CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations January 2023

Programme: Integrated B.Sc. M.Sc. (Chemistry/Mathematics)

Semester: III **Session: 2022-23**

Course Title: Waves and Optics (GE) **Max. Time: 3 Hours**

Course Code: SBS PHY 03 301 GE 4004 **Max. Marks: 70**

Instructions:

- Question no. 1 has seven parts and students need to answer any four. Each part carries three and half marks.
- Question no. 2 to 5 have three parts and student need to answer any two parts of each question. Each part carries seven marks.

Q1. (a) The equation of a transverse wave on a string is: $y = (2.0\text{mm}) \sin[(20\text{m}^{-1})x - (600\text{s}^{-1})t]$. The tension in the string is 15 N. Find the wave speed and linear density of this string in grams per meter

(b) In which of the following: air, water, vacuum, and steel; the speed of sound will be highest and in which it will be the lowest. Justify your answer.

(c) An object undergoing simple harmonic motion takes 0.25 s to travel from one point of zero velocity to the next such point. The distance between those points is 36 cm. Calculate the (i) period, (ii) frequency, and (iii) amplitude of the motion.

(d) Green light of wavelength 0.51 μm from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen 200 cm away is 2 cm, find the slit separation.

(e) Newton's rings are observed in reflected light of $\lambda = 5.9 \times 10^{-5}$ cm. The diameter of the 10th dark ring is 0.5 cm. Find the radius of curvature of the lens.

(f) Deduce the missing orders for a double slit Fraunhofer diffraction pattern, if the slit widths are 0.16 mm and they are 0.8 mm apart.

(g) Is diffraction of light a wave phenomenon or ray phenomenon? Discuss briefly.

$(4 \times 3.5 = 14)$

Q2. (a) Two simple harmonic oscillators are oscillating with same frequency in same direction, but with different phases ϕ_1 and ϕ_2. Derive the expression for amplitude and phase of resultant motion due to the superposition of these oscillators.

(b) What are Lissajous' figures? Discuss the composition of two simple harmonic vibrations having equal frequency acting at right angles, and having a phase difference of $\pi/2$.

(c) Derive wave equation for a transverse wave that is excited by applying tension 'T' in a string having mass per unit length 'μ'.

$(2 \times 7 = 14)$

Q3. (a) Derive the expression for intensity of sound in a medium having mass density ρ. What is intensity of sound of a fighter jet in W/m^2 if it is producing a noise of 120 dB. Take reference intensity I_0 as 10^{-12} W/m^2.

(b) What is reverberation time. Derive Sabine's reverberation formula.

(c) State and the prove Bernoulli's theorem. Explain the lifting action of an aeroplane.

$(2 \times 7 = 14)$

Q4. (a) Find the formula for intensity distribution when two coherent light waves superimpose on each other. What are the conditions necessary for obtaining a sustainable interference pattern?

(b) What are Newton rings? Discuss the difference between the fringes obtained by using a white light and a monochromatic light.

(c) Draw a well labeled diagram of Michelson Interferometer. Explain the formation of circular fringes in it.

$(2 \times 7 = 14)$

Q5. (a) Derive the expression for resultant amplitude in Fraunhofer pattern obtained in a plane diffraction grating and discuss the conditions for maxima and minima in it.

(b) What is a zone plate? Give its theory. Compare the zone plate with a convex lens.

(c) What do you understand by polarization of light? Explain how do you distinguish unpolarized, plane polarized, circularly, and ellipticaly polarized light.

