged through a high resistance. Time taken for one-third of the charge on the capacitor to leak is found to be 20 s. Calculate the value of the high resistance.

11) A Helmholtz tangent galvanometer has coils of radius 11 cm and 100 number of turns. Calculate the current through the coils which produces a deflection of 45°. ($B_H = 0.32\times10^{-4}$ T)

12) The magnetic flux linked with a coil of resistance 10Ω at any instant is given by $\phi = 6t^2 + 1.2t + 4$ where ϕ is in Wb and t in s. Find the magnitude of induced current at 0.4 s.

13) An inductance of 10 H and a resistance of 0.5 Ω are connected to a battery of emf 6 V. Calculate the time taken for the current to reach 6 A.

14) Evaluate the value of permittivity of free space from the standard value of speed of light in free space. ($c = 3\times10^8\ ms^{-1}$, $\mu_0 = 4\pi\times10^{-7}\ Hm^{-1}$).

15) A 60 V, 10 W lamp to be run on 100 V, 60 Hz ac mains. Calculate the inductance of the choke coil required.

16) Determine the neutral temperature and inversion temperature for a thermocouple in which emf is given by $e = -15\theta + 0.025\theta^2$ (μV). Cold junction is maintained at 0°C.

PART – C

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

a) Electric potential at a point due to a dipole is zero. Will electric intensity at that point be zero ? Explain.

b) A stationary electric charge of 10 nC is kept in a strong magnetic field of 40 T. What is the force on the charge ?

c) An aluminium bar falls much more slowly through a small region containing a magnetic field than a similar bar of an insulating material. Explain.

d) A conducting rod is moved with its length parallel to the magnetic field lines with a velocity v. What is the emf induced in the rod ?

e) The inductance of a series LR circuit is doubled. What happens to the time constant ?

f) If $\vec{A}$ is such that $\nabla.\vec{A} = 0$, then what is the vector field $\vec{A}$ called ? Why ?

g) A capacitor blocks dc but allows ac. Why ?

h) Why is Sb-Bi thermocouple preferred to Fe-Cu thermocouple ?

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)**

P.T.O.

7. a) Derive with a diagram an expression for self inductance of a coil using Maxwell's Bridge. 279

b) What is Q-factor ? Explain its significance. 266 (5+3)

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

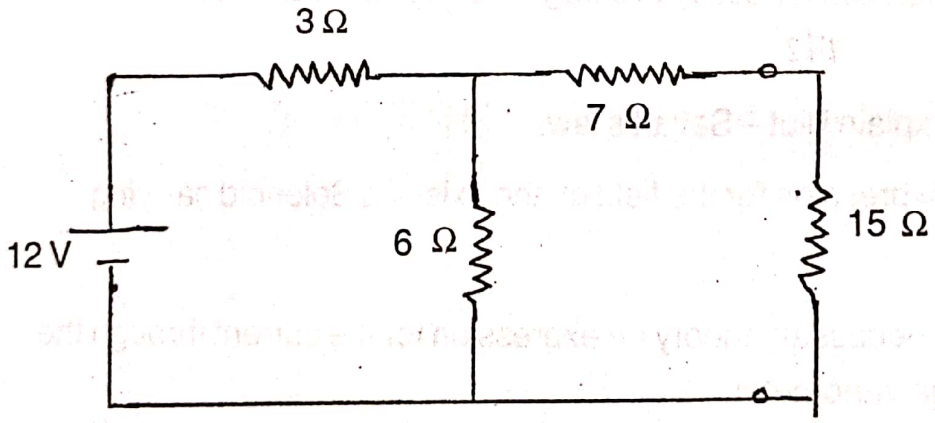
b) What is meant by Thermo electric diagrams ? Discuss in detail any two of its applications. 318 (2+6)

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.



$P = \frac{V_{Th}^2}{4R_{Th}}$

$V_{Th} = \frac{ER_3}{R_3 + R_1}$

$R_{Th} = R_2 + \frac{R_1 R_3}{R_1 + R_3}$

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. (5x2=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.

