Total No. of Questions : 7]

SEAT No. :

PC3721

[Total No. of Pages : 3

[6335]-101
M.Sc. - I
PHYSICS
PHCT-111 : Mathematical Methods in Physics
(CBCS 2020 Pattern) (Semester-I) (4-Credits)

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Attempt/solve any five questions from Q.2 to Q.7.***
3) ***Q.2 to Q.7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any five of the following. **[10]**

a) Find modulus of sinz. **[2]**

b) Show that, S = { (1, 1, 1), (1, 1, 0), (1, 0, 0)} is linearly independent in R^3. **[2]**

c) Determine Hermite polynomials $H_1(x)$ and $H_2(x)$ using Rodrigues formula. $H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n}\left[e^{-x^2} \right]$ **[2]**

d) Find L{t sin wt}, where L is laplace transform of given function. **[2]**

e) Find an analytic function whose real part is $u = y^3 - 3x^2y$. **[2]**

f) For any vectors u and v in any inner product space, show that

$||u+v||^2 - ||u-v||^2 = 4\langle u,v \rangle$ **[2]**

P.T.O.

Q2) a) i) State and prove a necessary condition (Cauchy-Riemann equations) for a function $f(z) = u(x,y) + iv(x,y)$ to be analytic in region R. **[4]**

ii) Determine whether or not the set **[3]**

B = {(3, 1, –4),(2, 5, 6), (1, 4, 8)} is basis for R^3.

b) Prove the recurrence relation for Bessel polynomial, **[5]**

$$ZJ_n^1(z) = ZJ_{n-1}(z) - nJ_n(z)$$

Q3) a) i) Using Parseval's identity, show that **[4]**

$$\int_o^w \frac{dt}{(a^2+t^2)(b^2+t^2)} = \frac{\pi}{2ab(a+b)}$$

ii) Find Laurent's series about the indicated singularity for the function, **[3]**

$$\frac{e^{2z}}{(z-1)^3};\ z=1$$

b) Find eigenvalues, basis and dimension of eigenspace of the matrix, A

where, $A = \begin{bmatrix} 2 & -1 & 1 \\ 0 & 3 & -1 \\ 2 & 1 & 3 \end{bmatrix}$ **[5]**

Q4) a) i) Write the generating function for Laguerre polynomial and prove the recurrence relation, **[4]**

$(n+1)\ L_{n+1}(x) = (2n+1-x)\ L_n(x) - n\ L_{n-1}(x)$

ii) If $L\{f(t)\} = F(s)$, then show that **[3]**

$$L\{t^n f(t)\} = (-1)^n \frac{d^n}{ds^n}[F(s)]$$

Where, 'L' is the laplace transform of function.

b) Prove that, **[5]**

$$\frac{1}{2\pi i}\int_C \frac{e^{\lambda z}}{Z^2+1}\,dz = \sin\lambda,$$ where $\lambda > 0$ and C is a circle $|Z| = 3$

Q5) a) Apply the Gram-Schmidt orthogonalization process to find an orthogonal basis and then an orthonormal basis to the subspace U of R^4 spanned by **[6]**

$V_1 = (1, 1, 1, 1)$, $V_2 = (1, 1, 2, 4)$ and $V_3 = (1, 2, -4, -3)$.

b) Show that Legendre's polynomials satisfies the orthogonality condition,

$$\int_{-1}^{1} P_m(x)P_n(x)dx = 0 \text{ if } m \neq n$$ **[6]**

Q6) a) Find the fourier sine and cosine transform of $f(x) = e^{-ax}$ **[6]**

b) Evaluate by contour integration. **[6]**

$$\int_0^{2\pi} \frac{d\theta}{5 + 3\cos\theta}$$

Q7) Solve any three of the following. **[12]**

a) Prove the recurrence relation for Hermite polynomial, **[4]**

$2xH_n(x) = 2nH_{n-1}(x) + H_{n+1}(x)$

b) Using laplace transform method, solve the differential equation, **[4]**

$$\frac{dy}{dt} + 2y = e^{-3t} \quad ; y(0) = 1$$

c) Define Dirac delta function, $\delta(t-a)$ and find its complex fourier transform. **[4]**

d) State and prove Cauchy-Schwartz inequality for inner product space. **[4]**

Total No. of Questions : 7]

SEAT No. : ____

PC-3722

[Total No. of Pages : 2

[6335]-102

M.Sc.

PHYSICS

PHCT - 112 : Classical Mechanics

(2020 Pattern) (CBCS) (Semester - I) (4 Credits)

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

Instructions to the candidates:

1) ***Question 1 is compulsory.***
2) ***Attempt/Solve any five questions from question Q.2. to Q.7.***
3) ***Q.2 to Q.7 carries equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log tables and non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) **Solve any five of the following :**

a) State Kepler's third law. **[2]**

b) What are inertial and non inertial frame of reference. **[2]**

c) Write the type of constraints for Gas filled in hollow sphere. **[2]**

d) What do you mean by Geosynchronous orbit. **[2]**

e) What are cyclic co-ordinates. **[2]**

f) Calculate the reduced mass of H_2 molecule Assume mass of Hydrogen atom is M. **[2]**

Q2) a) Explain Inertia tensor and prove the relation J = IW. **[7]**

b) State and prove viral theorem. **[5]**

Q3) a) Explain in detail normal co-ordinates and normal frequencies. **[7]**

b) Describe the Hamiltonian and Hamilton's equation of motion for charged particle in an electromagnetic field. **[5]**

P.T.O.

Q4) a) Derive an equation for two body problem into equivalent one body problem. **[7]**

b) Prove Euler's equations using Newtonian method. **[5]**

Q5) a) Prove $\left[\frac{d}{dt}\right]_{\text{fixed}} = \left[\frac{d}{dt}\right]_{\text{rot}} + \bar{w}\, x$ ..... in case of rotating frame of reference. **[6]**

b) Show that the transformation **[6]**

$q = \sqrt{2p}\,\sin Q,\ p = \sqrt{2p}\,\cos Q$ is canonical.

Q6) a) Show that the Poisson bracket is invarient under canonical transformation. **[6]**

b) Show that the shortest distance between two points in a plane is a straight line. **[6]**

Q7) **Solve any three of the following :**

a) Prove that **[4]**

$$\frac{d}{dt}[\mathrm{F},\mathrm{G}] = \left[\frac{d\mathrm{F}}{dt},\mathrm{G}\right] + \left[\mathrm{F},\frac{d\mathrm{G}}{dt}\right]$$ in case of Poisson Bracket.

b) Solve the problem of one dimensional harmonic oscillator by Hamilton's equation of motion. **[4]**

c) A cylinder of radius R and mass M rolls down an inclined plane making an angle α with horizontal set up the Lagrangian and Find the equation of motion. **[4]**

d) Find the equation of motion of spring mass system using Hamilton's principle. **[4]**

▽▽▽▽

Total No. of Questions : 7]

SEAT No. : ____

PC-3723

[Total No. of Pages : 2

[6335]-103

M.Sc.

PHYSICS

PHCT - 113 : Electronics

(2020 Pattern) (CBCS) (Semester - I) (4 Credits)

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

Instructions to the candidates:

1) ***Question 1 is compulsory.***
2) ***Attempt/Solve any five questions from question Q.2. to Q.7.***
3) ***Q. 2 to Q.7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log table or non-programmable electronics calculator is allowed.***
6) ***Neat diagrams must be drawn where necessary.***

Q1) **Solve <u>any Five</u> of the following :**

a) State the difference between AM and PM. **[2]**

b) Map the following expression on k-map and minimize it $Y = \bar{A}BCD + \bar{C}\bar{D} + \bar{A}B\bar{C}D + ABC\bar{D}$. **[2]**

c) Draw scaling circuits for MOD - 7 and MOD - 10. **[2]**

d) Draw the circuit diagram of Astable multivibrator using OPAMP. Write the expression for frequency of oscillation. **[2]**

e) Draw circuit diagram of R-2 R ladder write the expression for output voltage. **[2]**

f) Differentiate between PAM and PWM. **[2]**

Q2) a) Explain two transistor analogy of an SCR. Discuss I-V characteristics in detail. **[7]**

b) Draw block diagram of IC-555 and explain PAM in detail. **[5]**

P.T.O.

Q3) a) Draw block diagram of PLL IC-565. Explain each block in brief and discuss FSK with suitable diagram. **[7]**

b) Draw circuit diagram of DC-DC converter Explain each block in detail. **[5]**

Q4) a) Explain the concept of SMPS power supply. Differentiate between Boost and Buck type of SMPS Power supply. **[7]**

b) Write note on Dual Slope ADC. **[5]**

Q5) a) What is BCD to 7-segment decoder Using Karanaugh Map draw logic circuit for BCD to 7-segment decoder. **[7]**

b) Draw block diagram of VCO IC-566 explain each block in brief. **[5]**

Q6) a) Draw schematic diagram of IC-7495. Discuss its application SISO and SIPO in brief. **[6]**

b) State the difference between DIAC and TRIAC. Explain any one in detail. **[6]**

Q7) **Answer <u>any Three</u> of the following :**

a) Draw circuit diagram of Monostable multivibrator using OPAMP. Obtain an expression for its pulse width. **[4]**

b) What is FSK? Explain it with suitable diagram. **[4]**

c) Calculate the output voltage for 5 bit weighted resistor type DAC, for input 10110, Assume logic 0 = 0V and logic 1 = 10V. **[4]**

d) The IC-555 timer has R_1 = 75 kΩ, R_2 = 30 kΩ and C = 47 nf. What is the frequency of output signal? What is the duty cycle? **[4]**

▽▽▽▽

Total No. of Questions : 7]

SEAT No. : ____

PC3724

[Total No. of Pages :2

[6335]-201

First Year M.Sc.

PHYSICS

PHCT-121 : Electrodynamics

(2020 CBCS Pattern) (Semester- II) (4 Credits)

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

Instructions to the candidates:

1) ***Question 1 is compulsory.***
2) ***Attempt/Solve any five questions from Q.2 to Q.7.***
3) ***Question 2 to Question 7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn where necessary.***

Q1) Solve any five of the following:

a) Write Maxwell's equations in differential form. **[2]**

b) What are Lorentz and Coulomb's gauges? **[2]**

c) Calculate the magnitude of Poynting vector at the surface of the sun. Given that the power radiated by the sun is 3.8×10^{26} watt and radius of sun is 7×10^{8} m. **[2]**

d) What is space like and time like intervals? **[2]**

e) Write the two postulates for the theory of Relativity. **[2]**

f) Find out the skin depth of sea water with conductivity $\sigma = 5\Omega\ m^{-1}$ and frequency 10^{10} Hz. Given : $\mu = \mu_0 = 4\pi \times 10^{-7}$ Wb/A–m. **[2]**

Q2) a) i) Explain the term "Four vector potential". **[4]**

ii) Find the velocity at which the mass of the particle is double its rest mass. **[3]**

b) Describe magnetic interaction between two current loops. **[5]**

P.T.O.

