Total No. of Questions : 7]

SEAT No. :

P276

[Total No. of Pages : 3

[5829]-1001
M.Sc.
PHYSICS
PHCT - 111 : Mathematical Methods in Physics
(2020 Pattern) (CBCS) (Semseter - 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 logarithmic table or non-programmable electronic calculator is allowed.*
6) *Neat diagrams must be drawn wherever necessary.*

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

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

b) Determine whether or not the following form a basis for the vector space R^3: **[2]**

$\{(1, 2, 3), (1, 0, -1), (3, -1, 0), (2, 1, -2)\}$

c) Prove that : **[2]**

$H_{n+1}(x) = 2x\, H_n(x) - 2n\, H_{n-1}(x)$

d) Prove that the Laplace transform operator L is linear. **[2]**

e) Evaluate $\oint_c \frac{\cos z}{(z-\pi)}$ where C is the circle $|z-1|=3$. **[2]**

f) State and prove Parseval's identity. **[2]**

P.T.O.

Q2) a) i) State Residue theorem. Explain how the Cauchy's theorem and integral formulas are special cases of residue theorem. **[4]**

ii) Let $V = R^3$. Determine whether or not W is a subspace of V. **[3]**

Given : $W = \{(a, b, c): a^2 + b^2 + c^2 \le 1\}$.

b) State and Prove the orthogonality property of Hermite functions. **[5]**

Q3) a) i) Determine the first three Laguerre polynomials $L_0(x)$, $L_1(x)$ and $L_2(x)$. **[4]**

ii) Determine the residue of

$$\frac{z^2}{(z-2)(z^2+1)} \text{ at } z = i.$$ **[3]**

b) Let $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ and let T be the linear operator on R^2 defined by $T(V) = AV$ (where V is written as a column vector). Find the matrix of T for the basis $\{f_1 = (1, 3), f_2 = (2, 5)\}$ **[5]**

Q4) a) i) Find $L^{-1}\left\{\frac{5s^2 - 15s + 7}{(s+1)(s-2)^3}\right\}$. **[4]**

ii) Find the Fourier coefficients a_n and b_n in the interval $(-L, +L)$ for odd function. **[3]**

b) Define basis and dimension of a vector space. Explain with one example. **[5]**

Q5) a) Consider the following basis of Euclidean space R^3 : **[7]**

$\{v_1 = (1, 1, 1), v_2 = (0, 1, 1), v_3 = (0, 0, 1)\}$

by using Gram-Smidt orthogonalization process transform $\{v_i\}$ into an orthonormal basis $\{u_i\}$.

b) Evaluate $\oint_C \frac{e^z}{z(z+1)} dz$ where C is the circle $|z-1| = 3$. **[5]**

Q6) a) Prove that if $L\{f(t)\} = F(s)$ then $L\{f(at)\} = \left(\frac{1}{a}\right)F\left(\frac{s}{a}\right)$. **[7]**

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

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

Q7) Attempt any three questions from the following : **[12]**

a) Determine the region in the z plane represented by $1 < |z + 2i| \leq 2$. **[4]**

b) Obtain the Associated Legendre function $P_2^3(x)$. **[4]**

c) Determine the first three Hermite polynomials $H_0(x)$, $H_1(x)$, and $H_2(x)$. **[4]**

d) Find $L^{-1}\left\{\frac{3s+1}{(s-1)(s^2+1)}\right\}$ **[4]**

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Total No. of Questions : 7]

SEAT No. :

P277

[Total No. of Pages : 2

[5829]-1002
M.Sc.
PHYSICS
PHCT - 112 : Classical Mechanics
(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 tables or 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 second law. **[2]**

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

c) Write the type of constraints for pendulum with variable length. **[2]**

d) Define poisson Bracket. **[2]**

e) What do you mean by Geostationary orbit. **[2]**

f) Find the relation between angular momentum vector, the inertia tensor and the angular velocity vector. **[2]**

Q2) a) Define Euler's angles and obtain an expression for complete transformation matrix. **[7]**

b) Write Hamiltonian and obtain equation of motion for linear harmonic oscillator. **[5]**

Q3) a) Show that poisson bracket is invarient under canonical transformation. **[7]**

b) Obtain the Lagrangian and equation of motion for simple pendulum. **[5]**

Q4) a) Show that the transformation **[7]**

$Q=\sqrt{29}\,e^{q}\cos p, P=\sqrt{29}\,e^{-q}\sin p$ is canonical

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

Q5) a) Discuss two body problem reduced into a one body problem. Hence, explain the concept of reduced mass. **[6]**

b) Write a note on Inertia tensor. **[6]**

Q6) a) Show that the path followed by a particle in sliding from one point to another in the absence of friction in the shortest time is a cycloid. **[6]**

b) Describe the Hamiltonian and Hamilton's equation of motion for changed particle in an electromagnetic field. **[6]**

Q7) Solve any Three of the following :

a) Find the horizontal component of coriolis force acting on a body of mass 1.5 Kg moving north word with a horizontal velocity of 100 m/sec, at 30°N lattitude on earth. **[4]**

b) Prove the Euler's equations using Newtonian method. **[4]**

c) State the condition for stability and closure of the orbit. **[4]**

d) In case of poisson Bracket **[4]**

Solve i) $[L_x, L_y]$

ii) $[L_z, P_x]$

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Total No. of Questions : 7]

SEAT No. :

P278

[Total No. of Pages : 2

[5829]-1003
M.Sc. (Physics)
PHCT - 113 : ELECTRONICS
(2020 CBCS Pattern) (Semseter - 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 logarithmic table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

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

a) What is meant by monostable multivibrator?

b) State any two parameters of an ADC.

c) What is meant by asynchronous counter?

d) Give the gray code of binary number 11011010.

e) What is meant by duty cycle?

f) Draw the schematic symbol of TRIAC.

Q2) a) i) What is SCR? Explain its construction. Give its schematic symbol. **[4]**

ii) Reduce the following boolean expression using K-map **[3]**

$$Y = \bar{A}\bar{B}\bar{C}D + AB\bar{C}D + \bar{A}B\bar{C}D + A\bar{B}\bar{C}D$$

b) Explain with neat circuit diagram, the working of Astable multicibrator using OPAMP. Give the formula for its period. **[5]**

P.T.O.

Q3) a) i) Explain with neat circuit diagram the working of 4 bit serial counter. **[4]**

ii) Draw the block diagram of VCO, IC 566. **[3]**

b) Explain with neat circuit diagram, the working of Instrumentation Amplifier using 3 OPAMPS. **[5]**

Q4) a) Draw the internal block diagram of IC7495. Explain the use of this IC7495 as SISO register. Give its timing diagram. **[7]**

b) Explain with neat circuit diagram, the use of IC 555 as FSK generator. **[5]**

Q5) a) Explain with neat circuit diagram, the working of 4-bit R-2R type DAC. Derive the formula for its output voltage. **[6]**

b) Draw the block diagrm of PLLIC 565. Determine the output frequency fo, lock range Δf_L and capture range Δf_C, if $R_1 = 15\ k\Omega$, $C_1 = 0.01\mu f$, $C = 1\mu f$ and the supply voltage is + 12V. **[6]**

Q6) a) What is meant by UP-DOWN counter? Explain with neat diagram, the working of 3 bit UP-DOWN counter. **[6]**

b) What is ADC? Explain with neat circuit diagram the working 3 bit flash (simultaneous) type ADC. **[6]**

Q7) Write short notes on <u>any three</u> of the following :

a) DC-DC converter. **[4]**

b) IC 7490 as decade counter. **[4]**

c) OPAMP as half wave precision rectifier. **[4]**

d) PLLIC 565 as frequency multiplier. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P279

