Total No. of Questions :7]

SEAT No. :

P1263

[Total No. of Pages : 2

[5122]-11

M.Sc. (Semester I)

PHYSICS

Phyutn 501: Classical Mechanics

(2008 Pattern)

Time : 3 Hour] *[Max. Marks :80*

Instructions to the candidates:

1) ***Question NO.1 is compulsory, and any four from the remaining.***
2) ***Draw neat diagram wherever necessary.***
3) ***Figures to the right indicates full marks.***
4) ***Use of log table & calculator is allowed.***

Q1) Attempt any four of the following :

a) Give the classification of constraints. **[4]**

b) Explain the effect of coriolis force on rivers. **[4]**

c) What is cyclic coordinate? Show that momentum corresponding to cyclic coordinates remains constant. **[4]**

d) Prove that

$[uv, w] = u[v,w] + [u,w]v$ **[4]**

e) Compare cagrangian & humiltonian formulation **[4]**

f) Explain the concept of reduced mass. Find reduced mass of H_2 Molecule **[4]**

Q2) a) For potential energy function $v(r) = br^{n+1}$, b being constant, show that orbit is stable if $n > -3$ **[8]**

b) Show that the total linear momentum of any closed system is conserved due to the homogeneity of space **[4]**

c) Explain the concept of phase space & configuration space **[4]**

P.T.O

Q3) a) Prove that the given transformation

$Q = q^{\alpha} \operatorname{Cos} \beta p \qquad P = q^{\alpha} \operatorname{Sin} \beta p$

is canonical if $\alpha = ½$ & $\beta = 2$ **[8]**

b) Using variational principle solve the brachistochrone problem. **[8]**

Q4) a) Solve the problem of simple pendulum oscillating in x - y Plane by using lagrangds equation of motion. **[8]**

b) Prove the following properties of poisson's bracket. **[8]**

i) $$\frac{\partial}{\partial t}[u,v] = \left[\frac{\partial u}{\partial t}, v\right] + \left[u, \frac{\partial v}{\partial t}\right]$$

ii) [u + v, w] = [u, w] + [v, w]

Q5) a) State & prove virial theorem **[8]**

b) Show that hamiltonian for a relativistic charged particle moving in an electromagnetic field is given by.

$$H(\bar{r}, \bar{p}) = \sqrt{\left(\bar{P} - e\bar{A}\right)^2 C^2 + m^2 o C^4} + e\phi$$ **[8]**

Q6) a) Prove that if u & v are any two constants of motion of any given holonomic dynamical system then their poisson bracket [u, v] is also a constant of motion. **[8]**

b) Solve atwoods machine problem by using D' Alembeet's principle. **[8]**

Q7) a) Show that canunical momentum for a charged (q) particle moving through electro magnetic field is given by $\bar{P} = m\bar{v} + q\vec{A}$ **[8]**

b) Show that the generating function F_3 = pQ leads to an ldentify transformation **[4]**

c) Prove that angular momentum of a planet moving around the sun remains constant. **[4]**

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Total No. of Questions :7]

SEAT No. :

P1264

[Total No. of Pages : 2

[5122]-12

M.Sc. (Semester - I)

PHYSICS

PHY UTN - 502 : Electronics

(2008 Pattern)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Question No.1 is compulsory, Attempt any four questions from the remaining.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate maximum marks.***
4) ***Use of logarithmic tables and calculator is allowed.***

Q1) Attempt any four of the following :

a) Design a second - order high pass filter at a cut-off frequency of 1 kHz with a pass band gain of 2. **[4]**

b) Design an adjustable voltage regulator using LM 317 to meet the following specifications : V_o = 5 to 10V, I_o = 0.8A. **[4]**

c) Sketch a circuit diagram of a halfwave precision rectifier and explain it's working . **[4]**

d) Explain the working of a sample and hold circuit. **[4]**

e) Draw a block diagram of DC-DC converter. Explain it's operation. **[4]**

f) Give the circuit diagram for R-2R ladder type converter. Discuss the advantages and disadvantages of binary type and R - 2R type converter. **[4]**

Q2) a) Discuss the working of an instrumentation amplifier. **[8]**

b) What is a shift register? How is it used? Explain the working of two types of shift registers. **[8]**

P.T.O

Q3) a) Sketch a functional block diagram of Ic 566 and explain its working. **[8]**

b) Explain the specifications of DAC / ADC in details. **[8]**

Q4) a) Draw internal block diagram of Ic 8038. Explain its operation. Design a waveform generator using type Ic 8038.The frequency of oscillation is 5kHz and duty cycle is 50 % .