Q3) a) i) Two identical bodies move towards each other, the speed of each being 0.9 C. What is their relative speed to each other? **[4]**

ii) Show that the ratio of electrostatic and magnetic densities $\left[\frac{ue}{um}\right]$ is equal to 1. **[3]**

b) Given the em wave $E = \hat{i}E_0 \cos\omega(\sqrt{\in \mu z} - t) + \hat{j}E_0 \sin\omega(\sqrt{\in \mu z} - t)$ where E_0 is constant. Find corresponding magnetic field. **[5]**

Q4) a) Write Maxwell's equations for a stationary medium. Show that for a charge free region the Maxwell's eqns lead to $\nabla^2 E - \mu \in \frac{\partial^2 E}{\partial t^2} - \mu\sigma\frac{\partial E}{\partial t} = 0$ which term is predominant is metals. **[7]**

b) Describe Michelson. Morley experiment with a suitable diagram. Hence derive the formula for fringe shift. **[5]**

Q5) a) Show that $C^2B^2 - E^2$ and E.B are invariant under Lorentz transformations. **[6]**

b) A plane em wave is incident obliquely on an interface between the two non-conducting dielectric media. Obtain an expression for Snell's law. **[6]**

Q6) a) State and prove Poynting's Theorem. **[6]**

b) If a medium is moving with a velocity $\bar{u}$, then show that Faraday's law has the form $\nabla \times (E' - \bar{u} \times \bar{B}) = \frac{-\partial \vec{B}}{\partial t}$ **[6]**

Q7) Attempt any three of the following:

a) Derive an expression for potential at a point due to a small linear quadrupole. **[4]**

b) Write the expression for magnetic field B at a point and show that $\nabla \times \bar{B} = \mu_0 \bar{j}$. **[4]**

c) Explain the term Hertz potential. Show that the electric field can be expressed in terms of Hertz potential as $\bar{E} = \bar{\nabla} \times (\bar{\nabla} \times z)$. **[4]**

d) Explain the terms 'Skin effect and skin depth'. **[4]**

Total No. of Questions : 7]

SEAT No. :

PC3725

[Total No. of Pages : 2

[6335]-202

First Year M.Sc.

PHYSICS

PHCT - 122 : ATOMS AND MOLECULES

(2020 Pattern) (Semester - II) (4 Credits)

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

Instructions to the candidates:

1) ***Question no.1. is compulsory.***
2) ***Attempt/solve any five Questions from Q.No.2. to Q.No.7.***
3) ***Q.No.2. to Q.No.7. Carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic table and non programmable electronic calculator is allowed.***

Given :-

Rest mass of electron = 9.10×10^{-31} kg

Charge on electron = 1.602×10^{-19} coulomb

Plank's constant = 6.626×10^{-34} Joule - Sec

Boltzman constant = 1.381×10^{-23} Joule/^{o}K

Avagadro's number = 6.023×10^{23} atoms/mole

1eV = 1.602×10^{-19} Joule

Bohr magnetron μ_B = 9.274×10^{-24} Joule/Tesla

Q1) Solve any Five of the following. **[10]**

a) State Hund's rule.

b) Explain Anomalous Zeeman effect.

c) Explain Principle of ESR.

d) State four application of Raman spectroscopy

e) Determine lande (g) factor for $^{2}P_{3/2}$ terms.

f) state selection rule for L,S, and J.

P.T.O.

Q2) a) State principle of NMR SpectroScopy. Explain it's construction and working with neat diagram. **[7]**

b) State and Explain Franck-Condon principle in molecular spectra. **[5]**

Q3) a) Explain Normal zeeman effect. Hence derive the necessary formula for shift in wavelength $d\lambda$. **[7]**

b) Discuss vibrational analysis of band system. **[5]**

Q4) a) Explain Paschen - Back effect. Determine It's effect in case of sodium atom. **[7]**

b) Electron Spin resonance is observed for atomic hydrogen with an Instrument operating at 9.5 GHz. If the g value for electron in hydrogen atom is 2.0026, what is the magnetic field applied? **[5]**

Q5) a) Draw a block diagram of ESR spectrometer and explain It's working. **[6]**

b) Explain Vibrational Coarse structure. **[6]**

Q6) a) Discuss the vibrational modes of one-dimenstional monoatomic lattice of identical atoms. Derive the necessary dispersion formula. **[6]**

b) Explain construction and working of IR spectrometer. **[6]**

Q7) Write a short note on any three of the following. **[12]**

a) Chemical Shift in NMR

b) Physical Interpretation of n_1 l_1 m_l and Ms.

c) FTIR spectroscopy

d) Laue Theory of X-ray diffraction.

Total No. of Questions :7]

SEAT No. :

PC-3726

[Total No. of Pages : 2

[6335]-203
M.Sc.
PHYSICS
PHCT-123: Quantum Mechanics
(2020 CBCS pattern) (Semester - II) (4 Credits)

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Attempt/Solve any five questions from Q.2 to Q.7.***
3) ***Q.2 to Q.7 carry equal marks.***
4) ***Figures to the right side indicates full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) **Solve any five of the following:** **[10]**

a) Define eigen value and eigen function.

b) What is Hilbert Space?

c) Find the reaction between group velocity and phase velocity.

d) Express the orthonormal condition using dirac notation.

e) What are degenerate states?

f) Give examples of perturbed system.

Q2) a) Using ladder operators of angular momentum L_+ and L_- obtain eigen equations of L^2 and Lz. Discuss the eigen values of these operators. **[7]**

b) Find the ground state energy of a particle in one dimenssional infinite potential well using variational method. **[5]**

Q3) a) The step potential with an infinite width potential barrier is given by

$$V(x) = 0 \quad , x \leq 0$$

$$= V_0 \quad , x > 0$$

obtain an expression of current density and discuss the probability of transmission and reflection of a wave. **[7]**

b) Explain projection operator and its properties in detail. **[5]**

P.T.O.

Q4) a) Find the normalised eigen states and eigen values of spin angular momentum operator S_x for spin half $\left(s = \frac{1}{2}\right)$ praticle. **[7]**

b) Explain perturbation theory with suitable diagram and derive first order correction to the energy of the perturbed system. **[5]**

Q5) a) Find the ground state wavefunction of a simple harmonic oscillator using ladder operator a_+ and a_-. **[6]**

b) The wave function of a particle is given by **[6]**

$$\varphi(x) = xe^{-\alpha x} \quad , x \geq 0$$
$$= 0 \quad , x < 0$$

α is a constant

i) Normalise the given wave function.

ii) Find $< P_x >$.

Q6) a) Explain the fermi golden rule for a system of constant perturbation $H'(t) = V(\vec{r})$. **[6]**

b) Explain bra and ket vectors in Hilbert space spanned by basis vectors $[\phi_1, \phi_2, ...\phi_n]$. Give the matrix respresentation of bra and ket vectors. **[6]**

Q7) **Solve any Three of the following.** **[12]**

a) Explain the total angular momentum operator $\vec{J}_z, J^2$ and $\vec{J}_\pm$.

b) Discuss the wave function of a particle using WKB approximation.

c) Explain Dirac delta function.

d) Define self adjoint operator. Show that the eigen values of self adjoint operators are real.

Total No. of Questions : 7]

SEAT No. :

PC-3727

[Total No. of Pages : 3

[6335]-204
M.Sc.
PHYSICS
PHOT - 234 G4 : Acoustics - I
(2020 Pattern CBCS) (Semester - III)(4 Credits) (Group - II)

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

Instructions to the candidates:

1) ***Question 1 is compulsory.***
2) ***Attempt/Solve any five questions from Q.2. to Q.7.***
3) ***Q. 2 to Q.7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) **Solve any five of the following :**

a) Find sound power Level in an enclosure which emits 1W of acoustic power. (Wo = 10^{-12} Watt) **[2]**

b) Define acoustic inertance with its formula and unit. **[2]**

c) Give formula for characteristics frequency corresponding to allowed room modes. **[2]**

d) Write formula and unit for "Sound Pressure Level" and "Sound Power Level". **[2]**

e) Define Reverberation Time with formula. **[2]**

f) Derive the expression relating phon and sone. **[2]**

Q2) a) i) Write a note on Haas Effect. Why is the straight delay for speaker placement around 1 millisecond per foot? **[4]**

ii) The speech power associated with whispering is 1.3×10^{-9} W Whereas that associated with shouting is 1.1×10^{-3} W. Determine difference in PWL. **[3]**

b) Determine the room modes : (8 0 0), (3 0 2), (1, 2 2), (2 2 2) for a seminar hall 54 × 36 × 15 ft. What do you conclude? Use C =1130 ft/sec. **[5]**

P.T.O.

Q3) a) i) Explain in brief acoustics of middle ear. **[4]**

ii) In case of 'reflection at the surface of a solid', the SWR is 2.0 and the first node is located at a distance of $\frac{3}{8}\lambda$ from the reflecting surface. Determine the magnitude of normal specific acoustic impedance of the solid. **[3]**

b) The Resonator Frequency of unflanged Helmholtz is 192 Hz. Determine its volume if length and radii are 0.006 m and 0.019 m respectively.Also determine effective stiffness constant and quality factor for the resonator. [C = 343 m/s] **[5]**

Q4) a) i) Sketch the intensity versus frequency curves representing the threshold of audibility and threshold of feeling. **[4]**

ii) Explain Sound Transmission Class (STC) in brief. **[3]**

b) Give significance of the equation $f = \frac{c}{2}\sqrt{\frac{p^2}{l^2} + \frac{q^2}{w^2} + \frac{r^2}{h^2}}$. The '001' and '110' mode frequencies for a living room turn out to be indentical. Determine the length - to - width ratio of the room if the length - to - height is in ratio 9/5 [c = 1100 ft/sec]. **[5]**

Q5) a) Show that the effective absorption coefficient of material being investigated using a reverberation chamber is given by, $\alpha_e = \frac{0.049V}{S}\left(\frac{1}{\mathrm{T}}, -\frac{1}{\mathrm{T}}\right) + \alpha_0$. **[6]**

b) Explain what is meant by Effecitve Perceived Noise Level LEPN. Following are LPN observations collected during an aircraft flyover. Calculate LEPN. **[6]**

Time (hrs.)	02: 01: 00 02: 01: 05	02: 01: 05 02: 01: 10	02: 01: 10 02: 01: 15	02: 01: 15 02: 01: 20	02: 01: 20 02: 01: 25
LPN (dB)	95	100	105	103	100

Time (hrs.)	02: 01: 25 02: 01: 30	02: 01: 30 02: 01: 35
LPN (dB)	98	94

Q6) a) Derive the expression for sound power reflection and transmission coefficient in case of 'reflection at the surface of a solid'. **[7]**

b) A plane sound wave in air of 100 Hz frequency has a peak acoustic pressure amplitude of $2N/m^2$. Find : **[5]**

i) Intensity and Intensity Level

ii) Peak particle displacement amplitude

iii) Peak particle velocity amplitude

iv) Effective pressure

v) Sound pressure level re 0.0002 microbar [$Io=10^{-12}$ W/m^2]

Q7) **Write short note on any three of the following :**

a) Velocity of sound in fluids **[4]**

b) Expansion Chamber Muffler **[4]**

c) Hearing mechanism **[4]**

d) Eyring, Millington and Sette Approach **[4]**

♦ ♦ ♦

Total No. of Questions : 7]

SEAT No. : ____

PC-3728

[Total No. of Pages : 2

[6335] - 205
M.Sc.
PHYSICS
PHOT-234H4: Energy Studies - I
(2020 Pattern) (CBCS) (Semester - III) (4 Credits) (Group - II)

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

Instructions to the candidates:

1) ***Q. 1 is compulsory.***
2) ***Attempt /solve any five questions from Q. 2 to Q. 7.***
3) ***Questions 2 to 7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logtable or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) **Solve any five of the following :**

a) What is Air mass? **[2]**

b) What is solar pond? **[2]**

c) What is the main reason behind Global warming? **[2]**

d) What is conservation of energy? **[2]**

e) What is Greenhouse? **[2]**

f) What is the use of pyranometer? **[2]**

Q2) a) What are Fossil fuels? What are the Impact of excessive use of Fossil fuels. **[6]**

b) Draw schematic diagram of pyrheliometer and explain in brief its principle. **[6]**

P.T.O.