[Total No. of Pages : 2

[5829]-2001
M.Sc. (Physics)
PHCT - 121 : ELECTRODYNAMICS
(CBCS) (2020 Pattern) (Semseter - 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 indicate full marks.***
5) ***Use of logarithmic table or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any five of the following :

a) State poynting theorem. **[2]**

b) Write Maxwells equations in free space. **[2]**

c) Write the field component for invarience of Maxwell's equations under Lorentz Transformation. **[2]**

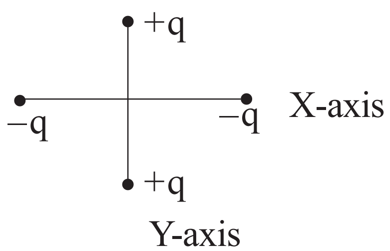
d) Write the boundary conditions at the interface between two media for $\vec{E}, \vec{D}, \vec{B}, \vec{H}$. **[2]**

e) Write down the coulomb and Lorentz gauge condition. **[2]**

f) What is meant by skin depth? **[2]**

Q2) a) i) Explain the term gauge Transformation. **[4]**

ii) Four charges are arranged as shown in fig. **[3]**



Calculate monopole moment, dipole moment and quadrapole moment of system.

P.T.O.

b) Write Maxwell's equation in conducting medium and 'Free space - static field' condition. **[5]**

Q3) a) Derive an expression for potential at distant point using multipole expansion for localized charge distribution in free space. **[7]**

b) Show that the differential version of poynting theorem is given by **[5]**

$$\frac{\partial}{\partial t}\left(\bigcup_{\text{mech}}+\bigcup_{\text{em}}\right)=-\nabla\cdot \text{S}$$

Q4) a) A plane e.m. wave is incident obliquely on an interface between the two non-conducting dielectric medium. Obtain the Fresnel's equation and snels Law. **[7]**

b) Describe michelson - morley experiment with a neat diagram.Give significance of negative result. **[5]**

Q5) a) Derive in homogeneous wave equation in terms of scaler potential ϕ and vector potential A. **[7]**

b) Obtain an expression for Lorentz force on charged particle. **[5]**

Q6) a) Obtain expressions for skin depth in good conductor and poor conductor. **[6]**

b) Write the boundary conditions at the interface of a dielectric and explain them. **[6]**

Q7) Solve any three of the following :

a) Show that $(\in^2 - C^2B^2)$ is invarient under Lorentz transformation. **[4]**

b) In a certain region of space through which an EM wave propagating the poynting vector is given by $\vec{\text{S}}=\vec{\text{Z}}0.16\cos^2(\text{kz}-\text{wt})\text{w}/\text{m}^2$. Find the total time average power carried by EM wave through 100 cm^2 of area on the plane $y + 2x = 5$. **[4]**

c) Write short note on poyntings vector. **[4]**

d) Derive the electromagnetic wave equation in free space. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P280

[Total No. of Pages :3

[5829] - 2002
M.Sc.
PHYSICS
PHCT - 122 : Atoms and Molecules
(2020 Pattern) (CBCS) (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 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) Explain the significance of principle quantum number and orbital quantum number. **[2]**

b) Obtain the ground state for Cr^{2+}–($3d^4$) as per the Hunds rule. **[2]**

c) Find S, L and J values corresponds to the spectroscopic term symbol - $3P_2$. **[2]**

d) What is rotational quantum number? Explain the selection rule for rigid diatomic rotator. **[2]**

e) What is Raman effect? Hence explain the meaning of stokes and antistokes line. **[2]**

f) An NMR signal for a compound is found to be 180 Hz - downward from TMS peak using a spectrometer operating at 60 MHz. Calculate its chemical shift in ppm. **[2]**

Q2) a) State and explain the difference between normal and anomalous Zeeman effect. Draw the normal Zeeman splitting using energy level diagram for $l = 1$ and $l = 2$ without and with magnetic fields (l - orbital quantum number). **[7]**

b) Obtain the spectroscopic term symbols and draw the energy level diagram for SP coupling scheme for two electron spectroscopy. **[5]**

Q3) a) What is Paschen - Back effect. Prove that the frequency shift for strong field is given by **[7]**

$$\Delta\nu = \frac{lH}{4\pi m}\Delta(m_l + 2m_s)$$

b) What is Bremsstrahlung in continuous X ray production. How characteristic X rays are produced. **[5]**

Q4) a) State and Explain Franck-Condon principle. Draw the probability distribution for diatomic molecule. Also explain and draw the operation of Franck-Condon principle for upper and lower states with the variation in internuclear distance. **[7]**

b) Consider the equation of wave number as given below.

$\overline{\nu}_{\text{spect.}} = \overline{\nu}_{(v',v'')} + B'J'(J'+1) - B''(J''+1)\,cm^{-1}$; where B', B'', J' and J'' refers to the rotational constant and rotational quantum number for upper and lower electronic state. Using the condition of Δ J, J' and J'' for P, R and branch. Obtain the relation for change in total energy $\Delta\in$. **[5]**

Q5) a) Explain the principle, construction and working of Infrared spectrometer with the help of neat diagram. **[7]**

b) The exciting line in of incident radiation is 5460 A°. The stokes lines is obtained at 5520 A°. Find the wavelength of anti - stokes line. **[5]**

Q6) a) What is Nuclear Magnetic Resonance (NMR)? Draw the block diagram of NMR spectrometer and explain the function of each block/component. **[7]**

b) A free electron is placed in a magnetic field strength of 1.3T. Calculate the resonance frequency if g = 2.0023. If the resonance frequency is increased by 10%. How much will be the required magnetic field. **[5]**

$(\mu_B = 9.274 \times 10^{-24}\ JT^{-1})$

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

a) Draw the principle series in case of Sodium. Hence explain the Sodium Doublet. **[4]**

b) Explain the electronic angular momentum in diatomic molecules. **[4]**

c) Explain the types of molecular energies associated with Born. Oppenheimer approximation with their significance. **[4]**

d) Explain the resonance condition in NMR spectroscopy. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P281

[Total No. of Pages :3

[5829] - 2003
M.Sc.
PHYSICS
PHCT- 123 : Quantum Mechanics
(2020 Pattern) (CBCS) (Semester - II) (4 Credits)

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

Instructions to the candidates :

1) ***Q.1 is compulsory.***
2) ***Attempt 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 - tables or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

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

a) Define eigen functions and eigen values with one example. **[2]**

b) Explain unitary operator. **[2]**

c) What is meant by Harmonic Perturbation. **[2]**

d) Show that momentum operator $\hat{p}_x$ is Hermitian. **[2]**

e) For Pauli matrices, prove that **[2]**

i) $[\sigma_x, \sigma_y] = 2i\sigma_z$

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

f) The Harmonic oscillator is perturbed by $H' = \lambda x^3$. Obtain first order perturbation energy in the ground state. **[2]**

Q2) a) i) State and explain the four fundamental postulates of quantum mechanics. **[4]**

ii) Find the energy levels and eigen functions of Hamiltonian.

$$H = \begin{bmatrix} 1+\varepsilon & \varepsilon \\ \varepsilon & 1+\varepsilon \end{bmatrix}$$

where $\varepsilon << 1$, corrected up to first order in ε using perturbation theory. **[3]**

b) Using operator method obtain energy eigen values of one dimensional harmonic oscillator. **[5]**

Q3) a) i) Define projection operator, show that the sum of all the projection operators leaves any state $|\Psi\rangle$ unchanged. **[4]**

ii) Obtain eigen values and eigen function for L_Z operator. **[3]**

b) Obtain matrix of Clebsh - Gorder coefficients for a system having $j_1 = \frac{1}{2}$ and $j_2 = \frac{1}{2}$ **[5]**