[Given : V_{cc} = 5V, V_{oH} = 3.6V, V_{oL} = 0.2V, I_{LL} = - 1.6 mA and I_{LH} = 40 μA] **[8]**

b) What output voltage would be produced by a D/A converter whose output range is 0 to 10 V and whose input binary number is **[4]**

i) 10 (for a 2 - bit DAC)

ii) 0110 (for a 4 - bit DAC)

iii) 10111100 (for a 8 - bit DAC)

c) Explain the working of Notch filter using op-amp. Draw a frequency response of the notch filter. **[4]**

Q5) a) Explain the working of foldback current limit using Ic 723 and external components. **[8]**

b) Explain the working of Ic 555 as a monostable multivibrator. **[4]**

c) Explain the operation of Dual slope ADC. **[4]**

Q6) a) Explain the working of a PLL. Discuss the use of a PLL as a frequency multiplier. **[8]**

b) What is a Karnaugh map? Illustrate with example. **[8]**

Q7) Write short notes on any <u>four</u> of the following. **[16]**

a) Optical fiber communication

b) Switched mode power supply

c) One shot multivibrator Ic 74121

d) Frequency spectrum - MW, SW, FM, and LHF and its applications

e) UPS

f) PLA

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Total No. of Questions :7]

SEAT No. :

P1265

[Total No. of Pages : 3

[5122]-13

M.Sc. (Semester - I)

PHYSICS

PHY UTN 503 : Mathematical Methods in Physics

(2008 Pattern)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Question No.1 is compulsory. Attempt any four questions from the remaining.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table & calculator is allowed.***

Q1) Attempt any four of the following :

a) Find Laplace transform of sinωt. **[4]**

b) Determine whether or not the following vectors in R^3 are linearly dependent: **[4]**

i) {(2, –3, 7) (0, 0, 0), (3, –1, –4)}

ii) {(1,1,1) (1, 0, 0), (0,1,0), (0, 0, 1)}

c) State and explain Dirichlet conditions. **[4]**

d) Discuss whether or not R^3 is a subspace of R^4. **[4]**

e) Prove that :

$P'_{n+1}(x) - P'_{n-1}(x) = (2n + 1) P_n(x)$ **[4]**

f) Determine the region in the z plane represented by $\pi/3 \leq \arg z \leq \pi/2$. **[4]**

Q2) a) Let v be the vector space of polynomials with inner product given by $\langle f, g \rangle = \int_0^1 f(t)\, g(t)\, dt$. Let $f(t) = (t + 2)$ and $g(t) = (t^2 - 2t - 3)$. Find $\langle f, g \rangle$ and $\|f\|$. **[8]**

P.T.O

b) Let $A = \begin{pmatrix} 1 & -3 & 3 \\ 3 & -5 & 3 \\ 6 & -6 & 4 \end{pmatrix}$. Find a (real) orthogonal matrix P for which $P^{-1}AP$ is diagonal. **[8]**

Q3) a) Find $L^{-1}\left\{\frac{3s+1}{(s-1)(s^2+1)}\right\}$. **[8]**

b) Determine the residues of following function at the indicated poles :

$$\frac{z^2}{(z-2)(z^2+1)};\ z = 2, i, -i\ .$$ **[8]**

Q4) a) State and prove the orthogonality property of Legendre polynomials. **[8]**

b) Find the Fourier coefficients a_n and b_n in the interval (–L, +L) for odd and even functions. **[8]**

Q5) a) Find Laurent series about the indicated singularity for each of the following functions. Name the singularity in each case and give the region of convergence of each series. **[8]**

i) $\frac{\sin z}{z-\pi}; z = \pi$

ii) $\frac{z}{(z+1)(z+2)}; z = -1.$

b) Determine the first three Laguerre polynomials $L_0(x)$, $L_1(x)$ and $L_2(x)$. **[8]**

