QUESTION BANK
PHYSICS (054) E

Question–1

Q.–1 A Answer the following very briefly **(5)**

1. Define Simple Harmonic Motion.
2. Write the formula of angular frequency of Damped Oscillation
3. Write the dimensional formula of Intensity of wave.
4. Find the distance between the consecutive nodes of the stationary wave given by $y = 10 \sin \left(\pi x/4\right) \cos 20 \pi t$.
5. If the linear velocity of a particle is made half times its original value, how much percent decrease will be there in its kinetic energy 3

B. Answer any three in brief : **(6)**

1. Derive the expression for the potential energy of a S.H.O. accepting the equation of then as F = – ky
2. Define forced oscillations. Obtain the differential equation of forced oscillations in the presence of damping forces.
3. Explain wave front by necessary diagrams.
4. Explain the interdependence of Newtons laws of motion

C. Work out any three. **(9)**

1. The frequency of a S.H.O. is 50 Hz. Its mass is 2 kg. At a certain instant its kinetic energy is 5 joule and potential energy is 4 joules
   Find its amplitude of oscillation.
2. The length of a string is 2m. The initial (fundamental) frequency is 652 Hz. In order to make its fundamental frequency 256 Hz, how much should be its length
3. A ball of mass m_1 moves along x^+ – axis with a velocity of U_1 and hits head – on with another ball of mass m_2 at rest. if it is one–dimensional elastic collision, find the velocities V_1 and V_2 of the balls after collision. (show that and $V_{1f} = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) V_{1i}$ and $V_2 f = \left(\frac{2m_1}{m_1 + m_2}\right) V_{1i}$)
4. A thief is running with a velocity of 16 km/hr. A policeman running after him with a velocity of 36 km/hr blows a whistle with a frequency of 640 Hz.
   Find the frequency of the whistle as heard by the thief. Velocity of sound in air is 330 m/sec.

Q.–2 (A) Answer the following question in short **(5)**

(1) A particle having initial phase $\frac{\pi}{6}$ radian exicutes S.H.M. What will be its phase after 15 oscillations ?

(2) What will be the value of frequency of motion, If $\frac{d^2y}{dt^2} + 81Y = 0$ is differential equation of S.H.M.

(3) Write a dimentional formula for intensity of a wave.

(4) What is reverberation ?

(5) Write the law of conservation linear momentum.

(B) Answer the following question (Any Three) **(6)**

(1) Obtain a formula of mechanical energy of an S.H. oscillator and show that is does not depend on displacement.

(2) Obtain an equation of one dimensional propagating wave travelling in a positive direction

(3) Define a centrer of the mass for system of the particals and using it obtain equation

$M\vec{V}cm = \vec{P}$

(4) What is Beats ? Prove that periodic time of amplitude of resultant oscillation

$T = \frac{2}{f_1 - f_2}$

(C) Compute the following example (any three) **(9)**

(1) An oscillalor has an initial displacement 8–cm and initial velocity is 16 cm/sec. If its angular frequency is 2 radian/sec then write an equation of S.H.M.

(2) Prove that motion represented by equation y = A sin wt + B cos wt is simple harmonie motion

(3) An interval between 2 frequencies of the sound is 21/20. If we can hear a beat 5 per second by the sound, then find frequency of each.

(4) A small uniform sphere having radius "a" is cut off from a big sphere having radius "R", then find a center of the mass of the rest part in the reference of center of main sphere.

(4) Prove that $\beta = \frac{\alpha}{1-\alpha}$

Q.–3 A. Answer in one line/word **[5]**

1. Phase difference between displacement and velocity of particle in SHM. is _____
2. Total energy of SHO is E when displacement is half of amplitude, its P.E is _____
3. Periodic time of SHO is 2 second Ratio of its maximum velocity to maximum acceleration is_____
4. By differentiating wave equation with respect to time wave velocity is obtained. Do you agree ?
5. A bomb falling vertically down with constant velocity suddenly explodes. Velocity of centre of mass would _____.

b. Answer in short (any–3) **{6)**

1. Write without deriving expression for displacement in SHM. Using differentiation obtain expression for velocity and acceleration.
2. Write only expression for differential equation for forced oscillation with damping. Obtain its solution in absence of damping.

3. Define wavelength, wave – velocity, wave number and wave equation.
4. Write Newton's 2nd Law of motion and hence obtain F = ma. What assumption is made in deriving this equation.

C Solve examples (any – 3) **[9]**

1. For damped oscillations find time for decrease of amplitude to $\frac{A}{2^n}$
2. When a person of mass 60 kg is standing on spring balance, it executes SHM with period of I sec. If amplitude of oscillations is O.I meter, find maximum and minimum weights of person recorded by balance ($\pi^2 = 10$, g = I0m/s^2)
3. A thief is running at speed of 9 Km/Hr. Policeman is chasing him with speed of 18 Km/Hr, and is also blowing whistle of frequency 1000 Hz. Calculate frequency heard by thief. Velocity of sound is 340 m/s.
4. A batsman hits ball of 150 gm mass, moving with speed of 12 m/sec. As a consequence, ball now moves in reverse direction at 20 met/sec. If force exerted by bat is 480 N, find duration of contact between bat and ball.

Q.–4 A Answer the following questions very briefly : **5**

1. What is resonance ?
2. Write the dimensional formula of impulse of force.
3. Two bodies of same mass are oscillating from two springs, one soft and the other hard. Which of the two springs will oscillate with lesser periodic time ?
4. Define anti–node in the case of a Stationary wave.
5. State Newton's law of conservation of linear momentum.

B Attempt ANY THREE of the following : **6**

1. Explain in geometrical representation of SHM.
2. Explain using a system of two particles, as an example, that only the external forces need to be taken into account in the expression $M\vec{a}_{cm} \vec{F}_1 + \vec{F}_2 + - - - + \vec{F}_n$. Hence explain the mutual dependence of Newton's laws of motion.
3. Write a short note on importance of good acoustics in a auditorium.
4. Define the terms : (i) Interval, (ii) Chord, (iii) Consonant interval and (iv) echo.

C. Solve ANY THREE of the following numerical problems : **9**

1. A stationary wave formed on a string of length 100 cm has a fundamental frequency of 196 Hz. If one wants a fundamental frequency of 40 Hz, what should be the length of the string ?
2. A ball of 6 kg mass hits a wall at an angle of 30^o and is then reflected making an angle of 120^o with its original direction. If the duration of the contact between the ball and the wall is I sec; calculate the force exerted on the wall. The initial and the final velocities of the ball is I m/s.
3. A lineman on a railway track sees two trains approaching him from opposite directions. The frequency of the whistles of both the trains is 433 Hz. The speeds of the trains are 54 km/hr and 36 km/hr respectively. Calculate the number of beats per second heard by the lineman, Velocity of the sound in air is 340 m/s.

4. A simple harmonic oscillator starts oscillating from its mean position in the upward direction (i.e. + y). Its period is 12 seconds. Find the earliest time at which its kinetic energy will be half of its mechanical energy.

Q.–5 A. Answer in very brief. **[5]**

(1) On attaching some weight to the end of spring and making it oscillate, its periodic time is found to be T. Now, on attaching its four times mass and making it oscillate, what will be its periodic time ?

(2) Define resonance

(3) Two sources A & B are sounding notes of frequency 680 Hz. A listner moves from A to B with a constant velocity u. If the speed of sound is 340 m/s what must be the value of u so that he hears 10 beats per sound ?

(4) A sound wave of frequency 1020 Hz falls normally on a perfectly reflecting wall. If the speed of sound in air is 340 m/s. the shortest distance from the wall at which the air particles have the maximum amplitude of vibration is _____ cm.

(5) The centre of mass of a system of two particles is on the line joing them at point whose distance from each particle is proportional to the mass of that particle. True or False ?

B. Answer any three in aboot 10 lines. **[6]**

(1) Show that angular speed of a reference particle is the angular frequency of the corresponding S.H.O.

(2) Classifying the waves write an illustration for each of them.

(3) Write the equation of a stationary wave and with proper explanation derive $\lambda_n = \frac{2L}{n}$ Write your conclusion from this equation.

(4) In the equation $M\vec{a}_{an} = \vec{F}_1 + \vec{F}_2 \ldots \vec{F}_n$ only external forces need to be taken into consideration.' explain with an example of the system of two particles.

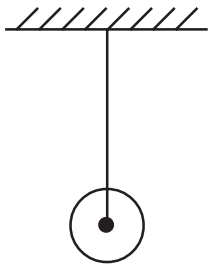
C. Solve any three **[9]**

(1) For damped oscillations, find the time for decrease of the amplitude of $A/2^n$.

(2) A simple harmonic osicllator starts Oscillating from its mean position in the upward direction (i. e. + y). It's period is 16 seconds Find the earliest time at which its kinetic energy will be half its mechanical energy.

(3) $f_1, f_2, \ldots f_n$ are the frequencies of a set of `n' forks. Any two consecutive forks of the set generate 6 beats per second. If the nth fork has frequency n times the first one, find the frequency of the first and (n – 1)th fork.

(4) A this rod of uniform cross section and length 5 m is suspended from a support as shown. At the other end of the rod a sphere of unform density is fixed in such a way that the other end of the rod is at the centre of the sphere. Find the centre of mass of the system with reference to the support point, if M_1 = 16 kg is the mass of the rod and M_2 = 9 kg is the mass of the sphere.



Q.–6 A Answer in short. **5**

(1) Write dimensional formula of damping co-efficient.

(2) The differential eqation of an oscillator is $\frac{d^2y}{dt^2} + 100\ y = 0$, then its periodic time.

(3) The intensity ration of two wave is 4:9, then what is their amplitude ratio ?

(4) Define node in case of stationary waves.

(5) Two particles have masses in the ratio 1:2 but have value of the momentum, then what is the ratio of their kinetic energies ?

B Answer any three of the following questions. **6**

(1) Obtain differential equation for simple harmonic motion defien S.H.M.

(2) What is resonance ? Write two example of the resonance.

(3) State the law of conservation of linear momentum. Explain it with a suitable example.

(4) Write short note on centre of mass of a rigid body.

C Attempt any three of the following problems. **9**

(1) An oscillator having a mass of 100 gm is executing damped oscillation. After 100 oscillations the amplitud reduces to half its original value. Find the damping co-efficient if its period is 2 sec.

(2) Interval between two sound freguencies is 21/20. If they generate 5 beats per second find the frequencies.

(3) Distance between two particle having masses m1 and m2 is r. If the distance if these particles from the centre of mass of the system are respectively r_1 and r_2, show that $r_1 = r\left[\frac{m_2}{m_1 + m_2}\right]$ and $r_2 = r\left[\frac{m_1}{m_1 + m_2}\right]$

(4) A stationary wave formula on a string of length 100 cm has a fundamental frequency of 196 Hz. If one wants a fundamental frequency of 400 Hz. what should be the length of the string ?

Q.–7 A Answer in short **(5)**

(1) The amplitude of a damped oscillator between half in one minute. What is its amplitude after 3 minutes ?

(2) Two particles vibrating in SHM along the same line and same period cross each other at the mean position its oppotite direction what is the difference at its phase ?

(3) A turning fork and a siren produce 18 beats in 3 sec. The frequency of the siren is 256 z. Which decreases with adecrease in the speed of siren. What is the frequency of turning fork.

(4) Write the statement of Huygen's Principle.

(5) A light and a heavy body have equal momenta which has the greater kinetic energy ?

B Attempt any three. (6)

(1) Define the term 'phase' in SHM. Which are the parameters of the motion that can be deduced from the phase ?

(2) What is wave e the ? Obtain the eqn

y = A sin (Wt – kx) for one dimensional. harmonic wave propagating in x – direction ?

(3) Explain the term "wave front" giving an appropriate figure.

(4) Explain what is the mutaul dependence at Newton's Laws for a system of particle.

C Solve the following (Any three) (9)

(1) A simple harmanic oscillator starts oscillatig from its mean position is the upward direction (ie five) Its period is 6 seconds find the earliest time which its kinetic energy will be one fourth. Its mechanical energy.

(2) Initial placement at a damped oscillator is zero and its initial velocity is V_o. Obain the values of the constants in the expression. for its displacement. Take angular frequency as W'.

(3) Ratio of the frequencies of the horn of a car when approaching to that when receding as heard by a stationary traffic polive is 1.6 Taking speed of sound as 340 m/sec. Fidn the speed of the car.

(4) A ball of 8 kg. mass hits a wall at an angle of 30^o and is then reflected making an angle of 60^o with its original direction. If the duration of contact between the ball and the wall is 0.1 sec. Calculate the force exerted on the wall. The initial and the final velocities of the ball are 1 m/sec.

Q.–8 A Write short answer to the following questions. 5

1. If displacement of a simple harmonic oscillator is increased by 20% then what will be the percentage increase in its potential energy ?
2. Give the definitions and magnitude of a wave vetor.
3. What kind of disturbance propagates in case of electromagnetic waves if a meduim is not required for their propagation.
4. A bomb at rest explodes in two fragments of 2 kg and 3kg what will be the ratio of their velocity after the explosion ?
5. The centre of mass of the substances having simple geometry symmetry can be easily determined. True / False.

B. Write answer in eight to ten statements as asked (Any 3) 6

1. Write the equation of displacement of SHO with the help of differentiation obtain the equation of velocity in terms of dissplacement and write the values of & position of maximum & minimum velocities
2. What are natural & forced oscillations ? Derive differential equation of forced oscillation with damping.
3. Explain beats effect in short.
4. Using the expression :

$$\vec{M}cm = m_1\vec{v_1} + m_2\vec{v_2} + ... + mn\ \vec{v_n}$$

for a system of particles Derive $M\vec{a}_{cm} = \vec{F}$ and show the forcess acting on the system.

C. Solve the following (Any 3) **9**

1. A given damped oscillator has period T. Prove that the decrease in the natural logarithm of its amplitude per oscillations is bt/2m.
2. An oscillator having a mass of of 100 gm. is executing damped oscillations after 100 oscilations the amplitude reduces to half its original value. Find the damping coefficient if its period is 2 sec.
3. A stationary listener experiences that the ratio of the frequency of the sound of horn when a car is approaching him, to that when it is receding from him is 1.7 Taking velocity of sound as 340 m/s. Find the speed of car.
4. In a lake, a person is standing on a stationary raft. The distance between the person and the bank is 50 meter. Mass of the person is 40 kg. and that of the raft is 60 kg. The person now starts running towards the bank with a velocity of 10 m/s w.r. to the raft. How far will the person be from the bank after 4 sec ?

Q.–9 A. Answer the following in short **5**

1. A S H O takes 1.5 sec to reach one of its ends from its equilibrium point. Find its angular frequency.
2. Define resistive force co–effcient.
3. The velocity of wave propagated in a wire is 10 m/sec.
   It wave length is 4cm. What will be the angular frequency ?
4. On what factors the place of center of mass of a rigid body depends ?
5. What are natural oscillations ?

B. Answer any three in eight to ten sentences. **6**

1. For S H O obtain the expression $U = 1/2\ KY^2$ for its potentional energy.
2. Write down thee differential equation for forced oscillation without damping and obtain its solution.
3. Give the formula of $\vec{V}$cm for a syatem of particals. Accepting expression $\vec{P} = M\vec{V}$cm derive Newton's second law of motion.
4. Discuss the reflection of wave from a rigid support for tx – direction

C. Solve the following (Any Three) **9**

1. An oscillator having a mass of 100gm is executing damped oscillation After 100 oscillations the amplitude reduces to a forth of its original value. Find the damping co–efficient if its period is 2 sec.
2. Interval between two sound frequencies are 12/11. If they generate 8 beats per second find the frequencies.
3. Astationary wave formed on a string of length 100cm has fundamental frequency of 196 Hz. What should be the length of the string. if one wants frequency of 400Hz.
4. Amplitude of a propagating wave is 10mts. A point located at 2mt from the source has the displacement of 5mt at 2sec, and point located at 16mt the displacement is $\sqrt{3}$mt at 8sec. Find the angular frequency and the wave vector for this wave.

Q.–10 A **5**

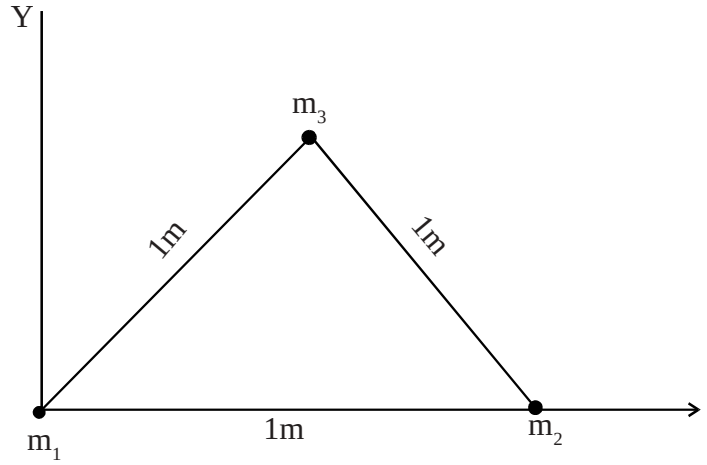
1. At which positions do the kinetic and potential energies become equal ?
2. Phase difference of oscillationss of two medium particles during the propagation of wave is 17 radian. what is the distance between the two particles in terms of wavelength.
3. Write the dimensional formula of damping co–efficient (resistive force co–efficient) of a medium.
4. What is the value of resultant amplitude at nodal point ?
5. At which point is the acceleration of a simple harmonic oscillator equal to the linear acceleration of its reference particle ?

B. Answer the following questions in eight to ten sentences : (Any three) **6**

1. Derive the equation of a stationary wave produced by the superposition of two waves $y_1 = A \sin (wt - kx)$ and $y_2 = A \sin (wt + kx)$ Define nodes and Antinodes.
2. In the expression $\vec{M}_{a_{c.m}} = \vec{F}_1 + \vec{F}_2 + \vec{F}_n$ ... only external forces are taken into account. Explain using a system of two particles; when and how is this possible. Hence explain what is meant by mutual dependence of Newton's law of motion.
3. Explain the term "Wave front" giving an appropriate figure.
4. What is beat ? Prove that in the phenomena of beats the periodic time is $T = \frac{2}{f_2 - f_1}$ of the resultant oscillating amplitude.

C. Solve the following examples (Any three) **9**

1. A stationary listener expriences that the ratio of the frequency of the sound of horn when a car is approaching him, to when it is receding from him is 1.5. Taking velocity of sound as 340m/s, find the speed of the car.
2. Derive differential equation of damped oscillator. Explain the graph showing relation of displacement with time in damped motion.
3. A stationary bomb explods, and on explosion it fragments into 3 parts. Two of these parts having equal mass fly apart perpendicular to each other with a velocity of 20 m/s each. The third part has a mass two times of other two. Find the magnitude and the direction of motion of the third part.
4. Particles shown in the figure, having masses $m_1 = 1$ kg, $m_2 = 2$kg and m_3 kg, are placed at the verticles of an quilateral triangle having length of each side equal to 1m. Find the center of mass of this system of particles.



Q.–11 A Answer the following questions in very short. 5

1. At which point is the acceleration of a simple harmonic oscillator equal to the linear acceleration of a reference particle ?
2. The dimensional formula of damping co-efficient (resistive force coe-fficient)of a medium is ____
3. The wave propagting in a wire has 10 meter/sec wave velocity and wavelength of 4 cm. What will be the angular frequency of the wave ?
4. What is a chord ?
5. ____ is the dimensional formula of impulse of force.

B. Answer the following questions in eight to ten sentences (any three) 6

1. Define phase and explain it in brief. What can we know from the phase ?
2. Prove that, when the progressive harmonic wave is reflected from the rigid support, the phase of the reflected wave is increased by an amount π with respect to the incident wave.
3. Give the definition, unit and dimensional formula of the linear momentum of a particle with the help of an example, explain the advantage of defining linear momentum.
4. State Newton's second law of motion for a particle, and deduce the formula $\vec{F} = m\vec{a}$ is this equation true for all cases.

C. Solve the following examples : (Any three) 9

1. A horizontal plank is executing simple harmonic oscillations in a vertical direction. A coin of mass m is placed on the plank. Find the periodic time of oscillations of the plank for which the coin will just lose contact with the plank. (Amplitude of oscillation is A).
2. $f_1, f_2 \ldots f_n$ are the frequencies of a set of n forks. Any two consecutive forks of the set generate 5 beats per second. If the nth fork has a frequency n times the first one, find the frequency of the first and (n–1) fork.
3. Interval between two sound frequencies is $\frac{20}{21}$. If they generate 5 beats per second, find the frequencies.
4. A ball of 10 kg mass hits a wall at an angle 30o and is then reflected making an angle of 120^o with its original direction. If the duration of contact between the ball and the wall is 0.2 s, calculate the force exerted on the wall. The initial and the final velocities of the ball is 2 m/s.

Q.–12 A Answer in short of the following 5

1. For an elastic spring of force constant k, the slope of ($M \rightarrow T_2$) graph for oscillation is _____ (Fill in th blank)
2. Differential equation for pure SHM is given by $\frac{d^2y}{dt^2} + 8y = 0$. If the mass of the oscillator is 5 Kg, find the force constant of the system.
3. Equation of a wave is given by $y = 5 \sin \frac{\pi}{3}\left(2t - \frac{x}{4}\right)$ cm. Find the distance traveled by the wave when the particle of the medium completes 5 oscillations.

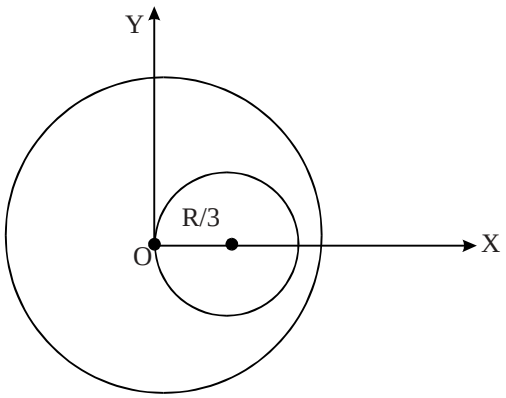
4. Huygen's principle can be applied to any medium. Is it true ?
5. Write the factors affecting the position of centre of mass.

B. Answer any three of the following. **6**

1. Define forced oscillation write the differential equation for such oscillation without damping. Hence derive its solution.
2. State Huygen's principle. Using this principle, explain how a plane wave front is formed.
3. Define progressive, harmonic, one–dimentsional wave. Derive an equation for such a wave propagating along negative X–direction.
4. Write a note on inter dependence of Newton's laws of motion for system of particles.

C. Solve any three of the following. **9**

1. If a body of mass 50 g is suspended at the end of an elastic spring, its length increases by 20 cm. In this condition, the body is displaced by 7 cm in upward direction and then released, it executes SHM. Obtain the equation for its displacement.
2. Prove that for a wave propagating in medium, the ratio of the instantaneous velocity of a particle of the medium to the wave velocity is equal to the negative value of the slope of waveform at the point.
3. From a thin disc of radius R and surface density ϱ, a part having radius R/3 is cut off as shown in the figure. Find the center of mass of the remaining part of the disc, with referencee to the center of original disc.



4. A batsman hits a ball of mass 150 g, moving with speed of 25 m/s. As a consequence the ball now moves in the reverse direction at 30 m/s. If the time of contact with the ball and the bat is 0.125 sec. calculate the force exerted on the ball by the bat.

Q.–13 A Write the answer in very short : **5**

1. Obtain the ratio of Maximum Acceleration and Maximum velocity of Simple Harmonic Oscillator.
2. The equation of stationary Wave is $y = 5 \sin 30 \pi \left(t - \frac{x}{240} \right)$ meter. Find out the velocity of wave.
3. Write the name of physical quantity whose unit is Newton – Second.
4. Which information are obtained by knowing the Phase of Simple Harmonic Oscillator ?
5. Write the dimensional equation of Intensity of a Wave.

B. Write answer in eight to ten statements as asked : (Any three) **6**

1. Accepting the equation of force for simple harmonic oscillator obtain its Periodic Time.
2. State Huygene's Principle and draw figure explaining the propagation of Cylindrical Waves.
3. Obtain the equation of wavelength $\lambda = \frac{v + v_s}{f_s}$ for the waves approaches from source to listener in Doppler effct.
4. Write only the Newton's Second law of motion for system of particles in the form of equations. From that write the law of conservation of linear momentum and state it's importance.

C. Calculate Any three Numerical Problems. **9**

1. Mass of S.H.O. is gm, frequency .. radian and Amplitude is 10 cm. Then obtain Force constant of this spring.
2. The length of string is 200 cm. The fundamental frequency of a stationary wave formed on it is 200 Hz. If the required fundamental frequency is 50 H. What should be the length of a string ?
3. Three uniform spheres each of diameter 18 cm and uniform density are placed on a horizontal surface so that their surface are in contact. Determine the center of mass of the system taking origin at the center of any one sphere.
4. A spring of length l and force constant k is divided into two parts of lengths l_1 and l_2 respectively. If $l_1 = {}_n l_2$, (n being an integer) then prove that $k_2 = k(n + l)$.

Q.–14 A Answer the following questions in very short as asked. **5**

(1) Whart is the angular frequency of S.H.O. whose maximum acceleration and maximum velocity are $4\pi \frac{cm}{s^2}$ and $2 \frac{cm}{s}$ respectively ?

(2) There are three loops in a 120 cm long string tied from both of its end. What will be the distance between two consecutive nodes and antinodes ?

(3) What is impulse of force ? Write its unit.

(4) What will be the slope of the graph ln A(t) $\rightarrow$ t for a damped osillation ?

(5) A planee wave front of light is incident on a convex lens the wave front coming out it will be – _____ (spherical, plane, cylindrical, of any irregular shape)

B Answer the following questions in eight to ten sentences. (Any three) **6**

(1) Derive potential energy $U = \frac{1}{2} ky^2$ for a S.H.O.

(2) Explain the reflection of a progressive, harmonic wave from a rigid support.

(3) State the law of conservation of linear momentum and explain it with example of explosion of a stationary, chemical bomb.

(4) Write a note – 'Musical Scale'

C Slove the following examples. (any three)

(1) A spring of length l and force constant k, is divided into parts of length l_1 and l_2 respctively. If $l_1 = nl_2$; n being an integer, obtain force constants k_1 and k_2 of the two springs in terms of n and k.