Q4) a) Develop the time dependent perturbation theory to obtain first order correction to transition amplitude $a_n^{(1)}(t)$. **[7]**

b) Show that the variation principle gives upper bound to the ground state energy Eo. **[5]**

Q5) a) Let F be a linear operator such that $F|\Psi\rangle = |\chi\rangle$, where $|\Psi\rangle$ and $|\chi\rangle$ are arbitrary vectors. Represent F as a matrix element in A representation. **[6]**

b) Show that eigen values of self adjoint operators are real. **[6]**

Q6) a) Obtain eigen functions and eigen values of particle in one - dimensional infinite well. **[6]**

b) If U is unitary operator and if $\langle\Psi|\Psi\rangle = 1$ then show that $\langle \cup\Psi | \cup | \Psi\rangle = 1$. **[6]**

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

a) Fermi Golden rule. **[4]**

b) Explain Hilbert space. **[4]**

c) Conditions of validity of WKB approximation. **[4]**

d) Concept of wave packet. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P282

[Total No. of Pages : 3

[5829] - 3001

M.Sc. (Physics)

PHCT- 231 : STATISTICAL MECHANICS

(2020 Pattern) (CBCS) (Semester - III) (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) Explain the concept of phase space. **[2]**

b) State and explain the postulate of equal-a- priori probability. **[2]**

c) Explain thermal interaction between systems. **[2]**

d) State the law of equipartition of energy. **[2]**

e) What are bosons? **[2]**

f) A system of 3 particular has energy levels with energies 0, 1, 2, 3 units. The total energy of the system is 3 units. List the accessible microstater if the particles are distinguishable. **[2]**

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

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

P.T.O.

b) State the partition function for F. D. statistics and obtain the Fermi- Dirac distribution in the form **[5]**

$$\overline{n}_s = \frac{1}{e^{\beta(\epsilon_s - \mu)} + 1}$$

Where μ is the chemical potential.

Q3) a) State and prove Liouville's theorem. **[7]**

b) Show that the entropy in canonical ensemble can be represented as **[5]**

$$S = -K \sum_r P_r \, hr \, P_r$$

Q4) a) Show that for temperature smaller than the Debye temperature ($T << \theta_D$) the specific heat of solid is given by **[7]**

$$C_v = \frac{12}{5} \pi^4 NK \left(\frac{T}{\theta_D} \right)^2$$

b) Show that the fluctuation in the number of particles in the system in grand canonical ensemble is given by **[5]**

$$\overline{N}^2 - \overline{N}^2 = KT \left(\frac{\partial \overline{N}}{\partial \mu} \right)_{V.T}$$

Q5) a) Show that the Fermi energy of fermions is **[7]**

$$E_F = \frac{h^2}{2m} \left(\frac{3\pi^2 N}{V} \right)^{2/3}$$

b) A system has 10^{10} distinguishable particles. Each particle has two non-degenerate states with level separation of 0.1 eV. Find the average number of particles in each state when the system is in thermal equilibrium with a heat reservoir at temperature 600 K. **[5]**

Q6) a) Show that the relation $PV = \frac{2}{3}E$ is satisfied by a gas of free monatomic particles in quantum statistics (BE and FD statistics) **[7]**

b) Show that the single particle partition function for quantum mechanical oscillator is given by **[5]**

$$Z = \left[2\sinh\left(\frac{hw}{KT}\right)\right]^{-1}$$

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

a) Write a short note on white Dwarf. **[4]**

b) A particle of unit mass is executing simple hormonic vibrations. Determine its trajectory in phase space. **[4]**

c) "The lowest energy of a gas obeying F-D statistics is much higher than that it would have been if the particles had obeyed B - E statistics". Explain. **[4]**

d) What are classical limits? Explain how quantum distribution reduced to classical Maxwell - Boltz mann distribution. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P283

[Total No. of Pages : 3

[5829] - 3002
M.Sc. (PHYSICS)
PHCT - 232 : Solid State Physics
(2020 Pattern) (Semester - III) (4 Credites) (CBCS)

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

Instructions to the candidates :

1) *Q.1 is compulsory.*
2) *Attempt any five questions from the remaining.*
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 where necessary.*

Given:

Planck's constant = 6.626×10^{-34} J-s

Mass of electron = 9.1×10^{-31} Kg

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

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

Permeability of free space = $4\pi \times 10^{-7}$ Henry/m

Charge of electron = 1.6×10^{-19} C

Permittivity of free space = 8.85×10^{-12} $C^2/N\text{-}m^2$

Bohr magneton = 9.27×10^{-24} Am^2

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

a) Describes the assumptions of BCS theory of super conductivity?

b) What do you mean by 'hole'?

c) What do you mean by 'Anisotropy Energy' with reference to magnetization?

d) What do you understand by a crystal lattice and unit cell?

e) What do you understand Diamond structure?

f) A magnetic material has a magnetization of 3300 A/m and flux density of 0.0044 Wb/m^2. Calculate the magnetizing force.

P.T.O.

Q2) a) Explain Antiferromagnetism with reference to the neel temperature and susceptibility. Hence describe ferrimagnetism. **[7]**

b) Describe the origin of band - gap using nearly free electron model. **[5]**

Q3) a) i) Give an account of Weiss theory of ferromagnetism. Hence obtain curie- weiss law. **[4]**

ii) Calculate the critical current which can flow through a long thin super conducting wire of A1 of diameter 10^{-3}m. The critical magnetic field fer A1 is 7.9×10^3 A/m. **[3]**

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

Q4) a) Explain qualitatively the Kronig - penny model in brief. Plot the functions for $P = 6\pi$ and interpret. **[7]**

b) Distinguish between metal, semiconductors and insulators on the basis of band theory of solid. **[5]**

Q5) a) Explain the concept of reduced, extended and periodic zone schemes used for the representation of energy band with neat diagrams. **[7]**

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

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

ii) Atomic weight at nickel = 58.7

Q6) a) Distinguish between ferromagnetism ferrimagnetism and antiferromagnetism. **[7]**

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

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

a) Bloch Theorem. **[4]**

b) Type I and Type II super conductors. **[4]**

c) Cyclotron resonance. **[4]**

d) Langerin Theory of paramagnetism. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P284

[Total No. of Pages : 3

[5829]-3003

S.Y. M.Sc. (Semester - III)

PHYSICS

PHCT - 233 : Experimental Techniques in Physics - I

(2020 Pattern (CBCS)) (4 Credits)

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) ***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 wherever necessary.***

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

a) Define the terms : Signal and Measurement. **[2]**

b) Give the sources of uncertainty and experimental error. **[2]**

c) What are systematic and random errors? **[2]**

d) State important applications of vacuum. **[2]**

e) Comment on impingement rate of molecules on a surface. **[2]**

f) Describe the terms : average velocity and mean free path of gas molecules. **[2]**

Q2) a) With the help of a neat diagram, explain the principle, construction and working of a Rotary pump. **[7]**

OR

a) i) Explain signal analysis in context with time and frequency domain. **[4]**

ii) Describe in detail about signal to noise ratio. **[3]**

b) Discuss any one electric sensor in detail. **[5]**

P.T.O.