Q6) a) Let $f(t)$ be continuous and have a piecewise continuous derivative $f'(t)$ in every finite interval $0 \le t \le T$. Suppose also that $f(t)$ is of exponential order for $t > T$. Then prove that :

$$L\{f'(t)\} = sL\{f(t)\} - f(0)$$ **[8]**

b) Consider the following basis of Euclidean space R^3 :

$\{v_1 = (1, 1, 1), v_2 = (0, 1, 1), v_3 = (0,0,1)\}$ by using Gram - Smidt orthogonalization process transform $\{v_i\}$ into an orthonormal basis $\{u_i\}$. **[8]**

Q7) a) Prove that : **[4]**

$$J_{n+1}(x) = \frac{2n}{x} J_n(x) - J_{n-1}(x)$$

b) Evaluate $\oint_c \frac{\cos z}{(z-\pi)} dz$ where C is the cricle $|z - 1| = 3$ **[4]**

c) Prove that : $H_{n+1}(x) = 2x\, H_n(x) - 2nH_{n-1}(x)$. **[4]**

d) State and prove Cauchy's theorem. **[4]**

Total No. of Questions :7]

SEAT No. :

P1266

[Total No. of Pages : 2

[5122]-14

M.Sc. (Semester I)

PHYSICS

PHYUTN 504 : Quantum Mechanics - I

(2008 Pattern)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Question No.1 is compulsory and solve any four questions from the remaining.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table & electronic pocket calculator is allowed.***

Q1) Attempt any four of the following :

a) State and explain postulates 1and 2 of quantum mechanics. **[4]**

b) Define Hibert space. Write the expressions for norm and scalar product in this space. **[4]**

c) Show that eigenvalues of a self adjont operator are real. **[4]**

d) Prove : $[L_x, L_y] = i\hbar\ L_z$ **[4]**

e) For $j = \frac{1}{2}$, obtain matrix of J_x. **[4]**

f) For Pauli - spin matrices show that **[4]**

i) $\sigma_x^2 + \sigma_y^2 + \sigma_z^2 = 3$ and

ii) $\sigma_x\ \sigma_y = i\ \sigma_z$

Q2) a) Obtain Clebsch - Gordon coefficients for a two non - interacting particles with angular momentum $j_1 = \frac{1}{2}$ and $j_2 = \frac{1}{2}$ **[8]**

b) Give physical significance of eigen values, eigen functions and expansion coefficients. **[8]**

P.T.O

Q3) a) Write a note on Heisenberg picture of time evolution.Discuss it resemblance with Hamiltonian equation in classical mechanics. **[8]**

b) When a set of functions $\{\psi_a\}$ will be orthonormal and complete? Hence, obtain the closure relation $\sum_a \psi_a(x)\,\psi_a^*(x) = \delta(x - x')$ **[8]**

Q4) a) Using operator method obtain energy eigenvalue of one dimensional harmonic oscillator. **[10]**

b) Show that the eigen functions $\psi_n = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi x}{L}\right)$ for a deep potential well of width L are normalized. **[6]**

Q5) a) Given that $J_+ |j,m\rangle = C_{jm}^+ \, |j, m+1\rangle$, where J_+ is a raising angular momentum operator, obtain the expression for C_{jm}^+, where $|j,m\rangle$ are simultaneous eigenstates of j^2 and J_z operators. **[8]**

b) i) For unitary operator $\cup$, show that $\langle \cup\psi | \cup\psi \rangle = 1$ **[4]**

ii) Prove that $\frac{L_z}{\hbar}$ generates infinitesimal rotation. **[4]**

Q6) a) Draw potential well for finite and infinite values of potential energy. Write Schrondinger equations in both cases. Draw first two eigen functions for both and discuss difference in two cases. **[8]**

b) Write notes on

i) Matrix representations of an operator. **[4]**

ii) Change of basis **[4]**

Q7) a) Show that $(xp_x)^2 \neq x^2 p_x^2$ where x and p_x are operators. **[4]**

b) Using uncertainty relation show that electron cannot reside inside the nucleus . **[4]**

c) If A and B are Hermitian, then show that i [A, B] is also Hermitian. **[4]**

d) Define Dirac δ function. Represent it graphically and discuss its properties. **[4]**