Q3) a) What are different types of energy storage systems? Explain chemical energy storage system. **[7]**

b) Explain laws of thermodynamics. **[5]**

Q4) a) What is a sustainable developments? what are the essential factors of sustainable development? **[7]**

b) Explain sensible and latent heat storage systems. **[5]**

Q5) a) i) Explain energy consumption and its impact on environmental climate change. **[4]**

ii) Explain Stefans-Boltzman relation and Fourier's law. **[3]**

b) Explain Electrical energy storage system with suitable example. **[5]**

Q6) a) What is a solar pond? Explain its principle and working with neat diagram. **[7]**

b) What are the different types of Heat transfer? Define each type Explain the basic units of Heat. **[5]**

Q7) **Write short note on any three of the following :**

a) Major harmful effects of acid rain **[4]**

b) Energy security **[4]**

c) Terrestrial and extraterrestrial solar radiation. **[4]**

d) Sun acts as a fusion reactor **[4]**

Total No. of Questions :7]

SEAT No. :

PC-3729

[Total No. of Pages : 2

[6335]-206
M.Sc.
PHYSICS
PHOT-234I4: Electronic Instrumentation - I
(CBCS) (2020 Pattern) (Semester - III) (4 Credits) (Group - II)

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Attempt/Solve any five questions from Q.2 to Q.7.***
3) ***Q.2 to Q.7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) **Solve any five of the following:** **[10]**

a) What is the signal conditioner?

b) Define the term : accuracy, precision.

c) List different types of transducer.

d) Draw the structure of LED.

e) How are the displays classified? List different types of display device.

f) State different types of thermocouple.

Q2) a) On the basis of functional element of instrument give valid interpretation for rudimentary pressure gauge and pressure thermometer. **[7]**

b) Explain different types of error's in measurement. **[5]**

Q3) a) What is the pyrometer? Explain selective radiation pyrometer with neat sketch. **[7]**

b) Explain resistance type displacement transducer in detail. **[5]**

Q4) a) Derive an expression for gauge factor for bonded resistance wire strain gauge. **[7]**

b) Draw block diagram of general multichannel DAS and explain its operation in short. **[5]**

P.T.O.

Q5) a) State the important features of LCDS. **[7]**

b) Explain the principle of operation of a dot matrix-printer. **[5]**

Q6) a) Define principle operation of thermocouple and explain types of thermocouple. **[7]**

b) What are main advantage of electric transducer. **[5]**

Q7) **Write a note on any three of following:**

a) Piezoelectric Transducer. **[4]**

b) LASER Printer. **[4]**

c) Data logger. **[4]**

d) Selective Radiation Pyrometers. **[4]**

Total No. of Questions : 7] **SEAT No. :**

PC-3730

[Total No. of Pages : 2

[6335] - 210
M.Sc.
PHYSICS
PHOT-234M4: Material Science - I
(2020 Pattern) (CBCS) (Semester - III) (4 Credits) (Group - II)

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

Instructions to the candidates:

1) ***Q. 1 is compulsory.***
2) ***Attempt solve any five questions from Q. 2 to Q. 7.***
3) ***Questions 2 to 7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logtable or non-programmable electronic calculator is allowed.***

Given:- 1) Boltzman Constant $K_B=1.38\times10^{-23}$ J/K

2) Avogadro's number $N=6.023\times10^{23}$/gm–mole

Q1) **Solve any five of the following :** **[10]**

a) Define the term i) specific heat ii) thermal conductivity **[2]**

b) Give various application of diffusion **[2]**

c) State Gibb's phase role **[2]**

d) Caluclate the spacing between dislocations in a tilt boundary in FCC crystal when angle of tilt is 2º given Burgers vectors b=4.50Aº **[2]**

e) In phase diagram, define system and component. **[2]**

f) What is solid solution? What are the factors governing solid solubility **[2]**

Q2) a) What do you understand by mechanical properties of the material? Define any five mechanical properties. **[7]**

b) Obtain the relation for auxilliary thermodynamic state function. **[5]**

P.T.O.

Q3) a) What is atomic diffusion? On what factors it depends? Explain process of mechanism of atomic diffusion in detail. **[7]**

b) Explain with the help of free energy diagram, the thermodynamic origin of equilibrium lens shape phase diagram. **[5]**

Q4) a) i) Explain the concept of regular solution **[4]**

ii) State Richard's & Trouton's rule for metals **[3]**

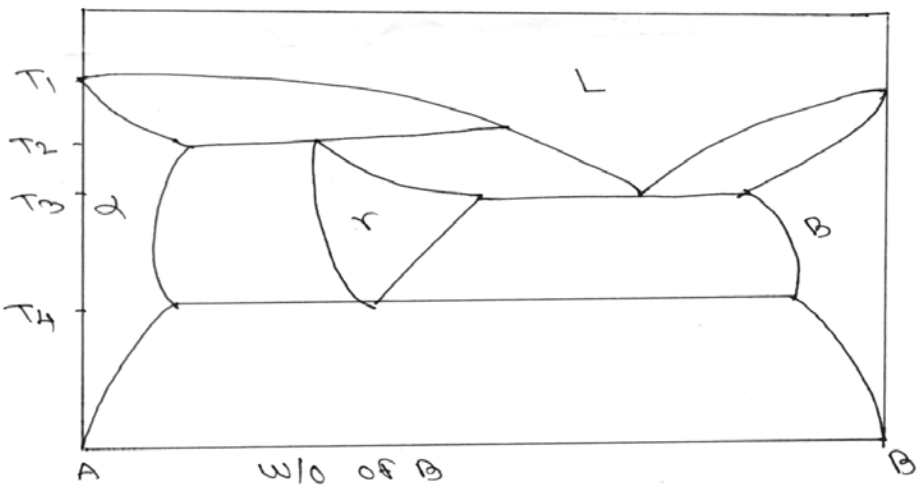
b) The diffusivity of alluminium in copper is 2.7×10^{-17} m^2/s at 500ºC and 1.6×10^{-12} m^2/s at 1000ºC. Determine Do and activation energy E for this diffusion couple. Also calculate diffusivity at 750ºC. **[5]**

Q5) a) Describe Frank - Read generator for the multiplication of dislocation **[6]**

b) Explain Fick's first and second law of diffusion. Also obtain expression for Fick's second law. **[6]**

Q6) a) For an ideal reaction mixture A-B, show that solidus and liquidus compositions are determined by $\Delta G^{o}_{M,A}$ and $\Delta G^{o}_{M,B}$ with the help of Gibb's free energy diagram **[7]**

b) In the phase dagram given below, mark various phase fields. Also write invarient equation and type of invariant equation corresponding of temperature T_3 **[5]**



Q7) **Write short note on any three of the following :**

a) Importance of phase diagram **[4]**

b) Twin boundary **[4]**

c) Gibbs phase rule with binary invarient system **[4]**

d) Lever rule with diagram **[4]**

Total No. of Questions : 4]

SEAT No. : ____

PC3731

[Total No. of Pages : 2

[6335]-213
M.Sc. - II
PHYSICS
(Group - II) PHOT-234H2: Energy Studies - I
(CBCS 2020 Pattern) (Semester - III) (2 Credits)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Question No.1 is compulsory.***
2) ***Attempt/ Solve any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Attempt any four of the following:

i) Give the at least two characteristics of sun. **[2]**

ii) What is green house effect? **[2]**

iii) What is latent heat storage? **[2]**

iv) What is conductive heat transfer coefficient? **[2]**

v) What is air mass? Calculate it at zenith. **[2]**

b) Calculate the intensity of solar radition, I that reaches to earth on 19^{th} June 1980, if solar constant is $1353 W/m^2$. **[3]**

Q2) a) i) State and explain 1^{st} and 2^{nd} law of thermodynamics. **[4]**

ii) Define the terms: solar constant, hour angle, zenith angle. **[3]**

b) Explain with neat diagram, the working of Pyrheliometer. **[5]**

Q3) a) Explain with neat diagram, the spectral distribution of extra-terrestrial radiations. **[6]**

b) Explain with neat diagram, the working of solar ponds as an energy storage. **[6]**

P.T.O.

Q4) Write short notes on any three of the following.

a) Sun as fusion reactor. **[4]**

b) Terrestrial solar radiations. **[4]**

c) Types of heat transfer. **[4]**

d) Renewable energy sources and their advantages. **[4]**

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Total No. of Questions : 4]

SEAT No. : ____

PC3732

[Total No. of Pages : 2

[6335]-214
S.Y.M.Sc.
PHYSICS
PHOT-234I2: Electronics Instrumentation - I
(CBCS 2020 Pattern) (Semester - III) (Group - II)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Question No.1 is compulsory.***
2) ***Attempt any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table & non-programmable calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Attempt any four of the following:

i) Define the terms: Accuracy and precision. **[2]**

ii) What do you mean by static characteristics? **[2]**

iii) A resistance strain gauge with a gauge factor of 2 is cemented to a steel member which is subjected to a strain of 1×10^{-6}. If the original resistance value of the gauge is 130Ω, calculate the change in resistance. **[2]**

iv) What are signal conditioners? **[2]**

v) List out the objectives of dalo loggers. **[2]**

b) Explain capacitive type displacement sensor. **[3]**

Q2) a) i) Explain unbounded strain gauge as displacement transducer with the help of suitable diagram. **[4]**

ii) Explain first order system with a suitable example. **[3]**

b) Draw a block diagram for multichannel DAS and explain it in details. **[5]**

Q3) a) Draw circuit diagram of instrumentation amplifier and obtain equation for it's voltage gain. **[6]**

b) Explain step response of first order instrument in brief. **[6]**

P.T.O.