(2) Obtain the equation of s stationary wave generated on superposition of waves, $y_1 = 10 \sin (3\pi t - \pi x)$ and $y_2 = -10 \sin (3\pi t - \pi x.)$ From x = 0 of stationary

wave, find (i) the amplitude of the particle at x = 0.25m (ii) distance of the first node and the first antinode from x = 0

(3) In a lake, a person is standing on a stationary raft. The distance between the person and the bank is 30 meters. Weight of the person is 60 kg and that of the raft is 40 kg, the person now starts running towards the bank with a velocity if 10 m/s with respect to the raft. After what time will the person reach the bank ?

(4) Prove that for a wave propagating in a medium, the ratio of the instantaneous velocity of a particle of the medium to the wave – velocity is equal to the negative value of the slope of the wave form at the point.

Q.–15 A Write short answer to the following questions. 5

1. The mechanical energy of a simple harmoni oscillator is E = ___ or ____.
2. Find the displacement of a simple harmonic oscillator when its velocity is maximum.
3. Write the unit of the intensity of wave.
4. What is the rate of change of momentum of a body when the resultant external force acting on it is zero ?
5. The position coordinates of two particles of mass 1 gm and 2 gm are (1, 2) cm and (2, 1) cm respectively. Writee the coordinates of their center of mass.

B. Write answer in Eight to Ten statements as asked (Any Three) 6

1. Derive the equation of potential energy of the simple harmonie oscillator accepting F = – ky
2. Derive equation of a stationary wave. Why is it called so ?
3. Only with the help of figure derive the equation of wavelength $\lambda = \frac{v + v_s}{f_s}$, of the waves going from the source to the listener in Doppler's effct.
4. Define center of mass for a system of particles, thereby obtain $\vec{P} = M\vec{V}$cm.

C. Calculate any three Numerical Problems from following. 9

1. A particle executing SHM along y – axis has an initial displacement 2 cm and an initial velocity 2cm /sec. If its period is 2 sce, obtain an exprssion for the displacement. Take x – axis as the reference direction.
2. ASHO starts oscillating from its mean position in upward direction (i.e. + y.) The period is 16 seconds. Find the earliest time at which its kinetic energy wil be half the mechanical energy.
3. Prove that for a wave propagating in a medium, the ratio of the instananeous velocity of a particle of the medium to the wave velocity is equal to the negative value of the slope of the wave form at that point.
4. A stationary bomb explodes, and on explosin it fragments into three parts. Two of these parts which ar of equal masses, fly apart perpendicular to each other with a velocity of 15 m/s each. The third part has a mass 3 times the other two. Find the magnitude and direction of motion of the third part.

Q.–16 A Answer the following questions in short as asked. 5

1. The period of oscillations of a spring is measured T, by suspending certain mass at ts end. Now if the mass is taken nine times greater, what will be its new period ?

2. The amplitude of a S.H.O. having massing A. IF = Y = 1 unit, the force is 'b' unit. What will be the maximum potential energy of the oscillator ?
3. The ratio of intensites of two waves is 1 : 16. Find the ratio of their amplitudes.
4. A 100 cm long string is fixed at its two ends. If there are four loops in the stationary pattern constructed on it, find the distance between two consecutive autinodes.
5. If the Kinetic energy of a body becomes nine times that of its original value, the increase in its momentumis .... %

B Answer the following questions in eight to ten sentences (any three) 9

1. For a S.H.O obtain the expression $U = \frac{1}{2} KY^2$ for its potential energy.
2. Discuss the reflection of a wave from a rigid support.
3. Write Huygen's principle. Using this principle explain propagation of place wave front.
4. Explain the law of conservation of linear momentum with a suitable illustration.

C Solve any three examples. 9

1. A spring of length '*l*' having its force constant K is cut intio two parts. These parts have their length in 4 : 1 proportion and their force constants are K_1 and K_2 respectively. Show that $K_1 = \frac{5K}{4}$ and $K_2 = 5K$
2. A rectangular vessed of cross – sectional area A is closed by a block having same cross – section So that the system is airtight. In the equilibrium position the pressure inside the vessel is P and the volume enclosed is V. Now the block is given a small displacement x and then released. Show that the block will perform S.H.M Let. the motion be frictionless and take compression isothermal.
3. $f_1, f_2, f_3, ... f_{10}$ are the frequencies of a set of 10 forks. Any two consecutive forks of the set generatee 6 beats per second. If the 10th fork has a frequences 4 times the first one, find the frequency of the first & 10 th fork and also find the frequency of 8th fork.
4. A sphere of mass m_1, moving with a velocity v_1 along the X – axis suffers an elastic one dimensional collision with a sphere of mass m_2, lying stationary on the same axis. If the velocities are v_1 and v_2 respectively, prove that $v_1 = \left[\frac{m_1 - m_2}{m_1 + m_2}\right] v_1$ & $v_2 = \left[\frac{2m_1}{m_1 + m_2}\right] v_1$

Q.–17 A Answer the following questions in very short as asked. 5

1. If a mass 'a' is suspended from a vertical spring of force constant 'b' & osicillated, then frequency of oscillation is ____.
2. The phase difference between two waves represented by
   $y = A \sin (\omega t - kx)$ and
   $y = A \cos (\omega t - kx)$ is ____ radian
3. Two particles execute SHM on the same path. During the motion, when they meet each other at the displacement half the amplitude, they are found to move in the opposite direction Find the difference of their phase.

4. The velocity of the centre of mass of a systen of total mass 25 kg changes uniformly from 10m/sec to 50 m/sec. in the same direction in 5 sec. find the force on it.
5. On what factors the amplitude of a forced oscillation of a body depend.

B. Answer the following in eight to ten sentences (Any Three) **6**

1. Give an account of two forces acting on an oscillator undergoing damped oscilations, there by derive, differential equation for it. Write the solutions of the equation and draw the graph of amplitude –> time.
2. State and explain Huygen's principle.
3. Give the general expression for Doppler effect and discuss all the special cases.
4. State the law of conservation of linear momentum. State the importance of the law.

C. Solve the following (Any time) **9**

1. Two sitar stringss A and B playing the note "Ga" are slightly out of tune and produce brass of frequency 6Hz. The length of the string A is slightly increaed and the beats frequency is found to reduce to 3Hz. If the original frequency of A is 324 Hz what is the frequency of B ?
2. A wooden rod of mass M and cross section A floats in the liquid. Its centre of mass is slightly under the liquid surface. If it is slightly pressed bellow and then released show that it performs SHO. Obtain the formula for its periodic time.
3. The displacement of SHO is givein by $y = 5\sqrt{3} \sin 10\pi t + 5 \cos 10\pi t$ cm, where t is in second. Find its amplitude and periodic time
4. Distance between two particle having masses m_1 and m_2 is r. If the distance of these particles from the centre of mass of the system are respeectively r_1 and r_2,

   prove that $r_1 = r\left(\frac{m_2}{m_1+m_2}\right)$ and

   $r_2 = r\left(\frac{m_1}{m_1+m_2}\right)$

Q.–18 (A) Answer the following questions in very short. **(5)**

1. A spring stretches by 9.8 cm on suspending a body of mass0.2 kg. What is the force constant at the spring?
2. What are the natural oscillations?
3. Wavelength of wave is 25 cm and its frequency is 400 Hz. The velocity of the wave =_____ m/s.
4. Define wave - vector and give it unit.
5. The centre of mass of the earth - moon is nearer to the earth? True or false?

(B) Answer the following questions in eight to ten sentence (Any Three) **(6)**

1. Explain reference circle and refrence particle with necessary figure.
2. explain with an example the various forms of waves depending on the medium for their propagation.
3. Write the help of suitable diagram, explain the forces acting on a system of particles and also explain the matual dependence of Newton's law.

(c) Solve the following examples. (Any Three) **(9)**

1. A.S.H.O. starts oscillating from its mean position in the upward direction (ie +y). Its period is 8 sec. find the earliest time at which its. Mechanical energy is half 15 kinetic energy.
2. When displacement of S.H.O. is 3 cm, its velocity is 4 cm/sec, and when the displacemenet is 4 cm, its velocity 3 cm/sec. find its (i) amplitude (ii) angular frequency and (iii) periodic time.
3. A thief running at a speed of 9 km/hr., a policeman is chasing him with a speed of 18 km/hr, and is also blowing a whistle of frequency 1000 Hz. Calculate the frequency heard by the thief.
4. Equation of propogating wave is y =20 sin (Πt – 2Πx) with y in metre and t in second. What will be the phase difference of oscillation at two points located at a distance of 5 mt at a given time? Also for a given point what will be charge in the phase of oscillation after a time interval of 2 second?

Q.–19 (A) Answer the following in very short. **(06)**

(1) At what distance from mean position is the kinetic energy in simple harmonic Osicllator equal to potential energy ?

(2) What are beats

(3) When a bomb at rest explodes suddenly. Where does - ue kinectic energy of the ffragments come from ?

(4) A spring of length *l* has force constant K. If it is cut into two equal parts and these parts are then joined in parallel, their effective force constant will be _____ fill in the blank.

(5) Two tuning forks at 256 Hz and 260 Hz are sounded together. In the beats produced. How much time will it take for the amplitude to change from zero to maximum value ?

(B) Answer any three of the following question in short. **(06)**

(1) What are natural oscillation? Derive differential equation for simple harmonic motion?

(2) Elplain propogation and dissipation of energy in wave and give definition, unit and dimensional formula of intensity of wave.

(3) Explain forces acting on the system of particles Hence explain what is meant by mutual dependence of Newtin's laws of motion.

(4) Obtain the expression for total energy of simple harmonic oscillator.

(C) Solve any three from the following example. **(09)**

(1) A 0.2 kg. mass executing simple harmonic motion has frequency equal to $\frac{25}{\pi}$ Hz.

At a particular instance its kinetic energy is 0.5 joule and potential energy is 0.4 joule, find the amplitade.

(2) Ratio of the frequencies of the horn of a car when approching to that when recedig, as heard by a stationary traffic polce is 1.6 Taking speed of sound as 340 m/s. Find the speed of the car.

(3) A rigth handed batsman is holding his bat obliquely, A ball hits the bat at 45^0 angle and gets reflected perpendicular to the surface of the bat with speed of 20

m/sec. Initial velocity of the ball is 30 m/s and it weight 150 gm. If the duration of contact between the ball and the bat is 0.1 second, find the force exerted on the bat (Cos $\frac{\pi}{4}$ = 0.7071)

(4) f1, f2.....fn are the frequencies of a set of 'n' forks. Any two consecutive forks of the set generate 5 beats per second If the n.....th frok has a frequency n times the first one find the freqency of the first and (n-1) the fork.

Q.–20 (A) Answer in short as require: **(05)**

(1) Define the force constant of the spring.

(2) What are normal modes of vibrations of a string fixed at its two ends ?

(3) On what factors the place of centre of mass of rigid body depend ?

(4) Distance between two particles having masses 5 kg. & 6 kg. is 22 meter. Find the distance of centre of mass from the particle of 6 kg. of mass.

(5) If three nodes are obtained on a string of length of 200 cm, fixed at its two ends give the distance between consecutive antinodes.

(B) Answer in about 8-10 sentence. (Any three) **(06)**

(1) Draw and discuss the graphs of potential enegry, kinetic energy versus displacement for a simple harmonic oscillator.

(2) Obtain the formula $V = \frac{\varpi}{k}$ for a wave and define quantities occuring in it.

(3) Write Newton's second law of motion for a particle and explain "the mutual dependence of Newton's laws".

(4) Write down the differential equation for forced oscillations without damping and obtain it solutiion.

(C) Solve following examples (any three) **(9)**

(1) An oscillator having a mass of 10 gm is executing damped oscillations. After 50 oscillations the amplitude reduces to half of its original value. Find the damping coefficient if its period is 4 second.

(2) Two wires placed close to each other are vibrating in their first harmonic. If the first harmonic of the smaller wire is 225 Hz and the sound produced by the two wires produces 5 beats per second, find the length of the longer wire. The velocity of waves in both wire is 299 m/s.

(3) A solider is firing bullets each having mass of 40 gm. with a speed of 1 km/s from a machine gun. He can withstand at most an average recoil force of 360 Newton. What is the maximum number of bullets that he can fire in one second ?

(4) For a wave propagating in a medium prove that the ratio of the instantaneous velocity of a practicle of the medium to the wave velocity is equal to the negative value of the slope of the wave form at that point.

Q.–21 (A) Answer the following questions as asked: **(05)**

(1) At which position of SHO, will the mechanical energy be four times the potential energy ?

(2) What will be the amplitude of aparticle performing damped oscilliations, at time

$t = \frac{2m}{b}$?

(3) What is an isotropic medium ?

(4) In case of sound, beats to be clearly heard, What should be the no. of beats per second ?

(5) An object of mass 10 gm. experience 50 N.s impluse of force, what will be the change in its momentum ?

(B) Answer any three of the following questions in eight to ten sentences: (06)

(1) Define Natural oscillations and forced oscillations. Obtain solution of differential equation for forced oscillations, in the absence of damping.

(2) Using the general expession for the Doppler effect. discuss any two particular cases.

(3) Using stationary wave equation for waves formed on the string, explain Normal modes of vibrations.

(4) Define centre of mass system of particles. Using the definition, prove that $\vec{P} = M. \vec{V}cm$

(C) Solve any three of the following examples : (09)

(1) Write down the expression for the total energy of a simple harmonic oscillation in terms of sum of its potential and kinetic energies. Using the fact that total energy does not change with displacement, obtain differential equation of Motion.

(2) When a person of mass 60 kg. is standing on a spring balance, the balance executes S.H.M. with period of 1 second. If the amplitude of oscillations is 10 cm. then find MAXIMUM and minimum weight of the person recorded by balance.

Take g =10 m/s^2 and $\pi^2 = 10$

(3) A stationary source is emitting frequency of 25 Hz. Find the minimum velocity with which a listner would be receding from the source so that he does not experience the sensation of sound. Speed of sound is 300 m/s.

(4) A batsman hits a ball of 150 gm. mass, moving with speed of 12 m/s. As a consequence, the ball moves in the reverse direction at speed of 20 m/s. If the force exterted by the bat is 480×10^5 dyne then find the duration of contact between the ball and ball.

Q.–22 (A) Answer the following questions in short. (05)

(1) When t =0 the S.H. Oscillator is at the end of negative terminal of its path write the formula of its displacement at time t.

(2) At what point of the path, of S.H.O the potential energy and kinetic energy becomes equal ?

(3) The velocity of a wave is 330 m/s and its frequency is 550 Hz. Two particles on the wave have their phase difference 30^0 What is the distance between the two particles ?

(4) The value of linear-momentum of a substance become half of its original value of linear-momentum How much precentage will the K.E. will dicrease ?

(5) State the factor on which centre of mass of a rigid body depends.

(B) Answer any three of the following questions. (06)

(1) What is phase ? Explain with suitable figure and define.

(2) Define wave-intensity. Give its unit and dimantional formula.

(3) What is beats ? Using the superposition of two waves given by y_1 = A sin w_1t and y_2 = A sin w_2t at a point in a medium. Hence obtain the expression for the number of beats per second.

(4) Write the statement of the law of conservation of linear momentum. Explain an example of explosion of a chemical bomb.

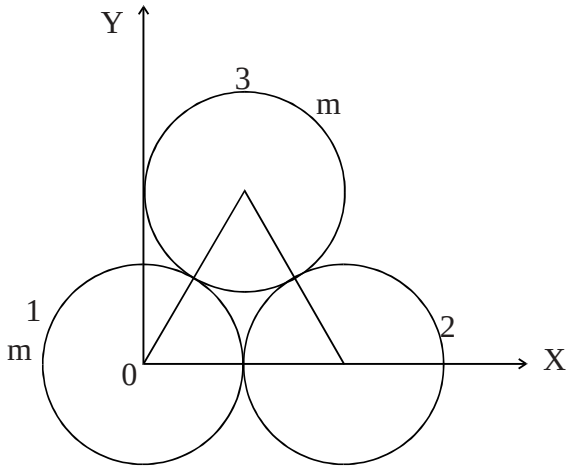
(C) Attempt any three of the following problems. **(09)**

(1) When a person of mass 60 kg. is standing on a spring balance, the balance executes S.H.M. with a period of 1 sec. of the amplitude of oscillators is 0.1 m then final the maximum and minimum weights of the person recorded by the balance.

(Take π^2 = 10, g = 10 m/s^2)

(2) A string is 100 cm. long. Two consecutive harmonics of stationary waves formed on that string have frequencies 300 Hz and 400 Hz respectively, (i) Find the fundamental frequency (ii) Find the frequency when 5 antinodes are formed on the string (iii) when the string is oscillating in the fundamental frequency the maximum width of the loop formed is 10 cm. Find the equation for the correspendig wave.

(3) Three uniform spheres each of raduice R and equal mass are placed on a horizontal surface so that their surface are shown in the figure of mass of the system taking origin at the centre of sphere 1 and axes are shown in the figure.



(4) A sphere of mass m_1 moving witha velocity V_1 along the X-axis suffers an elastic one-dimensional collision with a sphere of mass m_2 lying stationary on the same axis. If the velocities of the spheres m_1 and m_2 after collisions are V_1 and V_2 respectively prove the :

$$V_1^1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right) V_1 \text{ and } V_2^1 = \left(\frac{2m_1}{m_1 + m_2}\right) V_1$$

Q.–23 A Answer the following question in vey short as asked. **5**

1. Define intensity of a wave.
2. Kinetic energy of simple harmonic oscillator, having total mechanical energy 50 J, is 20 J when its displacement is 2 cm then find force constant.

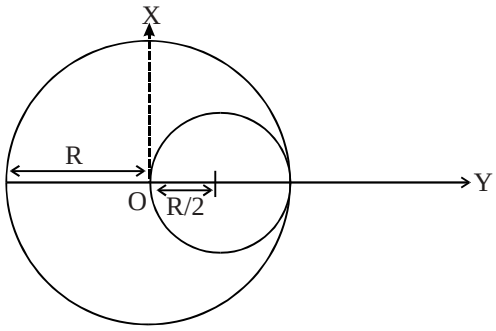
3. What is the number of wave s in 1 cm distance in case of light waves of $5000A^{o}$?
4. Two bodies of the same mass are oscillating from the two spring one hard another soft. Which one will have more periodic time ?
5. If mass of a distance remains some but kinetic energyu becomes 4 time then its linear momentum increases by how many times its original value ?

B Answer the following questions in eight to ten sentences (Any three) 6

1. Derive the equation of the phase of SHO at time t.
2. Classify the waves and write an illustration for each of them.
3. Obtain the equation of resultant force acting on a body suspended from the lower hand of an elastic spring when it is displaced by Y in downward direction from equilibrium.
4. Write Newton's Second law for particle thereby deduce $\vec{F} = m\vec{a}$

C Solve the following examples (Any three) 9

1. A 0.2 kg mass executing simple harmonic motion has frequency equal to $25/\pi$ Hz. At a particular instance. Its kinetic energy is 0.5 Joule and potential energy is 0.4 Joule find the amplitude.
2. Prove that for a wave propagating in medium, the ratio of the instantaneous velocity of a particle of the medium to the wave velocity is equal to the negative value of the slope of the waveform at the point.
3. Two persons A and B posses source of sound with frequency 66 Hz. Now A starts moving toward B who is staionary with respect to ground at 3 m/s. Find number of beats as heard by A. Velocity of sound in air is 330 m/s.
4. From a thin disc of radius R and surfacee density p a part having radius R/2 is cut off as shown in fig. Find the center of mass of the remaining part of the disc, with reference to the center of the original disc.



Question–2

Q.–1 A. Answer the following very briefly : **(5)**

1. Write the definitions of a Rigid body and a Solid body.
2. The velocity of a rolling body at the bottom of a plane is less than the velocity of a slipping body there. Why ?
3. Find the ratio of the maximum range (Rmax) and the maximum height (Hmax) of a projectile.
4. Write the value and unit of Stephen Boltz mann constant.
5. If the temperature of a black body is made 3 times, what will be the increase in the emissive power of the body ?

B. Answer any three briefly : **(6)**

1. Obtain the expression for the frictional force acting on a cylinder rolling down an inclined plane accepting the expression. $V = \sqrt{4/3}\ gh$.
2. Explain "Thermal Steady State". In this state obtain the expression for heat current.
3. Define Cannot cycle. Explain the working of Carnot Engine.
4. Explain the vector representation of Newton's Law of Gravitation.

C. Work out any three : **(9)**

1. A pendulum clock whose period on earth is 2 seconds is taken to the moon. Will it go fast or slow ? By how much (slow or fast) per hour ? $g_e = 9.6\ ms^{-2}$ $gm = 1.6\ ms^{-2}$
2. A lift weighing 1000 kg moves up with an acceleration of 2.2. m/s^2.
   What is the tension experienced by its cable? What is the tension if the lift comes down in the acceleration 2.8 m/s^2
3. In a Carnot's Engine, the temperature of the sink is 300^o K. Its efficiency is 50%. If its efficiency is to be made 60 %, by how much should the temperature of source be increased keeping the temperature of sink fixed
4. Show that during an adiabatic process the work done is given by

$$W = \frac{P_1V_1 - P_2V_2}{\gamma - 1}$$

Q.–2 (A) Answer the following question **(5)**

(1) What are the aspects on which the moment of Inertia depends ?
(2) Define geodesic
(3) Define termperature gradients and write its unit
(4) A wheal having radius 50 cm, rotates 30 revolutions per minutes. What will be linear speed of a particle situated at a circumference of it ?
(5) Explain "The death of Heat is not completely possible."

(B) Answer in brief (any three) **(6)**

(1) Derive Kepler's second law for the orbital motion of the planet.

(2) What is projectile motion ? Obtain the expression for the range of a projectile

(3) What is thermal radiation ? Write stephen – Boltzmann law giving its mathematical expression.

(4) Define a simple pendulum and obtain differential equation $\frac{dx^2}{dt^2} + w^2x = 0$.

(C) Compute the examples (any three) **(9)**

(1) A string is wound around a smooth disc of mass M and radius R. At its free end a body of mass M in is attached the disc so that free to rotate about its geometric axis. which is horizontal. When the mass M in descends it cover a distance "d" in time "t" prove that the angular acceleration of the disc. $\alpha = \frac{2}{R}\left(g - \frac{2d}{t^2}\right)$

(2) A satellite weighting 200 kg is orbiting the earth at 1000 km height above the surface. Find binding energy of the satelite and its escape velocity. Mass of the earth = 6×10^{24} kg. And its radius = 6400 km.

(3) An ideal gas is isothermally expanded so that its volume becomes double then it is adiabatically compressed to its original volume. Find the pressure after the adiabatic compression. (use original pressure = 1 atmosphere $\gamma = 1.4$)

(4) The energy of the thermal radiation emitted per second per unit area for two substances with the same surface emissivity has a ratio of 16 : 1. If the hotter body is at 1000^o K find the temperature of cooler body.

Q.–3 A. Answer in one line/word **[5]**

1. If the earth were to shrink suddenly (mass constant) what would happen to length of day ?
2. Torque required to produce unit angular acceleration in a body is said to be _____
3. Can there be motion in 2 – dimension with acceleration in one direction one. Give one example.
4. Considering cold end of rod as reference point temperature gradient obtained is negative _____ True/False.
5. What kind of heat transfer depend on gravitation ?

B. Answer in short (any –3) **[6]**

1. From expression for angular momentum of particle prove that rate of change of angular momentum is torque applied.
2. Assume expression $a = \frac{2}{3} g \sin\theta$ for acceleration of cylinder rolling down a slope without sliding. Using it obtain condition for it to roll without sliding.
3. Prove that square of periodic time of revolution of a satellite is proportional to the cube of radius of its orbit.
4. Define thermal conductivity, temperature gradient and heat current. Also give their units.

C. Solve examples (any – 3) **[9]**

1. A hollow stationary cylinder has mass of 4 Kg and radius 2 meter. Cylinder can rotate about its geometrical axis. Thin string is wound around this cylinder and Force of 60 N is applied at its free end so that it acts tangentially to surface of cylinder and starts executing rotational motion. Find torque acting on cylinder and angular acceleration of cylinder.
2. On a smooth horizontal curved road with radios of curvature r and zero slope, cycle is moving at speed v km/hr. Under given circumstances calculate inclination to the vertical needed for cycle so that it does not slip off the road.
3. If earth were made of gold with uniform density of 19.3×10" kg/m^3, what would be the value of acceleration due to gravity on its surface ? Radius of earth is 6400 km.
4. Prove that for adiabatic process if temperature changes from T_1 to T_2 work done by –an ideal gas is given as $\frac{nR}{\gamma - 1}(T_1 - T_2)$

Q.–4 A Answer the following questions very briefly : **5**

1. Differentiate the terms "kinematics" and "dynamics" of rotational motion.
2. Under what circumstances does the direction of the angular acceleration coincide with the rotational axis ?
3. Define Geodesic.
4. Write Max Planck's Statement of the second law of thermodynamics.
5. Write the % efficiency of a Carnot's engine operating between 27^{o}C and 127^{o}C.

B. Attempt ANY THREE of the following : **6**

1. Obtain expression for work done by an ideal gas during an isothermal change.
2. Describe the sequence of strokes in an internal combustion engine; and write expression for its efficiency. Draw the necessary p $\rightarrow$ V diagram.
3. What are geo–stationary satellites ? Obtain the expression for the height at which a geo–stationary satellite should be orbiting.
4. Giving a suitable figure, explain (i) angular displacement, (ii) average and instantaneous angular speed, and (iii) angular velocity of a rigid body.

C. Solve ANY THREE of the following numerical problems : **9**

1. A car is moving at 108 km/hr. Its wheels are having a diameter of 100 cm. If on applying the brakes, it comes to a halt after executing 30 rotations, how much distance does it move after the brakes are applied ? Also find the angular acceleration of the wheels.
2. When the position vector of a particle is (2, 3, 6) unit, its velocity vector is $(1, \frac{3}{2}, 3)$ unit. Calculate the angular momentum of the particle. Mass of the particle is 100 units.
3. A 10 kg block is sliding down an inclined plane having an angle of inclination of (i) 30^o and (ii) 60^o. Calculate the force acting on it in each case.
4. A carnot engine converts one fifth of the heat absorbed from the source to work. If the sink temperature is reduced by 70^{o}C, its efficiency becomes twice. Calculate the initial temperatures of the sink and the source.