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Total No. of Questions :7]

SEAT No. :

P1267

[Total No. of Pages : 3

[5122]-21

M.Sc. (Semester - II)

PHYSICS

PHY UTN 601 : Electrodynamics

(2008 Pattern)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Question No.1 is compulsory and solve any four questions from the remaining.***
2) ***Draw neat labelled diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables & pocket calculator is allowed.***

Q1) Attempt any four of the following : **[16]**

a) Compute the electric field associated with a LASER beam having energy per unit volume as 100 J / m^3. **[4]**

b) Find the ratio of skin - depth in copper at 1 kHz to 100 MHz. **[4]**

c) Calculate the wave impendance of an e.m. wave travelling through free space.

Given : for free space $\mu = \mu_0 = 4\pi \times 10^{-7} \frac{Wb}{A\text{-}m}$

and $\in = \in_0 = 8.85 \times 10^{-12} \frac{c^2}{N - m^2}$. **[4]**

d) Compute the electric field vector associated with the sum light, if the earth receives about 1300 watt / m^2 radiant energy from the sun with normal incidence.

Given : $\in_0 = 8.85 \times 10^{-12} \frac{c^2}{N - m^2}$ and $= \mu_0 = 4\pi \times 10^{-7} \frac{Wb}{A\text{-}m}$. **[4]**

e) Two identical bodies move towards each other, the speed of each being 0.9 c. What is their speed relative to each other? **[4]**

f) Explain the concept of momentum space. **[4]**

P.T.O

Q2) a) Show that the Maxwell's equations in a charge free region lead to :

$$\triangle^2 \vec{E} - \frac{kkm}{c^2} \frac{\partial^2 \vec{E}}{\partial t^2} - \mu\sigma \frac{\partial \vec{E}}{\partial t} = 0$$

Explain which term can be ignored in a nonconducting medium. **[8]**

b) Show that $(C^2 B^2 - E^2)$ and $(\vec{E} \bullet \vec{B})$ are invariant under Lorentz transformations. **[8]**

Q3) a) Describe Michelson - Morley experiment with reference to the special theory of relativity. Derive the necessary formula for the fringe shift and comment on the result. **[8]**

b) The magnetic field intensity $\vec{B}$ at a point is given by $\vec{B} = \left(\frac{\mu_0}{4\pi}\right) \int \frac{\vec{j} \times \vec{r}}{r^3} d\tau$.

Show that curl $\vec{B} = \mu_0 \vec{j}$. **[8]**

Q4) a) Explain the term electromagnetic field tensor. Hence obtain an expression for electromagnetic field tensor $F_{\mu\gamma}$. **[8]**

b) Prove that the space interval $x^2 + y^2 + z^2$ is not invariant under Lorentz transformations, while the combined space - time interval $x^2 + y^2 + z^2 - c^2 t^2$ is Lorentz invariant. **[8]**

Q5) a) What is a linear quadrapole? Derive an expression for potential at a distant point due to a small linear quadrapole. **[8]**

b) Prove the relativistic addition theorem for velocities : $u_x = \frac{ux' + v}{1 + \frac{ux'v}{c^2}}$

where $ux' = \frac{dx'}{dt'}$ and $ux = \frac{dx}{dt}$.

Hence show that any velocity added relativistically to 'C' gives resultant velocity 'C', which is Lorentz invariant. **[8]**

Q6) a) What is Hertz potential? Show that the electric and magnetic fields can be expressed in terms of Hertz potential as

$$\vec{E} = \vec{\nabla} \times (\vec{\nabla} \times \vec{Z}) \text{ and } \vec{B} = \frac{l}{c^2} \frac{\partial}{\partial t} (\vec{\nabla} \times \vec{Z}),$$

where $\bar{Z}$ is the Hertz potential. **[8]**

b) A plane e.m. wave is incident on an interface between the two non-conducting electric media. Obtain expressions for Fresnel's equations if the electric field vectors are perpendicular to the plane of incidence. **[8]**

Q7) a) Write a short note on electric dipole radiation and explain the term 'radiation resistance'. **[4]**

b) Describe magnetic interaction between two current loops. **[4]**

c) Find the phase velocity of a plane e.m. wave at a frequency of 10 GHz in polyethelene material.