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.

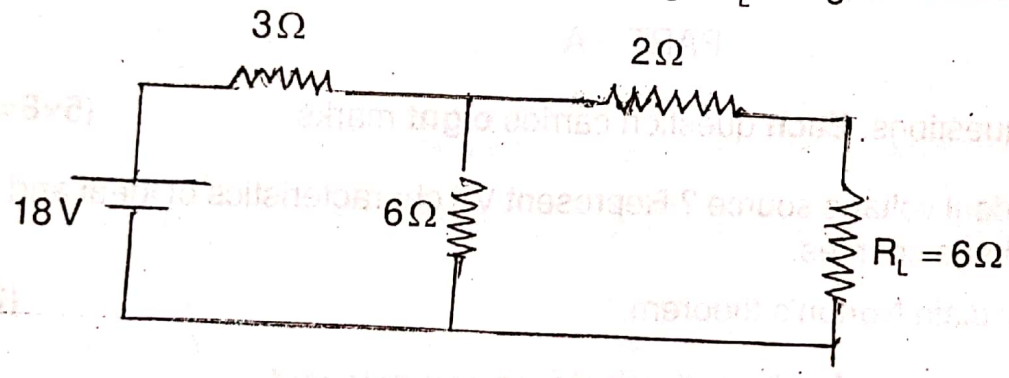
7. Derive expressions with diagram for impedance, current and phase angle of a series CR ac circuit by j operator method. 8

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.

61321

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

(CBCS - Freshers Scheme)

Physics

Paper 301 – ELECTRICITY AND MAGNETISM

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

Instructions to Candidates : Answer any ***FIVE*** *questions from each Part.*

PART – A

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

1. (a) What are ideal voltage and current sources?

   (b) State Thevenin's theorem. With a suitable network of resistances explain the determination of Thevenin's voltage and Thevenin's resistance. **(2 + 6)**

2. (a) Derive an expression for energy stored in an inductor.

   (b) Derive an expression for the decay of charge in a series CR circuit. **(3 + 5)**

3. Derive an expression for magnetic field at a point on the axis of a current carrying solenoid and hence show that field at one end of the solenoid of infinite length is half that at the centre. **(8)**

4. (a) Give the theory of moving coil ballistic galvanometer and hence obtain an expression for charge flowing through it.

   (b) Mention any three applications of ballistic galvanometer. **(5 + 3)**

5. (a) What is displacement current? Mention any two properties of displacement current.

   (b) Derive the Maxwell's equation $\nabla \cdot \vec{B} = 0$. What is its physical significance? **(3 + 5)**

6. (a) State and explain Poynting theorem.

   (b) Show that in an electromagnetic field energy is equally shared between electric and magnetic fields. **(6 + 2)**

7. (a) What is the condition for resonance of a series LCR circuit and hence obtain the expression for resonant frequency?

   (b) For a series resonant circuit, define (i) quality factor (ii) band width. Also write the expressions for them. **(4 + 4)**

8. (a) State the laws of thermoelectricity.

   (b) Applying the principle of thermodynamics arrive at the relation $\pi = T\left(\frac{dE}{dT}\right)$.

(4 + 4)

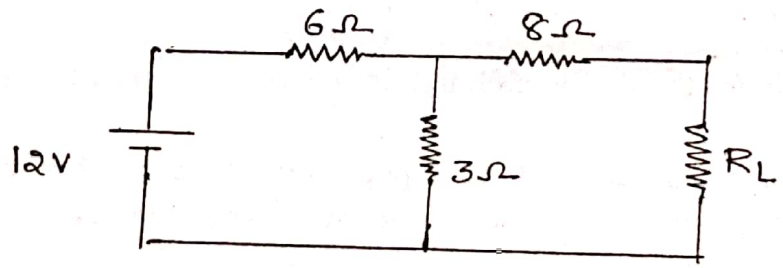
PART – B

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

(permeability of free space = $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$)

(permittivity of free space = $t_0 = 8.85 \times 10^{-12} Fm^{-1}$)

9. Find the value of R_L in the given network to obtain maximum power in it. Also find the maximum power.



10. In an LR circuit the current attains $\frac{1}{3}$rd of its final steady value in 1s after the circuit is closed. What is the time constant of the circuit?