Q4) Attempt any three of the following.

a) Explain construction and working of total radiation pyrometer. **[4]**

b) Write a note on sample and hold circuit. **[4]**

c) The power radiated from a hot piece of metal was measured by the radiation pyrometer and the temperature was determined on 820°C assuming a surface emissivity of 0.75. Later it was found that the accurate value of emissivity was 0.69. Find the error in the temperature determination. **[4]**

d) Draw the circuit diagram for phase detection using LVDT and Explain it. **[4]**

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Total No. of Questions : 4]

SEAT No. :

PC3733

[Total No. of Pages : 2

[6335]-215

M.Sc. -II

PHYSICS

GROUP - II -PHOT - 234 - J2 : Biomedical Instrumentation -I

(2020 CBCS Pattern) (Semester - III) (2 Credits)

Time : 2 Hours] **[Max. Marks : 35**

Instructions to the candidates:

1) ***Question no.1. is compulsory.***
2) ***Attempt/solve any two Questions from Q.No.2. to Q.No.4.***
3) ***Q.No.2. to Q.No.4. Carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log table or non programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Solve any four of the following.

i) Explain ECG wave form. **[2]**

ii) State the amplitude and frequency range of ECG. **[2]**

iii) What is systolic and diastolic pressure. **[2]**

iv) What is the purpose of electrode jel or electrolyte? **[2]**

v) What are the disadvantages of surface contact electrodes? **[2]**

b) The intracellular K^+ concentration of a group of cells averages 160×10^{-6} moles /Cm^3. The extracellular concentration of K^+ averages 6.5×10^{-6} moles /Cm^3 . Calculate **[3]**

i) The concentration ratio.

ii) Diffusion potential for K^+

P.T.O.

Q2) a) Explain the specifications of medical instrumentation system. **[7]**

b) Draw the block diagram of ECG machine and explain each block **[5]**

Q3) a) What are the different problems encountered in measuring a living System. **[7]**

b) Explain structure and working of heart. **[5]**

Q4) Write a short note on any two of followng. **[12]**

a) Heart as a natural pacemaker.

b) Precautions to minimize electric shock hazards.

c) Any two temperature transducers.

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Total No. of Questions : 4]

SEAT No. :

PC3734

[Total No. of Pages : 2

[6335]-216

M.Sc. -II

PHYSICS

PHOT - 234 K2 : Nuclear Techniques -I

(2020 Pattern) (Semester - III) (CBCS) (2 Credits)

Time : 2 Hours] **[Max. Marks : 35**

Instructions to the candidates:

1) ***Question no.1. is compulsory.***
2) ***Attempt/solve any two Questions from Q.No.2. to Q.No.4.***
3) ***Q.No.2. to Q.No.4. Carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log table and non programmable electronic calculator is allowed.***
6) ***Neat diagram must be drawn wherever necessary.***

Q1) a) Attempt any four of the following. **[8]**

i) Define the units RBE, BED and Kerma. How are these units are used in assessing the biological effects of ionizing radiation? **[2]**

ii) Describe the characteristics of Scintillation detector using NaI - (Tl) Crystal. **[2]**

iii) Discuss the importance of dose limits in radiation protection. What factors are considered in establishing these limits. **[2]**

iv) Explain the principle of operation of a surface barrier detector. What are its advantages? **[2]**

v) Define the unit Rontgen (R) and explain its use in expressing exposure to ionizing radiation. **[2]**

b) A technician is exposed to a neutron radiation field with a dose of 5 msv. Calculate the equivalent dose in sieverts, taking into account the radiation weighting factor (WR) for neutrons as 10. **[3]**

P.T.O.

Q2) a) i) Explain relationship between dose equivalent and effective dose. How is effective dose calculated and why is it a valuable metzic in assessing overall impact of radiation exposure on human health?**[4]**

ii) A Semiconductor detector records an energy deposition of 0.02 Mev when exposed to a certain radition source. Calculate the number of electron - hole pair created in the detector. given the energy required to create a pair 3 ev. **[3]**

b) Discuss the advantages and limitations of a proportional counter. How does it is differ from other types of detectors in terms of operational principles? **[5]**

Q3) a) Discuss the interactions of directly ionizing radiations (electron, proton, and ions) with matter. provide specific examples for each type of radiation. **[7]**

b) Examine the characteristics of semiconductor detectors such as Si (Li) and GeI (Li) Discuss the advantages & limitations of semiconductor detectors **[5]**

Q4) Write a short note on any three of following. **[12]**

a) Ionization chamber as a nuclear detector.

b) The role of preamplifiers, amplifiers, and discriminators in the signal processing chain of nuclear detectors.

c) Concept of Straggling in the Context of radiation interactions.

d) Discuss the interaction mechanism of gamma radiations with matter.

Total No. of Questions : 4]

SEAT No. : ____

PC3735

[Total No. of Pages : 2

[6335]-217

M.Sc. - II

PHYSICS

Group - II-PHOT-234L2: Microcontroller Based Instrumentation System - I

(2020 Pattern) (Semester - III)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Question No.1 is compulsory.***
2) ***Solve any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log table, non-programmable calculator is allowed.***
6) ***Neat and labeled diagram must be drawn wherever necessary.***

Q1) a) Solve any four of the following: **[8]**

i) Give comparision between microprocessor and microcontroller.

ii) What is PSW register? Draw it's format.

iii) Explain LJMP and SJMP instructions.

iv) What is stack pointer and give its size.

v) List various types of interrupts in microcontroller 8051.

b) Write an assembly Language program to generate delay of 2 ms using any register of 8051 microcontroller. **[3]**

Q2) a) What is interrupt priority in microcontroller 8051? and explain interrupt priority registers with example. **[7]**

b) Explain parallel part structure in 8051 μc. **[5]**

Q3) a) Draw functional block diagram of microcontroller 8051 and explain ALU and bus structure. **[7]**

b) Explain various flags of 8051 with functions in detail. **[5]**

P.T.O.

Q4) Attempt any two of the following. **[12]**

a) Write an assembly Language program to arrange 8 bit numbers in the descending order. **[6]**

b) Explain following instructions with example. **[6]**

i) SWAP A

ii) XCH A, Byte

iii) XCHD A, @Ri

c) Explain importance of TMOD and TCON registers in microcontroller 8051 in details. **[6]**

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Total No. of Questions : 4]

SEAT No. : ____

PC3736

[Total No. of Pages : 2

[6335]-218
S.Y.M.Sc.
PHYSICS
PHOT-234M2: Material Science - I
(CBCS 2020 Pattern) (Semester - III) (Group - II) (2 Credits)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Question No.1 is compulsory.***
2) ***Attempt any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Solve any four of the following:

i) State the difference between ductility and malleability. **[2]**

ii) State and explain Vegard's law. **[2]**

iii) Explain Hume-Rothery rules of solid solution. **[2]**

iv) Al crystal has dislocation density of $10^{10}/m^2$ calculate the elastic energy of line imperfection stored in the crystal (Given a = 4.05 Å) shear modulus of A1 = 25.94 G Mm^2.) **[2]**

v) Give some applications of diffusion process. **[2]**

b) Find the equilibrium concentration of vacancies in Nickel at 0 k and 300k (ENi = 1.74 eV) **[3]**

Q2) a) Calculate the fraction of lattice sites that are Schottky defects for NaCl at its melting temperature of 80l °C. Assume the energy for defects formation of 2.3 eV.

($K = 8.62 \times 10^{-5}$ eV/K) **[6]**

b) What is a dislocation? Distinguish between edge and screw dislocation. **[6]**

Q3) a) Explain following applications of diffusion **[7]**

i) Corrosion resistance of Duralumin.

ii) Carburization of steel.

b) Derive Fick's I and II Law. **[5]**

P.T.O.

Q4) Write short note on any two

a) Surface defects **[6]**

b) Volume defects **[6]**

c) Experimental determination of 'D' **[6]**

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Total No. of Questions : 7]

SEAT No. :

PC3737

[Total No. of Pages : 3

[6335]-301

M.Sc. - II

PHYSICS

PHCT-231 : Statistical Mechanics

(2020 Pattern) (CBCS) (Semester-III) (4 Credits)

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

Instructions to the candidates:

1) ***Question No.1 is compulsory.***
2) ***Attempt any five questions from Q.2 to Q.7.***
3) ***Question 2 to 7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log table and/or non programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Given constants.

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

Q1) Attempt any five of the following.

a) State the postulate of equal priori probability. **[2]**

b) Write the physical interpretation of α **[2]**

c) Define the term **[2]**

i) Phase space

ii) Phase point and

iii) Phase path

P.T.O.

d) A system of two particles has three energy levels E_1, E_2, E_3. Compute the accessible microstates when the particles are indistingushable. **[2]**

e) Find the average number of photons in an enclosure of 22.4 lit at 273k. **[2]**

f) In cannonical ensemble show that the pressure: **[2]**

$$\overline{P} = \frac{1}{\beta} \frac{r \ln z}{\partial v}$$

Q2) a) For a system in contact with heat reservoir (Cannonical ensemble) show that the probability of finding the system in a particular microstate 'r' of energy Er is given by **[7]**

$$P_r = \frac{e^{-\beta \varepsilon_r}}{\sum_r e^{-\beta \varepsilon_r}}$$

b) The table below gives the energy parameters and accessible states for two systems A & B as given below: **[5]**

System A	System B
$E_1 = 3, 4, 5$	$E_2 = 3, 4, 5$
$\Omega_1 = 10, 30, 90$	$\Omega_2 = 20, 50, 120$

If the systems are in thermal contact with each other, obtain the maximum number of accessible states for eight units of energy in the equilibrium.

Q3) a) On the basis of cannonical distribution, obtain the Curie law of paramagnetism. **[7]**

b) Discuss the distribution of energy between two systems are in thermal contact and obtain the condition at thermal equilibrium. **[5]**

Q4) a) What is Gibb's paradox? How it is resolved. **[7]**

b) A system consists of 6.625×10^{23} atoms and the system is at room temperature 300k. Assume that there is no interatomic energy in the system. Calculate the total internal energy? **[5]**

Q5) a) On the basis of cannonical distribution, obtain the law of atmosphere as, **[7]**

$$P(2) = P(0)e^{-mgz/kT}$$

b) The molar mass of lithium is 0.00694 and its density is 0.53×10^3 kg/m^3. Calculate the fermi energy and fermi temperature of the electron. **[5]**

Q6) a) Show that the entropy of the cannonical ensemble can be represented as:

$$S = -k\sum_r P_r \ln P_r$$ **[7]**

b) Show that when $T << \theta_r$, where θ_r is the rotational characteristic temperature in the lowest approximation. **[5]**

$$(Cv)_{nt} = 12NK\left(\frac{\theta_r}{T}\right)^2 .e^{-2\theta_r/T}$$

Q7) Write short notes on any three:

a) Equipartition theorem. **[4]**

b) Compare B.E. and F.D. statistics **[4]**

c) Stefan's law of Black Body Radiation. **[4]**

d) White Dwarf. **[4]**

Total No. of Questions : 7]

SEAT No. : ____

PC-3738

[Total No. of Pages : 2

[6335]-302
M.Sc. - II
PHYSICS
PHCT - 232 : Solid State Physics
(2020 Pattern) (CBCS) (Semester - III) (4 Credits)

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

Instructions to the candidates:

1) ***Question 1 is compulsory.***
2) ***Attempt/Solve any five questions from Q.2. to Q. 7.***
3) ***Q. 2 to Q.7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log table or non-programmable electronic calculator is allowed.***
6) ***Neat diagram must be drawn where necessary.***

Gives :

Plancks constant = 6.626×10^{-34} Js

Mass of electron = 1.6×10^{-31} kg

Boltzmann constant = 1.38×10^{-23} J/k

Avogadro's Number = 6.023×10^{23} /mole

Permeability of free space = 411×10^{-7} Henry/m

Charge on electron = 1.6×10^{-19} C

Permittivity of free space = 8.85×10^{-12} C^2/Nm^2

Bohr magneton = 9.27×10^{-24} J/T

Q1) **Solve any five of the following :** **[10]**

a) Explain Ferromagnetic domains.

b) Explain Fermi sphere.

c) Define Anisotropy energy.

d) What are type 1 & type II super conductor's ?

e) Explain cyclotron resonance.

f) Explain quenching of orbital angular momentum.