Given : $\mu \simeq \mu_0 = 4\pi \times 10^{-7} \frac{Wb}{A - m}$,

$\in_r = 2.3$,

$\in_0 = 8.85 \times 10^{-12} \frac{c^2}{N - m^2}$

and $\sigma = 2.56 \times 10^{-4} \frac{mho}{m}$. **[4]**

d) Find the velocity at which the mass of the particle is double it's rest mass.

Given : C = 3 $\times 10^8$ m/sec. **[4]**

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Total No. of Questions :7]

SEAT No. : ____

P1268

[Total No. of Pages : 3

[5122]-22

M.Sc. (Semester II)

PHYSICS

PHY UTN 602 : Atoms, Molecules and Solids

(2008 Pattern)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

1) ***Question No.1 is compulsory. Solve any four questions from the remaining.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and electronic calculator is allowed.***

Given : Rest mass of e = 9.109×10^{-31}kg

Charge on the e = 1.6021×10^{-19}coulomb.

Plank's constant = 6.626×10^{-31} Js

Boltzmann Constant = $1.38054 \times 10^{-23}JK^{-1}$

Avogadro's number = $6.022 \times 10^{+26}$ $(kmoles)^{-1}$

l eV = 1.6021×10^{-19}J.

Q1) Solve any four of the following.

a) What is the physical significance of Lande g factor? Find its value for $^2P_{3/2}$ state . **[4]**

b) The value of Xe for lower and upper states of C_2 are 0.0071 and 0.00919 respectively. Find the number of levels in upper and lower states. **[4]**

c) The Calcium line of wavelength $\lambda = 4226.73$ $\mathring{A}$ $(P \rightarrow S)$ exhibits normal Zeeman effect splitting when placed in uniform magnetic field of 2.5 Wb/m^2. Determine the wavelengths of three components of Zeeman pattern and the separation between them. **[4]**

P.T.O

d) The concentration of Schottkey defects in an ionic crystal is 1 in 10^{10} at temperature 300K. Estimate the energy of the vacancy pair. **[4]**

e) Calculate the Debye specific heat of copper at 10 K, given that the Debye characteristic frequency is 6.55×10^{-12} Hz. **[4]**

f) Show that the maximum radius of the sphere that can just fit into the void at the body centre of the fcc structure confined by the facial atoms is 0.414r. Where r is the radius of the atom. **[4]**

Q2) a) Define atomic scattering factor & derive an expression for it. **[8]**

b) Derive an expression for the specific heat of solid based an Einstein model. What are the drawbacks of the model. **[8]**

Q3) a) Derive the dispersion relation for a linear diatomic lattice and explain the origin of optical and acoustic mode. **[8]**

b) Derive an expression for the temperature dependance of the concentration of Schottkey defects in an ionic crystal. **[8]**

Q4) a) Write note on vibrational coarse structure explaining *v*' progression. Explain with the help of neat diagrams. **[8]**

b) Explain band origin and band head in relation to rotational fine structure of electronic vibrational spectra. **[8]**

Q5) a) State and explain Frank - Condon principle . **[8]**

b) Write note on :

i) Screw dislocation &

ii) Edge dislocations **[8]**

Q6) a) Explain the principle of NMR. Explain the working of typical NMR spectrometer and write the applications of it. **[8]**

b) Distinguish between normal and anomalous Zeeman effect. Explain why anomalous Zeeman effect is observed only in atoms with odd number of electrons. **[8]**

Q7) a) Obtain an expression for configurational entropy. **[4]**

b) What are normal and Umklapp processes. **[4]**

c) Explain the factors responsible for broadening of a spectral line. **[4]**

d) Explain the concept of phenon and quantization of elastic waves. **[4]**

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Total No. of Questions :7]

SEAT No. :

P1269

[Total No. of Pages : 3

[5122]-23

M.Sc. (Semester - II)