11. An electron experiences greatest force as it travels $3.9 \times 10^5 ms^{-1}$ in a magnetic field when it is moving westwards. The force is upward and is of magnitude $8.2 \times 10^{-13} N$. What is the magnitude and direction of the magnetic field? (Given electron charge = $1.6 \times 10^{-19} C$)

12. A Helmholtz galvanometer has coils of circumference 0.49 m each and number of turns 50. Calculate the current through the coils which produces a deflection of 45^0 (Given $B_H = 0.38 \times 10^{-4} T$)

13. A plane wave travelling in a loss less medium has a wavelength of 0.25 m and its velocity of propagation is $1.5\times10^{8}ms^{-1}$. Find the frequency and permittivity of the medium.

14. An electromagnetic wave of frequency $1.6\times10^{6}Hz$ propagating in a conducting medium has the conductivity of $38.2\times10^{6}Sm^{-1}$, calculate the skin depth Given $\mu_r = 1$.

15. A condenser of capacitance $2\mu F$ is connected in series with a resistor to a 220 V, 50 Hz ac supply. If the potential difference across the condenser and resistor are equal in magnitude, calculate the resistance and phase current in the circuit.

16. The temperature of cold junction of a thermocouple is $0^{0}C$ and the temperature of the hot junction is $\theta^{0}C$. The thermo emf is given by $E=16\theta-0.040^{2}\mu v$. Find (a) neutral temperature (b) temperature of inversion.

PART – C

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

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

(b) An α-particle and a β-particle are projected with the same velocity perpendicular to the magnetic field. Do they experience the same force? Explain.

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

(d) In a ballistic galvanometer the leakage method is suitable to determine high resistance only. Why? Explain.

(e) What does the small value of quality factor indicate? Explain.

(f) Does the skin depth for a good conductor depend on the wave frequency? Explain.

(g) A series resonance circuit is called an acceptor circuit. Why? Explain.

(h) Does the thermo electric effect obey the law of conservation of energy? Explain.

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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 ?

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.

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 $2 \times 10^{23}\ m^{-3}$

15. Calculate the drift velocity of free electrons in a metal of area of cross section $2 \times 10^{-4}\ m^2$ in which a current of 100 A is flowing. The density of free electrons in a metal is $7.23 \times 10^{28}\ m^{-3}$.

16. For a transistor amplifier in CE – mode, $R_S = R_L = 1\ K\Omega$, $h_{ie} = 1.1K\Omega$, $h_{re} = 2.5 \times 10^{-4}$, $h_{fe} = 50$ 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.

SS – 322

V Semester B.Sc. Examination, November/December 2018
(CBCS) (Fresh) (2018 – 19 and Onwards)
PHYSICS – VI
Astrophysics, Solid State Physics and Semiconductor Physics

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **five** questions from Part – **A**, **5** questions from Part – **B** and **5** questions from Part – **C**.*

PART – A

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

1. a) Define apparent magnitude and absolute magnitude of a star. Hence obtain the distance modulus expression.

   b) Obtain an expression for core temperature of a star. **(4+4)**

2. a) Write a note on Yerke's luminosity classification of stars.

   b) Obtain an expression for core pressure of a star on the basis of Linear density model. **(3+5)**

3. a) State and explain Moseley's law. Mention any two applications of Moseley's law.

   b) Distinguish between the continuous and characteristic X-ray spectra. **(4+4)**

4. a) State Wiedmann-Franz law.