$(2 \times 7 = 14)$

CENTRAL UNIVERSITY OF HARYANA

End Semester Examinations January 2023

Programme: Integrated B.Sc. M.Sc. (Chemistry/Mathematics)

Semester: III | **Session: 2022-23**

Course Title: Waves and Optics (GE) | **Max. Time: 3 Hours**

Course Code: SBS PHY 03 301 GE 4004 | **Max. Marks: 70**

Instructions:

- Question no. 1 has seven parts and students need to answer any four. Each part carries three and half marks.
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Q1. (a) The equation of a transverse wave on a string is: $y = (2.0\text{mm}) \sin[(20\text{m}^{-1})x - (600\text{s}^{-1})t]$. The tension in the string is 15 N. Find the wave speed and linear density of this string in grams per meter

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CENTRAL UNIVERSITY OF HARYANA
Jant-Pali, Mahendergarh, Haryana
Term End Examination January-2023

Name of Programme	: M.Sc. Physics	
Year & Semester	: January 2023, Third Semester	
Course Name	: General Theory of Relativity	
Course Code	: SBS PHY 01 306 DCEC 3104	
Maximum Marks	: 70	Duration : 3 Hrs

Note:
All Questions are compulsory.
Attempt any four parts in Question 1, each part carries 3.5 marks.
Attempt any two parts in Question 2 to 5. Each part carries 7 marks.

1. (a) Define four-vector in special relativity. Give two examples of four-vectors.

   (b) Show that the product of a symmetric tensor and an antisymmetric tensor in the same pair of indices vanishes.

   (c) State the Weak Equivalence Principle and the Einstein Equivalence Principle.

   (d) An optical photon has wavelength 500 nm. Estimate its gravitational mass.

   (e) Show that the invariant volume element is $\sqrt{-g}d^4x$, where g is the determinant of the metric tensor for a general space time.

   (f) Show that $\frac{\partial g^{ik}}{\partial x^l} = -\Gamma^i_{ml}\, g^{mk} - \Gamma^k_{ml}\, g^{mi}$

   (g) Comment on the linearisation of gravity. What are various metric tensors involved in this procedure ?

2. (a) Consider a spacelike vector V^μ such that $\eta_{\mu\nu}V^\mu V^\nu = -1$. Show that, under Lorentz transformation $V^{\nu'} = \Lambda^{\nu'}_{\mu} V^\mu$ the vector remains spacelike i.e. $\eta_{\mu'\nu'}V^{\mu'}V^{\nu'} = -1$. Will the result be different if the vector V^μ was timelike or null ?

   (b) The trajectory of a particle is parameterized by a monotonic parameter λ as

   $$t(\lambda) = a\ sinh(\lambda/a), x(\lambda) = \frac{a}{2}\ cosh(\lambda/a), y(\lambda) = \frac{a}{2}\ cosh(\lambda/a), z(\lambda) = b$$

   where a and b are constants. Compute the four-velocity and four-acceleration for this particle.

   (c) Starting from the action $\mathcal{A} = -m\int ds - q\int A_i dx^i$ for a particle of mass m and charge q, interacting with an electromagnetic field with four-potential $A^i = (\phi, \mathbf{A})$, derive the equation of motion and show that it is equal to

   $$\frac{d^2x^\mu}{d\tau^2} + \Gamma^\mu_{\rho\sigma}\frac{dx^\rho}{d\tau}\frac{dx^\sigma}{d\tau} = \frac{q}{m}F^\mu_{\ \nu}\frac{dx^\nu}{d\tau}$$

   Here $F^\mu_{\ \nu}$ is electromagnetic field tensor and τ is the proper time.

3. (a) Show that the equation of motion of a particle in general curved space time with metric g_{ab} is $\frac{dU_c}{ds} - \frac{1}{2}\frac{dg_{ab}}{dx^c}U^aU^b = 0$ where U is the 4 velocity of the particle.

   (b) The curvature tensor is defined via $R^a_{\ bcd} = \partial_c\Gamma^a_{bd} - \partial_d\Gamma^a_{bc} + \Gamma^a_{ec}\Gamma^e_{bd} - \Gamma^a_{ed}\Gamma^e_{bc}$. Prove that $\nabla_e R_{abcd} + \nabla_c R_{abde} + \nabla_d R_{abce} = 0$

(c) The Riemann tensor for a maximally symmetric spacetime is given by

$$R_{abcd} = \frac{K}{n(n-1)}(g_{ac}\, g_{bd} - g_{ad}\, g_{bc})$$

where n is the number of spacetime dimensions, and K is a constant. Calculate the Ricci Tensor $R_{bd} = g^{ac}R_{abcd}$, the Ricci scalar $R = g^{ab}R_{ab}$ and the Einstein tensor.