Q2) a) i) Describe band structure of semiconductor crystal. **[4]**

ii) What is Meissner effect ? Explain with neat labelled diagram. **[3]**

b) Explain qualitatively the Kronig - penny model. **[5]**

P.T.O.

Q3) a) Explain classical theory paramagnetism, hence derive Curie law. **[7]**

b) The Saturation magnetic induction of nickel is $0.65 Wb/m^2$, calculate the magnetic moment of nickel atom in Bohr magnetion. Given **[5]**

i) Density of nickel = $8906 kg/m^2$

ii) Atomic weight of nickel = 58.7.

Q4) a) State and prove Bloch theorem. **[7]**

b) Explain quantum theory of paramagnetism. Derive Curie law. **[5]**

Q5) a) On the basis of band theory of solids distinguish between a metal, semiconductor and insulator. **[7]**

b) Describe the assumptions of BCS theory of Superconductivity. **[5]**

Q6) a) Show that for a super conductor on the basis of meissner effect and Maxwell's equation magnetic susceptibility is H = -1 **[7]**

b) Describe the motion of electron in 1-D periodic potential. **[5]**

Q7) **Write short note on any three of the following :** **[12]**

a) London equation for a superconductor.

b) Classical theory of diamagnetism

c) Quantization of electronic orbit in magnetic field.

d) Saturation magnetization.

♦ ♦ ♦

Total No. of Questions : 7]

SEAT No. : ____

PC-3739

[Total No. of Pages : 2

[6335]-303

M.Sc. - II

PHYSICS

PHCT - 233 : Experimental Techniques in Physics - I

(2020 Pattern) (CBCS) (Semester - III)(4 Credits)

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

Instructions to the candidates:

1) ***Question 1 is compulsory.***
2) ***Attempt/Solve any five questions from Q.2. to Q. 7.***
3) ***Q. 2 to Q.7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logtable or non-programmable electronic calculator is allowed.***
6) ***Neat diagram must be drawn wherever necessary.***

Q1) **Solve any five of the following :**

a) State important applications of Vacuum. **[2]**

b) Define average velocity and mean free path of gas molecules. **[2]**

c) Define term outgasing and backstreaming. **[2]**

d) Define precision and accuracy in measurement. **[2]**

e) Write various ranges of Vacuum. **[2]**

f) Name Four types of Vacuum guages commonly used in vacuum system. **[2]**

Q2) a) With the help of neat diagram, write principle, construction and working of McLeod guage. **[7]**

b) Explain the vacuum system design with the help of Schematic diagram. **[5]**

Q3) a) With the help of neat diagram, explain the principle, construction and working of oil diffusion pump. **[7]**

b) What is throttling process and prove that entropy remain constant in this process. **[5]**

P.T.O.

Q4) a) i) Discuss the various types of errors in measurement system. **[4]**

ii) Calculate the mean free path of air at ambient temperature with pressure 10×10^{-3} Torr **[3]**

b) What is pumping speed and pump down time? Derive an expression for Pump down time. **[5]**

Q5) a) i) Give classification of sensor. Explain the operational principle of thermal sensor. **[4]**

ii) Calculate the pump down time to reduced the pressure 760 torr to 10^{-3} torr, if the volume of the chamber is 15 lit. and pump speed is 45 lit/min. **[3]**

b) What are the primary method used for leak detection in vacuum pump? Briefly explain one of them. **[5]**

Q6) a) i) With the help of neat diagram, explain Bayard-Alpart guage. **[4]**

ii) The speed of the vacuum pump is 100 lit/sec and the pump is connected to the tube of conductance 500 lit/sec. Calculate the effective pumping speed. **[3]**

b) With the help of neat diagram, explain the working of arbitrary pump. **[5]**

Q7) **Write a short note on any three of the following :**

a) Electric Sensor. **[4]**

b) Reliability chi-square test **[4]**

c) Periodic and Random Signals. **[4]**

d) Viscosity and diffusion of gases. **[4]**

♦ ♦ ♦

Total No. of Questions : 7]

SEAT No. : ____

PC3740

[Total No. of Pages :2

[6335]-401

S.Y.M.Sc.

PHYSICS

PHCT-241 : Nuclear Physics

(2020 CBCS Pattern) (Semester- IV) (4 Credits)

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

Instructions to the candidates:

1) ***Question 1 is compulsory.***
2) ***Attempt/Solve any five questions from Q.2 to Q.7.***
3) ***Question 2 to Question 7 carry equal marks.***
4) ***Figure to the right indicate full marks.***
5) ***Use of log table or non-programmable electronic calculator is allowed.***
6) ***Neat diagram must be drawn where necessary.***

Q1) Solve any five of the following:

a) Define mass defect and packing fraction. **[2]**

b) Write down the assumptions of the liquid drop model. **[2]**

c) Give's the list of operational power plants in India. **[2]**

d) What is elementary particles? **[2]**

e) Find the B.E/nucleon when two deuterons combine to form α-particle. **[2]**

f) Define α-value of Nuclear Reaction. **[2]**

Q2) a) What is mass spectrograph? Explain the basic component's of Mass spectroscopy. **[7]**

b) Describe the term four factor formula in details. **[5]**

Q3) a) Discuss in details of the evidence for the existence of magic numbers in the shell model. **[7]**

b) Write down any two properties of π-meson. **[5]**

P.T.O.

Q4) a) With the help of elementry particles, describe the classification of four fundamental Interaction. **[7]**

b) Which of the following reactions are allowed & forbidden under the conservation of strangeness. Conservation of charge and conservation of baryon number **[5]**

i) $\pi^+ + n \rightarrow \wedge^\circ + K^+$

ii) $\pi^+ + n \rightarrow K^\circ + K^+$

iii) $\pi^+ + n \rightarrow \pi^- + p$

iv) $\pi^- + p \rightarrow \wedge^\circ + K^\circ$

v) $\pi^- + p \rightarrow \pi^\circ + \wedge^\circ$

Q5) a) Describe the principle, construction, working and uses of van de Graft Accelerator. **[7]**

b) With the help of Nuclear Magnetic Diapole moment, prove that

$$\mu = g_l \left(\frac{e\hbar}{2m} \right) \frac{I}{\hbar}.$$ **[5]**

Q6) a) Describe the conservation law's in Nuclear Reactions. **[7]**

b) Calculate the binding energy per nucleon of ^{7}Li and ^{56}Fe.
(M_{Li} = 7.016 amu; M_{Fe} = 55.935 amu) **[5]**

Q7) Write a short note on any three of the following:

a) NaI (Tl) Detector. **[4]**

b) Half life and Decay Scheme of ^{137}Cs. **[4]**

c) Reactor Materials. **[4]**

d) Concept of Higg's Boson. **[4]**

Total No. of Questions : 7]

SEAT No. : ____

PC3741

[Total No. of Pages : 2

[6335]-402
M.Sc. - II
PHYSICS
PHCT-242: Experimental Techniques in Physics - II
(CBCS 2020 Pattern) (Semester - IV)

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

Instructions to the candidates:

1) ***Question No.1 is compulsory.***
2) ***Attempt/ Solve any five questions from Q.2 to Q.7.***
3) ***Q.2 to Q.7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any five of the following: **[10]**

a) List the types of detectors used for the detection of infra-red radiation.

b) Calculate the energy in eV for a photon whose radiation wavelength is 700 nm.

c) Draw a neat, labelled diagram of Bragg's diffraction condition.

d) Draw a schematic diagram of an optical microscope.

e) What is a hysteresis loop?

f) What is the SQUID Technique?

Q2) a) i) Explain the powder method technique for X-ray diffraction. **[4]**

ii) Write a procedure for sample preparation in TEM. **[3]**

b) State different source radiations for y-rays, X-rays, IR, UV-visible, and microwave. **[5]**

Q3) a) i) Distinguish between thermogravimetric (TGA) and differential thermal analysis. **[4]**

ii) State the merits of electron microscopy over optical microscopy. **[3]**

b) Explain the basic physical processes that take place in radiation detection. **[5]**

P.T.O.

Q4) a) i) State the different modes of operation in atomic force microscope (AFM). **[4]**

ii) Why does a microwave oven heat up a food item containing water molecules most efficiently? **[3]**

b) Describe the construction and operation of the scanning Tunneling microscope (STM). **[5]**

Q5) a) Write electromagnetic radiation with its wavelength range and related energies. **[6]**

b) Explain the principle, construction and operation of the UV-visible spectrometer. **[6]**

Q6) a) Derive the scherrer formula for crystallite size determination. **[6]**

b) Explain the principle, construction and working of Raman spectrometer. **[6]**

Q7) Write a short note on any three of the following.

a) Write short note on the factors affecting thermogravimetric analysis. **[4]**

b) Merits of Neutron diffraction over X-ray diffraction. **[4]**

c) What is nuclear magnetic resonance (NMR)? Explain in detail with neat labelled diagram. **[4]**

d) Write significance of FESEM over SEM. **[4]**

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Total No. of Questions : 7]

SEAT No. : ____

PC3742

[Total No. of Pages : 2

[6335]-403

M.Sc.

PHYSICS (Semester - I / II & IV)

CBOP-I(PHOT - XXXA4 : Physics of Thin Films

(2020 CBCS Pattern) (Group - I) (4 Credits)

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

Instructions to the candidates:

1) ***Q1 is compulsory.***
2) ***Attempt/solve any five questions from Q.2 to Q.7.***
3) ***Q.2 to Q.7 carry equal marks.***
4) ***Figures to the right indicates full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any five of the following :

a) Write the difference between Thin and Thick Films? **[2]**

b) Define spin coating and steps Involved in it. **[2]**

c) Define Nucleation. **[2]**

d) Define Tempetarure coefficient of Resistance in Thin films. **[2]**

e) What are the types of optical coating? **[2]**

f) Write Thin Film resistance properties (any four)? **[2]**

Q2) a) Explain the statistical or Atomistic Theory with nucleation rate. **[7]**

b) Explain pulsed Laser Abiation. **[5]**

Q3) a) Explain spray pyrolysis with it's construction and working. **[7]**

b) Explain optical coating with it's type. **[5]**

P.T.O.

Q4) a) i) Explain Fuch - Sondhemir theory. **[4]**

ii) Explain condensation process in Thin Film growth. **[3]**

b) Define Adhesion. Write mechanical measurement method of Adhesion. **[5]**

Q5) a) i) Explain thin film Gas sensor. **[4]**

ii) What is difference between Dip coating and spin coating. **[3]**

b) What is Physical vapour deposition method? Explain it's types in short notes. **[5]**

Q6) a) Draw a neat diagram of Electron beam deposition, and Explain it's construction and working. **[7]**

b) Describe various chemical reactions involved in chemical vapour deposition process. **[5]**

Q7) Write short note on any three of the following :

a) Photolithography. **[4]**

b) Hall effect in Thin Film. **[4]**

c) Various stages of growth of Thin Films. **[4]**

d) Thin Films for information storage. **[4]**

Total No. of Questions : 7]

SEAT No. :

PC3743

[Total No. of Pages : 2

[6335]-404

M.Sc.