   b) Derive an expression for electrical conductivity of a metal based on free electron theory. **(2+6)**

5. a) Define Hall Voltage. Derive an expression for Hall coefficient in the case of metals.

   b) What is meant by critical magnetic field in superconductivity ? Explain its temperature dependence. **(5+3)**

6. a) Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids.

   b) Describe a Zener diode as a voltage regulator and explain its load regulation. (4+4)

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

8. a) With neat diagram explain the working of an NPN transistor in CE-mode, as an amplifier.

   b) Mention the h-parameters of the transistor. (6+2)

PART – B

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

$G = 6.67 \times 10^{-11}\ Nm^2Kg^{-2}$; $M_\odot = 2 \times 10^{30}$ Kg; $R_\odot = 7 \times 10^8$ m, $T_\odot = 6000K$; $C = 3 \times 10^8\ ms^{-1}$.

9. Suppose the sun shrank from its present size so that its radius is halved. What would be the change in its gravitational potential energy ?

   Given : The mass of the sun ($M_\odot$);

   Radius of the sun ($R_\odot$).

10. The luminosity of a star is 10^4 times that of sun and its surface temperature is 2000 K. How much larger is the radius of the star compared to that of the sun ?

    Given : Surface temperature of the sun ($T_\odot$);

    Solar radius ($R_\odot$).

    Calculate the radius of the star.

11. Calculate the Schwarzschild's radius of a black hole of mass $20 \times 10^6\ M_\odot$.

    Given : Gravitational constant (G);

    Mass of the sun ($M_\odot$); Velocity of light (C).

12. Find the Miller indices of a set of parallel planes which make intercepts in the ratio 3a:4b, parallel to Z-axis. Also calculate the interplanar spacing of the planes taking the lattice to be cubic with a = 2 Å.

13. X-rays of wavelength 0.3 Å undergo a 60° compton scattering. Find the wavelength of the photon after scattering.

14. Assuming one free electron per atom, estimate the Fermi energy for copper.

    Given : The density of copper = 8.95×10^3 Kg/m^3.

    Atomic mass = 0.0635 Kg/mole.

15. Mobilities of electrons and holes in a sample of intrinsic germanium at 300 K are 0.36 $m^2v^{-1}s^{-1}$ and 0.17 $m^2v^{-1}s^{-1}$ respectively. If the resistivity of the specimen is 2.12 Ω m. Calculate the carrier concentration in intrinsic semiconductor.

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. **Each** question carries **two** marks. **(5×2=10)**

a. The brightness of a star is not a good indicator of its distance. Why ?

b. A massive star is more luminous than a less massive star. Why ?

c. Can a black hole be seen ? Explain.

d. Does electrical conductivity of a semiconductor depend on its temperature ? Explain.

e. Why ordinary light can not be used for crystal diffraction ? Explain.

f. Are there holes in the n-type semiconductor ? Explain.

g. Are the energy levels completely filled below Fermi-level at absolute zero ? Explain.

h. Why are hybrid parameters called so ?

SS – 322

V Semester B.Sc. Examination, November/December 2018
(CBCS) (Fresh) (2018 – 19 and Onwards)
PHYSICS – VI
Astrophysics, Solid State Physics and Semiconductor Physics

Time : 3 Hours Max. Marks : 70

Instruction : *Answer **five** questions from Part – **A**, **5** questions from Part – **B** and **5** questions from Part – **C**.*

PART – A

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

1. a) Define apparent magnitude and absolute magnitude of a star. Hence obtain the distance modulus expression.

   b) Obtain an expression for core temperature of a star. **(4+4)**

2. a) Write a note on Yerke's luminosity classification of stars.

   b) Obtain an expression for core pressure of a star on the basis of Linear density model. **(3+5)**

3. a) State and explain Moseley's law. Mention any two applications of Moseley's law.

   b) Distinguish between the continuous and characteristic X-ray spectra. **(4+4)**

4. a) State Wiedmann-Franz law.

   b) Derive an expression for electrical conductivity of a metal based on free electron theory. **(2+6)**

5. a) Define Hall Voltage. Derive an expression for Hall coefficient in the case of metals.

   b) What is meant by critical magnetic field in superconductivity ? Explain its temperature dependence. **(5+3)**

P.T.O.