4. (a) Write down Einstein's Field equation. Prove that $\nabla_b G^b{}_a = 0$

   (b)What are Killing vectors ? Show that $T^a_b \xi_a$ leads to a conserved quatity where T^a_b is Energy momentum tensor and ξ_a is a set of Killing vectors.

   (c) For a line element (or interval) of the form $ds^2 = f(r)dl^2 - \frac{1}{f(r)}dr^2 - r^2(d\theta^2 + sin^2\theta\ d\phi^2)$, with unknown f(r), the Einstein's equation can be simplified to produce $\frac{1}{r^2}(1-f) - \frac{1}{r}\frac{df}{dr} = E$, where E is the energy density of the matter contained within the space time. Assuming E=0 and E= Constant, solve the differential equation to obtain the value of f(r) for the two cases.

5. (a) In order to understand the propogation of gravitational effects through space time as gravity waves, we have to study the linearization of general relativity. Calculate the Ricci Tensor, Ricci Scalar and Einstein Tensor for linearised gravity to linear order.

   (b) From the linearized variables derived above, write the linearised gravity equation (or Einstein Equation) in terms of trace reversed perturbation variable.

   (c) Define Lorentz gauge. Write down the equation for gravitational waves in Lorentz gauge.

CENTRAL UNIVERSITY OF HARYANA

End Semester Examination (January 2023)

Programme: Integrated B.Sc. M.Sc. (Physics)

Semester: III | **Session: 2022-23**

Course Title: Thermal Physics | **Max. Time: 3 Hours**

Course Code: SBS PHY03 302 CC 4004 | **Max. Marks: 70**

Instructions:

- Q1 has seven parts and students need to answer any four. Each part carries three and half marks.
- Q2 to Q5 have three parts and student need to answer any two parts of each question. Each part carries seven marks.
- The use of a personal non-programmable calculator is allowed.

Q1. (a) The ratio of densities of ice and water at 0 ^oC is 10:11. Calculate the decrease in melting point of ice with the one-atmosphere increase in pressure. Given that the latent heat of fusion of ice is 80 cal/gm.

(b) The efficiency of an ideal heat engine is 0.2. It increases to 0.25 if the temperature of the sink is lowered by 20 K. Find the original temperatures of the source and the sink.

(c) The Van der Waals constants for CO_2 are: a = 1.32 $\times$ 10^4 Nm^4 $mole^{-2}$ and b = 3.64 $\times$ 10^{-5} m^3 $mole^{-1}$. Calculate critical pressure and critical temperature.

(d) Calculate the mean free path of nitrogen molecule at NTP. The molecular diameter of nitrogen is 3.5 x 10^{-8} cm.

(e) How first order phase transitions are different from second-order phase transitions?

(f) What is the importance of a T-S diagram? Derive the expression for efficiency of a reversible Carnot's engine with help of a T-S diagram.

(g) Explain reversible and irreversible processes using examples.

(4 $\times$ 3.5 = 14)

Q2. (a) What is an adiabatic process? Prove that work done during an adiabatic process is a function of only initial and final temperatures.

(b) Write the principle used in the refrigerator. How a refrigerator is different from a heat engine? Also, discuss the coefficient of performance.

(c) State: (i) zeroth law of thermodynamics, (ii) first law of thermodynamics, (iii) second law of thermodynamics, (iv) Carnot's theorem.

(2 $\times$ 7 = 14)

Q3. (a) What is entropy? Derive the expression for the entropy of a perfect gas in terms of: (i) temperature and volume, and (ii) temperature and pressure.

(b) Write Maxwell's thermodynamical relations and derive Clausius-Clapeyron's equation using these relations. Also, discuss the effect of pressure on: (i) the boiling point of a liquid, and (ii) the melting point of a solid.