Q.–5 A. Answer in very brief. **[5]**

(1) When a particle moves under a central fore (i.e. a force whose line of action passes through the reference point), the angular momentum about the centre is constant & vicecersa. True or False, justify.

(2) A metalic ciruclar disc having a circular hole at its centre rotates about an axis passing through its centre & perpendicular to its plane. When the disc is heated its angular speed will _____.

(3) A satellite is orbiting the earth in circular orbit of radius R. It's frequency varies with radius as _____

(4) The amount of energy radiated by a body depends upon which factors ?

(5) Define cyclic process.

B. Answer any three in about 10 lines. **[6]**

(1) Write a short note on the generalised motion of a rigid body.

(2) Write the expression which shows that the motion of a projectile is parabolic & using it derive the expression for its range.

(3) Define carnot's cycle & describe the construction at a carnot's Engine.

(4) Write the general expression for heat current. What is thermal steady state ? Deduce the formula for heat current for a uniform rod in thermal steady state if its two ends are at fixed temp's T_1 & T_2 ($T_1 > T_2$)

C. Solve any three. **[9]**

(1) The second's hand of a watch is 2 cm long. Find (1) the angular velocity (2) linear velocity (3) the angular acceleration (4) the radial acceleration (5) the tangential acceleration & the total linear acceleration of a particle on the tip of it.

(2) Prove that the binding energy of a satellite orbiting the earth close to its surface is $= -\frac{1}{2}$ mg Re

(3) One mole at ideal gas at NTP is expanded adiabatically to thrice its volume and its temperature becomes 150°K. Calculate the change in the internal energy of the gas during this expansion (Use $\gamma = 1.4$, R = 8. J/mole °K)

(4) In a cannot engine, temperature of the source is 400 k and that of the sink is 285 k. If the engine is absorbing 550 kilo cal. from the source per cycle, calculate (i) its efficiency (ii) work done by the engine per cycle (iii) calculate heat returned to the sink. (J = 4.2 joule/cal)

Q.–6 A Answer in short. **5**

(1) What is unit of gravitaional potential ?

(2) 1 Mks unit of universal gravitional constant is equal to howmany CGS units ?

(3) Escape velocity depends on the mass of the object. Do you agree with this statement ?

(4) What are the kinematic variables of rotation motion ?

(5) the total omissive power of an object kept at 127°c is w_1, what will be its emmisive power at 527°c ?

B Answer any three of the following question. 6

(1) Prove that rate of change of angular momentum of a rigid is equal to torque.

(2) What is a projectile motion ? Obtain expression for the maximum height attained by a projectile.

(3) Write the theorem of paralled axis and obtain its mathematical expression.

(4) What is cycle process ? Derive expression for thermal efficiency for cycle process.

C Attempt any three of the following problems. (9)

(1) A solid sphere has a mass of 4 kg. on rolling down a slope with 7 met height it attains a linear velocity of 10 meter/sec at bottom. Find its rotational kinetic energy at the bottom of the slope. [g = 10 meter/sec^2]

(2) If the earth were made of gold with a uniform density equal to 19.3×10^3kg/meter^3, what would be value of accederation hue to gravity on its surface ? (Redius of earth = 6400 km)

(3) Prove that the point where a projectile hits the horizontal plane, makes a same angle with the –X direction as that made by it with the x directio at the point from where it was projected, x being the /horizonatal direction from the point of the projection.

(4) A carnot engine is operating between 1000 k and 500 k. In order to extract wark of 210 joule per cycle from this engine, how much heat must be absorbed from the source in each cycle ? (J =4.2 joule/cal)

Q.–7 A Answer the following in short. (5)

(1) What is the ratio of the SI Unit to the C.G.S unit of angular momentum ?

(2) A sphemical ball rolls on a table without slipping. What is the fraction at its total energy associated with rotation ?

(3) The raduis of earth is reduced by 4% and the mass at the earth remains uncharged. Wha is its escape velocity ?

(4) What is the ratio at length of two rod having thermal conductivity 4:3 ? If the rods have the same diameter and equal heat (thermal) resistance.

(5) What is radiant energy ?

B Attempt any three. (6)

(1) Explain how the rotational motion of a rigid body is completely decribed when motion at any single representative particle of the body is describe.

(2) Write and prove the theorem of parallel axis its moment of inertia.

(3) Obtain the expressive for the gravitational poleutial at a point or earth's surface.

(4) Obtain expression for work done by an ideal gas during an isothermal change.

C Attempt any three. (9)

(1) A string is wound around a smooth disc at mass m and of raduic R and at its free end a body of mass m is attached. The disc is free torotate about its geomeric axis which is horizantal. When the mass m descends, it covers distance "d" in time 't' prove that the angular acceleration at the disc $\alpha = \frac{2}{R}\left[g - \frac{2d}{t^2}\right]$

(2) a satellite is orbiting the earth at a height above its surface, egnal to its radius find its (1) Orbital velocity (2) Period G = 6.67×10^{-11} Mks. Redius of earth = 6400 km., mass of earth 6×10^{24} Kg.

(3) One mole at ideal gas at NTP is expanded adiabatically to twice its initial volume and its temprature becomes 200 K Calculate the change in interval energy of the garduring the expansion (use $\gamma = 1.4$ R = 8.3 J/mol K)

(4) A thin rectangular plate is 15 cm. long and 12 cm. wide. Its temprature is 727o An electrical water is use to maintain at this temprature if the emissivity at its surface is 0.25 find the power rating at the heater to be used.

$$\sigma = 5.67 \times 10^{-8} \frac{\text{watt}}{m^2k^4}$$

Q.–8 A Answer in short **5**

1. State the law of conservation of angular momentum.
2. Mass of an artificial satellite moving around the earth is 1000 kg. and its angular momentum is 4×10^7 J – sec calculate its areal velocity.
3. Periodic time of a geostationary satellite is 1 day. Do you agree ?
4. Write Kelvin's statement of 2nd law of thermodynamics.
5. The efficiency of a canot's engine is 25% IF the engine absorbs 400 Calorie heat per cycle then find cork done per cycle in calorie (J = 4.2 J/ cal).

B. Answer in eight to ten sentences (Any 3) **6**

1. Prove that the velocity of a solid cylinder rolling down without slipping from the top of an incined plane of height h is $\sqrt{4gh/3}$ at the bottom of the slope.
2. Deduce Newton's universal law of gravitation in vector form with figure.
3. Write the expression for acceleration due to gravity at distance ``r'' from the centre of the earth (r > Re). Discuss the change in acceleration due to gravity with small changes in a “r” ?
4. Write the main characteristics of a heat engine based on the cyclic proces. Define its efficiency & derive the formula for its efficiency

C. Solve the following (Any 3) **9**

1. A circular disc has mass of 3kg. and a diameter of 4 meter. Find it moment of inertia about an axis whicfh is perpendicular to its plane and touching the edge.
2. The maxiumum safe speed for a vehicle on a curved road with 10^o slope and a radius of curvature of 200 m is 72 km/hr. If the same road has a radius of curvature of 100 met, what would have been the maximum safe speed for the vehicle.
3. The compression ratio for an internal combustion engine is 8. The initial temperature in the cylinder is 27^oC at the begining of the stroke. Find the temperature of the gas at the end of the compresion stroke. The compression is adiabotic $\gamma = 1.5$
4. Volume of a gas at normal temperature and pressure is 30 liters. One expanding it adiabatically it becomes 40 litres. Find the resulting pressure Atmospheric pressure = 10^5 N/m^2 $\gamma = 1.4$

Q.–9 A Answer the following questions in very short. **5**

1. A rigid body performing rotational motion along a circle has a_r = 3 m/s^2 and a_T = 4 m/s^2. Calculate its linear acceleratio.
2. Give the formula for moment of inertia of a solid sphere revolving about an axis tangential to the sphere and is parallel to the axis passing through the canbe of mass.
3. The MKS unit of gravitational potential is ____
4. An object is projected from the earth. It's vertical component of initial velocity is 29.4 m/s What will be the time taken by the object to reach maximum height ?
5. 'Work done in a cyclic process is always positive' – Do you agree with this statement ?

B. Ans the following questions in eight to ten sentences. (Any three) **(6)**

1. Obtain the formula for linear velocity $v = \sqrt{\frac{4}{3}gh}$ of a solid cylinder rolling down without slipin from the top of an inclined plane of height 'h' to its bottom.
2. Write short note on the general theory of relativity.
3. Obtain the expression for work done by an ideal gas during an isothermal change.
4. What is thermal radiation ? State the stephen – Boltman law and given an expression for it.

C. Solve the following examples (Any three) **(9)**

1. A Fiat car is moving at 180 km/hr. Its wheels are having radiis of 50 cm. If on applying the brakes it comes to a halt after executing 50 rotations, how much distance does it move after the breaks were applied ? And also find the angular acceleration of the wheels.
2. Earth is orbiting around the sun, with its orbital radius equal to 1.5×10^8 km. The orbital velocity is 30 km/s. Find the mass of the sun.
   G = 6.67×10^{-11} MKS.
3. Prove that for an adiabatic process, if the temperature changees from T_1 to T_2, the work done by an ideal gas is given by $\frac{nR}{\gamma - 1}(T_1 - T_2)$
4. A cubic wooden box, contains 15 kg of ice. It is suspended from ceiling of a room Internal length of the box is 50 cm and its sides are 7.5 mm thick. If thee initial temperature of ice is 0^{o}C; how much time will it take for ice to melt completely ? Thermal conductivity of wood = 6×10^{-4} C.G.S Temperature outside base = 25^{o}C. Latent heat of melting of ice = 80 cal/gm.

Q.–10 A Answer all the questions : **5**

1. Why the angular displacement, angular velocity and angular acceleration are chosen as kinematic variables of rotational motion ?
2. Write the condition for sliding of solid cylinder on an inclined plane ?
3. Write the unit of intensity of gravitational field.
4. Write the equation to calculate the slope of (y $\rightarrow$ x) graph for a projectile.
5. State Stephen – Boltzmann's law on radiation.

B. Answer any threee of the following **6**

1. Define torque acting on a particle. Explain the physical significance of definition of torque.
2. State and derive Kepler's II law on planetary motion.
3. Define acceleration due to gravity. Explain its variation with respect to distance above the surface of earth.
4. Explain the working of I and II stages of Carnot engine.

C. Solve any three of the following: **9**

1. Angular speed of a wheel is changing from 300 rev/min to 600 rev/min in 5 minutes. Find the angular acceleration and the number of revolutions completed by the whell during this time interval.
2. A simple pendulum, made by suspending a small sphere at the end of a string, is having period T. Now, when the sphere is immersed in a liquid of density 1/3rd of density of material of the sphere and oscillated, find its period of oscillation in the liquid T'. Neglect all resistive forces.
3. A satellite is orbiting the earth at a height five times the radius of earth. Find the period of revolution of the satellite. Take $G = 6.67 \times 10^{-11}$ MKS unit, mass of earth $= 6 \times 10^{24}$ Kg and radius of earth = 6400 Km.
4. As shown in the figure, a horizontal tube closed at one end contains a column of mercury of length 1.2 m. Pressure of either side of mercury column is 10^5 N/m^2. If the tube is now made vertical (closed end downwards) suddenly, find the volume of the enclosed gas in terms of original volume (Density of mercury $= 13.6 \times 10^3$ Kg/m^3 and $\gamma = 1.4$)



Q.–11 A Write Answer in very short : **5**

1. What will be the difference in duration of a day if the ice at Poles of an earth melts and water flow towards the equator ? Increase OR decreases ?
2. Sate the Moment of Inertia with respect to the axis touches solid sphere of uniform density having mass M and radius R.
3. State the unit of ratio of Gravitational constant and Gravitational Acceleration $\frac{\in}{g}$
4. Write Kelvin's statement for second law of thermodynamics.
5. State working efficiency of a Carnot Engine working between 27^{o}C and 127^{o}C temperatures.

B. Writee answer in Eight to Ten statements as asked : (Any three) **6**

1. Obtain the relation between angular velocity and linear velocity in scaler form.
2. What is Geostationary sattelite ? Obtain the necessary equation of height of a Geostationary sateellite from the surface of an earth.
3. Define Isothermal Process. Obtain the equation of work done during Isothermal expansion.
4. Obtain the eqn PV^γ = constant for an adiabatic process

(C) Solve the following Numerical Problems : (Three out of four) 9

1. A body experiences an angular displacement of 250 radians in 4 seconds, at the end of which it has attained an angular velocity of 25 rad/sec. Find its constant angular acceleration and its initial angular velocity.
2. A Bomber Plane is flying horizontally with velocity of 1960 meter from the earth's surface. A Bomb is to be thrown exactly on a city from this plane. At how much distance far away from the city, the plane should be situated that the Bomb falling down from it, falls on the city ?
3. Prove that work done by an ideal gas during an adiabatic process is given by

$$W = \frac{P_1V_1 - P_2V_2}{\gamma - 1}$$

4. The energy of the thermal radiations emitted per second per unit area for two substances with the same surface emissivity has a ratio of 8 : 1. If the hotter body is at 1600 K, find the temperature of the cooler body.

Q.–12 A Answer the following questions in very short as asked. 5

(1) The angular speed of a particle 5 cm away from the axis of rotation of a rigid body is 10 rads/s, then what will be the angular speed of a particle 10 cm away ?

(2) What is the ratio of liner orbital velocity of a satellite orbiting close to the surface if the earth, to the escape velocity of a stationary body on the earth.

(3) ____ is the condition for the motion of a cylinder rolling down a slope without sliding.

(4) 'Work done in a cyclic process is always positive'. Do you agree with statement ?

(5) Give Max Plank's statement regarding thermodynamics second law.

B Answer the following question in eight to ten sentences. (Any three) 6

(1) Prove that rate of change of angular momentum is a Torque.

(2) Define gravitational potential and derive its expression at distance from Mass M.

(3) Derive the relation PV = Constant for an ideal gas undergoing an adiabatic change.

(4) Write a not on the general theory of relating.

C. Solve the following examples. (any three) 9

(1) One mole of an ideal gas is expended adiabatically to four times its initial volume and its temperature becomes 250K. calculate the change in the internal energy of the gas. (r = 1.5 and R = 8.3J/ Mole – K)

(2) A satellite weighting 200 kg is orbiting the earth at 1000 km height above thee surfac. Find the binding energy of the satellite and its escape velocity. Mass of earth if 6×10^{24} and radius is 6400 km.

(3) In a system of three particles, the masses are 2, 3 and 5 kg and their respective position co–ordinates are (2, 1, 3), (3, 9, 7) and (2, 2, 9) meter, calculate the moment of inertia of the system about the Z – axis.

(4) A thin spherical shell is rolling down a slope without sliding. Taking $I = \frac{2}{3} MR^2$, where M = Mass, R = radius for the moment of inertia of the shell obtain its linear acceleration parallel to the surface of the slope.

Q.–13 A Write short answer to the following questions. **5**

1. Write Einsten's opinion about the curvature of geodesic.
2. The equation of linear acceleration of a rigid body rotating with constant angular velocity is ____
3. A hollow sphere is filled with water & suspended as the bob of a simple pendulum. If water slowly flows out of the sphere through a fine hole at its bottom then how does the period of the pendulum change ?
4. Write Max Plank's statement of the second law of thermodynamics
5. Name thee methods of heat transmission.

B. Write answer in Eight to Ten statements as asked (Any three) **6**

1. State theorem of parallel axis and explain its importance.
2. Define a simple pendulum & draw its diagram. Taking $I \frac{d^2\theta}{dt^2} = -g \sin\theta$ as given derive the formula for its periodic time.
3. Writ a detailed note on geo – stationary satellite.
4. Explain thermal conduction in solids.

C. Calculate any three Numerical problems from following. **9**

1. A thin circular dis is rolling down a slope without sliding. Taking $I = \frac{2}{3} MR^2$ (M = mass, R = radius) for the moment of inertia of the disc obtain its linear acceleration parallel to the surface of the slope.
2. A car is moving at 72 KM/Hr. Its wheels are having radii of 20 cm. If on applying the brakes it comes to a halt after executing 20 rotations, how much distance does it move after the brakes were applied ? Also find the angular acceleration ot the wheel.
3. In a carnot engine, the temperature of sink is 27°C. Its efficiencyu is 25%. Find the temprature of the source. If one wants to have 40% efficiency with the same sink temperature, how much temperature increases for the source is required ?
4. Imagine a pendulum suspended from a support vertically above the surface of the earth at on infinite height with thee suspended mass close to the surface of the earth. Prove that such a (hypothetical) pendulum will have a periodic time $T = 2\pi \sqrt{\frac{R_e}{g}}$

Q.–14 A Answer the following questions in short as asked. **5**

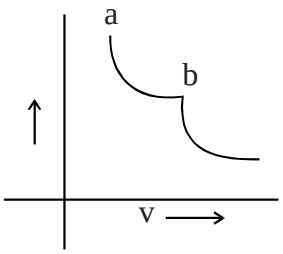
1. Radius of a wheel is 5 cm. It performs 300 rotations in one minute. Find out the linear speed of a a particle at the rim of the wheel.
2. What are Geostationary satelites ?
3. For a projectile $\frac{H_{max}}{R_{max}}$ = ... (Fill in the gap)
4. Compression ratio of an intrnal combustion engine is equal to 32. Find its efficiency (r = 1.4)
5. State thee second law of thermodynamics given by Kelvin.

B. Answer any three in eight to ten sentences. **6**

1. Assumee the expression a = $\frac{2}{3}$ g sinθ for the acceleration of a cylinder rolling down a slope with out sliding. Using it obtain the condition for it to roll with out sliding.
2. Derive the expression V = rω for a rigid body executing rotational motion with proper diagram.
3. Deriving the necessary expression show that the trajectory of a projectile is a prabola.
4. Draw the figure and P → V diagram of internal construction engine and explain intake stroke and compression stroke.

C. Solve any three examples. **9**

1. Find the torque produced if the force acting on a particle is $\vec{F} = 5\hat{i} + 6\hat{j} + 7\hat{k}$ and position vector of the particle is $\vec{\gamma} = 2\hat{i} + 2\hat{j} + \hat{k}$
2. If periodic time of a simple pendulum doubless on increassing its length by 3 meter, find its original length.
3. Prove that the projectiles thrown indirection making equal angles with that of 45° to the horizontal direction have equal ranges.
4. In the figure of P → V diagram ab & be curves shows the isothermal and the adiabatic process respectively prove that at the point b_1 the ratio of the slope for the adiabatic curve to that for the isothermal curve is $\frac{C_P}{C_V}$



Q.–15 A Answer the following in very short as asked. **5**

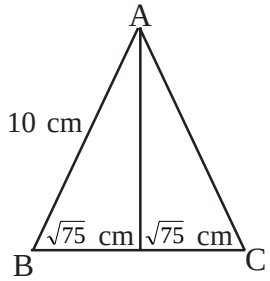
1. When rotating key chain which is wound around the finger, the rate of rotation increases gradually why ?
2. What happens to the value of g when one goes above or below the surface of earth.
3. Efficiency of marine propulsion steam engine is given by $n = 1 - \frac{T_2}{T_1}$ Is the formula correct ?
4. State Max Plank law.
5. In 5 seconds 200 calorie of heat flows normally through a cross section of a slab in its steady thermal state Find the heat current.

B. Answer the following in eight to ten sentences (Any Three) **6**

1. Define angular momentum and areal velocity write the law giving the geometrical representation of law of conservation of angular monentum. Which scientist is credited with this law ?
2. Write down the expression for gravitational potential and the gravitational potential energy at a point on earth's surface and from that obtain the expression for escape velocity.
3. Describe the sequence of strokes is an internal combustion engine and write expression for its efficiency. Drawthe necessary P $\rightarrow$ v diagram.
4. Prove that two different rings having differet diameter when allowed to roll from the same slope they come to bottom of the scope at the same time.

C Solve the following (Any Three) **9**

1. The maximum safe speed for a vehicle on a curved road with 10^o slope and radius of curvature of 200m is 54 km/hr. If the same road has a radius of curvature of 128 m what would have been the maximum safe speed for the vehicle.
2. Prove that a ring rolling down without sliding on a slope of angle θ and height h has a linear acceleration $\frac{1}{2}$ g sinθ along the slope.
3. A carnot engine converts 1/5 of the heat absorbed from the source to work. If the sink temperature is reduced by 70^oC its efficiency becomes twice. Calculate the initial temperature of the source and ths sink.
4. Two spheres each of mass equal to 5 kg are placed at points A and B as shown in figure. If a small sphere of 20 gm is placed at a point P, what will be the acceleration experimented by it due to gravitational force of masses at A and B ? (Assume that mass at P experience only the force due to gravitation of masses A and B)



Q.–16 A Answer the following in short **5**

1. State Kelvin's statement of 2nd of thermodynamics.
2. Write unit and value of Stephen – Boltzman's constant
3. What are geostationary satellites.
4. Emissive power of a substance at 27^oC temp is w_1. What will be the emissive power at 127^oC temp ?
5. Define cyclic process.

B. Answer any three in eight to ten sentences. **6**

1. Draw the necessary figure of a simple pendulum. Assuming $\vec{\tau} = \vec{l} \; x \; m\vec{g}$ derive formula for its periodic time.
2. Define cyclic process Give characteristics of a heat engine based on cyclic process.

3. Assume the expression $a = \frac{2}{3} g \sin\theta$ for the acceleration of a cylinder rolling down a slope without sliding. Using this obtain the condition for it to roll without sliding.

4. Prove $v = \sqrt{\mu rg}$ for a curved road without slope.

C. Slove the following (any three) **9**

1. A car is running at a speed of 72 km/hr comes to acomplete halt in 10 sec, when the brakes are applied to give a constant retardation. If the wheels of the car having radius of 50 cm find angular acceleration of the wheels.
2. In a Cornot engine temp of the sink is at 7°C its efficiency is 40%. If one wants to make the efficiency 50% how much should be the temperature the source be reduced keeping temp of sink constant
3. Length of simple pendulum is *l* cm. Its periodic time is 10 sec. On increasing its length by 10 cm its periodic time increases by 2sec find its original length.
4. A satellit of mass 200kg is orbiting the earth at 1000km height above the surface. Find the binding energy and escape velocity of this satellite. Me = 6×10^{24} kg, R_e = 6400 km, G = 6.67×10^{-11} Nm^2/kg.

Q.–17 A. **6**

1. Which physical quantity has unit cal/m – sec – k ?
2. Write the condition of rolling without slipping from slope in case of a solid cylinder.
3. Why is total energy of a satellite negative ?
4. State Kelvin's second law of thermodynamics.
5. The ratio of temperatures of two bodies of same material are 2 : 3 What is the ratio of their total emissive power ?

B. Answer the following questions in eight to ten sentences (Any three) **6**

1. One end of a uniform rod is kept in contact with a heat source at temperature T_1 and the other end is kept in contact with a heat sink at Temperature T_2. From this state at time t = 0 to t = ∞, draw graphics of T → x at different times, hence explain what is thermal steady state of the rod.
2. What is a geo–stationary satellite ? Derive the expression for height of a geo–stationary satellite from the surface of the earth.
3. Draw the diagram to obtain the parallel axis theorem. Taking $I = \sum m_i r_i^2$ and $I_c = \sum m_i r_c^2$ using the distance formula derive the mathematical form of the parallel axis theorem.
4. Using the formula $\vec{v} = \vec{w} \times \vec{r}$ obtain the formula for the radial and the tangential accelerations.

C. Solve the following examples (Any three) **9**

(1) On a smooth horizontal curved with a radius of curvatur 4 and zero slope (i.e; unbanked) a cycle is moving at a speed of v km/m. Under the given circumstances calculate the inclination to the vertical needed for the cycle so that it does not slip off the road.

(2) What should be the period of rotation of the earth with reference to its rotation axis, so that the acceleration due to gravity becomes zero at equator on its surface ?

(3) Prove that for a adiabatic process, if the temperature changes from T_1 to T_2, the work done by an ideal gas is given by

$$\frac{nR}{\gamma - 1}(T_1 - T_2)$$

(4) Consider the earth as a solid sphere of uniform density. If earth contracts uniformly till its radius reduces to half of its present radius. What will be the duration of a day ?

Q.–18 A Answer the following questions in very short as asked. (5)

(1) Rotation kinetic energy of a rigid body is 10 joule and its meoment of enertia is 5 $J.5^2$ Then its angular momentum will be _____

(2) For what type of the road, any speed is not safe spees?

(3) What is the unit of thermal conductivity?

(4) Why are the handles of doors and windows kept away from the hings ?

(5) What are the assumptions taken in projectile motion.

B Answer any three of the following. (06)

(1) Show that the linear velocity of a solid cylinder rolling without sliding from the top of a slope is $V = \sqrt{\frac{4}{3}gh}$ at the bottom of the slope.

(2) For the projectile motion write the expression for the time taken to attain maximum height. Hence obtain the expression for the range and write condition for the maximum range.

(3) Give the statement of "Stephen Boltzmann Law" what is total emmissive power? Write down the Stphen Boltzmann Law formula in the from of total emissive power. Write the unit of constant occuring in it.

(4) What is escape velocity ? Obtain the expression for escape velocity for the body stationary on the surface of the earth.

C Solve any three of the following. (09)

(1) Prove that for any particle of a rigid body performing rotation about a fixed axis with a constant angular ecceleration and starting with zero angular velocity, its radial acceleration is proportional to its angular displacement.

(2) If the earth were made of iron with a uniform density of 7.86 gm/cm^3 What would be the value of acceleration due to gravity on its surface ? Radius of the earth = 6.37×10^6m and G = 6.658×10^{-11}m Nm^2/kg^2.

(3) 3 mole of gas at 127^0c is isothermally compressed. Hence its volume reduce from 80 litre to 20 litre. Calculate the work done on the system and the heat lost durign this compression. R = 8.3 Joule/mole K and J = 4.2 J/C.

(4) In a carnot engine temperature of the sink is 280 K and its efficiency is 40%. To make its efficiency 50% how much should be reduced the temperature by keeping the source temperature constant ?

Q.–19 A Answer in short as required. **(05)**

(1) A cylinder, sphere and a ring are allowed to roll down an inclined plane; in which order will they reach the bottom ?

(2) Mass of a disc is M and radius is r, moment of intertia of the disc about an axis perpendicular to its plane and touching its edge is.....

(3) If the radius of the earth were to decrease by 2% what would be the percentage change in the acceleration due to gravity on its surface ?