PHYSICS

PHY UTN - 603 : Statistical Mechanics in Physics

(2008 Pattern)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Question No.1 is compulsory. Attempt any four questions of the remaining questions.***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat diagrams wherever necessary.***
4) ***Use of logarithmic tables and nonprogrammable electronic calculator is allowed.***

Constants :

1) Boltzmann constant $K_B = 1.38 \times 10^{-23}$ J/K.
2) Planck's constant $h = 6.625 \times 10^{-34}$ J.s
3) Avogadro's number $N = 6.023 \times 10^{23}$ / gm. mole
4) Mass of electron $m_e = 9.1 \times 10^{-31}$kg
5) Velocity of light $C = 3 \times 10^{8}$ m/s
6) Charge on electron $e = 1.6 \times 10^{-19}$C

Q1) Attempt any four of the following :

a) Using canonical ensemble, show that the average pressure

$$\bar{P} = \frac{1}{\beta} \bullet \frac{\partial \ln Z}{\partial V}$$ **[4]**

b) State and explain postulate of equal priari - probability. **[4]**

c) Determine the phase trajectory of a bullet of unit mass fired straight upwards with an initial speed of 392 m/s. ($g = 9.8$ m/s^2) **[4]**

d) Write a short note on White - Dwarfs. **[4]**

P.T.O

e) State and prove equipartition theorem. **[4]**

f) Write the assumptions of Debye Model. Hence calculate γ^3_D, where γ_D is the Bebye cut off frequency. **[4]**

Q2) a) State and prove Liouville's theorem. **[8]**

b) In case of Bose - Einstein condensation for $T < T_B$, show that $N = No + N\left(\frac{T}{T_B}\right)^{3/2}$ where, N is the total number of particles and No is the number of particles in ground state. **[8]**

Q3) a) What is Gibb's paradox? How it is resolved? **[8]**

b) Show that the mean pressure of the photon gas is related to mean energy by the relation $\bar{P} = \frac{1}{3}\frac{\bar{E}}{V}$ **[8]**

Q4) a) On the basis of canonical distribution, obtain the curie law of paramagnetism. **[8]**

b) Show that the specific heat of strongly degenerate fermions is given by

$$C_v = \frac{\pi^2}{2} \bullet R \bullet \frac{T}{T_F}$$ **[8]**

Q5) a) What is black body radiation? Show that radiation pressure is equal to one third of the energy density. **[8]**

b) Considering Einstein's idea about system of oscillators and radiations in equilibrium in an isothermal enclosure, derive Plank's law. **[8]**

Q6) a) Obtain the Maxwell - Boltzmann velocity distribution and prove the following

i) Mean speed $\bar{V} = \left(\frac{8KT}{\pi m}\right)^{1/2}$ **[8]**

ii) $V_{rms} = \sqrt{\frac{3KT}{m}}$

b) Discuss the behaviour of sharpness of probability curve and show that the fractional width of maximum in P (E) is given by $\frac{\Delta * E}{\bar{E}} = \frac{1}{\sqrt{f}}$ **[8]**

Q7) a) Find the average number of photons in an enclosure of 22.4 litre at 273°K. **[4]**

b) Compare the basic postulates of B.E.& F.D. statistics. **[4]**

c) Determine whether the electron gas in copper at room temperature is degenerate or non - degenerate. **[4]**

(Concentration of electrons in copper is $8.5 \times 10^{28}/m^3$)

d) Show that the entropy of the composite system is equal to the sum of all sub system entropies, $S = S_1 + S_2 + S_3 + ...$ **[4]**

Total No. of Questions :7]

SEAT No. :

P1270

[Total No. of Pages : 2

[5122]-24

M.Sc. (Semester II)

PHYSICS

PHYUTN 604 : Quantum Mechanics - II

(2008 Pattern)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Question No.1 is compulsory.***
2) ***Attempt any four from the remaining.***
3) ***Figures to the right indicate full marks.***
4) ***Use of log tables and calculators allowed.***

Q1) Attempt any four of the followings : **[16]**

a) List the connection formulae which allow one to join the two types of WKB solutions across a turning point.

b) Obtain first order correction in energy for linear harmonic oscillator perturbed by $H^1 = bx^2$.

c) Explain selection rules for electric dipole transitions.

d) Show that total energies in laboratory and centre of mass systems are related by $E_{cm} = \frac{\mu}{m_1} E_{lab}$, where μ is reduced mass.

e) Obtain Einstein coefficients A and B in case of spontaneous emission of radiations.

f) Explain symmetric and antisymmetric wave functions for identical particles.