Q3) a) With the help of a neat diagram, explain the principle, construction and working of Mc Leod gauge. **[7]**

OR

a) i) Explain vacuum system design in detail with a schematic diagram. **[4]**

ii) How much time it would require for a vacuum with speed 30 m^3/hr and chamber capacity of 60 m^3 to reduce the pressure from 1000 Mbar to 500 Mbar **[3]**

b) Derive the relation for the effective pumping speed of the vacuum pump. **[5]**

Q4) a) With the help of a neat diagram, explain the principle construction and working of a Molecular drag pump. **[7]**

OR

a) i) How is elementary data fitting achieved? **[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) Discuss any one thermal sensor in detail. **[5]**

Q5) a) With the help of a neat diagram, explain the principle construction and working of an Oil diffusion pump. **[7]**

b) Derive the relation of the down time of the vacuum pump. **[5]**

OR

a) Explain the principle, construction and working of a Cryogenic getter ion pump with a neat diagram. **[6]**

b) Discuss the basic principle, construction and working of a Refrigeration system. **[6]**

Q6) a) With the help of a neat diagram, explain the principle, construction and working of a Pirani gauge. **[7]**

b) Write a short note on Titanium sublimation pump. **[5]**

OR

a) Describe throttling process and prove that entropy remains constant in this process. **[6]**

b) Write a short note on Penning gauge. **[6]**

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

a) Reliability-Chi square test. **[4]**

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

c) Gas conductance and gas impedance of a vacuum line. **[4]**

d) Classification of sensors. **[4]**

OR

a) Flow of gas in viscous flow regime. **[6]**

b) Sputter ion pump. **[6]**

c) Bayard-Alpart gauge. **[6]**

Total No. of Questions : 7]

SEAT No. :

P285

[Total No. of Pages : 3

[5829]-3004

M.Sc. (Semester - III)

PHYSICS

PHOT-234 G4 : Acoustics - I

(2020 Pattern) (CBCS) (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) Define specific acoustic impedence with its unit. **[2]**

b) Find Sound Power Level in an enclosure which emits 10W of acoustic power [$W_0 = 10^{-12}$ W]. **[2]**

c) Write formula and unit for energy density and Effective Pressure. **[2]**

d) What do you mean by live and dead rooms? **[2]**

e) Define Acoustic resistance with its formula and unit. **[2]**

f) What do you mean by Standing Wave Ratio? [SWR]. **[2]**

Q2) a) i) Discuss the term velocity of sound in fluids. **[4]**

ii) The decrease in Intensity Level of a plane wave from Medium A to Medium B is 29.5dB. Determine corresponding sound power reflection coefficient. If the characteristic impedence of Medium A is 415 rayl, determine $\rho_2 c_2$ of Medium B. **[3]**

b) Discuss types of room modes in details. **[5]**

P.T.O.

Q3) a) i) Derive the expression for Acoustic plane wave equation. **[4]**

ii) Determine the acoustic intensity level at a distance of 10 m from a source that radiates 1W of power assuming spherical propagation of sound in case of following reference intensity. **[3]**

1) 10^{12} W/m^2.

2) 10^{-12} W/m^2.

3) 10^{-13} W/m^2.

b) The resonator frequency of flanged Helmholtz resonator is 256 Hz. Determine its volume if length and radii are 0.006 m and 0.0155 m respectively. Also find effective stiffness constant, Quality factor and inertance [C = 343 m/s]. **[5]**

Q4) a) i) Define Phon and Sone. Derive relation between them. **[4]**

ii) Find reverberation time for an office which has volume of 1600 m^3 and total sound absorption of 80 metric Sabine. What is sound absorption required for an optimum reverberation time of 1.2 sec.? **[3]**

b) A rectangular room 10 ft high, 20 ft wide and 30 ft long has a reverberation time of 0.5 sec. The Walls are of plaster, wood and glass having an average absorption coefficient of 0.05. The floor is covered with a rug $(\alpha = 0.2)$, and the ceiling with an acoustical tile. Eleven people are present in the room, each equivalent to 4.4 Sabins. Calculate the absorption coefficient for the acoustic tile that covers ceiling. **[5]**

Q5) a) Derive the expression for growth of sound intensity in a live room. **[6]**

b) Derive the equation $T_{40} = \dfrac{2t}{\log_{10}\left(\dfrac{a_0}{a}\right)}$, on a 'level detector type' T_{40} measuring instrument, the upper and lower levels are 2.2V and 1.0 V respectively. The on-board clock frequency is 1KHz. Determine the number of counts that will be displayed when T_{40} = 660 milli seconds? What counts will be displayed in case the clock frequency is increased to 1.2 KHz. **[6]**

Q6) a) Derive the expression for sound power reflection coefficient in case of 'Transmission from one fluid medium to another' at normal incidence. Hence compare the limiting cases $\rho_2 c_2 / \rho_1 c_1 \to \infty$ and $\rho_2 c_2 / \rho_1 c_1 \to 0$. **[7]**

b) A small reverberation chamber is used to measure the effective sound absorption of particular material. The volume of chamber is 8 × 9 × 10 cubic ft. The observed Reverberation time reduces from 5 sec to 1 sec when 40 sqft of acoustic material is used to cover part of a wall of this chamber. Find effective sound absorption coefficient of material. **[5]**

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

a) Haas Effect. **[4]**

b) Helmholtz Resonator. **[4]**

c) Eyring, Millington and Sette approach. **[4]**

d) Hearing mechanism. **[4]**

Total No. of Questions : 7]

SEAT No. :

P286

[Total No. of Pages : 2

[5829]-3005

M.Sc. (Physics)

PHOT - 234H4 : ENERGY STUDIES - I

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

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 logtable or non-programable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn where necessary.***

Q1) Solve any five of the following.

a) What is conservation of Energy? **[2]**

b) What is Renewable energy? **[2]**

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

d) What is the use of Pyrheliometer? **[2]**

e) Define sensible heat storage. **[2]**

f) What are the Green house gases? **[2]**

Q2) a) What are different types of energy storage systems? Explain chemical energy storage system. **[7]**

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

Q3) 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]**

P.T.O.

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

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

Q5) a) Write the difference between terrestrial and extraterrestrial solar radiation. Explain sun as a fusion reactor. **[6]**

b) Explain the structure of sun with a neat diagram. Calculate the zenith angle for air mass 1.5. **[6]**

Q6) a) Explain Green House effect. Write its advantages and disadvantages. **[6]**

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

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

a) Energy security. **[4]**

b) Laws of thermodynamics **[4]**

c) Potential solutions to environmental problems. **[4]**

d) Conventional energy and non-conventional energy. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P287

[Total No. of Pages : 2

[5829]-3006

M.Sc. (Physics) (Semester-III)

PHOT 234I4 : ELECTRONIC INSTRUMENTATION - I

(2020 CBCS Pattern) (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 logtable or non-programable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) Solve any five of the following.

a) What do you understand by static characteristics? **[2]**

b) List different materials used to rediate different colour. **[2]**

c) Define the term accuracy and precision. **[2]**

d) List different types of transducer. **[2]**

e) State different types of thermo-couple. **[2]**

f) What is signal conditioner? **[2]**

Q2) a) With suitable block diagram, explain ultrasonic flow meter in detail. **[7]**

b) Explain unbounded strain gauge as displacement transducer with the help of suitable diagram. **[5]**

Q3) a) Explain static performance characteristics of measuring system. **[7]**

b) Discuss zero order system with suitable example. **[5]**

Q4) a) Explain data logger with necessary block diagram. **[7]**

b) What are main advantage of electrical Transducer. **[5]**

P.T.O.