(4) State Stefan - Boltxmann law.

(5) The compression ration of an internal combustion engine is 16 and $\gamma = 1.5$, what is its efficiency?

B Answer in about 8-10 sentence (any three) **(06)**

(1) Derive the formula for work done in case of an isothermal process of an ideal gas.

(2) Explain how thermal conduction takes place in solids.

(3) Show that the motion of a simple predulum for small amplitudes is simple harmonic.

(4) What is gravitational potential ? Derive its expression for any point on the surface of the earth.

C Solve following examples (Any three) **(09)**

(1) A plane flying horizontally with a speed of 600 km/hr release a bomb when it is 2 km vertically above a target. Find by how much distance the bomb will miss the target. (Take g =10 m/s^2)

(2) A car is turning on a curved road of radius 100 m having an inclination of 45^o. What is its maximum safe speed to avoid slipping ? Take g = 10 m/s^2 and coefficient of coefficient of friction between the tyres and the surface of the road as 0.2.

(3) A car is moving with speed of 72 mh/hr. Suddenly brakes are applied and the car comes to rest after 5 rotations of its wheel. Radius of its wheel is 40 cm. Find the distance traveled after brakes are applied and the angular acceleration of its wheels.

(4) 'n' moles of an ideal gas undergo adiabatic expansion from temperature T_1 to $T_{1.}$

Show that the work done by it is $W = \frac{nR}{\gamma - 1}(T_1 - T_2)$

Q.–20 A Answer the following question in very short. **(05)**

(1) What is the reason for the geodesic to be curved ?

(2) Unit of which physical quantity is joule. Sec^2 ?

(3) If the differential equation of simple pendulumm is $\frac{d^2x}{dt^2} = -9x$ than what will be its periodic time ?

(4) At absolute zero temprature (0^0 K,) the heat energy of the OBject is equal to zero. Do you agree?

(5) The total emissive power of an object kept at 127^0 is W_1 ; What will be its emissive power at 527^0 c ?

B Answer any three of the following questions in eight to ten sentences : (06)

(1) Derive Kepler's second law for the orbital motion of the planets.

(2) Assume the expression $a = \frac{2}{3} g \sin\theta$ for the acceleratoion of a cylinder rolling down a slope without sliding. Using it obtain the condition for it to roll without sliding.

(3) What is projectile motion ? Obtain expression for the range of a projectile.

(4) Obtain expression for work done by an ideal gas during an isothernmal change.

C Solve any three of the following example : (09)

(1) The escape velocity for a body at earth's syrface is 11.2 km/S. If a body is projected with velocity 3 times this velocity then obtain its velocity beyond the earths gravitational field.

(2) Position Co-ordinates of two point masses of 10 kg. and 20 kg. are respectively. (5,10,15) and (10,15,20) meter then find the moment of inertia of the system about the x -axis.

(3) In a carnot engine, the temprature of the sink is 280^0 k and its efficiency is 40%. If one wants to make the efficiency 60% then by how much the temprature of the source should be increased, keeping temprature of sink constant.

(4) A (hypothetical) bulbs has ratting of 314 watt. Length of tungsten filament is 0.1 meter and its radius is 5×10^{-5} m. If emissivity of the surface of the filament is 0.8 then claculate the temrature of the filament.

Use $\sigma = 5 \times 10^{-8} \ \frac{\text{watt}}{m^2 k^4}$

Q.–21 A Answer the following questions in short: (05)

(1) A pendulum clock having a period 2 sec on earth is taken to moon. Will it run faster or slower ?

(2) The angular speed of particle is 10 rad/sec. The distance of the particle from rotational axis is 10 cm. what is the linear speed of the particle ?

(3) If the radius of the Earth is decreased by 10%, What is percentage increase in 'g' ?

(4) The projectiles thrown in direction making an angle of 60^o to the horizontal direction what is the ratio of the maximum height the range of the projectile ?

(5) Under what circumtances the efficency of carnot-engine become 100% ?

B Answer any three of the following questions. (06)

(1) Write and prove the theorem of parallel axis in moment of inertia.

(2) Derive keplers second law for the orbital motion of the planates.

(3) What is a projectile motion ? Deriving the necessary expression show that the trajectory of a projectile is a parabola.

(4) Write stephen-Boltzmann Law, Give its mathematical expression and explain it.

C Attempt any three of the following problems. (09)

(1) Prove that a ring rolling down without sliding on a slope of anlge θ and and height h has a linear acceleration $\frac{1}{2}$ g sin θ along the slope.

(2) The maximum safe speed for a vehicle on a curved road with 10^0 slope and a radius of curvature of 200 meter is 72 km/hr. It the same road had a radius of curvature of 108 meter what would have been the maximum safe speed for the vehicale ?

(3) A box is dropped from an aeroplane moving horizantally with a speed of 100 m/sec. If the height of the aeroplane is 2 km. above the surface find (i) the time taken by the box to reach the surface and (ii) by the time it reaches the surface how much horizontal distance will it traverse ?

(4) One mole of gas at 27^0 c is adiabatically compressed so that its pressure becomes 8 times the initial pressure. Find the final temperature of the gas. (Use $\gamma = 1.4$)

Q.–22 A. Answer in short 5

1. If the radius of the earth becomes double without the influence of external torque then length of one day will become ____ hours.
2. The ratio of radii of orbits of two artificial satellites is 4.1 what is the ratio of their periods ?
3. The efficiency of a cyclic proces is 40%. If the not heat absorbed at the end of cycle is 200 cal then the not amount of work done at the end of a cycle is = _____ J.
4. In case of projectile H = R what will be the value of θ ?
5. Total emissive power of a body is X at temperature T. What will be its total emissive power at temperature 3T ?

B. Answer any three of the following questions : 6

1. Using v = wr and drawing necessary diagram, deduc the corresponding vetor relation.
2. Write the expression for time taken by a projectile to reach maximum height and henc derive the expression for its rang. What is the condition to get maximum range ?
3. Define angular momentum and areal velocity. Write the law giving thee geometrical representation of the law of conservation angular momentum. Which scientist is credited with this law ?
4. Write the names of the stays of the carnot's cycle and state the relation between pressure and volume for each stage.

C. Attempt any three of the following problems : 9

1. A planet is orbiting around a star, with its orbital radius equal to 1.5×10^8 Km. The orbital velocity is 40 Km /Sec. Find mass of the star $G = 6.67 \times 10^{-11}$ M.K.S.
2. For a gas, relation between pressure and volume is given by the following expression :

$$P = \frac{a}{v} + \frac{b}{v^2},$$

Where a and b are constants depending on the temperature. Obtain an expression for the work done when volume of this gas is changed isothermally from v_1 to v_2.

3. Prove that the projectile thrown in direction making equal angles with that of 45^o to the horizontal direction have equal ranges.

4. The maximum saf speed for a vehicle on a curved road with 10^o slope and a radius of curvature of 100m is 54 Km/hr. If the same road had a radius of curvature of 200m, what would have been the maximum safe speed of the vehicle ?

Q.–23 A. Answer the following as directed : **5**

(1) How will the time period of a simple pendulum change if its length doubled ?

(2) For a given object will moment of inertia change with change of the axis of rotation ?

(3) ``The atmosphere is held to the earth by clouds." Correct the statement if it is wrong.

(4) Escape velocity of a body of mas 1 kg. From the earth's earth's gravitational field is 11.2 km/sec. ∴ Escape velocity of 10 kg of object under same conditions is .... m/s

(5) Define isothermal change

B. Answer the following questions in eight to ten sentences. (Any three) **6**

(1) State and prove parallel axes theorem.

(2) Define cyclic thermodynamic change. Obtain the equation of efficiency for thee same.

(3) What is projectile motion ? Obtain expression for the maximum height attained by it and time taken to acquire this height.

(4) Write a note on : Stefan – Bolz man law.

C. Solve any three **9**

(1) Temperature of a perfect black body is 2000k and area of ists radiating surface is $\frac{10^5}{5.7}$ cm^2. What heat the body would have radiating in 15 minutes if it has two radiating surfaces.

$\sigma = 5.7 \times 10^4$ erg. cm^2. K^{-4}/sec.

(2) Five mole of gas at 27^oC is allowed to expand isothermally to twice its original volume. Calculate the work done and heat absorbed in one complete cycle. R = 8.314 MKS, 1 cal = 4.2 Joule

(3) On a smooth frictionless inner surface of a funnel. An insect is going along circle of radius r without slipping off the path either way. Show that $V = \sqrt{\gamma\, g \cot\alpha}$, where '$\alpha$' is semi angle of the cone of the funnel.

(4) A50 kg mass is tield at the free end of a rope and accelerates vertically up. A maximum tension the rope can stand–on is 10^7 dyne. Calculate what can be the maxi acceleration produced in the rope.

Question–3

Q.–1 A. Answer the following very briefly : **(5)**

1. What is meant by Resistivity ?
2. A student wrote : "Electromotive force is not a force". Give your opinion.
3. What is a "Solenoid" ?
4. The magnetic flux associated with a coil of 10 turns is changed from 2.5 weber to zero in 0.25 second. Calculate the induced emf between the ends of the coil.
5. The resistance of a volt–meter is I kilo Ohm. Find the high resistance required to make its range 5 times.

B. Answer any three briefly : **(6)**

1. Draw the Wheat stone's network Obtain the condition of balancing the bridge in terms of resistances of its arms.
2. Write a note of Peltier Effect
3. Explain the principle of Potentiometer by suitable fig,
4. Define mutual inductance in two ways. State the factors on which the mutual inductance of two coils depend.

C. Work out any three **(9)**

1. The resistance of an iron wire is 2.4 Ω at 24°C and 4.2 Ω at 124°C.
   Find the temperature coeff' of resistance of iron
2. For a thermocouple, $\alpha = 15\ \mu$ v/°c and $\beta = -0.151.\ \mu$ v/°c^2 find its neutral temperature and inversion temperature.
3. A coil of N turns is made out ofa wire of length L metre Find the max torque experienced by the coil when suspended in a uniform magnetic field B tesla and when a current of I ampere passed through its wire.
4. The flux associated with a coil is given by (in weber)
   $\phi = 9t^2 + 2t - 3$ at time t sec.
   when t = 5 sec, find the emf induced in the coil.

Q.–2 (A) Answer the following question (5)

(1) What do you mean by electric potential gradient ?

(2) What will be a nature of a graph plotted thermo electric power against temperature in seeback's effect ?

(3) If 60 coulomb charges are passed in conducting wire for 5 min. then that what will be number of electrons passing in unit time through wire ?

(4) Write a law of write hand for a direction of magnetic force for a wire carrying current.

(5) What is Inductor ? Draw its circuit symbol.

(B) Answer the following (any three) **(6)**

(1) Prove the electric field $E = \frac{I\varrho}{A}$ for a wire having length L and potential difference V volt is applied between two ends of it

(2) Write a brief not on Fuel cell

(3) Obtain a formula for magnetic intensity at a point situated on axes of aring carrying current with necessary diagram.

(4) Explain a mutual induction for two coils carrying an electric current.

(C) Compute (any three)

(1) A Q quantity of the charges is equally distributed on disc of non–conducting material having radius R. If the disc is rotated around geometric axes with frequency f then find the intensity produced at a center of the disc.

(2) A coil having surface area $0.15m^2$ has 400 number of the turns. When a value of magnetic field intensity changes from 0.2 W/m^2 to 0.4 W/m^2 in 0.2 second which perpendicularis to coil, then find an induced emf in the coil.

(3) Two wires of length L_1 and L_2 and equal cross–section A of the same material are used as fuse, prove that they would melt in the equal time of interval when the equal current is passed through them.

(4) A voltmeter of 1000 Ohms resistance is joint parallel to resistance R. This comination is also connected in series with A meter. When P'D is applied, observation for A meter and voltmeter is 0.07 amp and 50 volts respectively. Find the values of R.

Q.–3 A. Answer in one line/word [5]

1. when potential difference across given wire is increased what happen to drift velocity of charge carriers.
2. n equal resistors are first connected in series then in parallel. What is ratic of maximum and minimum resistance.
3. How electrical energy is related to electrical power.
4. Which physical quantity has unit V–S/A
5. Define shunt

B. Answer in short (any – 3) [6]

1. What is resistivity? On which factor does it depend? Give its unit. Write equation which describes change in resistivity of good conductor with temperature.
2. Write inferences drawn from study of electroplating process.
3. Rectangular coil carrying some current is suspended in uniform magnetic field so that its area vector makes – angle θ with direction of field. Taking appropriate co–ordinate system obtain expression for forces acting on its sides.
4. Write and explain Farady's Law of electromagnetic induction.

C. Solve examples (any – 3) [9]

1. Two wires which are made of same material are having same cross–sectional area, but are of different lengths are used as fuse wires, they will melt for same value of current flowing through them in same time.
2. A current of 0.25 A is passed through and electrochemical cell containing $AgNO_3$ solution for 10 minutes. Find amount of silver deposited on cathode. Faraday constant = 96500 C/mole. Atomic weight of silver = 108 gm/mole valency of silver = 1.
3. A– circular coil having N turns is made form a wire L meter long. If a current of I ampere is passed through coil, which is suspended in a uniform magnetic field B Tesla, Find maximum torque that can act on coil.

4. Coil having 100 turns has surface area 15×10^{-2} m^2. Area vector of coil is kept parallel to field of 0.5 weber/m^2. If coil is now given rotation of 90^o in 0.05 second at uniform rate, what is average emf included in coil.

Q.–4 A. Answer the following questions very briefly : 5

1. A 40 W and a 100 W bulbs are joined in series and connected to the mains. Which bulb will glow brighter ?
2. Why is negative sign used in Faraday's law ?
3. What is open circuit condition?
4. Unit of flux density is..... (a) volt, (b) Weber (c) Weber/meter^2 (d) volt/sec.
5. The colour bands of a carbon resistor are red, green, blue and golden respectively. What will be the value of the tolerance ?

B. Attempt ANY THREE of the following : 6

1. Explain parallel connection of resistances with an appropriate circuit diagram. Derive the expression for its effective resistance.
2. What is Seebeck effect ? Explain how the effect arises. Write down the expression relating the emf generated in a thermocouple with the temperature.
3. Explain the statement : "A simple table voltmeter measures the terminal voltage of a battery and not its emf'.
4. Explain Faraday experiment for E.M. Induction.

C. Solve ANY THREE of the following numerical problems : 9

1. A coil having 100 turns has a surface area of 15×10^{-2} The area vector of the coil is kept parallel to a flux of 0.5 weber/meter^2 If the coil is now given a rotation of 90^o in 0.05 second at a uniform rate, what is the average emf induced in the coil ?
2. Find the value of the self inductance of a very long solenoid of length /, having total number of turns equal to N and cross–sectional area, A.
3. A proton is moving at an angle of 30^o to a uniform field, with a velocity of 4×10^6 m/s; and experiences a force of 6.4×10^{-19} N. Find the intensity of the magnetic field, $e = 1.6 \times 10^{-19}$C.
4. A current of 0.5 A is passed through an electrochemical cell containing $AgNO_3$ solution for 12 minutes. Find out the amount of silver deposited on the cathode.

   Faraday constant = 96500 coulomb/mole.

   Atomic weight of Silver = 10^8 gm/mole, valency of silver = I

Q.–5 A. Answer in very brief. [5]

(1) Your are provided with two fuse wires A & B having cross sectional areas in the ratio 1 : 4. Which one of the two can withstand more current & by what factors ?

(2) A student connects four cells having an internal resistance of $\frac{1}{4}$ Ω each in series but one cell has its terminals reversed. If each cell has an e.m.f. of 1.5 v and the external resistance is 2Ω, then the current flowing is _____ amp.

(3) A wire connected to a bulb does not glow, where as the filament of the bulb glows when the same current flows through them why ?

(4) In an ammeter 10% of the main current is passing through galvanometer. If resistance of the galvanometer is G, what will be the valve of shunt ?

(5) Write Lenz's law.

B. Answer any three in about 10 lines. [6]

(1) How are thermistors made ? what are the uses of thermistor ? write their expression of temp. coefficient of resistance of thermistor.

(2) Write the definitions & units of exlectrochemical equivalent and chemical equivalent. What is Faradya's constant ? Obtain its unit.

(3) A rectangular conducting coil is suspended in a uniform magnetic field such that it can freely rotate. Using the equation of force acting on its vertical sides as BlI, derive equation of torque $\vec{\tau} = NI\vec{A} . \times \vec{B}$

(4) Using Faladays law, obtain = – Blv.

C. Solve any three 9

(1) P & Q are two conducting wires having same mass and are made up of the same material. Diameter of wire P is half that of Q. If resistance of wire P is 48 Ω, find the resistance of wire Q.

(2) On passing a current of 5 amp for 1 hour through a copper Voltameter 7.2 gm copper is deposited on its cathode. Atomic weights of copper & Nickel are respectively 63.57 gm/mole and 58.68 gm/mole. Find the electro chemical equivalent of Nickel. Copper & Nickel have the same valency.

(3) An electron in an atom is revolving around the nucleus in a circular orbit with a speed of 2×10^7 m/sec. If the radius of the orbit is 5×10^{-10} meter. Find the resulting magnetic field at the centre [$e = 1.6 \times 10^{-19}$ coulomb $\mu_o = 4\pi \times 10^{-7} \frac{\text{Tesla.m}}{\text{ampere}}$]

(4) Two long solenoids are of equal length l & the smaller solenoid having a cross sectional area `a' is placed within the larger solenoid in such a way that their axes coinside. Find the mutual inductance ot the system.

Q–6 A Answer in short (5)

(1) If the change in the length of a given wire is 1% what is percentage change in its resistance ?

(2) Define Henry.

(3) A bulb is related 60W, 240V, then what is the maximum value of current which can be allowed to pass through its filament without damaging it ?

(4) What is chemical equivalent of a substance ?

(5) When will emf and terminal voltage of a battery be equal ?

B Answer any three of the following question. (6)

(1) Explain 'joule heat' and 'joule effect'

(2) Write the kirchhoff's second law and show that it represent the law of conserve of energy.

(3) Explain fuel cell with diagram.

(4) What is self induction ? Derive the formula $L = N\phi / 1$ for solt inductance.

C Attempt any three of the following problems. (9)

(1) 1.5 amp current is passing through conducting wire having cross-section of 1.76×10^{-4} met^2 area, The wire is made of a material having resistivity 2×10^{-8} meter. Taking c/m for an electron as 1.76×10^{-11} find the accederation of electron in the wire.

(2) For a thermocouple α = 14 μv (C^{-1}) and β = – 0.07 μv ($^oC^{-2}$) Find the neutral and the inversion tempratures.

(3) A proton and a deuteron having the same kinetic energiers enter a region of uniform magnetic field. Deteron's mass is twice that of a proton. Calculate the ratio of the radii of their resulting circular paths.

(4) The resistance of a coil having 1000 turns is 25 ohm. At some definite time 6×10^{-4} weber flux is linked with coil. If this flux reduce to 10^{-4} weber in 0.1 sec, Calculate the induced emf and total charge circulating in the coil.

Q.–7 A Answer in very short. 5

(1) A wire of resistance 3Ω is cut in to three equal pieces, which are then joined to form a triangle what is equivlent resptance bet anytwo corners of the triangle.

(2) How much electrical energy is consumed by a 100 W lamp used for 6 hours every day for 30 days ?

(3) Plote the graph at temp. Vs thremodectric power.

(4) 4 Voltmeter has aresistance "r" and ranye "V" What resistance should be connected in series with it to increase its range to nV ?

(5) Write the statement of lenz's law.

B Answer the following (Any three) (6)

(1) Accepting the single value d ners of electric potential is a steady circuit, derive Kirchhoff's second law.

(2) Draw the figure of electroplating and write four inferences.

(3) What is a potention meter ? Derive its principle.

(4) Explain mutaul inductance with the help at two coils. Derive $\varepsilon_2 = -M_{21}\frac{dI_1}{dt}$. Hence derive mutual inductance.

C Attemp any three. (9)

(1) Two wires one at aluminium and the otehr made copper are of equal lengths and they also have equal resistances which one at the two will be lighter ? $\varrho_{Al} = 2.63 \times 10^{-8}$ Ω m, $\varrho_{Cu} = 1.73 \times 10^{-8}$ Ω m.density at aluminium 2.7×10^3 kg/m^3 density of aluminium 2.7×10^3 kg/m^3 density of copper 8.9×10^3 kg/m^3

(2) A cell of 1.5 V and 0.1 internal resistance is joined in series with an ammeters and a resistance. Ammeter reads 1.5 A Resistance af ammeter is neglected. Find the rater at (2) Chemical energy used in the (2) energy dirsipated in the cell. (3) energy dissipated in the resistance.

(3) A potentionmeter wire, 2m long has a resistance of 20Ω it is connected in series with 12V battery and some resistance box. Find the value at the resistance required to be used in the resistance box, if a potential gradient at 0.2 V/m is desired (Take r = 0)

(4) Self inductance of an inductor is 50 mH. A current of 1.5 A Flowing in it reduces to zero in 0.5 sec. Find the induced emf.

Q.–8 A Answer in short : 5

1. Two resistances of 20 Ω are connected in parallel and a 20hm. resistance is connecteed in series with the combination what will be te equivalent resistance of the circuit
2. The resistivity of a conductor depends on _____ and _____
3. Define inversion temperature.
4. Write the use of an ammeter.
5. If the change in magnetic flux linked with a circuit is 60 weber in 2 minutes then find the induced emf generated in the circuit.

B Answer the following in eight to ten sentences (Any 3) 6

1. Derive Kirchoff's 1st rule of accepting conservation of electri change
2. What is potentiometer ? Deduce the principle of potentiometer with the help of necessary circuit diagram
3. Derive equation of force acting between two parallel conductor of length ``*l*'' carrying electric currents
4. Derive the expression for self inductance of a long solnoid.

C Solve the following (Any 3) 9

1. A and B are two conducting wires having the same mass and are made of the same material. Diameter of A is half, that of B. If resistance of wire A is 48. Find resistance of wire B.
2. A secondary cell has an internal resistance of 0.5 ohm and has emf. equal to 12 volt. It is to be changed using a d.c. source of 112 volts. If a changing current of 4 amp. is required what should be the value of resistance needed in series
3. Obtain an expression for the magnetic field at the mid point on the axis of a solenoid with n turns per unit length of length ``*l*'' raduis ``R'' and carrying a current ``I'' unit.
4. A coil having 100 terns has a surface area 0.12 m^2. A flux of strength 0.10 weber/m^2. linked perpendiuclar to this area changes to 0.5 weber/m^2 in 0.2 second. Find the emf induced in the coil.

Q.–9 A Answer the following in short 5

1. What will be the resistance of a wire if it is stretched to increase its length for four times ?
2. The unit of emf is ....
3. “Thermoelectric power is first derivative of thermo emf w.r.t time” true or false ?
4. Write Lenz’s law.
5. Write the statement of Joules law.

B. Answer any three in eight to ten sentences. **6**

1. Prove that the value of current is given by I = nAve
2. On which factors does the self Inductane of a coil depend ? Derive

$$E = L \frac{dI}{dt} \text{ from } L = \frac{N\phi}{I}$$

3. Accepting the single valuedness of electric potential in a steady circuit derive Kirchoff's second law.
4. Write note on "Thermistors"

C. Solve the following (Any three) **9**

1. Resistance of silve wire is 3Ω at 30° C and at 100°C it is 3.5Ω Find its temperature co–efficient of resistance.
2. Apotentiometer wire is 8 mt long. Its resistance is 8. It is connected in series with a 2volt battery and a resistance box. Find the value of resistance required. $\sigma = 10^{-3}$ V/cm
3. A circular coil having an average radius of 6cm has 100 turns. A current of 5 amp passes through it. Find the magnetic field at a point on its axis 8cm from the center. $\mu_0 = 4\pi \times 10^{-7}$ w/met – amp
4. A system formed by two coils has a mutual inductance of 16×10^{-3} H If the rate of change of current in one of the coils is 1.6 amp/sec find the emf induced in the other coil.

Q.–10 A **5**

1. A current of 5A flowing through a very long straight wire. What will be the magnetic field at perpendicular distance 4cm from the wire ?

   $\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1}
2. Resistance of a galvanometer 50Ω. To obtain six times range. What should be resistance of shunt to be connected in parallel.
3. Why is the magnetic field of a moving coil galvanometer kept radial ?
4. 30 Coulomb of charge passes through a conducting wire for 5 minutes. What will be the number of electrons passing through the conductor in unit time ?
5. Explain the statement :

   Potential difference is V volt between two ends of a conductor

B. Answer the following questions in eight to ten sentences. (Any three) **6**

1. State, "Lenz's Law" and explain that Lenz's law is in consequence of the law conservation of energy.
2. Magnetic field intensity at a point on the axis of a solenoid carrying current

$$B(x) = \frac{\mu_o n\, dx\, Ia^2}{2\left(a^2 + x^2\right)^{3/2}}$$

   Assuming this derive the formula for magnetic field intensity produced in a very long solenoid.

3. Prove the relation :

$$\varrho = \frac{m}{ne^2\tau}$$

4. Explain the working of a fuel cell with a neat diagram.

C. solve the following examples. (Any three) **9**

1. A proton and a deutron having the same kinetic energies enter a region of uniform magnetic field. Deuteron's mass is twice that of a proton. Calculate ratio of the radii of their resulting circular paths.
2. A conducting frame of U shape is placed in a uniform magnetic field B in a such a way that the plane of the frame is perpendicular to the field lines. A conducting rod is supported on the parallel arms of U, perpendicular to them and is given a velocity V at time t = 0. Prove that the velocity of the rod at time t will be given by

$$V_t = V_{exp}\left[\frac{-B^2 l^2}{mR}\cdot t\right]$$

R = resistance of the circuit

M = mass of the rod.

I = distance between two arms.

3. A current of 0.5A is passed through an electrochemical cell containing $AgNo_3$ solution, for 12 minute. Find out the amount of silver deposited on the cathode. Faraday constant = 96500 coulomb/ mole

Atomic weight of silver = 108 g/mole, valency of silver = 1.

4. A battery having an emf of 12 volt and an internal resistance of 2 ohm is connected to another battery having an emf of 18 volt and an internal resistance of 2 ohm in such a way that they are opposing each other, and the circuit is closed. Calculate the following.
   a. Terminal voltage of the two batteries.
   b. Electric power consumeed in the batteries.