Q2) a) Explain time independent perturbation theory and obtain first and second order corrections in wave functions. **[10]**

b) What do you mean by the term differential cross - section and total cross - section? How are these related to angle of scattering? **[6]**

P.T.O

Q3) a) Develop the time dependent perturbation theory to obtain transition amplitudes for 1^{st} and 2^{nd} order. **[8]**

b) Using partial wave analysis, obtain the expression for phase - shift, scattering amplitude and total cross - section. **[8]**

Q4) a) Explain Stark effect for n = 2 level of hydrogen atom using time - independent theory for degenerate state. **[8]**

b) Using perturbation theory, obtain first order correction to n^{th} energy level of linear harmonic oscillator perturbed by potential $H^1 = \lambda x^4$. **[8]**

Q5) a) Define exchange operator in case of system of identical particles. Show that exchange operator commutes with Hamiltonian operator. **[8]**

b) State and prove Fermi - Golden rule. **[8]**

Q6) a) Using variational method, obtain ground state energy of hydrogen atom by using trial wave function $\psi(r) = Ae^{-\alpha r}$, where α is variation parameter. **[8]**

b) Using WKB approximation, explain emission of alpha particle. **[8]**

Q7) a) Discuss conditions of validity of Born approximation. **[4]**

b) Using WKB approximation, obtain Bohr - Sommerfeld condition of quantization. **[4]**

c) Obtain slater determinant for system of four particles. **[4]**

d) Explain Zeeman effect for splitting of energy levels for atom placed in magnetic field. **[4]**

Total No. of Questions :7]

SEAT No. : ____

P1271

[Total No. of Pages : 3

[5122]-31

M.Sc. (Semester III)

PHYSICS

PHY UTN 701 : Solid State Physics

(2008 Pattern)

Time : 3 Hour] ***[Max. Marks :80***

Instructions to the candidates:

1) ***Question NO.1 is compulsory. Solve any four questions from the remaining .***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat labelled diagrams wherever necessary.***
4) ***Use of logarithmic tables and scienfic calculator is allowed.***

Given :

1) Rest Mass of electron $= 9.1 \times 10^{-31}$kg.
2) Electronic Charge $= 1.602 \times 10^{-19}$ C
3) Planck's constant $= 6.62 \times 10^{-34}$ J - s
4) Boltzmann constant $= 1.38 \times 10^{-23}$ J/K.
5) Avogadro's number $= 6.023 \times 10^{26}$ atoms per kgmole.
6) Bohr magneton $= 9.27 \times 10^{-24}$ A - m^2
7) Permeability of free space $= 4\pi \times 10^{-7}$ Henry / m
8) Permittivity of free space $= 8.85 \times 10^{-12}$ $\frac{C^2}{N - m^2}$

Q1) Attempt any four of the following : **[16]**

a) The fermi energy of sodium is 3 ev. calculate the difference in energy between the neighbouring levels at the highest energy state in a lubical box of side 1cm. Given : $n_n = n_y = n_z$.

b) At what temperature we can expect a 10 % probability that the electrons in silver have an energy which is 1 % above the fermi energy (E_F= 5.5 ev for silver).