Q5) a) Explain the principle and operation of ink-jet printers. **[7]**

b) Compare LCD and LED display for their advantage and limitation. **[5]**

Q6) a) Explain LVDT displacement sensor in details. How the direction of motion can be sensed from this sensor? **[7]**

b) Explain methods of corrections for interfering and modifying inputs. **[5]**

Q7) Write a short notes on <u>any three</u> of following.

a) Pitot tub **[4]**

b) Data Acquisition system **[4]**

c) Data logger **[4]**

d) Laser printer. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P288

[Total No. of Pages : 2

[5829]-3010
M.Sc. (Physics)
PHOT - 234M4 : MATERIAL SCIENCE - I (4 Credits)
(2020 Pattern) (Semester - II) (CBCS) (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 : (2 marks each) **[10]**

a) Write a short note on Mechanical properties of materials.

b) State Richard's and Trouton's rule.

c) Write a short note on Hume-RotheryRules.

d) Define Miscibility gaps in phase diagrams.

e) State Lever-Rule with an example.

f) What does mean by stacking faults?

Q2) a) Derive ficks first and second law : **[7]**

b) There are 0.19 a/o copper at the surface of some aluminium and 0.18 a/o copper, 1.2 mm underneath the surface. What will be the flux of copper atoms be from surface inwards at 500 °C (Aluminium is FCC and a = 0.4049 nm)

($D_0 = 0.15 \times 10^{-4}$ m^2/sec, $E = 0.210 \times 10^{-18}$ J, $K = 13.8 \times 10^{-24}$ J/K) **[5]**

Q3) a) Distinguish between the direction of dislocation, the burgers vector and direction of motion for edge and screw dislocations differentiating between +ve and –ve types. **[7]**

P.T.O.

b) Tabulate the various invariant reactions along with name of reaction, details of reaction and phase boundaries at the invariant lines eutectic, peritectic, Monotectic, eutectoid and sytactic reactions. **[5]**

Q4) a) Derive the equation for number of schottky defects in equilibrium at temperature T. **[7]**

b) Explain the thermodynamic origin of lens shaped phase diagrams along with curves. **[5]**

Q5) a) Define vegards law and give an explaination of strains in solid solutions. **[6]**

d) Write a short note on laws of thermodynamics and derive $dG = -SdT + VdP$. **[6]**

Q6) a) Write a short note on grain boundaries with high and law angles as well as tilt and twist boundaries. **[6]**

b) Prove ΔH^M is a parabolic function of composition given by **[6]**

$\Delta H^M = \Omega \; X_A \; X_B$.

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

a) Type - III phase diagram. **[6]**

b) Thermodynamic properties of solutions **[6]**

c) Distocation density and interaction between dislocations. **[6]**

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Total No. of Questions : 4]

SEAT No. :

P289

[Total No. of Pages : 2

[5829]-3013
M.Sc. (PHYSICS)
PHOT - 234H2 : Energy Studies - I
(2020 Pattern) (Semester - III) (CBCS) (Group - 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) Attempt any four of the following.

i) What is meant by Non-renewable energy source? Give its examples. **[2]**

ii) What is sensible heat storage? **[2]**

iii) State the 1^{st} and 2^{nd} law of thermodynamics. **[2]**

iv) What is meant by beam and diffused radiations? **[2]**

v) What is radiation heat transfer coefficient? **[2]**

b) Determine the declination of sun on 21^{st} June of 1980. **[3]**

Q2) a) i) Explain the solar radiations outside the Earth's atmosphere. **[4]**

ii) Define the terms Air mass, Zenith angle and hour angle. **[3]**

b) What are the different types of heat transfer? Explain them in brief. **[5]**

Q3) a) Explain with neat diagram, the construction and working of sunshine recorder. **[6]**

b) What the electrical and chemical energy storage systems? Explain them in brief. **[6]**

P.T.O.

Q4) Write short notes on <u>any three</u> of the following :

a) Fourier's law and Stefans Boltzman relation. **[4]**

b) Solar pond as energy storage. **[4]**

c) Importance of solar energy. **[4]**

d) Radiation on horizontal and titled surfaces. **[4]**

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Total No. of Questions : 4]

SEAT No. :

P290

[Total No. of Pages : 2

[5829]-3014
M.Sc.
PHYSICS
PHOT-234I2 : Electronic Instrumentation - I
(2020 Pattern) (CBCS) (2 Credits) (Semester - III) (Group-II)

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 diagram must be drawn wherever necessary.***

Q1) a) Solve any Four of the following.

i) State different type of thermocouple. **[2]**

ii) What is the signal conditioner? **[2]**

iii) Define the term : accuracy, precision. **[2]**

iv) List different types of Transducer. **[2]**

v) What is the rate of input scan of modern scanners of data logger? **[2]**

b) Draw block diagram of data acquisition system. **[3]**

Q2) a) On the basis of Functional element of instrument give valid interpretation For rudiementary pressure gauge and pressure thermometer. **[7]**

b) Derive an expression for gauge factor for bonded resistance wire strain gauge. **[5]**

Q3) a) Explain in details the use of microprocessor in improving Fuel efficiency of petrol engine. **[7]**

b) Define principle operation of thermocouple and explain types of thermocouple. **[5]**

P.T.O.

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

a) Piezoelectric Transducer. **[6]**

b) Zero order instrument. **[6]**

c) Data logger. **[6]**

Total No. of Questions : 4]

SEAT No. :

P291

[Total No. of Pages : 2

[5829]-3015

M.Sc. (PHYSICS)

PHOT234J2 : BIOMEDICAL INSTRUMENTATION - I

(2020 CBCS Pattern) (Semester - III) (2 Credit) (Group II)

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) Define leads. **[2]**

ii) Define active and passive transducer. **[2]**

iii) State any two types of leakage current. **[2]**

iv) Why right leg (RL) is used at ground potential? **[2]**

v) What is in-vitro and in-vivo measurement? **[2]**

b) The resistance of platinum wire at 0°C is 5.5Ω and at 1°C is 75Ω. Find the temperature of the wire. (Given α : 0.0039/°C) **[3]**

Q2) a) What are the different types of electrodes used for ECG recording, explain them. **[7]**

b) Discuss Basic recording system. **[5]**

Q3) a) What are bio-signals? Explain various sources of biosignals. **[7]**

b) State the difference between external and internal pacemaker. **[5]**

P.T.O.

Q4) Write short note on <u>any two</u> of the following :

a) ECG waveform showing amplitude and time interval of each wave & explanation of waveform. **[6]**

b) Physiological effects of electric current on human body. **[6]**

c) Objectives of instrumentation system. **[6]**

Total No. of Questions : 4]

SEAT No. :

P292

[Total No. of Pages : 2

[5829]-3017

M.Sc. PHYSICS

PHOT-234L2 : Microcontroller Based Instrumentation System - I

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

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-tables, Non-Programmable calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Solve any Four of the following.

i) What is an interrupt to a microcontroller 8051? What microcontroller does when it receives an interrupt signal. Name any two interrupts along with their vector locations. **[2]**

ii) What do you understand by 8 bit/16 bit microprocessor/controller. What is ROM & RAM size of AT89C51 microcontroller. **[2]**

iii) What is SFR? Name & explain any two SFR you know. **[2]**

iv) If processor clock frequency is 12 MHz. Calculate the time needed to execute MOV A, # O1H

MOV R2, # O2H

ADD A,R2 **[2]**

v) What are assembler directives? Explain use of any two directives you know. **[2]**

b) Write a program to toggle pin P 0.0 of port 0 indefinitely (in infinite loop) with some delay. **[3]**

P.T.O.