Q.–11 A Answer the following questions in very short. **5**

1. 'Drift velocity of the electron is from higher potential point to lower potential point' – Do you agree with this statement.
2. What is meant by kilo–watt hour ?
3. What is meant by potential gradient ?
4. A square coil having area of 10^{-2} m^2 is placed in a uniform magnetic field perpendicular to it, then flux passing through the coil is ____.
5. Two solinoids A and B have same length and equal self inductance. The number of turns of solenoids A and B are 100 and 200 respectively. Calculate the ratio of the radius of their cross – sections.

B. Answer the following questions in eight to ten sentences : (Any three) **6**

1. Assuming that is a steady circuit, the electrical potential at any point is single valved, derive Kirchoff's second rule.

2. Giving appropriate illastration, explain the process of electroplating. Write important conclusions drawn from the study of electroplating process.
3. Derive the necessary formula for the series resistance for converting a galvanometer into a voltmeter.
4. State and explain Lenz's law.

C. Solve the following examples (Any three)

1. A and B are two conducting wires having the same mass and they are made of the same material Diameter of wire A is double that of B. If resistance of wire A is 20Ω, find the resistance of wire B.
2. A battery having an emf E and an internal resistance r is connected with a resistance R. Prove that the power in the external resistance R is maximum when R = r
3. Coil of galvanometer has a resistance of 20Ω. Full seale deflection is registered on passing a current of 10 mA through it. Find the length of wire to be used as a shunt with it so that it can measure 10 A full scale. Diameter of the wire is 2 mm and resisttivity of its material is 3.14×10^{-7} ohm – meter.
4. Flux linked per each turn of a coil of N turns changes from ϕ_1 to ϕ_2. If the total resistance of the circuit including the coil is R, prove that the charge Q induced is given by

$$Q = \frac{N(\phi_2 - \phi_1)}{R}$$

Q.–12 A Answer all the questions : 5

1. Resistive wires used in resistance box should have less value for temperature coefficient of resistivity Why ?
2. Write the use of hydrometer.
3. State Biot–Savart's law on magnetism.
4. Write Ampere's method to find the direction of magnetic force acting on a current element kept in a magnetic field.
5. A bar magnet is moving towards a coil, keeping its north pole towards the coil. Find the type of pole induced at other end of the coil.

B. Answer any three of the following : 6

1. Write a note on Wheatstone bridge.
2. Write a note on fuel cell.
3. Derive an equation to calculate the intensity of magnetic field inside a solenoid of infinite length.
4. State Faraday's law on electromagnetic induction. A conducting rod is sliding on a U shaped metallic frame kept in a magnetic field. If the length of the rod, its direction of motion and the magnetic field are mutual perpendicular, derive an equation to calculate the induced emf across a conducting rod.

C. Solve any three of the following : 9

1. A hollow cylindrical shell has inner radius 1 cm and outer radius 1.5 cm. Its length is 5 m. If the resistivity of its material is 2.75×10^{-6} Ω–m, find its resistance.

2. Two electrochemical cells, one having $CuSO_4$ and the other having $AgNO_3$ as electrolytes, are connected in parallel with a battery. On passing some current for 1000 sec, 1.12 g copper accumulates on one cathode and 0.66 g silver accumulates on the cathode of th other cell. If the electrochemical equivalents of copper and silver are respectively 11.2×10^{-4} g/C and 6.6×10^{-4} g/C, and the total power consumed from the cell is 24 W, find the emf. of the battery. Neglect internal resistance of the battery.
3. A charge Q is uniformly spread over a disc of radius R, made from a non conducting material. This disc is now rotated about its geometrical axis with frequency f. Find the magnetic field generated at the center of the disc.
4. Area vector of rectangular coil of 60 cm^2 area makes an angle of 60^o with a uniform magnetic field. If, from this position the coil is rotated in 0.1 sec, so that the angle made by the area vector with the field becomes 120^o, find the average induced emf in the coil. The magnetic field intensity is 0.6 T and number of turns in the coil is 1000.

Q–13. A. Write answer in very short : 5

1. Write the equation of temperature co–efficient of a Thermistor.
2. "Most of the liquids are electrically non – conductor" why ?
3. For a thermo couple $\alpha = 14\mu V/^oC$ and $\beta = -0.07\ \mu\ V/^oC^2$ the find out Neutral temperature.
4. Define 1 Ampere electric current in reference of electric current passing through two very long conducting wires placed parallel to each other.
5. $\phi = 7t^2 + 2t - 3$ where ϕ is in weber and t is in sec. Then find out e.m.f. at the end of 2 sec.

B. Write Answer of any three in Eight to Ten statements from the following : 6

1. Draw circuit diagram of Wheastone Bridge. Derive the equation related the resistances of its different arms in its equilibrium condition.
2. Draw the schematic diagram of a Fuel cell and state it's uses.
3. State principle of pivoted Moving Coil Galvbanometer Prove that $I \alpha \phi$ here ϕ = deflection of coil.
4. Define 'Mutual Inductance' On which factors the mutual inductance of a system of two coils.

C. Calculate any three Numerical Problems from following : 9

1. A charge Q is uniformly spread over a disc of radius R made from a non conducting material. This disc is now rotated about its geometrical axis with frequency f. Find the magnetic field generated at the center of the disc.
2. A coil having 500 turns has surface area 0.25 $meter^2$. A flux of strength 0.20 wb/m^2 linked perpendicular to this area charges to 0.70 wb/m^2 in 0.4 second. Find the e.m.f induced in the coil.
3. A and B are two conducting wires having the same mass and are made of the same material. Diameter of wire A is half that of B. If resistance of wire A is 32 Ohm, find the resistance of wire B.
4. A and B are two electric bulbs with their ratings respectively 40W, 110v, and 100w, 110v. Find their respective filament resistances. If the bulbs are connected in series with a supply of 220v. which bulb will fuse ?

Q.–14 A Answer the following question in very short as asked. 5

(1) _____ electrons passes in one second through a cross section of a conductor carrying 4.8 A current.

(2) The specific gravity of a fully charged lead storage cell is _____

(3) What is thermistor ? Where is it used ?

(4) On incressing the length of the potentiometer wire potential gradient on it _____

(5) State Lenz's law.

B Answer the following questions in eight to ten sentences (any three) 6

(1) With a neat diagram explain "Electro plating." State the important points to be remembered during the process.

(2) Draw the circuit diagram of a wheat stone's bridge and derive the condition to get a balanced bridge.

(3) Obtain an expression for the torque on a rectangular coil carrying current suspended in a uniform magnetic field.

(4) Explain – self Inductance

C Solve the following examples. (Any three) 9

(1) A conducting wire has resistance of 10 ohm. It is stretched uniformly till its length increase by 3% Calculate the new resistance.

(2) 6 batterie, each of 2 volts are connected in series. So that they are helping each other. Internal resistance of each is 0.5 ohm. They are being charged using a direct voltage supply of 110 volts. To control the current, a resistance of 46 ohm is used in the series. Obtain (i) power drawn from the supply and (ii) power dissipated as heat.

(3) The resistance of a coil having 100 turns if 25 ohm. At same definite, 6×10^{-4}. Weber flux is linked with the coil. If this flux reduces to 10^{-4} Weber in 0.1 sec, calculate the induced emf and total charge circulating in the coil.

(4) A porton and a deuteron having the same kinetic energies enter a region of uniform magnetic field. Deuteron's mass is twice that of proton. Calculate the ration of the radii of their resulting circular paths.

Q.–15 A Write short answer to the following questions. 5

1. Colour bands of red, yellow, blu and gold are found on a carbon resistor. What is the value of its resistance ?
2. On passing 2A current through a conductor for 10 sec, 30 J heat is produced then find the resistance of the conductor.
3. Write the formula of Lorentz Force.
4. Write the use of R in potentiometer.
5. What is the effect of increasing the current in the self inductance of a coil ?

B. Write answer in Eight to Ten statements as asked. (Any Three) 6

1. Distinguish between 'Series' and 'parallel' connection by giving two points.
2. What is Seeback effect ? What are thermocouple and thermoelements ? Give reason for e.m.f.

3. In case of a ring carrying electric current, show that intensity of magnetic field of a point on at the axis of the ring distance x from the center of the ring due to a current elements $Id\vec{L}$ is, $dB(x) = \frac{\mu_o I}{4\pi} \frac{dl}{r^2} \cos\phi$, ϕ = angle made by the joining the element with given point and the line joining the element and the center of the ring.
4. Derive the expression for self – inductance of a long solenoid.

C. Calculate any three Numerical Problems from following. **9**

1. Two given materials, have their α_1 and α_2 are 6×10^{-4} $(^oC)^{-1}$ and -5×10^{-4} (^oC) respectively. Resistivity of the first material is $\rho_{20} = 2 \times 10^{-8}$ Ω m. If one wants to prepare a material mixing these two such that its resistivity does not change with the temperature, what should be the resistivity does not change with the temperature, what should be the resistivity of the second material ? Assume that the resistivity of the mixture is the sum of the resistivity of the individual components.
2. Two wires which are made of the same material are having same cross sectional area, but are different lengths l and l_2. Prove that if they are used as fuse wires, they will melt for the same value of the current flowing through them
3. Resistance of a galvenometer is 6 ohm. It is connected in series with a resistance of g ohm and a battery of an internal resistance 1 ohm. The galvenometer deflects by 65 divisions. Now if the galvanometer is shunted with a 6 ohm resistance. What will be the deflection recorded.deflection recorded.
4. The resistance of 4 coil having 1000 turns, is 25 ohm. At some definite time 6×10^{-4} weber flux is linked with coil. If this flux reduces to 10^{-4} weber in 0.1 sec, calculate the induced emf and total change circulating in the coil.

Q.–16 A. Answer in short as asked. **5**

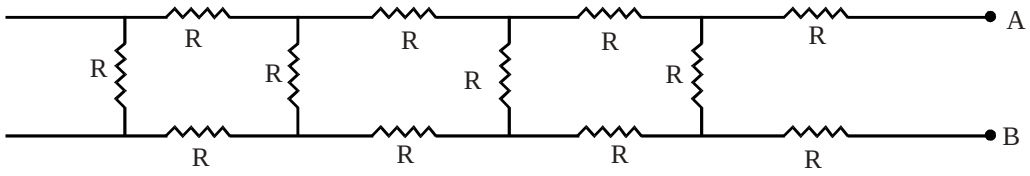
1. A circular resistive wire has resistance equal to 10Ω. Then what will be the resistance between any two end points of the diameter ?
2. For which substance is the temperature coefficient of resistivity negative ?
3. Give the direction of e.m.f. in sb – Bi thermocouple
4. What is the unit of magnetic moment ?
5. Define the unit "henry".

B. Answer any three in eight to ten sentences. **6**

1. Potential difference V is applied between two ends of a conductor of length L. Then prove that the electric field produced in the conductor is E = n veϱ
2. Describe th process of electroplating giving one example.
3. Explain the principle of potentiometer with a necessary diagram.
4. Explain mutual induction with an illustration of two coils. Give any one definition of mutual inductance and obtain $E_2 - M_{21} \frac{dI_1}{dt}$

C. Solve any three examples. **9**

1. If *g* an infinite series R resistance are connected as shown in fig. belong



Find the equivalent resistance between the points A and B.

2. A battery having an e.m.f. e and an internal resistance r is connected with a resistance R. Prove that the power in the external resistance R is maximum when R = r
3. If the voltage efficiency of a galvanometer is to be done n times then provve that the required series rsistance is (n – 1) times that of the resistance of galvanometer.
4. Two solenoids, each of 1.5 meter length and having cross – sections such that the larger onee just fits outside the smaller one are placed coaxially with their ends matching each other. The smaller solenoid has 1500 turns and the larger one has 500 turns. If the cross sectional area of the smaller solenoid is 15×10^{-4} m^2, find the mutual inductance of the system. $\mu_o = 4\pi \times 10^{-7}$ $\frac{T-m}{A}$

Q.–17 A Answer the following questions in very short as asked. **5**

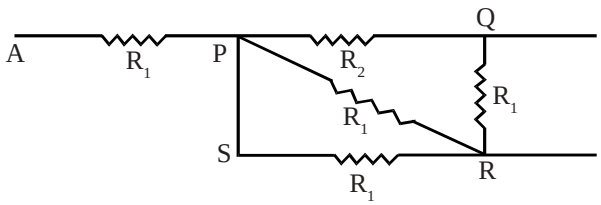
1. When thee storage battery is fully charged the specific gravity of electrolyte is ____.
2. On incresing the temperature of a germanium semi conductor 3°C near the room temperature its resistance decrease by about ____ %
3. Lorentz force of $10\hat{i}$ N is acting on the particle of charge 5c when it is passing through the magnetic field of intensity $2\hat{k}$ Tesla with velocity $25\hat{j}$ M/s, then electric field vector is ____
4. Define mutual inductance.
5. The resistance of a voltmeter, after increasing its voltage range 'n' times is ____

B Answer the following in eight to ten sentences (Any three) **6**

1. State Kirchoff's law of conservation of electric charge and explain it.
2. State lenz's Law. What does rate of change of magnetic flux with the time indicate ? Also give its unit.
3. State Farady's law of electromagnetic induction and derive the expression E = – Blv.
4. Write a note on see back effect.

C Solve the following (Any Three) **9**

1. Find the resistance between A and B in the following circuit



2. Area vetor of a rectangular coil of 50 cm^2 area makes an angle of 60^o with a uniform magnetic field. If from this position the coil is rotated in 0.1 second so that the angle made by the area vector with the field becomes 120^o, find the average emf induiced in the coil. The magnetic field intensity is 0.5 weber/M^2. Number of turns in the coil is 100.
3. A 3 coulomb charge passes with a velocity of $50\hat{j}$ met/sec through a region having a uniform magnetic field $2\hat{k}$ Trsla and some uniform electric field. If the Lorntz force acting on it is $300\hat{i}$ newton, find the electric field in the region.
4. A battery of any E and central resistance r is joined to a resistance R. Show that when R = r, power is maximum in the external resistane R.

Q.–18 A Answer in short **(5)**

(1) A wire of uniform cross-section area has resistance of 16 Ω. It is bent to form a sqaure. Find effective resistance between consecutive vertices of the square.

(2) Define peltier e.m.f.

(3) What value of shunt should be connected to an ammeter having resistance of 2 Ω, so that 50% of total current passes though it?

(4) Give two units of L/R.

(5) Write the color code of resistance having value 3.9×10^6 + 20% Ω.

B Attempt any three of the following. **(6)**

(1) State Kirchoff's second law and show that it is a specific example of conservation of energy.

(2) Giving appropriate circuit diagram and expression, describe of secondary cell.

(3) What is a shunt? Obtain the expression for the shunt value.

(4) Two solenoids are of equal length 1 and the smaller solenoid having a cross Section are "a" is placed within the large solenoid in such a way that their axes coincide. Find the mutual inductance of the system.

C Attempt any three of the following. **(9)**

(1) Two wires A and B have mass and are made of the same material. Diameter of wire A is double that that of B. If resistance of wire A is 64 Ω, find the resistance of wire B.

(2) Electro chemical equivalent of Ag is 11.18×10^{-7} Kg./C, its valence and atomic mass are 1 and 108 respectively. Atomic mass and velence of Au are 197 and 3 respectively. Find electro chemical equivalent of Au.

(3) Obtain the expression for the magnetic field at the midpoint on the axis of a solenoid with n turns per unit length, of length L, radius a and carrying a current of I units.

(4) A rod of length 10 cm is moving at rigth to uniform magnetic field of 5 tesla with velocity 36 km / hr. Calculate the E.M.F induced in the rod.

Q.–19 A Answer the following question in very short. **(05)**

(1) As electric iron is of 2000 W capicity. If it is to be converted in 1000 w capicity. What change should be made in the resistance of the coil ?

(2) A current of 5 mA is flowing in a wire No. of electrons passing through each cross-section of this wire per second is _____

(3) What is the resistance of an ideal ammeter ?

(4) When the north pole of a magnet in moving away from a coil, the end of the coil facing the north pole of the magnet will behave like which pole of the magnet ?

(5) Give the formula for magnetic force acting on a charge ? Which enters in a magnetic feld $\overrightarrow{B}$ with velocity $\overrightarrow{V}$

B Answer any three of the following.

(1) If a voltage V is applied to a conductor of length l, prove that the electric held produced in the conduction is E = n ve ϱ ?

(2) Explain the processes occuring at the terminals of the fuel cell. Write its usefulness.

(3) Obtain the expression for the force acting on two parallel and straight current carrying wires from that obtain definition of ampere.

(4) State what is meant by the term electromagnetic induction. Define indicated electromotive force and induced electric current.

C Solve any three of the following. **(9)**

(1) A cube is made with 12 wires each having the same resistance find the equivalent resistance between any two of its diagonally opposite points.

(2) If the resistance of two bulbs are R1 and R2 respectively and their rating are 60 w/220 V...and 100W/220V respectively, find the values of R1 and R2. If these bulbs are connected in series with a supply with a supply of 440V, which bulbs will fuse first ?

(3) A 4 meter long solenoid has average radius 5 cm. If the solenoid carrying a current of 5 mA. find the intensity of magnetic field inside the solenoid $\mu_0 = 4\pi \times 10^{-7}$ T mA^{-1} Number of trans of solenoid is 1000.

(4) Suppose the flux linked per each of a coil of N turns changes from ϕ_1 to ϕ_2. If the total resistance of the circuit including the coil is R, prove that the charge induced is given by $Q = \frac{N(\phi_2 - \phi_1)}{R}$

Q.–20 A Answer in short as required: **(05)**

(1) What is emf of batter?

(2) "Thermoelectric power is first derivative of thermo emf w.r.t. time." It is true or false?

(3) A charged practicle enters prependicularly in to an uniform magnetic field and is moving in it. What will be the work by the magnetic force on the particle ?

(4) A plane is placed in the magnetic field. The magnetic flux related with it is...

(a) $\phi = \vec{B} \cdot \vec{A}$ (b) $\phi = \vec{B} \times \vec{A}$ (c) $\phi = \vec{A} \times \vec{B}$ (d) $\phi = AB$

(5) Resistance of wire is 10 Ω 6.25×10^{19} electrons passes in a 10 seconds from the cross section of this wire. What will be the amount of energy spent in the wire during 10 second ? Here e = 1.6×10^{-19} C.

B Answere in about 8-10 sentence (any three) (06)

(1) Define ampere and give the explanation of law of conservation of electrical charge.

(2) Write note on Thomson Effect.

(3) What is shunt ? Write down it's used and derive an experession for shunt.

(4) How the induced emf can be generated in the coi without using a bar magne ? Explain by an experiment of two coils palced near each other.

C Solve following examples (Any three)

(1) Cross section of a conductor carrying a current of 1.5 amp is $10(mm)^2$. The number of electrons per unit volume of its material is 18×10^{29}. Calculate the electron drift velocity. (Charge of electron = 1.6×10^{-19} coulomb)

(2) An electric motor is connected to a 50 volt d.c. supply and draws 5 amp current. If mechanical efficiency of this motor is 30% find the resistance of its windings.

(3) A potentiometer is 8 m long. Its resistance is 8 Ω. It is connected in series with a 2 volt battery and a resistance box. Find the value of the resistance required to be used in the resistance box, if a potential gradient of 1 milli volt/cm is desired.

(4) Magnetic flux linked per each turn of coil of N turns changes from ϕ_1 to ϕ_2 If the total resistance of the circuit including the coil is R, Prove that the charge Q inducced is given by $Q = \frac{N(\phi_2 - \phi_1)}{R}$

Q.–21 A Answer the following questions in very shor : (05)

(1) Four colourbands on a carbon resister are red, yellow, green, and silver. State its resistance.

(2) What is an electrolyte ?

(3) What is a shunt ?

(4) Write principle of moving coil galvanameter.

(5) Lenz's law is actually a statemet of _____ (Fill in the blank)

B Answers any three of the following in eight to ten sentences: (06)

(1) Obtain the expression for the magnetic field at a point inside a long solenoid carrying current, on its axis.

(2) Explain parallel connection of resisntance with appropricate circuit. Derive the expression for its effective rsistance.

(3) Draw a figure of $H_2 - O_2$ fuel cell. Explain its working.

(4) Prove the relation E = – Blv for a rod moving with uniform velocity in uniform magnetic field.

C Solve any three of the following examples : (09)

(1) Two Coils placed near each other have number of turns respectively equal to 300 and 600. On passing a current of 3.0 Ampere through Coil - A, the mag. flux linked with Coil - A is 1.2×10^{-4} weber and mag. flux linked with coil -B is 1.2×10^{-4} weber. Find self inductance of Coil -A and mutual inductance of the system formed by A and B.

(2) Resistance of a galvanometer is 4 ohm. It is connected is series with a resistance of 4 ohm and a battery of internal resistance of 1 ohm. The galvanometer, deflcets by 80 divisions. Now if the galvanometer is shunted with 4 ohm. resistance then what will be the deflection recorded ?

(3) A cube is made with 12 wires with each having the same resistance. Find the equavalent resistance between any two of its diagonally opposite points.

(4) 6 batteries, each of 2 volts are connected in series so that they are helping each other. Internal resistance of each is 0.5 ohm. They are being charged by using direct voltage supply of 110 volts. to control the current, a resistance of 46 ohms. is used in series. obtain power drawn from the supply and power dissipated as heat.

Q.–22 A Answer the following questions in shorts. **(05)**

(1) One neno-coulumb electric charge consist of _____ no of electrons.

(2) There are two copper wires. The cross-section and length of one wire are A and l, respectively. And for the other wire cross-section A/2 and length 2l. How many time the resistance of second wire is greater then the resistance of the first wire ?

(3) Give the statement of Joule's law with respect to the thermal effect of an electric current.

(4) Give the examples of primary cell.

(5) Give the value of intensity of magnetic field produced in a very long (infinite) solenoid.

B Answer any three of the following question. **(06)**

(1) Write a short note on "Thermistors".

(2) What is seebeck effect ? Explain how will it produce ? Give expression showing the relation between Thermo emf and temperature and draw necessary graph.

(3) What is potentiometer ? With circuit diagram explain the principle of potentiometer.

(4) State the Lenz's law, Explain it with reference of law of conservation of energy.

C Attempt any three of the following problem. **(09)**

(1) Atomic weight for copper is 63.54 gram/mole and its density is 8.9×10^3 kg/m^3. If its valency is 1. Find the number of free electrons per unit volume (A Vogrado no is 6.02×102^3 /mole)

(2) Emf generated in a thermocouple is given by an expression $e = \alpha t + \beta t^2$ If the reference junction kept at 0^0 c and the emf generated is e =1 mV find the temperature of the hot junction.

$\alpha = 5 \times 10^{-2}$ (Volt) $\times$ ($^0c^{-1}$)

$\beta = 50 \times 10^{-9}$ (Volt) $\times$ ($^0c^{-2}$)

(3) A charge Q is uniformly spread over a disc of radius R made from a non-conducting material. This disk is now rotated about its geometrical axis with frequency f. Prove that the magnetic field generated at the centre of the disc is

$$B = \frac{\mu_0 Q f}{R}$$

(4) A conducting bar of 2 m length is allowed to fall freely from the top of the Tower keeping it aligned along the east-west direction. The emf induced in the rod when it comes to the ground is 2.1 mV. Find the height of the Tower.

(Horizontal Component of earth's magnetic field is 0.35×10^{-4} T g = 10 m/s^2)

Q.–23 A Answer the following questions in very short as asked **5**

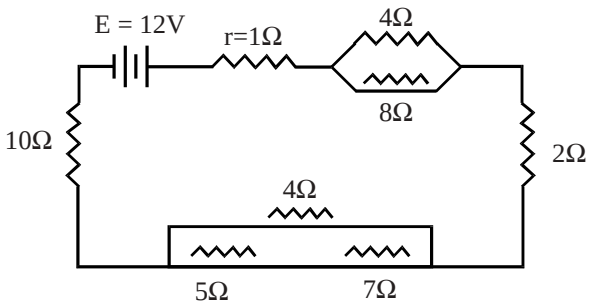
1. Terminal voltage of a cell is 5V. Calculate the net amount of energy gained by 5 coulomb charge while passing through the cell.
2. What is the direction of the thermo emf in sb–Bi thermocouple.
3. If voltage capacity if a galvanometer of 1000 Ω resistance is 20 V theen find its current capacity.
4. Write the eqation of the principle of potentiometer.
5. Write the equation of self –inductance of a solenoid.

B Answer the following questions in eight to ten sentences. (Any three) **6**

1. Prove that the intensity E = nvep, in case of applying potential difference V between two ends of a conductor having length of ``L''.
2. What is Joule heat ? Derive the expression W = I^2 RT for it.
3. Derive equation of force acting between two parallel conductor of length ? Carrying electric currents.
4. Derive the expression for self – inductance of a long solenoid.

C solve the following examples (Any three) **9**

1. Find the current flowing through the electrical cell in the circuit given below



2. On passing a current of 3 amp for 1hr through Copper voltammeter 3.6 gm is deposited on its cathode. Atomic weights of copper & nickel are respectively 63.57 gm / mole and 58.68 gm / mole. Find the electrochemical equivalent of nickel copper and nickel have the same valences.
3. Coil of a galvanometer of 20Ω. Full scale deflection is registered on passing a current of 5 mA through it. Find the length of wire to be used as a shunt with it so that it can measure 5A full scale. Diameter of the wire is 2mm and resistivity of its material is 3.14×10^{-7} ohm–meter.
4. A Conductivity loop of radius `r' is placed concentric with another loop of a much larger radius R. So that both the loops are coplanar. Find the mutual inductance of the system of the two loops. Take R >> r.

Question–4

Q.–1 A. Answer the following very briefly : **(5)**

1. Find the frequency of current in the a.c circuit with source voltage
   V = 250 sin 100 t.
2. Write the values of inductive reactance and capacitive reactance in L–C–R. a.c. circuit.
3. Do you agree with the statement :
   "Longitudinal waves cannot be polarized." Why ?
4. What is meant by Optical Axis ?
5. Find the wavelength of the radiation of frequency one mega hertz

B. Answer any three briefly : **(6)**

1. If an a.c. voltage is V = Vm cos wt Obtain the differential equation of charge in L–C–R circuit.
2. Explain the working of the transformer in power transmission. (Describe the working of a step–up transformer) with the necessary diagram.
3. Write a note on Green House effect.
4. Define plane of vibration & plane of polarization. Explain by drawing necessary diagram.