(c) A mass m of a liquid at temperature T_1 is mixed with an equal mass of same liquid at temperature T_2 in a thermally insulated system. Show that the change in entropy is $2m \cdot C_P \cdot log_e[(T_1 + T_2)/(2\sqrt{T_1 T_2})]$.

$(2 \times 7 = 14)$

Q4. (a) What is Maxwell-Boltzmann Law of distribution of velocities in an ideal gas? Derive the expression for molecular speeds: (i) mean speed, (ii) root mean square speed, and (iii) most probable speed.

(b) Derive an expression for the viscosity of a gas in terms of mean free path of its molecules. Show that it is independent of pressure, but depends upon the temperature of the gas.

(c) Define degrees of freedom and state the law of equipartition of energy. Derive the relation between molar-specific heats and degrees of freedom. Prove that ratios of specific heats are 1.67 (for monoatomic gas) and 1.40 (for diatomic gas).

$(2 \times 7 = 14)$

Q5. (a) What is the Joule-Thomson effect? Describe the porous-plug experiment along with experimental conclusions.

(b) What are the reasons that led to the need for modification of the ideal gas equation? Derive the Van der Waals equation.

(c) Define Boyle's point, the temperature of inversion, and the critical temperature of a gas. How these parameters are related to each other?

$(2 \times 7 = 14)$

CENTRAL UNIVERSITY OF HARYANA

End Semester Examination (January 2023)

Programme: Integrated B.Sc. M.Sc. (Physics)

Semester: III **Session: 2022-23**

Course Title: Thermal Physics **Max. Time: 3 Hours**

Course Code: SBS PHY03 302 CC 4004 **Max. Marks: 70**

Instructions:

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$(2 \times 7 = 14)$

CENTRAL UNIVERSITY OF HARYANA

Term End Examinations January 2023

Programme: M.Sc. Physics **Session: 2022-23**

Semester: Third **Max. Time: 3 Hours**

Course Title: Atomic, Molecular Physics & Lasers **Max. Marks: 70**

Course Code: SBS PHY 01 301 CC 3104

Instructions:

1. Question no. 1 has seven parts and students are required to answer any four. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and students are required to answer any two parts of each question. Each part carries seven marks.

Q 1. (4 x 3.5 = 14)

a) Explain the spatial and temporal coherence with examples.

b) Define Q-switching and mode locking. What are the different techniques used for Q-switching?

c) State and prove Bohr's quantization law of angular momentum.

d) How many revolutions does an electron in the n=2 state of a Hydrogen atom make before dropping to the n=1 state? The average lifetime of an excited state is 10^{-8}s. Given that $R_\infty = 1.097 * 10^7\ m^{-1}$.

e) The lithium atom has one 2s electron outside a filled inner shell. Its ground state is $^2S_{1/2}$. What are the term symbols of the other allowed states? Why would we think that the $^2S_{1/2}$ state is the ground state?

f) What is the Paschen-Back effect?

g) The fundamental mode of HCl occurs at 2886 cm^{-1}. Predict the frequency of the corresponding mode of DCl.

Q 2. (2 x 7 = 14)

a) Explain Bohr's correspondence principle. Prove that for very large quantum numbers, the quantum theory frequency and the classical orbit frequency become equal.

b) In a transition to a state of excitation energy 10.19 eV, an hydrogen-like atom emits a 4890 Å photon. Find the binding energy of the initial state.

c) What is the meaning of degeneracy of elliptic orbits in Sommerfeld theory of elliptic orbits? Discuss Hydrogen atom fine spectra with relativistic correction to energy levels of an atom using Sommerfeld theory.

Q3. (2 x 7 = 14)

a) Determine the possible terms of one-electron atom corresponding to n=3 and compute the value of total electronic angular momentum for the state $^2D_{5/2}$ and angle between $\vec{L}$ and $\vec{S}$ vectors for the term $^2D_{5/2}$.

b) Explain Born-Oppenheimer approximation in detail.

c) Discuss Anomalous Zeeman Effect. Describe the Zeeman splitting pattern of resonance lines of Sodium.