PHYSICS (Semester-I/II & IV)

CBOP-I (PHOT-124B4) CBOP-I (PHOT-114B4)-CBOP-I (PHOT-243B4) :

Physics of Nanomaterials

(2020 CBCS Pattern) (4 Credits) (Group -I)

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

Instructions to the candidates:

1) ***Question no.1. is compulsory.***
2) ***Attempt/solve any five Questions from Q.No.2. to Q.No.7.***
3) ***Q.No.2. to Q.No.7. Carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log - time or non programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any five of the following. **[10]**

a) What is fullerence with example.

b) What is meant by sol-gel.

c) What is the structure of carbon nanotubes?

d) What is another name for Chemical solution deposition?

e) What are carbon nanotube used for?

f) State any two applications of nano materials?

P.T.O.

Q2) a) What are the method of synthesis of nano materials? Explain Top-down and Bottom-up approach with neat diagram. **[7]**

b) Define nano technology. Give various commerical applications of nanotechnology for next several year. **[5]**

Q3) a) Describe synthesis of nanomaterial using physical vapour deposition with suitable diagram. **[7]**

b) Explain optical properties of nanosize materials with examples. **[5]**

Q4) a) Explain the effect of reduction of dimension of nanosize of materials. **[7]**

b) What is the mechanism of hydrothermal method? **[5]**

Q5) a) Describe synthesis of nano materials using energy ball milling with suitable diagram. **[7]**

b) Explain different type of carbon nanotubes. **[5]**

Q6) a) Describe step by step the chemical vapour deposition. **[7]**

b) Calculate the energy band gap in eV with wave length of 600 nm? **[5]**

Q7) Write short note on any three of the following: **[12]**

a) Aerogels

b) Graphene and its applications.

c) Application of carbon nanotubes.

d) Nano-composites its types.

Total No. of Questions : 7]

SEAT No. :

PC3744

[Total No. of Pages : 3

[6335]-405
M.Sc.
PHYSICS (Semester I/II & IV)
CBOP - I (PHOT - 124C4) - CBOP - I (PHOT-114C4) - CBOP - I (PHOT - 243C4) : Lasers & Applications
(2020 CBCS Pattern) (Group - I) (4 Credits)

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Attempt/solve any five questions from Q.2 to Q.7***
3) ***Q.2 to Q.7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any Five of the following.

a) Why metastable state is important in laser operation? **[2]**

b) Explain the term coherence length & coherence time. **[2]**

c) What do you mean by solid state laser? Give example. **[2]**

d) What is the active medium in laser? **[2]**

e) What is LIDAR? state its applications. **[2]**

f) Find the ratio of population of the two states in He-Ne laser that produces light of wavelength 6328 Å at 27°C. **[2]**

g) The difference between two laser levels is 0.117eV. Determine the wavelength of the radiation. **[2]**

Q2) a) Explain the construction & Working of He-Ne laser with neat energy level diagram. State its applications. **[7]**

OR

a) i) What is pumping? Explain different pumping methods. **[4]**

ii) Calculate the intensity of laser beam of 1mW power of He-Ne laser of wavelength 6328Å. **[3]**

b) Explain three & four level pumping scheme in laser. **[5]**

P.T.O.

Q3) a) What are the characteristics of laser light? Explain in brief each to them. **[7]**

OR

a) i) A laser beam has a width of 3KHz. What will be the coherence time & coherence length? **[4]**

ii) State & explain the condition for steady state oscillations. **[3]**

b) Explain the principle, construction & working of Ruby laser. **[5]**

Q4) a) What is holography? How the holograms are constructed & recorded? Write applications of holography. **[7]**

OR

a) i) Explain the three Einstein coefficients. **[4]**

ii) A gaseous medium gives a laser at infrared wavelength of 3.4μm. Calculate the difference of energy between upper & lower level. [Given: h = 6.63 $\times 10^{-34}$ JS, c = 3×10^{8}m/s] **[3]**

b) Explain the application of laser in bar code scanner in brief. **[5]**

Q5) a) Explain in brief: Absorption, spontaneous emission & stimulated emission. Give difference between spontaneous & stimulated emission. **[7]**

b) What is line broadening? Explain different types of it. **[5]**

OR

a) Explain the principle, construction & working of Nd : YAG laser with energy level diagram. **[6]**

b) Find the relative population inversion of the two states in a ruby laser that produces a light beam of wavelength 6943Å at 300º K & 500ºK. **[6]**

[Given : Boltzmann constant k = 1.38×10^{-23}J/K]

Q6) a) Explain the applications of laser in medicine in briet. **[7]**

b) What is the threshold condition for lasing action? Explain. **[5]**

OR

a) Explain with energy level diagram, construction & working of CO_2 laser. **[6]**

b) What do you mean by Q-switching? Explain two methods of Q-switching. **[6]**

Q7) Write short note on any Three of the following. **[4]**

a) Tunable dye laser

b) Applications of laser in industry

c) Threshold pump power

d) Optical resonator

OR

Write short note on any Two of the following, **[6]**

a) Excimer laser

b) Line width

c) Semiconductor laser

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Total No. of Questions : 7]

SEAT No. :

PC3745

[Total No. of Pages :2

[6335]-406

M.Sc.

PHYSICS (Semester-I/II & IV)

CBOP-I(PHOT-124 D4) CBOP-I(PHOT-114 D4)

CBOP-I(PHOT-243 D4): Physics of Semiconductor Devices

(2020 CBCS Pattern) (Group-I) (4 Credits)

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Attempt/solve any five questions from Q.2 to Q.7.***
3) ***Q.2 to Q.7 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams msut be drawn wherever necessary.***

Q1) Solve any Five of the following.

a) If the semiconductor is electrostatically neutral, write the space charge neutrality equation of it. **[2]**

b) Draw neat labelled diagram of temperature dependence of mobility with both lattice and impurity scattering. **[2]**

c) For a given semiconductor, if the masses of electrons and holes are same ($m_e = m_h$), where will the fermi level shift in the energy band diagram? **[2]**

d) Define
   i) Base transport factor and
   ii) Common emitter current gain of p - n - p transistor. **[2]**

e) A Si sample is doped with 2.70×10^{16} atoms/cm^3 of donor atoms. What is the equilibrium hole concentration at 300 K? Given $n_i = 1.5 \times 10^{10}$ cm $^{-3}$. **[2]**

f) Explain the device structure of SCR. **[2]**

Q2) a) i) Calculate the electron and hole concentration of a semiconductor at thermal equilibrium. **[4]**

ii) The n - type semiconductor has a minority carrier lifetime of 10^{-6} sec. Find the diffusion length of minority carrier at 300 K. Given, μ_n = 250 cm^2/v.s and (kT/q) = 0.0259 V. **[3]**

b) Find the expression of Shockley diode. Draw and label its practical I - V characteristics. **[5]**

P.T.O.

Q3) a) i) Derive an expression of maximum electric field and the diffusion capacitance of the linearly graded junction. **[4]**

ii) An abrupt Si p - n junction has $N_a = 10^{18}$ cm^{-1} on one side and $N_d = 10^{15}$ cm^{-3} on other. Determine the contact potential (qV_0) of p - n junction at 300 k. **[3]**
Given : kT = 0.0259 and $n_i = 2 \times 10^{20}$ cm^{-3}.

b) What is the junction breakdown? Explain different mechanisms of junction breakdown in brief. **[5]**

Q4) a) i) Consider the constant mobility of carriers and derive an expression of drain current in linear and saturation region of output characteristics of JFET. **[4]**

ii) What is the second breakdown phenomenon in power transistor? **[3]**

b) What is the IMPATT diode? Describe the avalanche and drift region of the IMPATT diode. **[5]**

Q5) a) State the assumptions of Thermionic emission theory of metal semiconductor contact and find the equation of total current density. **[6]**

b) What are the interface states? Explain the barrier height of metal - semiconductor system. Discuss the limiting cases of barrier height. **[6]**

Q6) a) What is the generation and recombination current density? Find the total forward current density J_f . **[6]**

b) How the triggering mechanism occurs in SCR? Draw I - V characteristics of SCR and explain it. **[6]**

Q7) Write a short note on any three of the following.

a) Narrow base diode **[4]**

b) Gummel number **[4]**

c) Image force lowering **[4]**

d) Excess carriers in semiconductor **[4]**

Total No. of Questions : 4]

SEAT No. : ____

PC3746

[Total No. of Pages : 2

[6335]-409

M.Sc.

PHYSICS (Semester - I / II & IV)

(PHOT - XXXA2T: Physics of Thin Films

(2020 Pattern) (Group - I) (2 Credits)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Q1 is compulsory.***
2) ***Attempt/solve any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicates full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Solve any four questions of the following :

i) Write advantages of thin film resistor. **[2]**

ii) Define dip coating & also write step involved in it. **[2]**

iii) Define nucleation. **[2]**

iv) Write principle of physical vapour deposition. **[2]**

v) What is thin film sensor. **[2]**

b) Write the difference between capillarity model and atomistic model. **[3]**

Q2) a) Explain in brief various stages of thin film growth. **[7]**

b) What is meant by sputtering? Write short note on it. **[5]**

P.T.O.

Q3) a) Explain construction & working of Molecular Beam Epitaxy with neat & labelled diagram. **[7]**

b) Write the tolansky method with its advantages & disadvantages. **[5]**

Q4) Write short note on any three of the following :

a) Optical coating. **[4]**

b) Electron Beam deposition. **[4]**

c) Solar cells. **[4]**

d) Thin film capacitor. **[4]**

e) Pulsed laser Ablation. **[4]**

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Total No. of Questions : 4]

SEAT No. :

PC3747

[Total No. of Pages : 2

[6335]-410

M.Sc.

PHYSICS (Semester-I/II & IV)

CBOP- I (PHOT - 124 B2), CBOP - I (PHOT - 114 B2), CBOP - I (PHOT - 243 B2) : Physics of Nano Materials

(2020 CBCS Pattern) (2 Credits)

Time : 2 Hours] **[Max. Marks : 35**

Instructions to the candidates:

1) ***Question no.1. is compulsory.***
2) ***Attempt/solve any two Questions from Q.No.2. to Q.No.4.***
3) ***Q.No.2. to Q.No.4. Carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic table and non programmable electronic calculator is allowed.***
6) ***Neat diagram must be drawn wherever necessary.***

Q1) a) Solve any four of the following. **[4×2=8]**

i) State any two applications of nano materials.

ii) Define Nano technology.

iii) What do you meant by thermal stress?

iv) What is mean by bottom up approach?

v) List application of physical vapour deposition.

b) Draw a neat labelled diagram of chemical bath deposition method of nanomaterials. **[3]**

Q2) a) i) Explain mechanical properties of nano material. **[4]**

ii) Calculate the optical energy band gap of a wavelength is 600nm.**[3]**

b) Explain the effect of reduction of dimension of nanosize of materials.**[5]**

P.T.O.