C. Work out any three. **(9)**

1. An inductor L and resistor R are connected in series with an a.c. voltage source, the max. value of a.c. voltage is 250 volt and max. current is 0.25 A Calculate the power and power factor of the circuit (reactance of the coil is 400Ω and resistance is 300 Ω)
2. Through an artificial satellite for mass communication waves of wavelength 5 mm to 500 cm are used. Find the frequency range corresponding to this wavelength range.
3. In an experiment of Young's fringes by double slit light of wave lengths 6500 $\mathring{A}$ and 6000 $\mathring{A}$ are used. At what minimum distance from the central maximum do the two maxima of these waves will over lap ?
   d = 0.5cm and D = l00 cm
4. The ratio of intensities of light from two coherent sources is α Then show that
   for the interference pattern, $= \frac{I_{max} + I_{min}}{I_{max} - I_{min}} = \frac{1+\alpha}{2\sqrt{\alpha}}$
   where I max = intensity of maximum brightness
   I min = intensity of minimum brightness.

Q.–2 A Answer in short **(5)**

(1) What is series resonance ?
(2) Define Q factor
(3) Define circularly polorised light
(4) At what height ozone layer is situated from the earth ?

(5) In Young's experiment, a ratio of maximum and minimum intensity for interference fringes is 16 : 1. Find ratio of amplitude of waves, when they are intercepted.

(B) Answer (any three) **(6)**

(1) For a A.C. circuit with R and C in series show impedance in complex plane. Also find its value. Write a formula for the current in this case. Draw a graph of phase, for voltage and current

(2) Draw a circuit diagram for induction coil with usual notation. Narrate the work function of the coil and also write their used.

(3) Write a short note on modulation.

(4) Discuss a first maximum in the Fraunboffer's diffraction by single slit.

(C) Calculate (any three) **(9)**

(1) Find the equation of the current for A.C. circuit having only inductor with frequency 159.2 Hz Vm = 200 volts and inductance 10 mH

(2) For a transformer, number of the turns is 2000 and 200 reply for primary and secondary coils. If the current passing from primary coil (Irms) is 4 amp then find the current passing from secondary coil.

(3) Find the distance between 4th bright fringe and 6th non–bright fringe in Young's experiment when the distance between two slits is 0.08 cm and distance between slit and screen is 1 meter.

(4) Prove that we can obtain maximum 9 bright fringes on the screen in Young's experiment when distance between two fringes is four time the wave length of the light source used in it.

Q.–3 A. Answer in one line/word **[5]**

1. What would be the rms value of $V = Vm \cos \omega t$
2. In LCR a.c circuit if $\omega = \frac{1}{\sqrt{LC}}$ Then what will be the phase difference between current and voltage
3. For radiated components amplitudes diminish slowly as _____
4. The frequency of waves generated in Hertz experiment is same as frequen of_____.
5. Define franhoffer diffraction

B. Answer in short (any – 3) **[6]**

1. Voltage applied to a.c circuit with L–C–R in series is $V = Vm \cos \omega t$. Obtain differential equation for Charge Q.
2. Write characterisitics of electromagnetic waves.
3. Give conditions for constructive interference and destructive interference in terms of path difference and phase difference.
4. Write a note on ground waves.

C. Solve examples (any – 3) **[9]**

1. To a.c. supply f = 100 Hz, L = 100 millihenry, c = 5.62 μF, R = 600 ohm. are connected in series. Obtain value of phase difference between current and voltage.
2. An a.c. generator gives Vm = 200 volts at 100 Hz. What will be angular speed of coil. What should be frequency if Vm = 400 volt is required

3. Taking units of μ_o and $\in_o$ as known prove that expression $1/\sqrt{\mu_o \varepsilon_o}$ has unit of velocity".
4. In a fraunhoffer diffraction by single slit at a point on a screen first minimum is obtained at 30^o angle . The wavelength is 6500^o A. (1) Find width of slit. (2) For which other wavelength first maximum will be constructed at this point.

Q.–4 A. Answer the following questions very briefly : **5**

1. State the condition for resonance in a.c. circuit with L–C–R in series.
2. Is it true that less is the distance between the slits in Young's experiment, nearer are the fringes' ?
3. Which electromagnetic waves are absorbed by the Ozone layer ?
4. What is demodulation ?
5. What should be done to prevent the wearing off of the platinum point in the induction coil ?

B. Attempt ANY THREE of the following : **6**

1. What is the function of a transformer ? Give its working principle. Describe construction of a typical transformer giving the figure.
2. Draw a schematic figure for Hertz's experiment and explain how the arrangement forms an oscillator circuit.
3. Derive the expression for the distance between two consecutive bright fringe seen in the Young's experiment.
4. Assuming that the flux linked with a coil of an a.c. generator is $\phi_t = NAB\cos \omega t$, describe the voltage developed across the brushes of the generator.

C. Solve ANY THREE of the following numerical problems : **9**

1. L–R circuit is connected to a source of a.c. voltage. The maximum voltage of the source is 220 V and maximum current is I A. Find the power and the power factor. Reactance of the coil is 40Ω and R = 30 Ω.
2. Primary coil of a transformer has 1000 turns and the flux linked with the coil is 10 weber. Find the amount of the flux linked with the secondary coil if the secondary has 600 turns.
3. A mixed ray having wavelengths 6500 A^o and 5200 A^o is used in Young's double slit interference. At what distance from the central fringe will the bright fringes of the two wavelengths superpose ? Distance between the slits is 0.5 mm and the screen is at 100 cm from the slits.
4. Find the frequency of electromagnetic waves corresponding to the visible radiation at 5000 A^o. Give your answer in MHz.

Q.–5 A. Answer in very brief. **5**

(1) A current is sent through vertical spring from whose lower end a weight is hanging. What will happen ? (The direction of the current is from the upper end to lower end)

(2) 220 volt A.C. is more dangerous than 220 volt D.C. Why ?

(3) Which part of the electromagnetic spectrum does the wavelength 10^{-10} m corresponds to ?

(4) What do you mean by red shift ?

(5) What is the effect on the interference fringes in a young's experiment if the monochromatic source is replaced by a source of white light ?

B. Answer any three in about 10 lines. 6

(1) Accept A.C. voltage V = Vm sin ωt and with the help of a graph, explain the changes in voltage with respect to time during one rotation of the coil.

(2) Draw a neat diagram of an induction coil and name its different parts in the figure. Write the function & uses of the capacitor in it.

(3) Write any four points regarding atmophere.

(4) Explain central maximum in Fraunhotter diffraction by a single slit.

C. Solve any three. [9]

(1) In an a.c. ckt L–C–R are connected in a series. The inductance is at 5 Henry. w = 200 rad/sec. The resistance R is 80Ω. Power factor is 0.5 Find the value of the capacitance.

(2) An a.c. supply at Vm = 150 volt f = 190 Hz frequency is connected to an inductance at 1 henry. Obtain the equation for the current in the ckt. The applied voltage is V = Vm cos ωt.

(3) Light of wavelength $\frac{d}{2}$ is incident on a slit of width d. How many bright fringes will be obtained in its diffraction pattern ?

(4) Two waves having the same wavelength are superposed at a point with a path difference of 13 wavelengths. Find the type & order of interference at that points. Find the wavelength if the value of path difference is 0.0104 mm.

Q.–6 A Answer in short. (5)

(1) Write expression for impedance of series L–C–R a.c. circuit. When will this impedance be minimum.

(2) What is modulation ?

(3) Define circularly polarised light.

(4) What are sky waves ?

(5) Write main parts of a d.c. motor.

B Answer any three of the following questions. (6)

(1) What is the meaning of r.m.s. value of a variable prove that the e.m.s. value of

$V = V_m \cos wt$ is $V_{r.m.s} = \frac{Vm}{\sqrt{2}}$

(2) Write s short note on a green house affect.

(3) Explain "resolving power" taking one illustration.

(4) Write four characteristics of electromagnetic waves.

C Attempt any three of the following problems. (9)

(1) In series L–R a.c. circuit maximum a.c. voltage is 220 v and maximam current is 1 A. Calculate the power used in the circuit and power factor. Reactance of indicator is 40 Ω and R = 30 Ω

(2) Velocity of electromagnetic waves in vacuum is 3×10^5 km/sec. If the permeability of vacuum is $4\pi \times 10^{-7}$ weber/amp. met, find its permittivity.

(3) In young's double slit experiment, the separation of slits is 0.05 cm and a screen is between centres of the third bright and fifth dark bringe, for light of wavelength 5000A°.

(4) In young's experiment, if the separation of the slits is 0.2 mm and the light used is of 5000° A wavelength, find the angular distance between the central and third bright bringe.

Q.–7 A Answer the following in short. (5)

(1) The resonant frequency at a senes LCR circuit is 700 Hz. the half power points are got at frequencier 650 Hz. and 750 Hz. what is the quality factor ?

(2) What is the maximum value of power factor ?

(3) What is meant by UHF brand and AM ?

(4) What is Diffraction ?

(5) Can sound waves be polarised ? Give resaon.

B Attempt any three. (6)

(1) Explain the difference between reactance and impedance.

(2) What is the meaning of rm S value at a variable ? Prove that the rms value of V = Vm cos wt is V_{rms} = Vm /$\sqrt{2}$

(3) Write imnportant uses of electromagnetic radiacties.

C Solve the following (Any three) (9)

(1) An a.c. circuit with L–C–R in series has voltage and current respectively given by

$V = 200\sqrt{2}$ cos (3000 t – 55°) Volt and

$I = 10\sqrt{2}$ cos (3000 t – 10°) ampere

Find the magnitude of impedance at the circuit.

(2) An ideal transfarmer has 1000 turns in the primary and 500 turns in its secondary coil. If 2 A current (Irms) flow in the primary find the current its the secondary.

(3) In young's double slit experiment seperation at shits is 1 mm Two consecutive bright fringer have a seperation of 0.03 cm on a screen. If the screen is now moved further away from the slits by 50 cm. the seperation at two consecutive dark fringes becomes twice. Find the wave length of the light used.

(4) A parallel beam at light at wavelength 6000 A° is oncident normally on a slit at width 0.01 cm. Find the angular position of the second order maximum is its frauhoffer diffractio pattern with reference to the central peak.

Q.–8 A Answer in short 5

1. What should b done to prevent the wearing off of the plantinum point in the induction coil ?
2. In the primary coil of an ideal transformer the maximum current is 1 amp. and in its secondary coil the maximum current is 4 amp. If the number of turns in the primay coil is 100 theen what will be the number of turns in its secondary coil.
3. What are the E and B components in the region nearer to the oscillator in the Hertz experiment called ?

4. In case of Franhoffer differaction by a single slit, the first minimum is formed at angle 30°. If the wavelength of light used is 5000A° then what is the width of the slit ?
5. In which case will the breadth of central maximum be more ? Ford = 5λ or for 10λ ?

B. Answer the following in eight to ten sentences. (Any 3) **6**

1. Write a note on green House effect
2. Define the term ``real power'' for an a.c circuit Derive the expression for powetr in case of an a.c circuit with LCR in series. Define power factor ?
3. The number of terms in the primary & the secondary coils of transformer are N_1 and N_2 respectively and the flux linekd with respectively and the flux linked with the coils are ϕ_1 and ϕ_2 respectively, show that $\frac{\varepsilon_2}{\varepsilon_1} = \frac{N_2}{N_1}$
4. With the help of tourmaline plate, how can it be determind that the incident light is polarized or unpolarized ?

C. Solve the following (Any 3) **9**

1. To an A.C supply F = 1000Hz, L = 100M Henry C = 5.62 μF, R = 600ohm are connected in series obtain the values of phase difference between the current and the voltage.
2. $\in_0 = 8.85 \times 10^{-12}$ C^2/Nm^2 and $\mu_0 = 4\pi \times 10^{-7}$ T–m/A Find the velocity of electromagnetic wave.
3. If 2 sources emit with third intensities in the ratio 25:4 what will be the ratio of the maximum to the minimum in the inteaference bands produced by their superposition.
4. In the Franhoffer deffration pattern of the slit, the angle at which the first order maximum is observed for the wavelength 4000A° is also the one at which the first order, minimum is observed for a wavelength / λ Find λ.

Q.–9 A. Answer the following in short **5**

1. In series L – C – R circuit What is the magnitude of impedence ?
2. What is the principle of transformer ?
3. What is the region of visible light ?
4. Which gas is filled in “starter” ?
5. What is the unit of impedence ?

B. Answer any three in eight to ten sentences. **6**

1. Write 4 characteristics of Electromagnetic waves ?
2. Give geometry of Young’s experiment and obtain formula for path difference.
3. Differentiate the two types of Diffraction.
4. V = V*m* Cos wt, is applied to an Ac circuit with L – C – R in series obtain differential equation for charge q for it.

C. Solve the following (Any three) **9**

1. In an L – C – R series AC circuit L = 0.5 H, C = 20μF, R = 100Ω If the supply has 50 Hz frequency find the impedence of the circuit.

2. Velocity of light in vaccum is 3×10^5 km/sec. If the permitivity of vaccum is 8.85×10^{-12} $C^2/N.m^2$ find its permiability.
3. Have phase differnce of 17π radian ? If their wave length is 600^o A. Find the corresponding path difference in a anstromg units.
4. In Young's double slit experiement the seperation of slits is 0.05 cm and screen is placed at a distance of 100 cm. Find the seperation between centers of the third bright and fifth dark fringe, for $\lambda = 5000^o$

Q.–10 A **5**

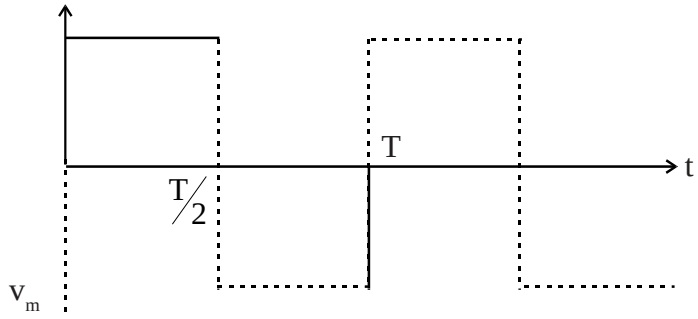
1. In L–C–R A.C circuit if $\omega = \frac{1}{\sqrt{LC}}$ then what will be the phase difference between current and voltage.
2. Which laws of electricity and magnetism were represented in the form of differential equations by Maxwell ?
3. Fill in the blanks :
   Wavelength of the electromagnetic waves smaller than _____ get absorbed by the ozone layer.
4. Sun glasses made of Polaroid is more beneficial than gogle's. Give reason.
5. On which factor the distance between two consecutive bright or dark frings depend.

B. Answer the following questions in eight to ten sentencs : (Any three) **6**

1. What is the meaning of r.m.s value of a physical quantity ? Prove that for V = Vm coswt $V_{r.m.s} = \frac{V_m}{\sqrt{2}}$
2. What is the function of transformer ? Write an expression, showing relationship between induced e.m.f. in primary and induced e.m.f. in secondary coil of a transformer.
3. Giving appropriate figures (i) Define – fresnel and fraunhoffer diffraction. (ii) What type of wave fronts are involved in these two types of diffraction ?
4. Obtain the expression for path difference $r_2 - r_1 = \frac{xd}{D}$ by the geometric figure of Young's experiment.

C. Solve the following examples (Any three) **9**

1. Taking the values of μ_0 and ϵ_0 prove that the velocity of electromagnetic wave is $c = \frac{1}{\sqrt{\mu_o \epsilon_o}}$
2. The figure shows an a.c voltage having square wave form. Peak voltages is 100 Volt. Find the r.m.s value of the voltage



3. The ratio of intensities of ray emitted from two different coherent sources α. For the interference pattern formed by them prove that

$$\frac{I_{max}+I_{min}}{I_{max}-I_{min}} = \frac{1+\alpha}{2\sqrt{\alpha}}$$

Where I_{max} = Maximum intensity in th interference frings
I_{min} = minimum intensity in the interference fringes.

4. A phase difference between the waves originating from two sources is 3π radian at the points of their origin. A point P is at distances of 20 λ and 21.5λ from the two sources. What type of interference will occur at the point P ?

Q.–11 A. Answer the following questions in very short. **5**

1. A Complex number is represented by $z = |z| e^{j\theta}$, where $e^{j\theta}$ = _____.
2. An A.C. Source has the voltage v = 240 sin (100πt). A resistor of 120 Ω and A.C. ammeter is connected with the A.C. source, then how much current will be measured by meter ?
3. 'Interference is not possible for longitudinal waves' is it true or false ?
4. In Young's experiment, distance between two successive bright (or dark) frings is 0.01 cm. calculate the distance between 9th and 4th bright fringes.
5. How will you produce the electromagnetic wave of 500 metre wavelength in vaccum ?

B. Answer the following question in eight to ten sentences: (Any three) **6**

1. Write the expression for the impedance of series L – C – R circuit. What will be the impedance of an A.C. circuit containing only inductor. Show its impedance in a complex plame and obtain the expression for the current in this case from the general expression of the current.
2. What is the function of a transformer ? Give its working principle. Give the symbol of a step down transformer. Write an expression, showing relationship between induced emf in primary and induced emf in secondary coil of a transformer.
3. Give the information of space wave and explain the modulation in brief.
4. Define (i) unpolarized eight, (ii) Plane polarized light.

C. Solve the following examples : (Any three) **9**

1. An inductor of 1 H and a resistance of 50 Ω are connected in a series circuit with an AC. source of 200 volt, 50 Hz. Find (i) the maximum current in the inductor. (ii) the place difference between current and voltage. (iii) the time difference between current and voltage.
2. Prove that if voltage obtained from an A.C. source is given by $V = V_m \sin \omega t$, its average value is $\frac{2V_m}{\pi} = 0.63\ V_m$.
3. Velocity of electromagnetic waves in vaccum is 300 thousands km/sec. If the permeability of vaccum is $4\pi \times 10^{-7}$ weber/amp. meter find its permittivity.
4. Prove that in young's double slit interference experiment, if the separation of slits is twice the wavelength of light used, the maximum number of bright fringes obtained on screen will be five.

Q.–12 A Answer all the questions : **5**

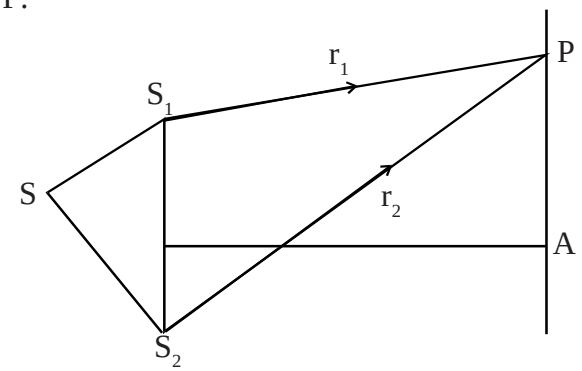
1. In an AC circuit with L only, when the applied voltage becomes maximum, the current in the circuit becomes zero. Is it true ?
2. Write the name of gas used in starter.
3. Write any ONE difference between the inductive component and the radiated component of electronmagnetic waves.
4. Under what condition stationary intrference is possible ?
5. Write the usee of Cornu's spiral.

B. Answer any three of the following: **6**

1. For a series LCR AC circuit, an AC voltage $V = V_m \cos \omega t$ is applied. Derive an equation to calculate the complex charge present in the circuit.
2. Explain the construction of an induction coil with a neat diagram.
3. Write a note on ground wave and sky wave.
4. Define plane – polarized light. Explain how a plane polarized light is obtained using a tourmaline plate.

C. Solve any three of the following: **9**

1. In an AC circuit LCR are connected in series. The inductance is of 10 H, W = 100 rad/s the resistance is 100 Ω and the power factor is 0.5. Find the capacitance the circuit.
2. The frequency band received by a radio is 90 MHz to 120 MHz. Find the corresponding wavelength range. ($c = 3 \times 10^8$ m/s)
3. As shown in the figure, in Young's double slit experiment, $SS_2 - SS_1 = 0.25\lambda$. Write down the conditions for the constructive and the destructive interference at a point P.



4. A parallel beam of light with wavelength 6000 A^o is incident normally on a slit of width 0.12 mm. Its Fraunhofer diffraction pattern is obtained with length of focal length 150 cm on the screen. Calculatee the width of the central maximum.

Q.–13 A Write Answer in very short : **5**

1. State unit of Impedance.
2. Which component is used to stop the erosion of tip of Plantinum in Induction Coil ?
3. State the main parts of Electric Motor.
4. If the Path difference betwen two waves superposing at a point is 3.5 λ then find out Phase difference between them.
5. In which case of the following central maximum is more broader ? $\alpha = 5\lambda$ OR $\alpha = 10\lambda$.

B Write answer as asked only : (Any three) **6**

1. State geometrical representation of Young's Experiment and obtain formula for path difference.
2. "One can hear the voice of a person standing outside the door but can not see him." Explain in context with diffraction.
3. Explain 'Green House Wave.'
4. Write a note on Ground Wave.

C. Solve any three Numerical Problems from following : **9**

1. An a.c. cricuit with L–C–R in seris has voltage and current respectively given by $V = 200\sqrt{2}\cos(3000t - 55^o)$ and $I = 5\sqrt{2}\cos(3000t - 10^o)$ then find the impedence of the circuit and the value of R.
2. The different values of L–C–R series a.c. circuit are as followed f = 100 Hz, L = 100 mH, C = 5.62 μ F R = 100 Ω. Obtain the value of phase difference between the current and the voltage.
3. The ratio of intersities of rays emitted from two different coherent sources is α. For the interference pattern formed by them prove that $\frac{I_{max} + I_{min}}{I_{max} - I_{min}} = \frac{1+\alpha}{2\sqrt{\alpha}}$ where

   I_{max} = maximum intensity of bright fringe and
   I_{min} = minimum intensity of dark fringe.
4. A parallel beam of light with wavelength of 6000 A is incident normally on a slit of width 0.01 cm. Its Fraunhofer diffraction pattern is formed on the screen kept at distance of 100 cm. Away from slit. Calculate the width of the central maximum.

Q.–14 A Answer the following : **5**

(1) The maximum voltage of 220v A.C. mains is ____
(2) In hertz experiment metallic sphere work as ____ and metallic rods work as ____
(3) Define – Plane Polarized Light
(4) Why capacitor is used in induction coil ?
(5) Diffraction depends on _____

B Answer the following questions. **6**

(1) Prove that in a an L.R.C. circuit. $P = V_{rms}\, I_{rms} \cos\delta$ and also discuss its special case.
(2) What are inductive and radiative components ?
(3) Describe Young's experiment and derive the formula for the path difference.
(4) Explain space wave and modulation.

C Solve the following examples. (any three) **9**

1. An ideal transformr has 1000 turns in the primary and 500 turns in its secondary coil. If 2 amp. Current in the secondary.
2. Velocity of electromagentic waves is 3×10^5 km/sec. If permeability of vaccum is $4\pi \times 10^{-7}$ weber –met. Find its permittivity.
3. Distance of the first maximum in a fraunphofer diffration at a slit from the central maximum is 1 mm. if screen is at a distance of 1 meter from the lens used for

forming the pattern and the light used is of wavelength 7000 A^o. Find the width of the slit.

4. Two waves superposing at a point have a phase diffference of 17π radian. If their wavelength is 6000 A^o, find the corresponding path difference inangstrom units.

Q.–15 A. Wirte short answer to the following questions. **5**

1. Write the importance of step up transformer.
2. An a.c voltage applied across a capacitor of 1 μf is V = $200\sqrt{2}$ sin (100t) volt. What will be the observation of an a.C ammeter connected with the circuit.
3. Write full form of VHF.
4. Amplitues of the points on nodal lines are maximum. True/False.
5. In younge's experiment, the distance between four consecutive bright fringers is 0.1 mm. What is the distance between the 10th bright and 12th bright fringes.

B. Write Answer Eight to Ten statements as asked. (Any Three) **6**

1. What is an electric motor ? Write its principle and names of various parts of the motor.
2. Voltage applied to an A.C. circuit with L–C–R in series is V = Vm cos wt obtain the differential equation for change Q.
3. Explain the generation of oscillating electric and magneetic fields in Hertz's experiment.
4. Expalin : Red shift, Violet shift, RADER with respect to Doppler Effect in Light.

C. Calculate any three Numerical problems from following. **9**

1. An inductor of 0.50H and a resistance of 100 ohm are connected in a series circuit withan A.C. Source Vr.m.s = 240 volt and 50 Hz. Find the maximum current in the inductor and the phase difference and the time lag between the current and the voltage.
2. An A.C. generator has coil with 50 turns and cross – sectional area of $25m^2$. The coil is rotated with an average speed of 60 rad/sec in a field of 0.3 tesla. Resistance in the circuit of the coil is 500 ohms. Find the maximum current drawn from the generator.
3. Distance of the first minimum in a fraunhoffer diffraction at a slit, from the central maximum is 5 mm. If the screen is a t a distance of 1 meter from the lens used for forming the pattern and the light used is of wave length 5000 A, Find the width of the slit.
4. The ratio of intensities of ray emitted from two different coherent sources is α. For the interference pattern formed by them prove

$$\text{that} = \frac{I_{max} + I_{min}}{I_{max} - I_{min}} = \frac{1+\alpha}{2\sqrt{\alpha}}$$

Q.–16 A Answer in short as asked. **5**

1. Write the formula of value of total resistance in L – C – R A.C. circuit.
2. How is Q – factor useful to L – C – R circuits ?
3. What is the process of communicating a sound from one place to some other remote place called ?

4. The distance between 3rd bright and 7th dark firnge is ... $\bar{x}$ in young's experiment (Fill in the blanks)
5. In what way is tourmaline plate called polarizer ?

B. Answer any three in eight to ten sentences. **6**

1. Accepting voltage source $V = V_m$ coswt obtain V_{rms} per periodic time.
2. Voltage $V = V_m$ cos wt is applied to an A.C circuit with L – C – R in series obtain the differntial equation for charge Q.
3. Write a note on "ground waves."
4. Give the conditions for the constructive and the destrutive interference in terms of path difference and the phase difference.