Q 4. (2 x 7 = 14)

a) The OH-radical has a moment of inertia of 1.48×10^{-47} kgm^2. Calculate its internuclear distance. Also, calculate its angular momentum and angular velocity for J=5. Determine the energy absorbed in the J=5 ➔ J=6 transition in cm^{-1} and in joule.

b) What is the Raman effect? Give its quantum theory. What light does it throw on the structure of molecules?

c) What are Stokes and anti-Stokes lines? Obtain expression for frequency shift of rotational Raman lines.

Q 5. (2 x 7 = 14)

a) What are three level and four level laser systems? Discuss the principle, construction, and working of He-Ne Laser.

b) What do you understand by the Einstein Coefficients? Explain their physical significance.

c) What are transition probabilities? Obtain a relation between the transition probabilities of spontaneous and induced emissions. Prove that $B_{21}A_{21} = 8\pi h_3 \nu_3$.

CENTRAL UNIVERSITY OF HARYANA

Term End Examinations, January 2023

Programme: M.Sc. Physics **Session: 2022-23**

Semester : III **Max. Time: 3 Hours**

Course Title: Nuclear Physics **Max. Marks: 70**

Course Code: SBS PHY 01 302 CC 3104

Instructions:

1. **Question no. 1 has seven sub parts and students need to answer any four. Each sub part carries three and half Marks.**

2. Question no. 2 to 5 have three sub parts and students need to answer any two sub parts of each question. Each sub part carries seven marks.

Question No. 1. (4X3.5=14)

a) Write the configuration of protons for the nuclei $^{179}_{79}Au_{118}$ and $^{47}_{22}Ti_{25}$.

b) Write a note on Gell-Mann-Okubo formula.

c) List the assumptions of liquid drop model.

d) Why Higgs particle is known as God particle?

e) Positive scattering length mean nucleus is bounded. Comment

f) Why nuclei have quadrupole moment?

g) Calculate radius of $^{131}_{54}Xe$ nucleus using Ngo and LDM paramerizations.

Question No. 2. (2X7=14)

a) Describe the internal conversion process in details

b) How Wu's experiment was able to establish the beta decay process?

c) Discuss one experimental method to determine the size of a nucleus.

Question No. 3. (2X7=14)

a) Show that nuclear forces are spin dependent.

b) Describe the ground state properties of deutron nucleus.

c) How meson theory proved that nuclear forces are of short range?

Question No. 4. (2X7=14)

a) Describe the Fermi gas model for nuclei.

b) Draw energy level diagram based on Shell model for nucleon configuration.

c) What do you mean by nuclear fission? Describe the fragment distribution.

Question No. 5. (2X7=14)

a) Discuss the C and P operations. Show that CP operation violate in weak interactions.

b) What do you mean by weak interactions? Describe the charged weak interactions.

c) Discuss the conservation of isospin, strangeness and hypercharge with suitable examples.

Central University of Haryana

Term end Examination: January 2023

Program: Integrated BSc MSc (Physics) Time: 3 Hours

Semester: Third Max. Marks:70

Course Title: Mathematical Physics II

Course Code: SBS PHY03 301CC 4004

Instructions:

1. Question no. 1 has seven parts and students are required to answer any four. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and students are required to answer any two parts of each question. Each part carries seven marks.

I Answer any 4 of the following briefly and to the point: **(3.5 X 4)**

(a) Define Fourier series in terms of Fundamentals and Harmonics.

(b) What are the advantages of a Fourier Series?

(c) Differentiate between ordinary point and a singular point.

(d) Obtain generating function of Bessel's function of First kind.

(e) Find relationship between Beta and Gamma Functions.

(f) Differentiate between Systematic and Random errors.

(g) Bring out importance of Partial Differential Equations.