6. a) Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids.

   b) Describe a Zener diode as a voltage regulator and explain its load regulation. **(4+4)**

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

8. a) With neat diagram explain the working of an NPN transistor in CE-mode, as an amplifier.

   b) Mention the h-parameters of the transistor. **(6+2)**

PART – B

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

$G = 6.67 \times 10^{-11}\ Nm^2Kg^{-2}$; $M_\odot = 2 \times 10^{30}$ Kg; $R_\odot = 7 \times 10^8$ m, $T_\odot = 6000K$; $C = 3 \times 10^8\ ms^{-1}$.

9. Suppose the sun shrank from its present size so that its radius is halved. What would be the change in its gravitational potential energy ?

   Given : The mass of the sun ($M_\odot$);

   Radius of the sun ($R_\odot$).

10. The luminosity of a star is 10^4 times that of sun and its surface temperature is 2000 K. How much larger is the radius of the star compared to that of the sun ?

    Given : Surface temperature of the sun ($T_\odot$);

    Solar radius ($R_\odot$).

    Calculate the radius of the star.

11. Calculate the Schwarzschild's radius of a black hole of mass $20 \times 10^6\ M_\odot$.

    Given : Gravitational constant (G);

    Mass of the sun ($M_\odot$); Velocity of light (C).

12. Find the Miller indices of a set of parallel planes which make intercepts in the ratio 3a:4b, parallel to Z-axis. Also calculate the interplanar spacing of the planes taking the lattice to be cubic with a = 2 Å.

13. X-rays of wavelength 0.3 Å undergo a 60° compton scattering. Find the wavelength of the photon after scattering.

14. Assuming one free electron per atom, estimate the Fermi energy for copper.

    Given : The density of copper = 8.95×10^3 Kg/m^3.

    Atomic mass = 0.0635 Kg/mole.

15. Mobilities of electrons and holes in a sample of intrinsic germanium at 300 K are 0.36 $m^2v^{-1}s^{-1}$ and 0.17 $m^2v^{-1}s^{-1}$ respectively. If the resistivity of the specimen is 2.12 Ω m. Calculate the carrier concentration in intrinsic semiconductor.

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. **Each** question carries **two** marks. **(5×2=10)**

a. The brightness of a star is not a good indicator of its distance. Why ?

b. A massive star is more luminous than a less massive star. Why ?

c. Can a black hole be seen ? Explain.

d. Does electrical conductivity of a semiconductor depend on its temperature ? Explain.

e. Why ordinary light can not be used for crystal diffraction ? Explain.

f. Are there holes in the n-type semiconductor ? Explain.

g. Are the energy levels completely filled below Fermi-level at absolute zero ? Explain.

h. Why are hybrid parameters called so ?

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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

Max. Marks : 70

Time : 3 Hours

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 $L_\odot$ 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 $(L_\odot)$ 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 $(M_\odot) = 5$. **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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SM – 351

VI Semester B.Sc. Examination, May/June 2018
(F + R)
(CBCS – 2016 – 17 & Onwards/NS – Repeaters – 2013 – 14 & Onwards)
PHYSICS – VIII
Atmospheric Physics, Electronics and Computational 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) What is a ozone layer ? Mention any two applications of ozone layer.
   b) Obtain an expression for the variation of pressure with height. Give its graphical representation. **(3+5)**

2. a) Explain the emission curves of sun and Earth's atmosphere.
   b) Explain the terms 'reflectivity' and 'transmittivity'. **(4+4)**