Q2) a) Explain features (facilities or functions it cando).

i) Available with port 0 & Port 3 of microcontroller 8051. **[4]**

ii) Write an assembly language program to add first 100 natural numbers. **[3]**

b) Explain the difference between a microprocessor & microcontrollers which one will you prefer in the following examples. **[5]**

i) For printer

ii) For computing complex programs

iii) For washing machine

Q3) a) Explain with one example & one advantage any three addressing methods used in 8051 programs. **[7]**

b) Write an assembly language program to find largest number from the numbers stored from memory location 0050H. Total number of elements in the string (array) are 10 (decimal). Draw flow chart for this program. **[5]**

Q4) Attempt any three :

a) Explain different types of logical instructions used in 8051 by giving one example for it (Any two). Also explain the difference between SUBB & compare instructions with one example. **[4]**

b) Explain the need of conditional & unconditional jump instructions in microcontroller programming. Give a list of conditional (at least 5) and unconditional jump instruction. Explain any two conditional jump instructions by using them in some program. **[4]**

c) How many types of registers are there in 8051? Name 16 bit registers & 8 bit registers (other than R0 – R7 register bank) which of them are bit addressable & byte addressable? **[4]**

d) Write a short note on stack memory, stack pointer register, addressing method used to store data on to stack memory, instructions used to store & retrive data from stack memory & use of stack memory in ACALL or LCALL instructions. **[4]**

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Total No. of Questions : 4]

SEAT No. :

P293

[Total No. of Pages : 2

[5829]-3018
M.Sc.
PHYSICS
PHOT-234M2 : Material Science - I
(2020 Pattern) (CBCS) (Semester - III) (2 Credits) (Group - II)

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 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 toughness and hardness. **[2]**

ii) Explain twin boundary. **[2]**

iii) What are different types of point defects. **[2]**

iv) For each of the following defects in FCC metals, identify the type of planer defects. **[2]**

1) ______ ABCABCBACBA _________

2) ______ ABCABCBCABC ________

v) What are different mechanism of diffusion. **[2]**

b) Write short note on carburization of steel. **[3]**

Q2) a) Explain the experimental method for determination of diffusion constant D. **[6]**

b) The atomic diameter of Al crystal is 4.05 Å and elastic modulus is μ. Find the elastic energy of line imperfection. **[6]**

P.T.O.

Q3) a) What is diffusion? Derive Fick's first and second law of diffusion. **[6]**

b) Describe in detail various surface defects. **[6]**

Q4) Write short note on any Two :

a) Burger vector. **[6]**

b) Thermal properties of material. **[6]**

c) Factors governing diffusion. **[6]**

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Total No. of Questions : 7]

SEAT No. :

P294

[Total No. of Pages : 2

[5829]-4001
M.Sc. (Physics)
PHCT-241: NUCLEAR PHYSICS
(2019/2020 Pattern) (Semester - IV) (CBCS) (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) Define mass defect and packing fraction. **[2]**

b) What is magic number? **[2]**

c) Write down any two limitations of the shell model. **[2]**

d) Find the binding energy per nucleon when two neutrons and two protons combine to form an alpha particle. **[2]**

e) What is Q-value of a nuclear reaction? **[2]**

f) What is law of radioactive disintegration? **[2]**

Q2) a) Discuss the principle, construction and working of a High purity germanium detector. **[7]**

b) Distinguish between the nuclear fission and nuclear fusion. **[5]**

Q3) a) Explain the construction and working of microtron accelerator, show that the minimum time period for the first orbit (T_1) is two times the period of R.F oscillator (e). **[7]**

b) Explain why the following decay processes are not observed. **[5]**

i) $p+p \rightarrow k^{+}+\Sigma^{+}$, ii) $p+n \rightarrow \wedge^{\circ}+\Sigma^{+}$,

iii) $\wedge^{\circ} \rightarrow k^{+}+ k^{-}$ iv) $\Sigma^{+} \rightarrow \wedge^{\circ}+ k^{+}$,

v) $\Xi^{\circ} \rightarrow \Sigma^{\circ}+\wedge^{\circ}$.

P.T.O.

Q4) a) Describe the Conservation law's in Nuclear Reactions. **[7]**

b) Deuterons are accelerated in the synchrocyclotron which has magnetic field of 15000 Gauss at the centre and 14310 gauss at the periphery of the dee. Calculate the maximum Frequency of the dee voltage. **[5]**

Q5) a) What are leptons? Name any three leptons and their anti-particle's. Discuss the properties of leptons. **[7]**

b) The half life of a radioactive substance is 5hr. What will be its one third life time? **[5]**

Q6) a) What is semi-empirical mass Formula? Derive the semi-empirical binding energy (E_B) formula with the help of volume energy, surface energy, coulomb energy, Asymmetry energy & paining energy. **[7]**

b) What is Quarks? Discuss the Quark model including coloured Quark. **[5]**

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

a) Light Hydron collidor (LHC). **[4]**

b) Spark chamber. **[4]**

c) Decay scheme & Half life of ^{60}Co. **[4]**

d) Electric Quadrupole moment of Nuclei. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P295

[Total No. of Pages : 2

[5829]-4002

M.Sc. - II

PHYSICS

PHCT - 242 : Experimental Techniques in Physics - II

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

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

Instructions to the candidates:

1) *Q. 1 is compulsory.*
2) *Answer/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 indicate full marks.*
5) *Use of log-table or non-programmable electronic calculator is allowed.*
6) *Neat diagams must be drawn where necessary.*

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

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

b) What is the working principle of SQUID?

c) Enlist different types of detectors used for detection of infra-red radiations.

d) What is selected area electron diffraction.

e) State the information from thermo gravimetric curve.

f) Draw neat labelled diagram for various components of optical microscope.

Q2) a) i) Explain detection mechanism of Infra-red radiation. **[4]**

ii) Derive Bragg's diffraction condition. **[3]**

b) Explain the effect of electromagnetic radiations on human health. **[5]**

Q3) a) i) Explain different modes of the Scanning Tunnelling Microscope (STM) and also mention its applications. **[4]**

ii) State the limitations of scanning electron microscope over the transmission electron microscope. **[3]**

b) Write the principle of Vibrating-Sample Magnetometer (VSM) and explain the advantages of SQUID technique over VSM. **[5]**

P.T.O.

Q4) a) i) Explain the principle and working of Differential thermal analysis (DTA). **[4]**

ii) Explain the principle of diffused reflectance spectroscopy. **[3]**

b) Draw neat diagram of field emission scanning electron microscope (FESEM) and explain each part in brief. **[5]**

Q5) a) Explain in detail the detection mechanism of photon. **[6]**

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

Q6) a) Derive the Scherrer formula for size determination of nanoparticles. **[6]**

b) Explain the principle, construction and working of atomic force microscope (AFM). **[6]**

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

a) Write short note on applications, advantages and disadvantages of scanning electron microscopy. **[4]**

b) An X-ray tube is operated at 30 kV. It emits a continuous X-ray spectrum with λ min = 0.0414 nm. Calculate the Planck's constant. **[4]**

c) Write short note on nuclear magnetic resonance (NMR). **[4]**

d) Explain the principle and working of Fourier Transform Infra-Red (FTIR) spectrometer. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P296

[Total No. of Pages : 2

[5829]-4003

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 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) Distinguish between frame and sector of a digital audio CD. **[2]**

b) Define Sound Reproducing System, mention its types. **[2]**

c) Define Directivity factor and Directivity index. **[2]**

d) What is volume compressor? **[2]**

e) Explain why the playback rpm of an audio CD gradually decreases as it progresses from the beginning to the end. **[2]**

f) Give circuit diagram for 18 dB/octave third order band pass filter. **[2]**

Q2) a) Derive the expression for the electro-acoustic efficiency of direct radiator loudspeaker. **[7]**

b) Determine the phase velocity of a 354 Hz plane wave progressing through an exponential horn of flare constant of 5.1 at a temperature of 38°C. **[5]**

Q3) a) i) Draw a diagram showing cross-section of a moving coil microphone. Derive the expression for its sensitivity. **[4]**

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

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

P.T.O.