II (a) Determine Fourier coefficients of a Fourier Series. Also, obtain the complex form of the Fourier series of the function $f(x) = \begin{cases} 0 & -\pi \leq x \leq 0 \\ 1 & 0 \leq x \leq \pi \end{cases}$

(b) Expand the fuction f(x) = x sinx as a Fourier series in the interval $-\pi \leq x \leq \pi$. Hence deduce that $\frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - \frac{1}{7.9} + \cdots .. = \frac{(\pi-2)}{4}$.

(c) Derive Parseval's formula and hence show that $\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \cdots \ldots \ldots$ **(7,7)**

III (a) Describe Frobenius method to solve a second order differential equation in terms of series solution. Obtain a series solution in powers of x for differential equation $2x(1-x)\frac{d^2y}{dx^2}+(1-x)\frac{dy}{dx}+3y=0$

(b) Derive Rodrigue's formula for Legendre Polynomials and hence prove their orthogonality condition.

(c) Prove that $\int_{-1}^{1} x^2 P_{n+1}(x)P_{n-1}(x)dx = \frac{2n(n+1)}{(2n-1)(2n+1)(2n+3)}$. Also, deduce the value of $\int_{0}^{1} x^2 P_{n+1}(x)P_{n-1}(x)dx$. (7,7)

IV (a) Evaluate value of Γ(½) using Cartesian frame of reference. Show that

$$\int_0^\infty \sqrt[4]{x}\, e^{-\sqrt{x}}dx = \frac{3}{2}\sqrt{\pi}$$

(b) Derive Legendre duplication formula and then prove that $\left(m+\frac{1}{2}\right)!! = \sqrt{\pi}\,(2m+1)!!/2^{m+1}$.

(c) If n is a positive integer then prove that $\beta(m,n) = \frac{(n-1)!}{m(m+1).....(m+n-1)}$. (7,7)

V (a) Construct for 2D steady flow of heat in Cartesian coordinates and hence find its solution.

(b) A long cylinder is made of two halves: the upper half is at Temperature V_1 while the lower half is at temperature V_2. Show that the distribution of the temperature inside the cylinder is

$\Psi = \frac{V_1+V_2}{2} + \frac{2}{\pi}(V_1-V_2)\left[\frac{Sin\theta.r}{R} + \frac{1}{3\pi R^3}Sin\theta r^3 + \cdots.\right]$.

(c) Construct wave equation and find its solution for vibrational modes of a rectangular membrane. (7,7)

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CENTRAL UNIVERSITY OF HARYANA

Term End Examinations, January 2023

Programme: M.Sc. Physics | **Session: 2022-23**
Semester: III | **Max. Time: 3 Hours**
Course Title: Solid State Physics | **Max. Marks: 70**
Course Code: SBS PHY 01 303 CC 3104

Instructions:

1. Question number 1 has seven sub parts and students need to answer any four. Each sub part carries three and half Marks.

2. Question numbers 2 to 5 have three sub parts and students need to answer any two sub parts of each question. Each sub part carries seven marks.

Question Number 1. (4X3.5=14)

a) Copper has fcc structure and its atomic radius is 0.1278 nm. Calculate its density. Take the atomic weight of copper as 63.5.

b) What is coordination number? What factors control the coordination number?

c) Explain Wiedemann-Franz law.

d) What is Fermi energy? Write down its relation with the concentration of conduction electrons in metals.

e) What are Brillouin zones? What is the physical significance of the boundary of a Brillouin Zone? How are they related to the energy of an electron in a metal?

f) How does superconducting transition temperature vary with magnetic field?

g) Prove that the crystals cannot have five-fold symmetry.

Question Number 2. (2X7=14)

a) Consider the crystal structure of NaCl which is modeled as a set of touching spheres. Each Na atom has a radius r_1 and each Cl atom has a radius r_2. The centres of the spheres form a simple cubic lattice. Determine the packing fraction of this crystal system.

b) Obtain the vector form of Bragg's law using the concept of reciprocal lattice.

c) Show (111) and (222) planes in a cubic unit cell of side *a*. Compute the distances of these planes from a parallel plane passing through the origin.