3. a) Derive an expression for centrifugal force on a rotating frame of reference, assuming $\left.\frac{dr}{dt}\right|_{fixed} = \left.\frac{dr}{dt}\right|_{rot} + (\omega \times r)$ where ω is the angular velocity.
   b) Write a note on cyclones. **(5+3)**

4. a) What are the limitations of IC technology ?
   b) With a neat circuit diagram obtain an expression for the voltage gain of the non-inverting operational amplifier. **(2+6)**

5. With a circuit diagram explain the working of Wein-Bridge oscillator. Write expression for its frequency of oscillation. Mention the advantages of this oscillator. **8**

6. a) Write the logic symbol, boolean expression and truth table of a NOT gate.
   b) What is a half-adder ? Explain the working of a half-adder with a logic diagram and its truth table. **(3+5)**

P.T.O.

7. Write a C-program to find the roots of a quadratic equation $x^2 + bx + c = 0$. 8

8. Write the algorithm and C-program to solve a differential equation using 2nd order Runge-Kutta method. 8

PART – B

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

9. The saturation vapour pressure at –10°C is 2.88 mb at a place with atmospheric pressure of 1000 mb.
   a) The vapour pressure was measured to be 0.72 mb. What is the relative humidity of that place ?
   b) When the relative humidity becomes 75%, what is the vapour pressure at the same temperature and pressure ?

10. The flux density of solar radiation reaching the earth, F_s is 1368 Wm^{-2}. The distance between earth and sun is 1.5×10^{11} m. If the radius of the sun is 7×10^{8}m. Calculate the equivalent black body temperature of the outer surface of the sun. Given $\sigma = 5.67\times10^{-8}$ $Wm^{-2}K^{-4}$.

11. At a certain station, the horizontal gradient of the sea level pressure is 550 Pa per 100 km. Find the pressure gradient per unit mass. Given that the density of air is 1.23 kgm^{-3}.

12. Calculate the output voltage of a three input inverting summing amplifier. Given : $R_1 = 200\ K\Omega$, $R_2 = 250\ K\Omega$, $R_3 = 500\ K\Omega$, $R_f = 1000\ K\Omega$, $V_1 = -2V$, $V_2 = 2V$, $V_3 = 2V$.

13. An RC phase shift oscillator has each capacitor of capacitance 0.0047 μF and resistors of resistance 10 KΩ in the phase shift network. Calculate the frequency of oscillations.

14. Convert the following numbers from decimal to octal
   a) 298 and b) 793.

15. Use the bisection method to solve $y = e^x - 3x$ with initial values 0.62000 and 0.60000.

16. Using Euler's method, obtain the solution of $y' = x - y$ with $y(0) = 1$; at $x = 0(0.2)0.6$.

PART – C

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

a) Does the temperature of troposphere change with height ? Explain.

b) Does the presence of water vapour influence density of air ? Explain.

c) The ionosphere is called a "radio-mirror". Justify.

d) What is a nibble and byte ?

e) What is the difference between monolithic IC and hybrid IC ?

f) An AND gate output will always differ from an OR gate output for the same input conditions. Justify.

g) What are arrays ? Explain.

h) Is bisection method convergent ? Explain.

GS 300

VI SEMESTER B.Sc EXAMINATION, MAY/JUN - 2019

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GS-300

VI Semester B.Sc. Examination, May/June - 2019

PHYSICS - VIII

Electronics Magnetic Materials, Dielectrics & Quantum Mechanics-III

(FRESH) (CBCS) (2018-19 & Onwards)

Time : 3 Hours Max. Marks : 70

Instruction : Answer **all** Parts.

PART - A

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

1. (a) Explain the concept of virtual ground of an operational amplifier. **3+5**

(b) Derive an expression for voltage gain of a non inverting amplifier using op-amp.

2. (a) State Barkhausen criterion for sustained oscillations. **2+6**

(b) Explain with a circuit diagram working of a phase shift oscillator. Write the expression for its frequency of oscillation.