P.T.O

c) Calculate the energy difference between the $n_x = n_y = n_z$ level and the next higher energy level for free for free electrons in a solid cube of side 10 nm.

d) A typical magnetic field achievable with an electromagnet with iron core is about 1 tesla. Compare the magnetic interaction energy $\mu_B B$ of an electron spin magnetic diapole moment with $K_B T$ at room temperature.

e) The London penetration depths for pb at 3k and 7.1k are respectively 39.6 nm 173 nm. Calculate its transition temperature as well as the depth at ok.

f) Explain the meissner effect in super conductivity

Q2) a) Explain qualitatively the kronig - penny model in brief. Plot the functions for $P = 3\pi / 2$ and interpret. **[8]**

b) Define dielectric function of the free electron. Derive an expression for the plasma frequency. **[8]**

Q3) a) With the help of a neat diagrams explain the reduced, extended and periodic zone schemes for the represeutation of energy bands. **[8]**

b) Write a note on ferroelectricity and ferroelectric crystals with reference to Ba Ti O_3. **[8]**

Q4) a) Explain the quantum theory of paramagnetism and obtain curie law. Discuss the behaviour of rare earth ions. **[8]**

b) Explain antiferromagnetism with reference to neel temperature and susceptibility. Hence describe ferro magnetism. **[8]**

Q5) a) Describe the assumptions of BCS theory of super conductivity. **[8]**

b) Give an account of the weiss theory of ferromagnetism. Hence, using plot of langevin's function show that the spontaneous magnetisation exists below the curie temperature and vanishes above it. **[8]**

Q6) a) Derive london equation for superconducting state and obtain expression for the penetration depth. **[8]**

b) Describe josephson super conducting tunneling. **[4]**

c) What is meant by hysteresis in magnetic materials? **[4]**

Q7) a) For an atom in a general lattice site, explain the depolarization and lorentz field contributions to the local field elocal. **[4]**

b) Explain the concept of hope. **[4]**

c) Calculate the critical current density for 1mm diameter wire of lead at (i) 4.2 k and (ii) 7 k. A parabolic dependence of Hc upon T may be assumed. Given : Tc for lead is 7.18k and Hc for lead is 6.5×10^4 A/M. **[4]**

d) Explain the concept of block wall reference to magnetism. **[4]**

Total No. of Questions :7]

SEAT No. :

P1272

[Total No. of Pages : 2

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M.Sc. (Semester - IV)

PHYSICS

PHY UTN-801 : Nuclear Physics

(2008 Pattern)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***Question No.1 is compulsory. Attempt any four questions from the remaining.***
2) ***Draw neat figures wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables and pocket calculators is allowed.***

Q1) Attempt any four of the following :

a) Explain Pauli's neutrino hypothesis. **[4]**

b) What is radioactivity? Write down any three properties of radioactive rays? **[4]**

c) Discuss shell model of nucleus. **[4]**

d) Write a note on Fission chain reaction. **[4]**

e) What is the principle of a Bubble Chamber? Explain its working. **[4]**

f) Calculate binding energy of Lithium isotope ${}^{7}_{3}Li$ nucleus. **[4]**

Given :

Mass of ${}^{7}_{3}Li$ nucleus = 7.01822 mu.

Mass of Proton, m_p = 1.007825 mu.

Mass of neutron, m_n = 1.008665 mu.

P.T.O

Q2) a) Explain the concept of nuclear magnetic dipole moment and show that for a nucleus of mass number A nuclear magnetic dipole moment.

$$\mu = \frac{e}{2m}\left[\sum_{k=1}^{A} J_s S_k + \sum_{k=1}^{z} g_e l_k\right]$$ **[8]**

b) Describe Gamow's theory of alpha decay. Hence deduce Geiger - Nuttall law. **[8]**

Q3) a) For P-P Scattering of low energies, derive an expression for differential cross - section in laboratory system. **[8]**

b) Describe the construction and working of NaI (Te) Scintillation defector. **[8]**

Q4) a) Describe the high energy electron scattering method to determine the size of a nucleus. **[8]**

b) What is straggling? Derive the formula for staggling when a charged particle is moving through the matter. **[8]**

Q5) a) Describe the working of Bainbridge mass spectrograph. What are its advantages and limitations. **[8]**

b) Explain in brief electron synchrotron and proton synchrotron. **[8]**

Q6) a) Discuss the Principle, Construction and Working of a microtron. **[8]**

b) What are quarks? Explain how quarks are treated as building blocks of hydrons and mesons . **[8]**

Q7) a) What are elementary particles? Give an account of classification of elementary particles. **[4]**

b) What is meant by high purity germanium detector (HPGe)? **[4]**

c) Write any two properties of π meson. **[4]**

d) Write a short note on pair production. **[4]**

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