Question Number 3. (2X7=14)

a) What is Debye temperature? What is its significance? If a solid has Debye temperature of 2000 ^{0}C, what can you say about its room temperature specific heat?

b) Describe inelastic scattering of photons by phonons. Obtain an expression for the frequency of phonons generated when a photon is scattered inelastically at an angle θ.

c) The radii of Na^+ and Cl^- ions are 0.98 and 1.81 Å respectively. The Young's modulus of NaCl in [100] direction is 5×10^{10} N/m^2. Assuming that the extension in [100] direction produces negligible contraction in the perpendicular directions, calculate the wavelength at which the electromagnetic radiation is strongly reflected by NaCl crystal. Atomic masses of Na and Cl are 23 and 35.5 amu respectively.

Question Number 4. (2X7=14)

a) Discuss the motion of electrons in one-dimension according to the band theory and show the variation of energy, velocity and effective mass as a function of wave-vector.

b) The energy of an electron in a band as a function of its wave vector k is given by E(k) $= E_0 - B(\cos k_x a + \cos k_y a + \cos k_z a)$, where E_0, B and a are constants. Calculate the effective mass of the electron near the bottom of the band.

c) The energy near the valence band edge of a crystal is given by $E = -Ak^2$, where $A = 10^{39}$ Jm^2. An electron with wave-vector $\boldsymbol{k} = 10^{10}\boldsymbol{k}_x$ m^{-1} is removed from an orbital in the completely filled valence band. Determine the effective mass, velocity, momentum and energy of the hole.

Question Number 5. (2X7=14)

a) Perfect diamagnetism of a material is due to a certain electron arrangement. Do you think that this electron arrangement is compatible with zero resistance of superconductors. Why are not all diamagnetic material have zero resistance property?

b) It is said that the phenomenon of superconductivity is analogous to the phenomenon of superfluidity in liquids. Comment.

c) The London penetration depths for Pb at 3 K and 7.1 K are respectively 39.6 nm and 173 nm. Calculate the transition temperature as well as penetration depth at 0 K.

CENTRAL UNIVERSITY OF HARYANA

Third Semester Term End Examinations January 2023

Programme: Integrated B.Sc. - M.Sc. Physics | **Session: 2022-23**

Semester: Third | **Max. Time: 3 Hours**

Course Title: Analog Systems And Applications | **Max. Marks: 70**

Course Code: SBS PHY 03 303 CC 4004

Instructions:

1. Question no. 1 has seven parts and students are required to answer any four. Each part carries three and half Marks.

2. Question no. 2 to 5 have three parts and students are required to answer any two parts of each question. Each part carries seven marks.

Q 1. (4 x 3.5 = 14)

a) Explain the flow of current in a forward biased diode. What is the order of currents in the forward and reverse biasing?

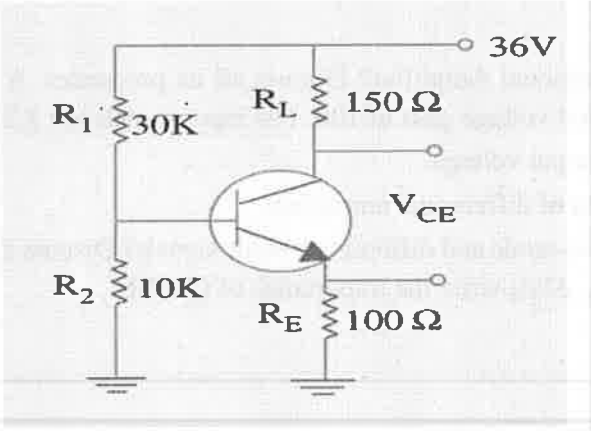
b) What is the effect of temperature on V-I characteristics of p-n junction?

c) Why does the zener breakdown voltage decrease with increase in temperature?

d) Explain the DC Load line.

e) Why do we prefer h-parameters in a transistor? Why are h-parameters called hybrid parameters?

f) Find the value of V_{CE} for the universal stabilization circuit given below:



g) A differential amplifier has a voltage gain of 150 and a CMRR of 90 dB. The input signals are 50 mV and 100 mV with 1 mV of noise on each input. Find (i) the output signal (ii) the noise on the output.