Q3) a) Describe step by step the physical vapour deposition method with suitable diagram. **[7]**

b) Describe the synthesis, properties and applications of graphene. **[5]**

Q4) Write a short notes on any three of the following. **[3×4=12]**

a) Magnetic properties

b) Sol-gel method

c) Biomedical Application

d) Hydro thermal method

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Total No. of Questions : 4] **SEAT No. :**

PC3748 **[Total No. of Pages : 2**

[6335]-411
M.Sc.
PHYSICS (Semester I/II & IV)
CBOP - I (PHOT-124C2), CBOP - I (PHOT - 114C2), CBOP - I (PHOT - 243C2) : Lasers & Applications
(2020 Pattern) (CBCS) (Group - I) (2 Credits)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Attempt any Two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Solve any Four of the following.

i) Define the term LASER. What is stimulated emission? **[2]**

ii) Define active medium. Which active medium used in He-Ne laser? **[2]**

iii) What is the difference between electrical pumping & opical pumping? **[2]**

iv) What do you mean by dye lasers? **[2]**

v) What is population inversion? How it can be achieved? **[2]**

b) Distinguish between spontaneous emission & stimulated emission in laser. **[3]**

Q2) a) Explain the construction, working & energy level diagram for He-Ne laser. State any four application at He-Ne laser. **[7]**

OR

i) Find the relative population inversion of two states in Ruby laser that produces a light beam of wavelength 6943A^{o} at 300k & 500k. (Given : Boltzmann constant k = 8.61×10^{-5}ev/k) **[4]**

ii) Calculate the wavelength, frequency & energy per pulse of CO_2 beam having energy difference between two states as 0.117ev. The laser contains total of 2.5×10^{19} atoms of elements in excited states. (Given: h = 6.63×10^{-34} J.s) **[3]**

b) Explain the principle, construction & working of CO_2 laser. **[5]**

P.T.O.

Q3) a) i) Explain the principle, construction & working of Ruby lasers. **[7]**

ii) Give the difference between three level laser system & four level laser system. **[5]**

OR

b) i) Explain construction & working of Nd-YAG Lasers with neat diagram. **[6]**

ii) Derive the relation between Einstein's coefficients. **[6]**

Q4) Write short notes on any three or any two of the following.

a) Threshold condition for laser **[4]**

b) Characteristics of laser **[4]**

c) Stimulated emission cross section **[4]**

d) Metastable state **[4]**

OR

a) Gas lasers **[6]**

b) Gain & Absorption coefficients **[6]**

c) Excimer lasers **[6]**

d) Semiconductor lasers **[6]**

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Total No. of Questions : 4]

SEAT No. : ____

PC3749

[Total No. of Pages :2

[6335]-412

M.Sc.

PHYSICS

CBOP-I (PHOT-124 D2) CBOP-I (PHOT-114 D2)CBOP-I (PHOT-243 D2): Physics of Semiconductor Devices

(2020 CBCS Pattern) (2 Credits) (Semester - I/II&IV)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Solve any Two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicates full marks.***
5) ***Use of log-tables or non-programmable electronic calculator is allowed.***
6) ***Neat labelled diagrams must be drawn wherever necessary.***

Q1) a) Solve any four of the following.

i) Define fermi energy and energy band gap. **[2]**

ii) Define base transport factor and emitter injection efficiency. **[2]**

iii) Draw a schematic representation of electric field distribution in an IMPATT diode. **[2]**

iv) What is the purpose of sandwitching insulator layer between p & n regions in p - i - n diode. **[2]**

v) What is the advantages of zener diode over normal p-n junction diode? **[2]**

b) Find the occupation probability of an electron at available energy state E < EF. Draw the diagram of occupancy probability of an electron. **[3]**

Q2) a) Obtain an expression for a basic equation used to derive the I - V characteristics of JFET under constant mobility condition. **[5]**

b) A Si sample is doped with 10^{17} Arsenic atoms/cm^3. What is the equilibrium hole concentration p_0 at 300 K? What is the location of E_f compare to E_i. **[4]**

c) Explain the operating characteristics of UJT with the help of I-V characteristics. **[3]**

P.T.O.

Q3) a) Enlist the various basic transport processes under forward bias in metal semiconductor contact. Explain one of them in detail. **[6]**

b) Define build - in potential. A Silicon p - n junction of 1 cm^2 area consist of a two-sided step junction with n - region of 10^{17} donors/cm^3 and a p - region of 4×10^{17} acceptor/cm^3. All donors and acceptors are ionized. Find the built-in potential. Given $n_i = 10^{10}\ cm^{-3}$. **[6]**

Q4) Write a short notes on any THREE of the following.

a) Expression of mass action law for an intrinsic semiconductor. **[4]**

b) Basic equations of semiconductor device operation. **[4]**

c) MOSFET **[4]**

d) Shockley Equation **[4]**

Total No. of Questions : 4]

SEAT No. : ____

PC-3750

[Total No. of Pages : 2

[6335]-413

M.Sc. (Part - I)

PHYSICS

CBOP-1 PHOT-124E2 : Communication Electronics (Group - I)

(2020 Pattern) (CBCS) (Semester - II) (2 Credits)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates :

1) ***Q. 1 is compulsory.***
2) ***Attempt/Solve any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Solve any four of the following :

i) Differentiate between analog and digital signal systems. **[2]**

ii) Calculate the capacity of a standard 4-kHz telephone channel has 3100 Hz bandwidth with a 30 dB signal to noise ratio. **[2]**

iii) What is the role of E-relay in telephone set? **[2]**

iv) Explain PRT and Duty cycle in RADAR. **[2]**

v) Explain the Touch tone DTMF. Which are the two sine wave frequencies produced when the 8 key is pressed. **[2]**

b) If you have a radar signal that is transmitted and returned from a contact in 33 μ secs, what is the range to the contact? **[3]**

P.T.O.

Q2) a) i) Explain the four wive - terminating set with suitable diagram. **[4]**

ii) Explain the cross talk characteristics of data transmission. **[3]**

b) Draw the circuit diagram of telephone subscriber loop circuit. Also Explain the role of DC battery in telephone system. **[5]**

Q3) a) Derive the basic radar equation, as governed by minimum receivable echo power P_{min}. **[7]**

b) Draw the block diagram of digital communication system & Explain function of each block. **[5]**

Q4) **Write short notes on any two of the following :**

a) Different codes used for data transmission. **[6]**

b) Network organization **[6]**

c) Satellite Communication **[6]**

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Total No. of Questions :7]

SEAT No. :

PC-3751

[Total No. of Pages : 2

[6335]-415
M.Sc.
PHYSICS
PHOT-244G4: Acoustics - II
(2020 CBCS pattern) (Semester - IV) (4 Credits) (Group - II)

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Attempt/solve any five questions from Q.2 to Q.7.***
3) ***Q.2 to Q.7 carry equal marks.***
4) ***Figures to the right side indicates full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) **Solve any five of the following:** **[10]**

a) What is volume compressor?

b) Define sound reproducing system, mention its types.

c) What do you mean by cavitation.

d) Give classification of microphones.

e) Define Directivity factor and Directivity index.

f) Distiniguish between frame and sector of a audio CD.

Q2) a) Derive the expression for sensitivity of velocity ribbon microphone. **[7]**

b) The cut off frequency of exponential horn changes at the rate of 1/3 with temperature, Determine the length of the horn if mouth to throat radii are in the ratio 10:1 **[5]**

Q3) a) i) Write a note on ultrasonic cleaning and ultrasonic range finding.**[4]**

ii) A condenser microphone having a diameter of 0.8cm is stretched to a tension of 10,000 N/m. The steel diaphragm is 0.001cm thick and spacing between the diaphragm and backing plate is 0.001cm with polarizing voltage of 150v. Determine the open ciruit constant pressure response for this microphone. **[3]**

b) Write a note on Acoustic Anechoic and semi-anechoic chambers. **[5]**

P.T.O.

Q4) a) i) Derive wave equation for horn loud speaker. **[4]**

ii) Find effective stiffness in case of louds speaker mounted in a cabinet of volume 0.05 m^3 and radius of speaker is 0.1m and density 1.21 $kg/m^{3.}$ **[3]**

b) Write a note on Dolby Noise reduction. **[5]**

Q5) a) Write a note on Reciprocity Calibration of microphone. **[7]**

b) A direct radiator loud speaker has total mass of 10gm and operated in a magnetic field of 2 wb/m^2. The radius of the speaker is 0.1m, the mechanical resistance is 1 kg/sec the radiation resistance and radiation reactance each are 2 kg/sec. The stiffness of cone system is 2500 N/M, the voice coil is 380cm long and has a resistance of 100hms. Calculated following quantities at frequency of 200Hz. **[5]**

i) F_o

ii) Efficiency

iii) Acoustic power output for an input current of 3 Ampere.

Q6) a) Derive the expression for motional impedance of the direct radiator loudspeaker. Give its physical significance. **[7]**

b) The open circuit voltage response of a carbon microphone is -50dB when connected to a 12v battery and its internal impedance is 1100hm. Its diaphragm has an area of 0.002 m^2 and an effective stiffness of 10^6 n/m. Calculate. **[5]**

i) 'h' resistance constant.

ii) ratio of second harmonic to fundamental voltage for 110 microbar pressure amplitude.

Q7) **Write a short note on <u>any two</u> of the following.**

a) Cross-over network. **[6]**

b) Audio file format. **[6]**

c) MIDI (Musical Instruments Digital Interface). **[6]**

Total No. of Questions :7]

SEAT No. :

PC-3752

[Total No. of Pages : 2

[6335]-416
M.Sc.
PHYSICS
PHOT-244H4: Energy Studies - II (CBCS)
(2020 pattern) (Semester - IV) (4 Credits) (Group - II)

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Solve any five questions from Q. 2 to Q. 7.***
3) ***Figures to the right indicates full marks.***
4) ***Use of log-tables or non-programmable electronic calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Q1) **Attempt any five of the following:**

a) What is aerobic bio conversion? **[2]**

b) What is solar cell? **[2]**

c) What is meant by pyrolysis and gasification? **[2]**

d) Give the different techniques selective coatings. **[2]**

e) What is wind energy? **[2]**

f) What are solar cell parameters? **[2]**

Q2) a) i) What are the different types of biofuels? Give their applications. **[4]**

ii) Explain the importance of hydrogen as a fuel. **[3]**

b) What are different types production of hydrogen? Explain any one of them. **[5]**

Q3) a) What is biomass gasifier? Explain with neat diagram, any one biomass gasifier. **[7]**

b) What are the different types of wind mills? Give their merits and demerits. **[5]**

P.T.O.