Q4) a) i) With neat diagram derive expression for sensitivity of carbon microphone. **[4]**

ii) Write a note on ultrasonic cleaning and ultrasonic range finding. **[3]**

b) A cone speaker has a total mass of 1.1×10^{-2} kg. Its mechanical resistance is 0.9 kg/s. Its radiation resistance are reactance are 2.1 kg/s each. Determine the frequency of mechanical resonance if the stiffness of the cone system is 5100 N/m. Also determine its mechanical impedance at 300 Hz. **[5]**

Q5) a) Derive the expression for sensitivity of velocity ribbon microphone. **[7]**

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

Q6) a) The equation for plane waves in an exponential horn is $\frac{\partial^2 \xi}{\partial t^2} = c^2 \left[\frac{\partial^2 \xi}{\partial x^2} + m \frac{\partial \xi}{\partial x} \right]$. Show that, for $\xi = \mathrm{A} e^{j(\omega t + \gamma x)}$ to be a solution to the equation, γ must satisfy the relation $\gamma^2 - jm\gamma - k^2 = 0$ where $k = \frac{\omega}{c}$. **[7]**

b) Write a note on Acoustic Anechoic and Semianechoic chambers. **[5]**

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

a) MIDI (Musical Instruments Digital Interface). **[4]**

b) Monophonic and Stereophonic Reproducing Systems. **[4]**

c) Graphic Equalizer. **[4]**

d) Audio File Format. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P297

[Total No. of Pages : 2

[5829]-4004

M.Sc.

PHYSICS

PHOT - 244H4 : Energy Studies - II

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

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

Instructions to the candidates:

1) ***Q. 1 is compulsory.***
2) ***Answer/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 indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagams must be drawn where necessary.***

Q1) Solve any Five of the following:

a) Write properties of Hydrogen. **[2]**

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

c) What is solar still? **[2]**

d) What is anaerobic bioconversion process? **[2]**

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

f) What is Solar cell? **[2]**

Q2) a) i) Which factors affecting the distribution of wind energy on the surface of earth. **[4]**

ii) Explain about Domestic hot water system with a suitable diagram. **[3]**

b) Write major applications of wind power. **[5]**

Q3) a) i) What are advantages of Energy farming? **[4]**

ii) What are the advantages of hydrogen over gasoline? **[3]**

b) What are the various hydrogen production methods? Explain any one of them. **[5]**

P.T.O.

Q4) a) i) What are the different generations of solar cell? **[4]**

ii) What are the applications of solar cell? **[3]**

b) What are solar concentrators? Write their applications. **[5]**

Q5) a) State the different types of solar cooker. Explain any one of them with a suitable diagram. **[6]**

b) Explain solar still with a suitable diagram. **[6]**

Q6) a) Explain Aerobic and anaerobic bioconversion process. **[6]**

b) Explain working principle of flat plate collector with a suitable diagram. **[6]**

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

a) Solar dry ers. **[6]**

b) Importance of Hydrogen. **[6]**

c) Biomass gasifiers. **[6]**

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Total No. of Questions : 7]

SEAT No. :

P298

[Total No. of Pages : 2

[5829]-4005

M.Sc.

PHYSICS

PHOT - 244I4 : Electronics Instrumentation - II

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

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

Instructions to the candidates:

1) ***Q. 1 is compulsory.***
2) ***Answer/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 indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagams must be drawn where necessary.***

Q1) Solve any Five of the following:

a) Define scan time of PLC. Mention factor affecting scan time. **[2]**

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

c) Explain in short "cyclic response" criteria evaluation of controller system performance. **[2]**

d) What is process control principle? **[2]**

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

f) Write the equation for integral and proportional controller mode? **[2]**

Q2) a) Draw block diagram for a PLC. Explain its operation in details with special reference to input module and output module and applicaitons. **[7]**

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

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

b) List the advantages of computer based controller over relay logic controller. **[5]**

P.T.O.

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. Downward motion is to be initiated by pressing down switch provided up motion of platform is not in progress, vice versa for up motion. **[7]**

b) Design a propotional integral controller with a propotional band of 30% and an integration gain of 0.1%/(%–5). The 4 to 2 mA input converts to a 0.4 to 2 V signal and output is to be 0 - 10 V. Calculate values of G_P, G_I, R_2, R_1 and C respectively. **[5]**

Q5) a) Explain in details the colon (:) operator used in matlab. Give at least two distinct use of this operator. Give the use of (;) semicolon, (%) percentage symbol in matlab. Give list of predefine variable in matlab. **[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 +5 V when the sump level exceeds 2.0 m. The pump is to be turned back off when the sump level drop to 1.5 m. Develop two position controller. **[5]**

Q6) a) With neat circuit diagram explain PD controller mode. Derive output voltage equation. **[7]**

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

Q7) Write a short note on any two of following:

a) Damped response and cyclic response evalution. **[6]**

b) P-I-D controller. **[6]**

c) Discrete process control. **[6]**

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Total No. of Questions : 7]

SEAT No. : [ ]

P299

[Total No. of Pages : 2

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M.Sc.

PHYSICS

PHOT - 244M4 : Material Science - II

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

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

Instructions to the candidates:

1) ***Q. 1 is compulsory.***
2) ***Answer/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 indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagams must be drawn where necessary.***

Q1) Solve any Five of the following:

a) What are ferromagnetic materials? Given an example. **[2]**

b) Write chemical formula for : **[2]**

i) Montmorillonite

ii) Illite

c) Draw structure of AX-type crystal structure. **[2]**

d) State difference between a diode and tunnel diode. **[2]**

e) What are ceramic super conductors? **[2]**

f) The resistivity of pure silicon at r.t. is 3000Ω m. Calculate the intrinsic carrier density $\mu_e = 0.14\,\text{m}^2/\text{Vs}$, $\mu_h = 0.05\,\text{m}^2/\text{Vs}$. **[2]**

Q2) a) With a well labelled diagram give a detail account of magnetization characteristics and hysteresis loop caused by domain action. **[7]**

b) List various applications of High T_C ceramic super-conductors. **[5]**

P.T.O.

Q3) a) The lattice constant of CaF_2 is 0.547 nm : **[7]**

i) Sketch the arrangements of ion on a {110} plane of CaF_2.

ii) What is the sum of two radii $\left(r_{ca^{2+}} + R_{F^-}\right)$.

iii) What is the linear density of lattice points in $\left[1\bar{1}2\right]$ direction.

b) With a well labelled diagram explain why/how quasi-crystal can be formed by 'Penrose Rhombus'. **[5]**

Q4) a) Draw a well labelled diagram of garnets structure unit and explain in detail contribution of spin. **[7]**

b) A rod of p-type Germanium 10 mm long and 1 mm diameter has a resistance of 100Ω. what is the concentration of impurity in this rod. **[5]**

$\left(\mu_e = 0.39\ m^2/Vs,\ \mu_h = 0.19\ m^2/Vs\right)$

Q5) a) Sketch diagrams depicting temperature dependence of inverse susceptibility in paramagnetic regime of : **[6]**

i) Paramagnetic

ii) Ferromagnetic

iii) Ferrimagnetic

iv) Anti-ferromagnetic

b) Explain in detail intrinsic and extrinsic semiconductor with diagram and examples. **[6]**

Q6) a) i) Find the conductivity of intrinsic silicon at 300 k, $N_D = 1.5 \times 10^{16}/m^3$. Mobilities of electron and holes in silicon are 0.13 and 0.05 m^2/Vs respectively.

ii) If donar type impurity is added to the extent of one impurity atom in 10^8 silicon atom, find the conductivity.