C. Solve any three examples. **9**

1. In an a.c circuit inductor $L = 10 \times 10^{-3}$ H and capacitor C = 1μf are joined in parallel. A resistance R = 100Ω is joined in series with it. In the circuit a.c voltage with frequency 10^3 Hz is applied calculate the impedance of the circuit.
2. An a.c source V = 60 sin 120πt is joined with two ends of a resistance of 200Ω An a.c. ammeteer joined in this circuit will indicate what amount of electric current ?
3. Velocity of light in vaccum is 3×10^5 km / sec. If the permitivity of vaccum is 8.85×10^{-12} $C^2/N–m^2$, find its permebility.
4. The differenc of the time for two waves originating from two coherent soures to reach a point is an integral multiple of the period of oscillations of the waves. Show that the interference taking place at the point is constructive (Assume the phase differenc at their origin zero)

Q.–17 A. Answer the following in very short as asked. **5**

1. The term jwl is called ____ of the indictor.
2. Draw the diagram of plane of oscillation and plane of polarisation.
3. Define plane polarised and elliptically polarized light.
4. What will be frequency of electromagnetic radiation having wavelength 21 cm ? ($C = 3 \times 10^8$ m/s)
5. Draw the diagram of stepdown transformers.

B Answer the following in eight to ten sentences (Any three)

1. Give difference between Fresnel's and Fraunhoffer diffraction.
2. A.C. voltage V = Vm cos wt is applied to a series L–C–R circuit. Derive the differential equation of the charge Q for this circuit.
3. What is an electric motor ? State its principle. Give the name of the different components of a d.c. motor.
4. Write a note on Q factor.

C Solve the following (Any three) **9**

1. In an a.c circuit L–C–R connected in series. The inductance is 10 henry, ω = 100 rad /sec.

   The resistance R is 100Ω, power factor is 0.5. Find the value of capacitance.
2. In young's experiment, the distance between two slit is 0.1cm when a screen is kept at a certain distance from the slit, the distance between two consecutive bright

frings is 0.02cm and when screen is shifted away by 50 cm, the distance between two consecutive bright fringes becomes 0.05 cm. Find the wavelength of light

3. The ratio of intensities of rays emitted from two diffferent coherent source is α for interference pattern formed by then, prove that,

$$\frac{I_{max}+I_{min}}{I_{max}-I_{min}} = \frac{1+\alpha}{2\sqrt{\alpha}}$$

4. A parallel beam of a monochromatic light is incident normally on a slit having a width of 0.18 cm. The Frauhoffer differaction pattern formed at the focal plane of a lens of focal length 50 cm shows its first order maximum on the either sides of central peak with a separation of 0.45 cm between them. Find the wavelength of ligh used.

Q.–18 A Answer in short **(5)**

(1) To evaluate the Q factor, two such points in the graph of $I_{rms} \rightarrow w/w_o$ are taken, where $I_{r.m.s} =$ ————

(2) What will be the wavelength in Fermi meter, of electromagnetic waves having frequency 3×10^8 Hz.

(3) In ripple tank experiment, if the width of the slit and wavelength are so changed that the ration of λ/d remain single valued then what happens to degree of diffraction.

(4) Show the plane of polarization and plane of vibration in the same figure.

(5) In L–C_R series A.C circuit, if co = /√LC then what will be phase difference between current and voltage.

B Attempt any three of the following. **(6)**

(1) Land C are connected in parallel in an A.C circuit. Find its equivalent impedance.

(2) Explain in principle of induction coil. Describe its construction giving a suitable figure.

(3) Explain modulation.

(4) Giving necessary figure explain the first maximum in fraunhofer diffraction and obtain the condition for the maximum.

C Attempt any three of the following.

(1) Prove that if voltage obtained from an A.C. source is given by V = Vm sin ωt, its average value is 2 Vm/π = 0.637 Vm.

(2) A resistance a coil and capacitor are connected in series in LCR circuit. If R = 20 Ω, L = 0.16 H and C = 30 μF. Find the resonating frequency of LCR circuit and |z|.

(3) Velocity of electromagnetic waves in vacuum is 3×10^5 km/sec. If permeability of vaccum is $4\pi \times 10^{-7}$ Wb/A–m, find its permittivity.

(4) Light of wavelength d/2 is incident on a slit of width d. How many bright fringes will be obtained in its diffraction pattern ?

Q.–19 A Answer in short as require. (05)

(1) Write the related expression of current and voltage for an inductor in A.C. circuit.

(2) What is the frequency of electromagnetic radiation of wavelength 15 cm.?

($c = 3 \times 10^8$ m/s.)

(3) State the condition for resonance in a.c. circuit with L-C-R is series.

(4) Why distance between two slits in Young's experiment is kept of the order one tenth of millimeter?

(5) Define plane-polarized light.

(B) Answer in about 8-10 sentence (any three) (06)

(1) Accepting voltage of a voltage source $V = V_m \cos \varpi t$ obtain V_{vms} per periodic time.

(2) Write a note on ground waves.

(3) Write in short the Doppler Effect in light.

(4) Giving appropriate figures (i) Define Fresnel and Fraunhoffer diffiaction (ii) What type of waves front are involved in these two types of diffiraction ?

(C) Solve following examples (Any three) (09)

(1) A 5 H inductor, 30 μ F capacitor and 40 Ω resistor and connected in series to an a.c. source of 230 V. Find the resonant frequency and impedance at resonance.

(2) In Young's Double Slit Experiment, separation between the slits is 0.05 cm and a screen is, placed at a distance of 1 meter. Find the separation between centers of the third bright fringe and the fifth dark fringe for light of wavelength $5000A^o$.

(3) Find the frequency of electromagnetic waves corresponding to the visible radiation at $6000A^0$. Give your answer in Meghahertz, ($C = 3 \times 10^8$ m/sec. in vacume)

(4) An a.c. voltage source gives V = 21.21 sin 314t. Find the value of the (i) maximum voltage, (ii) r.m.s voltage and (iii) frequency.

Q.–20 A Answer the following question in very short: (05)

(1) _____ is called half - power band width. (Fill in the blank)

(2) Indicate the wavelength in meter of the radiation having frequency 1 Mhz.

(3) What are carrier waves ?

(4) Write the important condition for stationary interference.

(5) Give Lord Rayleigh's criteria.

B Answer any three of the following question in eight to ten sentences : (06)

(1) Voltage applied to an a.c. circuit with L-R-C in series is V =Vm cos wt. obtain the differential equation for charge Q.

(2) L and C are connected in paralled in a.c. circuit Find its equivalent impedence.

(3) What are the inductive and radiative componenents of EM waves ? Drwa their figure also.

(4) Why spectral lines are found boardened ? Explain on the basis Doppler effect in light.

C Solve any three of the following example : (09)

(1) The ratio of intensities of rayas emitted from two different coherent sources is α. For the interference pattern formed by them prove that

$$\frac{Imax + Imin}{Imax - Imin} = \frac{1+\alpha}{2\sqrt{\alpha}}$$

(2) A parallel beam of light with wavelength of 5000 A^o is incident nirmally on a slit of width 0.01 cm. Its Fraunhoffer diffraction pattern is formed with a lens of 100 cm. focal length. on a screen. calculate the width of central maxima.

(3) Velocity of electromagnetic waves in vaccume is 3×10^5 km/sec. If the permeability of vaccum is $4\pi \times 10^{-7}$ wb/amp. meter then field its permittivity.

(4) L - R circuit is connected to a source of a.c. voltage. The maximum voltage of the source is 220 volt and maximum current is 1 Ampere. Find the power and power factor. Reactance of the coil is 40 Ω and R = 30 Ω

Q.–21 A Answer the following questions in short. (05)

(1) What is r.m.s. value of an electric current ?

(2) State the function of capacitor which is connected in curcuit of induction-coil.

(3) Give the range of existance of Ozon gas in the earth's atmoshphere.

(4) The distance of a point from two slits illuminated by a light of wavelength 6000 A^o are 100 and 100.00009 cm. respectively. What type of interference occure at that point ?

(5) Draw a neat diagram showing plane of oscillation and plane of polarization.

B Answer the three of the following questions (06)

(1) Describe the function of a starter used in Tube-light.

(2) Draw a neat diagram of Hertz's experiment to produce electromagnetic waves and describe the arrangment of the experiment.

(3) Give the condition for constructive and distructive interference in terms of path-defferance and phase difference.

(4) Explain two points of The Doppler effect in light.

C Attempt any three of the following problems. (09)

(1) L-R circuite is connected to a source of a.c. voltage. The maximum voltage of the sources is 220 V and the maximum current is I.A. Find the power and the power factor. Resistance of the coil is 40 Ω and R = 30 Ω

(2) Velocity of electromagnetic wave in vacuum is 3×10^5 km/sec. If the permeability of vacuume is 4×10^5 weber/Amp meter. Find the permitivity.

(3) Prove that in young double slit interference experiment if the saperation of slits is twice the wave length of light used the maximum number of bright fringes obtained on screen will be 5.

(4) A mixed ray having wave length 6500 A and 5200 A is used in youngs double slit interference. At what distance from the central fringe will the brigth fringes of the two wave lengths superpose ? Distance between the slits is 0.5 mm and the screen is at 100 cm. from the slits.

Q.–22 A Answer the following questions in very short as asked **5**

1. State the unit of capacitive reeactance.
2. On which factor does velocity of the electromagnetic waves in a medium depend.
3. At what height ozone layer is situated ?
4. State the condition of destructive interference in term of path difference & Phase difference.
5. What is meant by Violet shift ?

B Answer the following questions in eight to ten sentences (Any Three) **6**

1. Desrcibe AC dynamo and derive the expression for the maximum induced electromotive force.
2. In an A.C. Ckt L & c are joined in parallel and R is joined in series obtained an equation for Importance and electric current.
3. Discuss fraunhoffer diffraction due to a slit and obtain the condition for maxima.
4. What is Tourmaline plate ? Define its optics arcie. Explain the phenomenon of polarization with tourmaline plate.

C Solve the following examples (Any three) **9**

1. In series L–R a.c Circuit maximum ac voltage is 220v and maximum current is 1 A. Calculate the power used in the circuit and power factor. Recatance of inductor is 40 Ω and R = 30 Ω.
2. A 5H inductor 80μf capacitor and a 40Ω resister are connected in series with an ac source of 230 Vrms, find
   i. Frequency of resonance
   ii. The value of impedance of the circuit and thee current under resonance.
3. A parallel beam o monochromatic light is incident normally on a slit having a width of 0.018 cm. The frauhofer diffraction pattern formed at the local plane of a len's of focal width 50 cm shows its first order maximum on the either side of the central peak with a separation of 0.45 cm between them. Find the wavelength of light used.
4. The ratio intensities of rays omittd two different coherent sources is α. For the interference pattern formed by them prov that

$$\frac{I\,max + I\,min}{I\,max - I\,min} = \frac{1+\alpha}{2\sqrt{\alpha}}$$

Q.–23 A Answer in short : **5**

1. An a.c. voltage applied across a capacitor of 1 μf is given by V = 200 V_2 sin (100t) Volt. What will be the observation of an a.c ammeter connectd with the circuit.
2. What is half power width ?
3. Write full form of VHF.
4. What Kind of wave fornts can be used in Frenel diffration ?
5. For ideal transformer the ratio of the number of turn in primary coil to that in secondary coil is 1 : 25. If current is secondary coil is 4 amp, find current in primary coil.

B. Answer any three of the following questions. 6

1. Write an expression for impedence when C and R are in series in an A.C. circuit. By using geometrical representation. Obtain the expression for phase difference and write the expression of current.
2. Explain inductive and radiated componets with figures.
3. Discuss condition of mth order maximum in Fraunhoffer diffraction by a single slit.
4. Define : `Interference.' State the condition for constructive and destructive interference in terms of path difference and phase difference.

C. Attempt any three of the following problems: 9

1. An a.c. generator has a coil with 50 terms and a cross – sectiond area of $25m^2$. The coil is rotated with an average speed of 60 rad/sec in a field of 0.3 tesla. Resistance in the circuit of the coil is 500 ohm. Find the maximum current drawn from the generator.
2. Electromagnetic waves in the wavelength range 6 mm to 100 cm are used for satelite communications. Convert this range into corresponding frequency range. ($C = 3 \times 10^8$ m/s)
3. The ratio of intensites of rays emitted from two different coherent sources is α. For the interferenc pattern formed by then prove that

$$\frac{I_{max} + I_{min}}{I_{max} - I_{min}} = \frac{1+\alpha}{2\sqrt{\alpha}}$$

where I_{max} = maximum rf intensity in the interference frings.

I_{min} = minimum of intensity in the interference frings.

4. In Youngs interference expriment in the distance accomodating 6th bright fringe from the central fringe when the light used is of 4000 A^o, how many bright frings will be accommodated if the light used is of 6000A^o ?

Question–5

Q.–1. A. Answer the following very briefly : **(5)**

1. Compare the velocity of Cathode rays with that of light.
2. Define Electron volt.
3. Why is the base region of the transistor made narrow ?
4. The a.c. current gain of an N–P–N transistor is 21 and a c. voltage gain is 50. Find its power gain.
5. If the radius of a proton is 1.1 fermi, find the radius of Aluminium nucleus. (Al = 27)

B. Answer any three in brief. **(6)**

1. The displacement of the electron beam due to the electric field in the experiment of Thomson to find m is given by $Y = \frac{1}{2}\left(\frac{eE}{m}\right)\frac{1^2}{v^2}$ with the help oft his formula, explain how the velocity of electron in the field and $\frac{e}{m}$ are determined.
2. On which principle does Nuclear reactor work ? Give the outline of slow neutron reactor.
3. Write a note on P–type semiconductor.
4. Draw the diagram of circuit for full wave rectification. Explain how the output voltage is obtained from both half–cycles of the input voltage.

C. Work out any three : **(9)**

1. The wavelength of radiation falling on a photosensitive surface is decreased from 6000 $\mathring{A}$ to 4000 $\mathring{A}$ find the change in the stopping potential h = 6.2.$\times 10^{-34}$ SI, e = l.6 $\times$ l0^{-19} SI, C = 3 $\times$ 108 SI
2. When the counter is brought to the patient to who a radioactive dose is administered, the count is 64000 per minute. If after 8 hours the count becomes 250 per minute, calculate the half life of the radioactive specimen.
3. In N–P–N common emitter amplifier the voltage gain is 210 for load resistance 15 kΩ. Find the value of trans conductance. Write its unit. If the input resistance is 900 Ω, Calculate current gain.
4. In an experiment to find $\left(\frac{e}{m}\right)$ by Thomson's method the p.d. between the plates is V. An electron enters the electric field between the plates with zero velocity, in a direction ⊥ to the field, find the necessary magnetic field to nullify the deflection of electron due to electric field (Show that B = $\frac{1}{d}\sqrt{\frac{mv}{2e}}$ where mv where d = distance between the two parallel plates.

Q.–2 (A) Answer in short **(5)**

(1) Prove that unit of E/B is unit of velocity

(2) 10^{-10} cm = _____ fm

(3) "Iron nucleus is most stable." Why ?

(4) Why a P–N junction is called P–N junction diode ?

(5) What is an oscillator ?

(B) Answer (any three) **(6)**

(1) Describe the sequence of events that are seen in an electric discharge tube as the pressure of gas in the tube is gradually decreased from atmospheric pressure. Explain the reason for it.

(2) Describe the limitations of Bohr model

(3) Write the expression giving the exponential decay law for radio activity, using exponential decay law prove that the half–life $\frac{\tau}{2} = \frac{0.693}{\lambda}$

(4) What is rectification ? Explain P–N junction diode as a half wave rectifier

(C) Solve (any three) (9)

(1) For an oil drop in Millikan's experiment the value of constant K as obtained experimentally is 3.2×10^{-11} Mks units when an electric field of 20,000 volt/m is applied, upward steady velocity of the drop is 0.58 cm/sec on radiating in this region with X rays, the upward steady velocity becomes 0.11 cm/sec. Find the additional charge acquire by the drop due to ionization.

(2) Show that in a hydrogen atom angular speed of an electron is given by $w = \frac{\pi me^4}{2\varepsilon o^2 n^3 h^3}$

(3) A nucleus has an avearage radius of 6.6 fermi. If the mass (average) of the nucleon is 1.0088 amu. Calculate its density. 1 amu = 1.66×10^{-27} kg.

(4) A voltage gain in common emitter transistor amplifier is 2500 and input voltage is 50 milli volt. Find out the change in output current when a load 5000 ohm is existing in circuit.

Q.–3 A. Answer in one line/word **[5]**

1. Write Einstein's quantum theory about radiation.
2. If stopping potential is 3V, what is the value of maximum kinetic energy of the emitted electrons ?
3. What is the function of moderator ?
4. Write the unit and dimensions of Plank's constant.
5. What is depletion layer ?

B. Answer in short (any – 3) **[6]**

1. Draw figure of crooke's tube. Describe observations made by Cooke with this tube. Which radiations were named as cathode rays?
2. Give formula of characteristic average radius of nucleus. Assuming shape of nucleus to be spherical prove that density of nucleus does not depend on atomic mass number of an element.
3. Give Rutherford Soddy's law of α – decay and β – decay with suitable illustration.
4. What is rectification? Giving necessary' circuit explain working of Half wave rectifier

C. Solve examples (any – 3) **[9]**

1. If Threshold wavelength of metal is 3000^{o} A. Now a radiation of 1500^{o} A wavelength is allowed to fall on it.Find maximum kinectic energy of emitted photoelectron and stopping potential.
2. Prove that in a hydrogen atom, square of orbital period of an electron is proportional to the cube of radius of that orbit.
3. Half life of Ra^{222} is 3.82 day. To obtain I millicurie activity what amount of gram mass should be taken.
4. In N–P–N transistor Common Emitter circuit, emitter current is 12mA and collector current is 11mA. Find current gain β.

Q.–4 A. Answer the following questions very briefly : **5**

1. Write two uses of photocell.
2. Which physical quantity is represented by the slope of the graph of $N \rightarrow t$?
3. Find the value of energy of a photon of radiation of frequency 100 KHz. ($h = 6.62 \times 10^{-34}$ JS)
4. At what temperatures do semiconductors behave as insulators ?
5. Define threshold frequency.

B. Attempt ANY THREE of the following : **6**

1. Write the properties of Cathode rays ?
2. Describe the experimental arrangement of Millikan's experiment to determine the electron charge, e giving the necessary figure.
3. Define : (i) Fermi, (ii) amu, (iii) electron volt and (iv) nuclear binding energy.
4. What is rectification ? Giving a necessary figure explain the working of a full wave wave rectifier.

C. Solve ANY THREE of the following numerical problems : **9**

1. When collector current of a NPN transistor is 4.9 mA, its base current is 5 mA. Find its common base current gain and common emitter current gain.
2. A common emitter NPN amplifier has a power gain 3×10^{3}. If the voltage gain is 60, find the current gain. If the base current changes by 30 μA; find the change in the output current.
3. Calculate the quantum number for which the radius of the orbit of electron in Be^{3+} would be equal to that for the ground state of electron in a hydrogen atom. Also compare the energy of the two states.
4. Calculate the change in the stopping potential when wavelength of light incident on a photoemissive surface is reduced from $4000A^{o}$ to $3600A^{o}$.

   $h = 6.625 \times 10^{-34}$ Joule–sec, $e = 1.6 \times 10^{-19}$ Coulomb, $c = 3 \times 10^{8}$ m/s.

Q.–5 A. Answer in very brief : **[5]**

(1) Work function of Aluminium is 4.2 ev If two photons each of energy R–S ev are incident on its surface will the emission at electrons take place ? Justify.

(2) Why a discharge tube appears dark, when evacuated to very low pressure ?

(3) Is it possible that a nucleus has negative mass defect ?

(4) What is meant by critical mass ?

(5) A small portion of indium is incorporated in germanium. Is the crystal N · type or P · type ?

B. Answer any three in a about 10 lines. [6]

(1) What is potoelectric effect ? Define threshold frequency f_o & state the factor on which its value depends. Name two substances for which threshold frequency falls in the visible region.

(2) What is natural Radioactivity ? How can we conclude that it is a nuclear phenomenon ?

(3) Discuss Rutherford's atomic model & its failure in explaining the stability at the atom.

(4) Draw the circuit diagram of common emitter N.P.N transistor amplifier. Derive the equation of input voltage for the input section of this ckt.

C. Solve any three [9]

(1) Calculate the change in the stopping potential when wavelength of light incident on a photoemmisive surface is reduced to light incident on a photoemmisive surface is reduced from 4200 Ao to 3800 Ao.

[$h = 6.625 \times 10^{-34}$ j. Sec, $e = 1.6 \times 10^{-19}$ coulomb., $c = 3 \times 10^8$ m/sec).

(2) Mass of an oil drop in Millikan's experiment is m & its total charge is q. If its steady downward velocity in absence of an electric field calculate the strength of the electric field required to make it move upwards with uniform velocity at 7v. Ignore the buoyancy foree.

(3) Calculate the maximum wavelength for the spectral line of hydrogen spectrum in its Balmer series. Calculate the corresponding wave number Rydberg constant = 1.097×10^7 meter^{-1}.

(4) Prove that $\beta = \dfrac{\alpha}{1-\alpha}$

Q.–6 A Answer in short. (5)

(1) Define work function of the metal.

(2) ${}_{92}U^{235} + {}_0n^1 \rightarrow$ _____ + _____ + 4 $[{}_0n^1]$

(Fill in the blanks)

(3) Find value of 1 amu in kilegram.

(4) What is depletion layer ?

(5) At absolute zero temprature pure semiconductor behave as bad conductor. Do you agree with this statement ?

B Answer any three of the following questions. (6)

(1) Write a note on the particle nature OF light.

(2) Define half–life of radic active element and derive $\tau_{1/2} = 0.693/\lambda$

(3) Write down laws of Rutherforel and Soddy for α and β decay. Give one illustration for each.

(4) Draw the circuit for N.P.N. common emitter amplifier. Obtain the expression for input resistance of the input section of this circuit.

C Attempt any three of the following problems. (9)

(1) Work function of a metal is 2.2 ev. Calculate the maximam kinetic energy with which photoelectrons are emitted (in ev units) on irradiating this metal with light of 4800 A^o units where $c = 3 \times 10^8$ met/sec, $h = 6.62 \times 10^{-34}$ joule sec.

(2) Half–life of Ra^{226} is 4.98×10^{10} second. Find the activity of 1 gm of its sample.

(3) A nucleus has an average redius of 6.6 fermi. If the average mass of the nuclei is 1.0088 amc, Calculate its density. (1 amv = 1.66×10^{-27} kg.)

(4) If the collector current of NPN common emitter amplifier shows a change in its collector current by 6 mA When the input voltage changes by 30 milivolt, find its transconductance.

Q.–7 A Answer in short. **(5)**

(1) What is the velocity of electrons accelerated by a potential at 10,000 V. The electric charge = -1.6×10^{-19} C and mass 9.1×10^{-31} kg

(2) The maximum kinetic energy of photoelectrons depends on _____ and _____ but not on _____ (fill the gaps)

(3) What is atomic mass unit ?

(4) What are control rods ?

(5) Waht is the order of current in a transister.

B Answer the following (Any three) **(6)**

(1) Give Einstein's explanation for photoelectric effect.

(2) Write the limitation of Bohr model.

(3) Write short note on Nuclear fusion in the sun and stars.

(4) Describe working of NPN transister in common base circuit.

C Solve the following (Any three) **(9)**

(1) In thoman's Experiment to determine e/m., when a_n. electric field only is applied the displacement is ye, when a magnetic field only applied the displacement is ym. Prove that $\frac{y_m}{y_e}$ (Field are applied over the same regien st space)

(2) In Millikan's Exprement raduis of an oil. drop 0.5×10^{-4} cm. Its density is 900 kg/m^3 Density of air 1.3 kg/m^3 If electric field required to keep the drop in equillibrium between the plate is 14400 v/m Calculate the charge on the drop [g = 9^{o}8 m/sec^2]

(3) Half life at $_{92}U^{235}$ is 4098×10^{11} minutes find activity at 3 gm of this sample in curie.

(4) Voltage gain of a common emitter amplifier is 1200 and its input voltage is 40 millivolt. Find the change is the out put current if the load resistance is 4000 ohm.

Q.–8 A Answer in short : **5**

1. What is the effect of increases in temperature on the conductivity of semiconductor ?
2. Which physical quantity is represented by the slope of the graph of N–>t
3. 2 Kg. mass is equiwalint to _____ J energy.
4. Write two uses of photocell
5. What is the order of thickness of the deplition layer ?

B. Answer the following in eight to ten sentences (Any–3) **6**

1. Describe the appratus of experiment of conduction of electric current through gasess.
2. Write equation of radioactive decay rate and derive thee exponential law of radioactive disintegration.

3. Using equation of the radius of the nth stable orbit of electron derive the equation of energy of election in this orbit.
4. Write 2 main points of difference between N – type and P – type semiconductor.

C. Solve the following (Any 3) **9**

1. In a NPN common emitter amplifier the a.c circuit current gains is 100) when the voltage gain is 200 calculate the input resistance of the transistor if the value of the load resistance is 4000 ohm.
2. Work function of a metal is 2;2eV. calculate the maximum wavelength of light for which photoelectrons will be emitted C = 3×10^8 m/s; h = 6.62×10^{-34} Joule sec.
3. Calculat the energy of a photon emittedd when in a hydrogen atom an electron makes a transitor from the third exited state to the, ground state Rydberg constant = 1.097×10^{-6} met C = 3×10^8 m/s h = 6.62×10^{-34} Joule sec.
4. Calculate the quantum number for which the radus of the orbit of electron in Be^{+3} would be equal to that for the ground state of electron in hydrogen atom also compare the energy of the 2 states.

Q.–9 A Answer the following in short **5**

1. What is the nature of cathode rays ?
2. Define Isobars.
3. What is depletion layer ?
4. What is meant by doping in semi conductor ?
5. What are Isotopes ?

B. Answer any three in eight to ten sentences. **6**

1. Write two postulates of Bohr's Model.
2. Write a note on N – type semiconductors.
3. Derive the expression $r = n^2h^2 \in_o / \pi m Z_e^2$
4. Write a note on photocell

C. Solve the following (Any three) **9**

1. Work function of a metal is 2.2 ev. Calculate the maximum K.E with which photoelectrons are emmited on irradiating metal with light of 48000°A. C = 3×10 8m/sec, h = 6.62×10^{-34} J. sec
2. Calculate the wavelength and energy of the corresponding photon for the H_α line in Balmer series in spectrum. Rydberg constant is 1.09×10^7 / met^{-1}, C = 3×10^8 m/sec, h = 6.62×10^{-34} j–sec.
3. In P–N–P transistor in common base circuit the collector current is 9.6 mA and the emmiter current is 10^{-2} amp. Find the current gain and the base current.
4. Calculate the power gain of a N–P–N transistor amplifier if the a.c current gain is 21 and the a.c voltage gain is 40. What is the unit of power gain ?