Q4) a) i) Explain the different sources of hydrogen. **[4]**

ii) Calculate the array output of PV array for the system output of 454 watts, if battery charging efficiency, self discharge and variability factors are 0.9, 0.9 and 0.95 respectively. **[3]**

b) What is digester? Give the important factors used in designing of digester. **[5]**

Q5) a) Explain the different types of selective coatings along with the materials use fot it. **[7]**

b) Waht are the advantages and disadvantages of solar concentrators? **[5]**

Q6) a) Explain with neat diagram, domastic hot water system. **[6]**

b) Explain the block diagram of SPV conversion system. Give its applications. **[6]**

Q7) **Write a short note on <u>any three</u> of the following:**

a) Methods of conversion of biomass as energy. **[4]**

b) Solar Pond. **[4]**

c) Flat plate collector. **[4]**

d) Storage of hydrogen. **[4]**

Total No. of Questions : 7]

SEAT No. : ____

PC-3753

[Total No. of Pages : 2

[6335]-417
M.Sc.
PHYSICS
PHOT-244I4: Electronic Instrumentation - II
(2020 CBCS pattern) (Semester - IV) (4 Credits) (Group - II)

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Solve any five questions from Q. 2 to Q. 7.***
3) ***Q. 2 to Q. 7 carry equal marks.***
4) ***Figures to the right side indicates full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) **Solve any five of the following:**

a) Write the function of clc command in matlab. **[2]**

b) List the composite controller mode. **[2]**

c) Write purpose of command window & command history window in mat lab. **[2]**

d) Why derivative controller mode is never use alone? **[2]**

e) Define neutral zone for controller. Highlight its significance of a controller. **[2]**

f) Define scan time of PLC. Mention factor of fecting scan time. **[2]**

Q2) a) Explain in detail the colon (:) operator used in matlab. Give at least two distinct use of this operator. Give use of semicolon (;), percentage (%) symbol in matlab. Give list of predefine variable in matlab. **[7]**

b) Design a propotional integral controller with a proporational band of 30% and an integration gain of 0.1% (% -5). The 4 to 2 mA input converts to a 0.4 to 2v signal and output is to be 0-10v. calculate values of Gp, G_1, Rz, R1 and C respectively. **[5]**

P.T.O.

Q3) a) Draw circuit diagram using operational amplifiers for a two position controller. Explain how it works. Give one application of two position controller along with an advantage and limitation of this type of controller. **[7]**

b) With neat circuit diagram explain PID controller mode. Derive output voltage equation. **[5]**

Q4) a) Draw a ladder diagram for elevators system the global objective is to take a load in upward direction if start or up switch pressed. down ward motion is to be initiated by pressing down switch provided up motion of platform is not in progess, vice versa for up motion. **[7]**

b) What is script file in matlab? Write rule for defining scaler variable in matlab. **[5]**

Q5) a) What is process control loop? Explain control system evaluation criteria in detail. **[7]**

b) Explain process characteristics with special reference to process equation with suitable example draw necessary diagram. **[5]**

Q6) a) Draw block diagram for a PLC. Explain its operation in details with special reference to input module and out put module and applications. **[7]**

b) Level measurement in sump tank is provided by transducer scaled as 0.2 v/m. A pump is to be turned on by application of +5v when the sump level exceeds 2.0m. The pump is to be turned back off when the sump level drop to 1.5m. Develop two position controller. **[5]**

Q7) **Write a short note on any two of the following.**

a) Characteristics of system. **[6]**

b) Second order sensor time response. **[6]**

c) Control system objective. **[6]**

Total No. of Questions : 7]

SEAT No. : ____

PC3754

[Total No. of Pages : 2

[6335]-421
S.Y.M.Sc.
PHYSICS
PHOT - 244M4 : Materials Science - II
(2020 Pattern) (CBCS) (Semester - IV) (4 - Credits)

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

Instructions to the candidates:

1) ***Q.1 compulsory.***
2) ***Attempt any five questions from Q.2 to Q.7.***
3) ***Q.2 to Q.7 carry equal marks.***
4) ***Use of log-table or non-programmable calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any five of the following: **[10]**

a) Draw basic structure for p-n junction.

b) Give an example AX-type and AmXp type compounds.

c) Classify Dielectric materials.

d) What are hard and soft magnets.

e) Give chemical formula for Illite

f) What are pyroelectric materials.

Q2) a) Derive the relation for built-in potential in p-n junction. **[7]**

b) With a well labelled diagram discuss the subclasses of silicates (Any 3) **[5]**

Q3) a) With a labelled diagram explain the structure of yttrium barium cuprate. **[7]**

b) Explain in detail direct and super exchange interactions. **[5]**

P.T.O.

Q4) a) Determine the thermal equilibrium electron and hole concentration in silicon at T = 300k for given doping concentration. **[7]**

i) $N_d = 10^{16}/cm^3$, $N_a = 0$

ii) $N_d = 5\times10^{15}/cm^3$, $N_a = 2\times10^{15}/cm^3$

Given : $n_i = 1.5\times10^{10}/cm^3$ in silicon at T = 300k

b) Discuss in detail compensated semiconductors. **[5]**

Q5) a) With a well labelled diagram explain why quasi-crystals have golden proportion. **[6]**

b) Discuss in detail Ax-type and multiple compounds in ceramic crystals. **[6]**

Q6) a) A ferrospinal has a lattice of 32 oxygen ions, 16 ferric ions and 8 divalent ions. The unit cell contains 8 times as many oxygen ions as MgO does, so that the repeating pattern can be developed. If the divalent ions are Zn^{2+} and Ni^{2+} in a 3:5 ratio, What weight fraction of ZnO, NiO and Fe_2O_3 must be mixed for processing. **[6]**

b) Draw crystal structure of YBCO. yttrium Barium cuprate High T_c super conductor and explain its application. **[6]**

Q7) Write a short note on any three **[12]**

a) Tunnel diode

b) Quasi-crystals

c) Ferroelectric materials

d) Hysteresis loop caused by domain action

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Total No. of Questions : 4]

SEAT No. : ____

PC3755

[Total No. of Pages : 2

[6335]-424
S.Y. M.Sc.
PHYSICS
PHOT - 244H2 : Energy Studies - II
(2020 Pattern) (CBCS) (Semester - IV) (2 Credits)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Answer/solve any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Attempt any four of the following:

i) What is non-selective coating? **[2]**

ii) What is anaerobic bioconversion? **[2]**

iii) Define Evacuated tube collector. **[2]**

iv) What is meant by solar photovoltaics? **[2]**

v) Define solar concentrator. **[2]**

b) What are the application of biogas. **[3]**

Q2) a) i) What is solar cell? Describe the basic working principle of the solar cell. **[4]**

ii) Discuss the generation process of the biogas. **[3]**

b) Explain with neat diagram, the working of box type solar cooker. **[5]**

P.T.O.

Q3) a) Explain with neat diagram, the working principle of liquid flat plate collector. **[6]**

b) State the different types of wind mills. Explain any one of them with a suitable diagram. **[6]**

Q4) Write a short note on any three of the following:

a) Solar still. **[4]**

b) Importance of hydrogen as a future fuel. **[4]**

c) Types of solar cells. **[4]**

d) Biogas gasification. **[4]**

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Total No. of Questions : 4]

SEAT No. : ____

PC3756

[Total No. of Pages : 2

[6335]-425
S.Y. M.Sc.
PHYSICS
PHOT - 244I2 : Electronics Instrumentation - II
(2020 Pattern) (Semester - IV) (2 Credits)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Q.1 compulsory.***
2) ***Attempt/solve any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any four of the following.

a) i) Define proportional band. Write equation for proportional band. **[2]**

ii) What is tunning in case of process control? List tunning criteria. **[2]**

iii) What is Servomechanism? **[2]**

iv) Define ladder diagram. Draw circuit symbol for NC & NO type of Temperature limit & level limit swithes **[2]**

v) What is process control loop? List control system objective. **[2]**

b) Level measurement in a sump tank is provided by a transducer scaled as 0.2V/m.A pump is to be turned on by application of +5V when the sump level exceeds 2.0 m. The pump is to be turned back off when the sump level drops to 1.5 m. Develop a two position controller. **[3]**

Q2) a) The elevator employs a platform to move objects up and down. The global objective is that when the up button is pushed, The platform carries something to up position and when the Down button is pushed, the platform carries something to the down position.

The following hardware specifications.

P.T.O.

output elements:
M1 = Motor to drive the platform up
M2 = Motor to drive the platform down

Input elements:
LS1 = NC limit switch to indicate UP position.
LS2 = NC limit switch to indicate DOWN position
START = NO push button for START
STOP = NO push button for UP command
DOWN = NO push button for DOWN command
Prepare a ladder diagram to implement this control function. **[7]**

b) State process control principle. Explain Human aided control and automatic control. **[5]**

Q3) a) Explain an Op-amp proportional mode and integral mode controller with the help of neat circuit diagram. **[7]**

b) An integral control system will have a measurement range of 0.4 to 2.0V and an output range of 0 to 6.8V. Design an Op amp integral controller to implement a gain of $K_I = 4\% / (\div - \text{min})$ specify the values of G_I, R and C. **[5]**

Q4) Write a short note on any two of the following:

a) Programmable logic controller. **[6]**

b) Proportional-Derivative (PD) mode controller. **[6]**

c) Two position controller. **[6]**

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Total No. of Questions : 4]

SEAT No. : ____

PC3757

[Total No. of Pages : 2

[6335]-426
S.Y.M.Sc.
PHYSICS
PHOT - 244J2 : Biomedical Instrumentation - II
(2020 Pattern) (CBCS) (Semester - IV) (2 Credits)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Attempt/Solve any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any four of the following.

a) i) What are the basic functions of nervous system? **[2]**

ii) What is electroencephalogram? What is its typical amplitude? **[2]**

iii) Define frequency. State frequency range for infrasound, audible sound and ultrasound. **[2]**

iv) Define the term hypercapnea and hypoxia. **[2]**

v) State different respiratory therapy equipments. **[2]**

b) If the frequency of ultrasound in medium is 2.5 kHz and propagation volocity is 343 m/s, then calculate the wavelength of ultrasound. **[3]**

Q2) a) What are the biomedical computer application, explain in detail. **[7]**

b) Explain the generation and detection of ultrasound. **[5]**

P.T.O.

Q3) a) Explain basic pulse echo apparatus with block diagram. **[7]**

a) Explain the structure of neuron and its types. **[5]**

Q4) Write a short note on any two of the following:

a) Types of memories in computer hardware. **[6]**

b) Role of microprocessor in Biomedical Instrumentation. **[6]**

c) Procedure to perform EMG. **[6]**

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Total No. of Questions : 4]

SEAT No. : ____

PC3758

[Total No. of Pages : 2

[6335]-429
S.Y. M.Sc.
PHYSICS
PHOT - 244 - M2 : Material Science - II
(2020 Pattern) (CBCS) (Semester - IV) (2 Credits)

Time : 2 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

1) ***Q.1, is compulsory.***
2) ***Attempt/solve any two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Solve any four of the following. **[4×2=8]**

i) State Richard's and Trouton's rule.

ii) State first law of Thermodynamics.

iii) Derive maxwell's Third thermodynamic relation.

iv) State Rault's law.

v) Explain change in entropy.

b) What are the degree of freedom of system of three components when the number of phase is two. **[3]**

Q2) a) i) What do you mean by Type I, II and III phase diagram? **[4]**

ii) Explain Gibb's phase rule. **[3]**

b) State and explain lever rule with the help of suitable diagram. **[5]**

P.T.O.

Q3) a) Explain with help of free-energy diagram. The thermodynamic origin of equilibrium lens shape phase diagram. **[7]**

a) Consider two solids A and B which are unmixed in state - I and mixed in state 2. Calculate in entropy when the solution is ideally mixed. **[5]**

Q4) Write a short note on any three of the following: **[3×4=12]**

a) Miscibility gap.

b) Binary phase diagram.

c) Regular solution (Henry's law).

d) Limited mutual solid solubility.

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