Q 2. (2 x 7 = 14)

a) Explain the working of zener diode and what are its applications. Distinguish between avalanche breakdown and zener breakdown.

b) Draw and explain the V-I characteristics of p-n junction? Obtain the expression for saturation current and the a.c. resistance of the p-n diode.

c) Describe the light emitting diode and its working. How does the efficiency of light generation in LED change with temperature?

Q3. (2 x 7 = 14)

a) Determine the current gain, power gain, input impedance and output impedance of CE transistor amplifier in h-parameters.

b) Discuss single stage common base transistor amplifier.

c) Describe the various methods used for transistor biasing. State their advantages and disadvantages

Q 4. (2 x 7 = 14)

a) What is feedback? Explain how the gain of an amplifier can be stabilized with the help of negative feedback. Explain how it helps in reducing the non-linear distortion.

b) A MHz Colpitt's oscillator is generating waveforms of frequency 16 MHz. The coil used in it has an inductance of 10 μH and the transistor has $h_{fe} = 50$ and $\Delta h_e = 0.5$. Find the value of the capacitance ?

c) What is Barkhausen's Criterion for self-sustained oscillations? Discuss phase shift oscillator.

Q 5. (2 x 7 = 14)

a) What is an Operational Amplifier? Discuss all its properties. A differential amplifier has an open-circuit voltage gain of 100. The input signals are 3.25 V and 3.15V. Determine the output voltage.

b) Discuss operation of differential amplifiers.

c) What are common-mode and differential-mode signals? Discuss the double-ended input operation of DA. Also, write the importance of CMRR.

CENTRAL UNIVERSITY OF HARYANA

Term End Examinations January 2023

Programme: M.Sc. Physics **Session: 2022-23**

Semester: III **Max. Time: 1.5 Hours**

Course Title: Research and Publication Ethics **Max. Marks: 35**

Course Code: SBS PHY 01 306 CC 2002

Instructions:

1. Question no. 1 has nine parts and students are required to answer any seven. Each part carries One Marks.
2. Question no. 2 to 5 have three parts and students are required to answer any two parts of each question. Each part carries 3.5 marks.

Q 1. (7X1=7)

a) Illustrate the meaning of philosophy with a suitable example.

b) What are moral judgments and its reaction?

c) Explain the scientific misconduct and its types.

d) Define citation index of a research paper.

e) Explain the violation in publication ethics with and two examples.

f) Distinguish between open access and predatory journals?

g) Explain plagiarism and what tool is available to detect it?

h) What is conflict of interest?

i) Explain research gap with a suitable example.

Q 2. (2X3.5=7)

a) What are research ethics? Explain the importance with an example

b) Discuss the Redundant publications: duplicate and overlapping publications, salami slicing.

c) Summarize the best practice in research with an example.

Q 3. (2X3.5=7)

a) What is SHERPA/RoMEO online resource to check publisher copyright & self-archiving polices? Discuss in brief.

b) Briefly discuss two journal finder tools from reputed journals. Does it help the authors in finding the correct journal?

c) What is SPPU? How to identify the predatory journal using UGC CARE?

Q 4. (2X3.5=7)

a) Discuss a case study on complaint and scientific research appeals from fraud in India and abroad.

b) How to evaluate the nature of plagiarism for a scientific report.

c) Interpret the subject specific ethical issues, FFP and authorship

Q 5. (2X3.5=7)

a) Discuss the research metrics; h index, g index, and i10 index.

b) Summarize the indexing database and citation database with correct reference

c) Interpret the meaning of the following terms SNIP, SJR, IIP, Cite Score and journal citation report.