Q.–10 A

1. The work function of two metals are 1.2 ev and 3.6 ev respectively then state the ratio of their threshold frequencies.
2. The energy of the electron H_2 atom in the ground state is 13.6 ev. What will be energy in the second or bit.

3. Fill in the blanks :

   $_{2}He^{3} + _{2}He^{3} \rightarrow _{2}He^{4}$ + ... 5.5 ev

4. What is an avalanche ?
5. Give two names of donor impurity.

B. Answer the following questions in eight to ten sentences : (Any three) **6**

1. Draw the figure of Crooke's tube. Describe observations made by Crooke with this tube. Which radiation was named cathode rays ?
2. Describe the Tomson's method to determine the e/m ratio of Electron and derive the equation. Thomson's

$$\frac{e}{m} = \frac{2yE}{B^2l^2}$$

3. Discuss the use of transistor as an oscillator with the help of necessary block diagram.
4. Draw the graph showing characteristics of a P – N junction diode and discuss the reverse bias.

C. Solve the following examples (Any three) **9**

1. Obtain the relation between current gain α in common base and current gain β in common emitter for transistors.
2. Prove that if the value of load resistance RL and the input resistance r_1 are kept eqal in a common emitter NPN transistor amplifier, the a.c. current gain is equal to the voltage again.
3. In a Milikan's experiment to measure charge of an electron, value of k for an oil drop is 32×10^{-12} M.K.S. unit. During its free steady fall the dropp acquires a uniform velocity of 8×10^{-3} cm/s. On applying a uniform field of 200 v/cm; the drops move upwards with a uniform velocity of 12×10^{-3} cm/s. Calculate the charge on the drop in terms of a multiple of electronic charge.
4. A 100 – Watt bulb converts 3% of electrical energy consumed by it into light energy of wavelength emitted by the bulb 6625 A^o, calculate number of photons emitted per second. ($h = 6.625 \times 10^{34}$ Joule second., $c = 3 \times 10^8$ m.sc)

Q.–11 A Answer the following questions in very short : **5**

1. A 10 volt battery is connected between two parallel plates. What will be the Kinetic energy of an electron when it travels from negative plate and reaches positive plate ?
2. 'Stopping potential depends on the' battery voltage connected between two plates (collector and emitter)' – Do you agree with the statement ?
3. $1\overset{o}{A}$ = ____ f_m
4. 'For a given radioactive element, the time for total disintegration is dependent on its half life' – Do you agree ?
5. What is a majority charge carrier ?

B. Answer the following in eight to ten sentences : Any three **6**

1. What are cathode rays ? How was their nature infered ?
2. Mention the limitations of Bohr model.

3. Write a short note on Transistor Oscillator.
4. What is P – N junction ? Give the two points of difference between forward bias and reverse bias.

C. Solve the following examples : (Any three) **9**

1. Threshold wavelength for tungsten is 2.73×10^{-5} cm Ultraviolet light of wavelength 1.8×10^{-5} cm is incident on it. Find (i) work function and (ii) maximum velocity of photo electrons emitted. ($e = 1.6 \times 10^{-19}$ coulomb, $m = 9.10 \times 10^{-31}$ kg, $h = 6.625 \times 10^{-34}$ Joule – second, $C = 3 \times 10^{8}$ meter/sec.)
2. Prove that in a hydrogen atom, square of the orbital period of an electron is proportional to the cube of the radius of that orbit.
3. In a mixture of two radioactive elements A and B, the decay constant of A is 0.1 $(days)^{-1}$ and that of B is 0.2 $(days)^{-1}$ The activity of A is twice the activity of B. Find the activity of this mixture after 10 days. Its initial activity is 2 microcurie.
4. A common emitter NPN amplifier has a power gain 4×10^{3}. If the voltage gain is 80, find the current gain. If the base current changes by 20 microampere, find the change in the output current.

Q.–12 A Answer all the questions : **5**

1. Define work function of a metal surface.
2. Write any one reason to prove that the radioactive radiations are emitted from the nucleus.
3. Complete the following reaction.

   $_{82}Pb^{214} \rightarrow {}_{83}Bi^{214} +$ _____.
4. As the temperature increases, the current flows easily through a semiconductor than a resistor. Why ?
5. Write any one difference between emitter and collector in a transistor.

B. Answer any three of the following : **6**

1. Explain Millikan's apparatus to calculate charge of electron.
2. Write a note on uses of photo cell.
3. Explain binding energy and binding energy per nuclear of a nucleus.
4. Write a note on N–type semiconductor.

C. Solve any three of the following: **9**

1. How many photons at 6000 A^{o} wavelength will have energy equal to one – γ ray photon at 1.2×10^{-13} M ?
2. Stopping potential for a metal when irradiated with radiation of 2×10^{-7} m wavelength is 4.21 V. Calculate its work function. ($e = 1.6 \times 10^{-19}$ C, $h = 6.625 \times 10^{-34}$ J–s and $c = 3 \times 10^{8}$ m/s)
3. Obtain the mass (in Kg) and energy in (in Mev) equivalent to 1 amu. ($c = 3 \times 108$ m/s)
4. Half life of a radioactive element is 8 minute. Find the time taken to reduce the activity to 1/32 of the initial activity.

Q.–13 A Write Answer in very short : **5**

1. State Planck's revolutionary concept for the explanation results regarding perfect emitter.

2. State the name of two substances whose value of Thresold frequency is situated in Vissible Region.
3. If the energy of first orbit of electron in Hydrogen atom is E then energy of second orbit is .... (Fill in the gap)
4. 1 amu = ... KeV(Fill in the blank)
5. If in a Common Base Transistor, collector current is 4 m A and emitter current is 5 mA then current gain is .... (Fill in the gap)

B. Write the answer as asked (Any Three) 6

1. Draw the graphs representing characteristics of Photo electric effect. State itss characteristics. Draw the graph of stopping Potential $\rightarrow$ Frequency.
2. State limitation of Bohr Model.
3. Write the equation of rate of radioactive disintegration Deduce Exponential law for radio active disintegration.
4. Draw circuit diagram of Common Emitter Transistor Amplifier and obtain the equation of voltage of Input Signal.

(C) Solve any three Numerical Problems form following : 9

1. Prove that in a Hydrogen atom, square of the orbital period of an electron is proportional to the cube of the radius of that orbit.
2. Work function of metal is 2.2 eV. Calculate the maximum kinetic energy with which photo electrons are emitted in eV units on irradiating this metal with light of 4000 A units. C = 3×10^8 m/s, h = 6.62×10^{-19} Joule Second.
3. At a specific time the rate of radioactive decay of a substance is 6000 nuclei/second. At that time the undercayed number of nuclei is 8×10^7. Find the decay constant and the Half life.
4. In a common emitter transistor amplifier, the current gain is 50 and the input resistance is 4000 ohm. Find its transconductance. Find the voltage gain if the load resistance is 40 kΩ.

Q.–14 A Answer the following : 5

1. What threshold frequency ?
2. Why NPN transistor are preferred to PNP transistor ?
3. If stopping potential is 5V, what is value of max. kinetic energy of the emitted electrons ?
4. Define : Voltage gain
5. What are isotones ?

B Answer the following. (Any three)

(1) Describe along with necessary expressions the Thomson's experiment for determining e/m of an electron.
(2) Explain the working of common base NPN transitor.
(3) Derive exponential law for radioactive decay.
(4) Give the necessary precautions for controlled sucessful chain reaction.

C Solve the following examples.(Any three) 9

(1) In Millikan's experiment raduis of an oil drop is 0.5×10^{-4} cm. Its density is 900kg/m^3. Density of air is 1.3 kg/m^3. If electric field required to keep th drop in equilibrium between the plates is 14400 v/m. calculate the charge on the drop.

(2) In a ground state condition, energy of electrons is – 13.6 eV compute the energy of the electron in second orbit. State the answer in M.K.S. (leV = 1.66×10^{-19} joule)

(3) α of a transistor is 0.98 if collector current is 4.9 mA, find base – current.

(4) Half – life of a radioactive elements is 6.93 years. Its initial mass is 1 gm. Find undisitegrated mass of such an element after 10 years.

Q.–15 A Write short answer to the following questions. **5**

1. Define threshold frequency.
2. How much energy in Me V is released when a nucleus of deuteron is formed ?
3. ${}_1H^1 + {}_1H^2 =$ _____ + 5.5 Mev.
4. Give two examples of intrinsic semiconductors.
5. At what temperature do semiconductors behave as insulators ?

B. Write answer in Eight to Ten statements as asked. (Any three) **6**

1. Explain the emission of light of different colours in discharge tube and occurence of darkness at very low pressure.
2. Write a short note on nuclear fission.
3. Write a short note on dangers [Hazards] of nuclear energy.
4. Discuss the use of transistor as an oscillator using necessary block diagram.

C. Calculate any three Numerical problems from following. **9**

1. Mass of an oil drop in Millikan's expeeriment is m and its total charge is q. If its steady downward velocity in absence of an electric field is V Calculate the strength of the electric field required to make it move upwords with uniform velocity 5 v. Ignore the buoyancy force.
2. Show that in a hydrogen atom angular speed of an electron is given by

$$\omega = \frac{\pi m e^4}{2 \epsilon_0^2 n^3 h^3}$$

3. Mass of a ${}_{17}C^{135}$ nucleus is 34.9800 amu. If mass of a proton is 1.00783 amu, mass of Neutron is 1.00866 amu, find the binding energy of nudeus. Take 1 amu. = 931 Mev.
4. A common emitter NPN amplifier has a power gain 3×10^3. If the voltage gain is 60, find the current gain. If the base current changes by 30 micro amp; find change in the output current.

Q.–16 A Answer in short as asked. **5**

1. Write Einstein's's quantum theory about radiation.
2. If stopping potential is 5 V, what is the value of maximum kinetic energy of the emitted electrons ?
3. What is the function of moderator ?
4. Write the unit and diemensions of plank's constant ?
5. What is depletion layer ?

B. Answer any three in eight to ten sentences : **6**

1. In Thomson's experiment of determining e/m, assuming $y = \frac{1}{2}\left(\frac{Ee}{m}\right)\frac{l^2}{V^2}$ explain with necessary equations, how the velocity of electron can be obtained Obtain an expression for e/m of an election.

2. Give the Einstein's explanation for the photoelectric effect with necessary formula.

3. Assuming the radius of an electron in n the or bit in a hydrogen atom $r = \frac{n^2h^2 \in_o}{\pi mze^2}$ obtain the expression for the energy of an electron in nth orbit.

4. Giving necessary circuit of N–P–N common emitter transistor amplifier obtain the equation of input voltage.

C. Solve any three examples. **9**

1. Two electro beams have their velocity ratio 1 : 2 They enters in an uniform magnetic field perpendicular to it. Find the ratio of their deviations. (Beams are in the field for a very short durtation.)

2. Wavelength of Hα line in hydrogen atom is 6563 A. Calculatee the wavelength of Hβ line.

3. Angular velocity of an electron in nth orbit in a hydrogen atom is $\omega = \frac{\pi me^4}{2 \in_o^2 n^2h^3}$

   If one wants have the period of the electron in this orbit equal to that of a geostationary satellite, what should be the value of n ?
   ($m = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-9}$ C, $\varepsilon_o = 8.85 \times 10^{-12}$ $c^2/n - m^2$, $b = 6.625 \times 10^{-34}$ J–sec)

4. In a common emitter N–P–N amplifier if the collector current is changed by 8 m A when input voltage is given 40 millivolt, find its trancondutance If input resistance is 1000Ω find voltage gain.

Q.–17 A Answer the following in very short as asked. **5**

1. Give law for α decay.
2. $_{84}Po^{210} \rightarrow$ ___ + $_2He^4$.
3. Define P type semiconductor give example.
4. Give the formula for average radius of nuclueus.
5. Find out radius of Au^{197} nuclus in terms of fermi.

B Answer the following in eight to ten sentences (Any three) **6**

1. Explain giving examples Nuclear fission and Nuclear fusion.
2. Discribe the working of a NPN transistor in common base circuit.
3. What is rectification. Discuss half wave rectification.
4. Desribe the experimental arrangement of millikan's experiment to determine the election charge 'e' giving necessary diagrams.

C Solve the following (Any three) **9**

1. Calculate the quantum number for which the radius of the orbit of election is Be+3 woul be equal to that for ground state of election in a hydrogen atom. Also compare the energy of the two state.
2. A nuclus has an average radius of 6.6 freni. If average mass of nuclus is 1.0088 amu calculate its density.

3. The work function of cesium, Nickel and Fe are 1.8eV, 5.9eV and 4.8 eV respectively. Find there respective threshold frequences
4. When an input signal is applied to a common emitter transistor amplifier, one gets 0.02 volt voltage difference between base and emitter, change in base current of 20 μA and change in collector current of 2 mA. Find input resistance, a.c. current gain and transconductance.

Q.–18 A Answer the following questions in very short. (05)

(1) Calculate the photon energy of 500 nmA^0 light.

(2) Write down the dimensional formula of Rydberg's constant.

(3) What was the observation made by Goldstein about Cathode rays ?

(4) For a transistor collector current in 4 mA and emiter current is 5 mA find base current.

(5) Which fissile material is used in nuclear reactor.

B Answer the following question (Any three) (06)

(1) In Millikans' experiment, in the presence of an electric field explain the force acting during free fall and hence derive the expression for the charge.

(2) What is the limitation of the Bohr model.

(3) Draw the circuit for NPN common emitter amplifier. Obtain the expression for input resistance of input section of this circuit.

(4) What is photoelectric effect ? Write definition of threshold frequency. On which factor does it depend.

C Solve any three of the following.

(1) In Thomson's experiment to determine $\frac{\ell}{m}$ When an electric field only is applied, the displacement is Ye. When a magntic field only is applied the displacemet is Ym Prove $\frac{Y_m}{Ye} = \frac{B_v}{E}$

Here V = Horizontal velocity of the electron.

(2) Find the angular momentum of an electron in ground state for a hydrogen atom. Find angular momentum in fourth arbit. h = 6.625×10^{-34} JS

(3) In a common emitter amplifier transc condutance is 0.04 mho and voltage gain is 200 find load resistance.

(4) A $_{92}U^{235}$ reactor convert 2 Kg mass entirely into energy in 1 month. Find average power output. (1 month = 30 days).

Q.–19 A Answer in short as require: (05)

(1) What is theresold frequenct ?

(2) Write down the dimension formula of planck constant.

(3) 100 millicurie =..... Bequeral.

(4) in $_{92}U^{233}$ how much greater is the number of neutron than proton ?

(5) What is breakdown voltage ?

B Answer in about 8-10 sentence (Any three) (06)

(1) Assuming the radius of an electron in nth orbit in a hydrogen atom $r = \frac{n^2h^2\varepsilon_0}{\pi mZe^2}$ obtain the expression for the energy of an electron in n^{th} orbit.

(2) What is transistor ? Give its types and names of its different parts and its current noations,

(3) Write short not on photocell.

(4) Giving necessary circuit of N-P-N common emitter transistor amplifier obtain the equation of input voltage.

C Solve following examples (Any three) (09)

(1) An oil drop of 1.6×10^{-12} gm mass carries some charge. If the drop remains stationary in a uniform electric field of 500 volt/sm, claculate the charge on the drop (neglect buoyance force) how many electrons will there be on this drop? ($e = 1.6 \times 10^{-19}$ coulomb and $g = 10\ m/s^2$)

(2) Voltage gain of common emitter transistor amplifier is 1000. Input voltage is 50 millivolt. if the load resistance is 5000Ω find the change in the out put current.

(3) A nucleus has an average radius of 4.4 Fermi. If the average mass of the nucleus is 1.0088 amu claculate is density I amu = 1.66×10^{-27} Kg.

(4) Prove that if the value of load resistance R1, and the input resistance are kept equal in common emitter NPN transistor amplifier, the a.c. current gain is equal to the voltage gain.

Q.–20 A Answer the following question in very short: (05)

(1) What is the approximate velocity of cathode rays ?

(2) Why is the equipment of Millikan's experiment kept in a big wooden box ?

(3) State the ratio of the wavelengths of H_α line and H_β line of Balmer series.

(4) Write the unit of Rydberg's constant.

(5) What is an avlanche ?

B Answer any three of the following questions in eight to ten sentences: (06)

(1) Define half-life of a radioactive substance. Using it obtain the equation of half-life.

(2) Give an outline drawing of a nuclear reacter and name its different components.

(3) Describe working of NPN transistor in common base circuit.

(4) Give Einstein's explanation for the photo-electric with the help of necessary expressions.

C Solve any three of the following examples : (09)

(1) Howmany photons at $6000A^0$ wavelength will have energy equal to one gamma ray photon at 1.5×10^{-13} meter wavelength ?

(2) In Millikans' experiment, radius of oil drop is 0.5×10^{-4} cm. and its density is 900 km/m^3 If density of air is 1.3 kg/m^3 and electric field or 14,4000 vol t/m is needed to keep the drop stationary between the plates then find the charge on the drop. Take $g = 9.8\ m/s^2$

(3) What is the fraction of the radioactive substance that has decayed in time $\frac{1}{\lambda}$?

Where λ is the decay constant.

(4) In NPN common emitter amplifier, the a.c. current gain is 100, when the voltage gain is 200. Calculate the input resistance of the transistor if the value of load resistance is 4000 ohm.

Q.–21 (A) Answer the following question in short. **(05)**

(1) In Thomson's experiment to determine e/m when a magnetic field only is applied give the formula for the displacement ye.

(2) What is the work function of a metal ?

(3) In which section of the spectra of Hydrogen atom the Lyman series lie ?

(4) ${}_2H_\ell{}^3 + {}_2H_\ell{}^3 \rightarrow {}_2H_\ell{}^4 + 2({}_1H^1)$ +

(5) Draw a neat circuit diagram for the full wave-Rectifier.

(B) Answer any three of the following questions. **(06)**

(1) Give Einstein's explanation for the photoelectric effect with help of necessary expression.

(2) Write a short note on "Nuclear Redius"

(3) Write down laws of ratherford and soddy for the α and β decays. Give one example for each.

(4) Draw a neat diagram and explain P- type of semi conductors.

(C) Attempt any three of the following problems. **(09)**

(1) A 100 watt bulb converts 3% of elecrical energy consumed by it into light energy. If the wave length emitted by the bulb is 6625 A calculate number of photons emitted per second.

(2) An oil drop of 4×10^{-2} gm. mass carrier some charge of the drop remains stationary in a uniform electric field of 490 vott/cm. Calculate the charge on the drop neglect the buoyancy force. How many electrons will there be on thsi drop ?

$g = 9.8$ m/sec^2 $e = 1.6 \times 10^{-2}$ eoulumb.

(3) A nucleaus has an average raius of 6.6 fermi. If the average mass of the nucleor is 1.0088 GMV, Calculate its density.

1 amv = 1.66×10^{-27} kg

(4) A N-P-N common emitter amplifier has a voltage gain of 200. When the load resistance is 10 K1/0 ohm. FInd the tramscoductance giving its unit. If the input resistance of the circuit is 1000 ohm. Calculate the a.c. current gain.

Q.–22 A Write in very short. **5**

1. Define : The stopping potential
2. $8\pi 10^{-19}$ J _____ ev
3. State the principles underlying the construction of Atom bomb al Hydrogn bomb.
4. Draw the common base circuit diagram fr tu working of NPN transitor.
5. Writ use of oscillator.

B Write any three in Eight at tensentences. **6**

1. Explain Mass defect at Binding Energy
2. Deefine half half time of radioactive substance at dedyee the expression $\tau/_2 = \frac{.693}{y}$
3. Draw the circuit diogram of full wave rectifier at explain the process of rectification taks place during ar complete cycle of input A.C.
4. Explain Nuclear reactor.

C Calculate any three. **9**

1. Show that a hy droghen atom angalor speed of an electron is given hz

$$w = \frac{\pi m e^4}{2 \in_o^2 h^3 n^3}$$

2. A common emitter NPN amplifier has a power gain 3×10^3 If the voltage gain is 60, times the current gain if the base current changes bz 30μA, find the change in the output current.
3. Thresold frequency of sodium is 4.5×10^8 MHz. if The radiation of 6.4×10^{14} Hz frequency is incident on it them calculate by maximum k.t.at stopping potential ($e = 1.6 \times 10^{-19}$ $4 = 6.62 \times 10^{-34}$ J.S)
4. Calculate the maximum wavelength and minimum wavelength for spectral live of hydrogen spectrum in its Balmer series. Calculate the corresponding wave number ($R = 1.097 \times 10^{-7}$ metre^{-1})

Q.–23 A Write answers in short as require **5**

1. What is the shape of path of electron moving at right angle to magnetic field ?
2. Prove that the unit of Plank's constant and unit of angular momemtum are same.
3. What is the photoelectric effect ?
4. Name the spectral linee series H – atom which fall in the infared region.
5. Can both the slow and fast neuterons can produce fission of U235 ?

B Write answer in about 8 – 10 sentences (Any 3) **6**

1. In Millikan's experiment, write the formulae for various forces acting on the oil drop moving in downwards direction and also write the equation showing relation between them. Why does the electorn start moving in upward direction on applying electric field ? In this case, show that

$$q = \frac{k}{E}(v_1 + v)$$

2. Write Rutherford and soddy's laws of radioactive decay with suitable example it.
3. What is P – N junction ? Explain reverse bias condition with an appropriate circuit diagram.
4. Draw the circuit diagram of halfwave rectifier and explain th necessary modification which are required to convert half wave rectifier into full wave rectifier and give advantages of full wave rectifier over half waved rectifier

C Solve (Any 3) **9**

1. Calculatee the change in stopping potendtial when wavelength of light incident on a photoemission surface is reduced from 2000A^o to 1500A^o

   h = 6.62×10^{-34} J–S, e = 1.6×10^{-19} C

2. In an experiment to determine change to mass ratio by using Thomson's method, a potential difference of V valt is applied between two plates seprated by a distance Electrons accelerated from zero initial velocity by the same value of potential difference, v is made to enter the region between the plates; perpendicular to the electric field. If the magnetic field required to nultify the deflection of the beam is B, Prove that $B = \frac{1}{d}\sqrt{\frac{mV}{2e}}$

3. In a mixture of two radio active elements A and B the decay constant of A is 0.1 $(days)^{-1}$ and that of B is (0.2) $(days)^{-1}$. The activity of A is twice the activity of B. Find the activity of this mixture after 10 day Its initial activity is α microcurie

4. A CE NPN transister amplifier had a voltage gain 200 and input voltage is 20 mv If output resistance is 4 KΩ calculate to change in the output current.

Q.–24 A Answer in short : **5**

1. Define : Thresold frequency.
2. The electric and magnetic field applied in Thomson's expriement of e/m, are 4900 V/m and 3.5×10^{-4} tesla. If the deviation of election is zero find horizontal velocity of elextions.
3. Find angular momentum of an electron in 3rd excited state.
4. Atomic mass numbers of two atoms `a' and `b' are A_1 and A_2 respectively, where $A_1 < A_2 < 56$, then which nuclus is more stable ?
5. What is avalanche ?

B. Answer any three of the following questions : **6**

1. Obtain the equation of the radius of the orbit of election in n^{th} orbit in Bohr's model.
2. Draw the diagram of the circuit used to study characteristics of photoelectric effect and discuss what is studied in photoelectric effect.
3. Draw the circuit diagram of common emitter N–P–N transistor amplifier. Derive the equation of input voltage for the input section of this circuit.
4. Write equation of radioactive decay rate and derive ex–ponential law of radiusactive disintegration.

C. Attempt any three of the following problems : **9**

1. In Thomson's expriment to determine e/m, when an electric field only is applied, the displacement is ye. when a magnetic field only is applied the displacement is y_m

   Prove that $\frac{y_m}{y_e} = \frac{Bv}{E}$

2. A 100 watt bulb coneverts 5% of electrical energy consumed by it into light energy. If the wavelength emitted by the bulb is 6625 A^o, Calculate number of photons emitted persecond [h = 6.625×10^{-34} Joules – sec, C = 3×10^8 m/s]

3. If $_{84}Po^{210}$ is the end product of decay of $_{92}U^{238}$ find the number of α particless and β partides emitted in the sequence of reactions involved.
4. In a N–P–N common emitter amplifier, the a.c. current gain is 120, when the voltage gain is 180. Calculate the input resistance of the transistor if the value of the load resistance is 4.5 KΩ

Q.–25 A Answer the following as directed : **5**

(1) Write down electronic configuration of $_{32}Ge$.

(2) Write down the unit of Trans–conductance.

(3) Write down the dimensional equation of : $\frac{Ze^2}{4\pi \in_o r}$

(4) Stopping potential is measure of ..... of the photoelectrons.

(5) ``Cathode ray is an electronmagnetic wave." Correct the statement if it is wrong.

B Answer any three in eight to ten senteces : **6**

(1) What is P–N junction ? Discuss in brief the forwardbias and reverse – bias in P – N junction.

(2) Discuss the properties of α, β and γ rays.

(3) What is Mass – defect ? Explain and write down its equation. Hence explain what is Binding energy ?

(4) Describe the experimatal arrangement of Millikan's Oil drop expriment.

Draw figure and obtain : $kv = g\ (m - m_o)$

C Solve any three: **9**

(1) In Thomson's experiment to determine `e/m' the electric and magnetic fields applied over the same region in mutually perpendicular directions to nullify the displacement of electrons are respectively 3 Megavolt/km and 2 gauss. Calculate the horizontal velocity of the electrons.

(2) If $_{84}Po^{210}$ is the end product of decay of $_{92}U^{238}$. Calculate the number of α particles and β – particles emited in the sequence of reaction involved.

(3) Show that in a Hydrogen atom angular speed of an electron is given by :

$$w = \frac{\pi m e^4}{2 \in_o^2 n^3 h^3}$$

(4) In a NPN Ce amplifier the ac current gain is 100 when the voltage gain is 200. If Re = 4kΩ calculatee resistance and power gain.