3. (a) State De Morgan's theorems. **2+6**

(b) What is a full adder ? Draw the logic diagram of full adder using two half adders and write its truth table.

4. (a) Explain the weiss domain theory of Ferromagnetism. **4+4**

(b) Distinguish between hard and soft magnetic materials.

5. What is a Lorentz field ? Derive the expression for Lorentz field. **8**

6. (a) What is meant by Normalisation of a wavefunction ? **2+6**

(b) Solve Schrodinger time independent equation for a free particle in one dimension and show that the momentum of the particle is precisely defined.

7. Set up Schrodinger equation for a particle in one dimensional box and solve it to obtain the eigen values. Represent the first three wave functions graphically. **8**

P.T.O.

8. (a) Write Schrodinger equation for a linear harmonic oscillator. **2+3+3**

(b) What is a rigid rotator ? Write expression for energy of a rigid rotator.

(c) What is a quantum mechanical operator ? Write quantum mechanical operators for energy and momentum.

PART - B

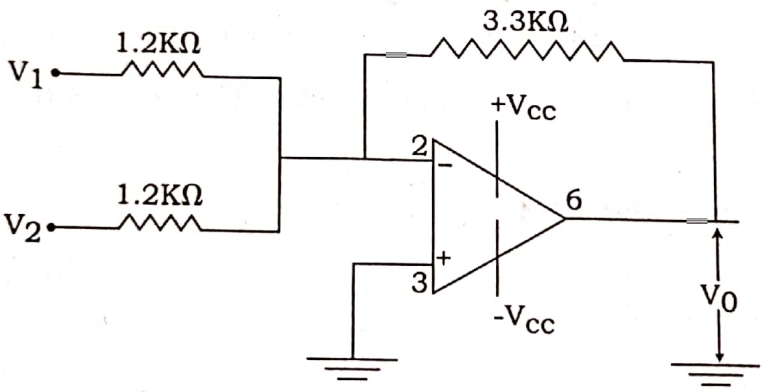
Solve **any five** problems. Each problem carries **four** marks. **5x4=20**

[$\epsilon_0 = 8.85 \times 10^{-12}$ Fm^{-1}; $\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}

mass of electron $= 9.1 \times 10^{-31}$ kg; $h = 6.625 \times 10^{-34}$ Js

mass of proton $= 1.67 \times 10^{-27}$ kg]

9. Find the output voltage in the given circuit if $V_1 = V_2 = 0.1V$



10. An amplifier has a gain of 800. When the feedback is applied, the gain is reduced to 150. Find the feedback fraction.

11. (a) Convert $(376)_8$ to binary number.

(b) Convert $(10110)_2$ to Gray code.

12. A paramagnetic material has magnetic field intensity of 10^4 Am^{-1}. If the susceptibility of the material at room temperature is 3.7×10^{-3}. Calculate the magnetisation and flux density of the material.

13. The dielectric constant of helium gas at NTP is 1.0000684. Calculate the electronic polarizability of atoms if the gas contains 2.7×10^{25} atoms per m^3.

14. The operator $\left(x + \frac{d}{dx}\right)$ has the eigen value λ, operating on a function.

Find the corresponding eigen function.

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15. Assuming the nucleus as a cubical box with a size of 10^{-14}m, calculate the lowest energy of a proton inside it.

16. The period of a linear harmonic oscillator is 1 milli second. Find its zero point energy in e.v.

PART - C

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

(a) Does the input resistance of op-amp decrease with negative feedback ? Explain.

(b) NAND gate is an universal gate. Explain.

(c) Is 8 an octal number ? Explain.

(d) Is BCD code a weighted code ? Explain.

(e) Is N_2 a polar dielectric ? Explain.

(f) It is easy to magnetise a soft magnetic material than a hard magnetic material. Why ?

(g) Is the ground state of a particle in three dimensional box degenerate ? Explain.

(h) $\psi = ax^2$ is not an acceptable wave function in quantum mechanics. Why ?