[6]

b) Draw crystal structure of Yttrium Barium Copper Oxide (YBCO) high T_C super conductor and explain the same. **[6]**

Q7) Write a short note on any two of following:

a) Network Modifiers. **[6]**

b) Hexagonal ferrites. **[6]**

c) Gaint Magneto-Resistance (GMR). **[6]**

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Total No. of Questions : 4]

SEAT No. :

P300

[Total No. of Pages : 1

[5829]-4012

M.Sc.

PHYSICS

PHOT - 244H2 : Energy Studies - II

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

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 side indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagams must be drawn where necessary.***

Q1) a) Attempt any four of the following:

i) What is the basic working principle of solar cell? **[2]**

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

iii) What are the sources of a hydrogen? **[2]**

iv) What is biomass? **[2]**

v) What is selective coating? **[2]**

b) Calculate the energy of photon having a wavelength of 0.5 μm, in-terms of eV. **[3]**

Q2) a) i) Explain a water pump as application of SPV system. **[4]**

ii) Give the different factors which affect the power of wind. **[3]**

b) Explain with neat diagram, the domestic hot water system. **[5]**

Q3) a) Explain with neat diagram, the working of a typical liquid Flat plate collector. **[6]**

b) Describe the various types of bio-mass gasifiers. **[6]**

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

a) Solar Dryer. **[4]**

b) Methods of production of Hydrogen. **[4]**

c) Thermal losses of Flat plate collector. **[4]**

d) Vertical axis wind mill. **[4]**

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Total No. of Questions : 4]

SEAT No. :

P301

[Total No. of Pages : 1

[5829]-4013

M.Sc.

PHYSICS

(Group- II) PHOT - 244I2 : Electronic Instrumentation - II

(2020 CBCS Pattern) (2 Credits) (Semester - I & II) (Common to Sem. IV)

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 side indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagram must be drawn wherever necessary.***

Q1) a) Solve any four of the following:

i) What is script file? Write purpose of command window in matlab. **[2]**

ii) Define ladder diagram. Draw circuit symbol for NC and NO type of physical limit switch. **[2]**

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

iv) What is process control principle? **[2]**

v) Write control system objective. **[2]**

b) A sensor measures temperature linearly with a static transfer function of 33 mV/°C and has a 1.5 –s time constant. Find the output 0.75 s after the input changes from 20° to 41°C. Find the error in temperature this represent. **[3]**

Q2) a) What is process control loop? Explain control system evaluation criteria in detail. **[7]**

b) List the advantages of computer-based controller over relay logic controller. **[5]**

Q3) a) Explain an op-amp proportional-derivative (PP) mode controller with the help of neat circuit diagram. **[7]**

b) Design a proportional-integral controller with a proportional band of 30% and an integration gain of 0.1%/(%–s). The 4 to 20 –mA input converts to a 0.4 to 2 V signal, and the output is to be 0-10 V calculate values of G_P, G_I, R_1, R_2 and C respectively. **[5]**

Q4) Write a short note on any two of the following:

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

b) Process objective. **[6]**

c) Two position analog controller. **[6]**

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Total No. of Questions : 4]

SEAT No. :

P302

[Total No. of Pages : 1

[5829]-4014

M.Sc.
PHYSICS
PHOT - 244J2 : Biomedical Instrumentation - II
(2020 CBCS Pattern) (Semester - IV) (Group- 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 side indicate full marks.***
5) ***Use of log-table or non-programmable electronic calculator is allowed.***
6) ***Neat diagams must be drawn where necessary.***

Q1) a) Solve any four of the following:

i) State any two basic functions of nervous system. **[2]**

ii) What are the types of EMG? **[2]**

iii) Define frequency. State frequency range for ultrasound. **[2]**

iv) Define the terms Hypercapnea any Hypoxia. **[2]**

v) What are the different display modes in ultrasound. **[2]**

b) Find the energy of X-ray, when wavelength of diagnostic X-ray is 1Å. **[3]**

Q2) a) Explain physiology of respiratory system. **[7]**

b) What is computer? Explain digital computer system in detail. **[5]**

Q3) a) Explain the interaction of ultrasound with matter. **[7]**

b) Explain microprocessor. State its types. **[5]**

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

a) Types of memories in computer hardware. **[6]**

b) Block diagram of EEG. **[6]**

c) Various characteristics of Sound. **[6]**

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Total No. of Questions : 4]

SEAT No. :

P303

[Total No. of Pages : 1

[5829]-4017

M.Sc.
PHYSICS
PHOT - 244M2 : Material Science - II
(2020 CBCS Pattern) (Semester - IV) (Group- 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 side indicate full marks.*
5) *Use of log-table or non-programmable electronic calculator is allowed.*
6) *Neat diagams must be drawn where necessary.*

Q1) a) Solve any four of the following:

i) Explain change in enthalpy. **[2]**

ii) Derive Maxwell's second thermodynamic relation. **[2]**

iii) State and explain second law of thermodynamics. **[2]**

iv) Explain activity coefficient. **[2]**

v) Name the types of binary phase diagrams. **[2]**

b) Calculate the increase in enthalpy and entropy of copper as it is heated from room temperature 300 K to 1000 K. Given specific heat CP = $22.61 + 6.27 \times 10^{-3}$ TJ $mol^{-1}k^{-1}$. **[3]**

Q2) a) i) Explain the concept of ideal solution with the help of Roults law. **[4]**

ii) Explain unary phase diagram. **[3]**

b) State & explain lever role with the help of suitable diagram. **[5]**

Q3) a) Draw & explain phase diagram of (i) Au-Cu (ii) Ag-Cu where melting points are Ag = 962°C, Au = 1064°C, Cu = 1085°C. **[6]**

b) Consider two solids A and B which are unmixed in state - 1 and mixed in state 2. Calculate in entropy when the solution is ideally mixed. **[6]**

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

a) Type-III Phase diagram. **[4]**

b) Limited mutual solid solubility. **[4]**

c) Miscibility gap. **[4]**

d) Peritectoid phase diagram. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P6483

[Total No. of Pages : 2

[5829]-402

M.Sc.

PHYSICS

PHCT - 242 : Material Science

(CBCS) (2019 Pattern) (Semester - IV) (4 Credits)

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

Instructions to the candidates:

1) ***Q. 1 is compulsory.***
2) ***Attempt 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-tables or non-programmable electronic calculator is allowed.***
6) ***Neat diagram must be drawn wherever necessary.***

Q1) Attempt/Solve any five of the following :

a) What is corrosion resistance of duralumin. **[2]**

b) Give the different magnetic properties of materials. **[2]**

c) What is maxima and minima in two phase region. **[2]**

d) State Richard's and Trouton's rule. **[2]**

e) A 50mm guage length is marked on copper rod. The rod is strained so that the guage marks at 59 mm apart. Calculate the percentage strain in guage wire. **[2]**

f) Define vacancy diffusion and interstitial diffusion. **[2]**

Q2) a) i) State and explain Fick's Ist and IInd law. **[4]**

ii) Give the different defects in solids. Explain any one defect in brief. **[3]**

b) State and derive clasius - clapeyron equation. **[5]**

Q3) a) i) Explain the auxillary thermodynamic function by Lengendre transformation. **[4]**

ii) With the help of neat diagram, explain miscibility gap in two-phase regions. **[3]**

b) What is Frankel defect? Derive an expression for the equillibrium concentration of vacancies of Frankel defects in the crystal. **[5]**

P.T.O.

Q4) a) i) Explain the different mechanisms occurred in solid solutions. **[4]**

ii) Explain Henry's law with the help of suitable diagram. **[3]**

b) With the help of neat diagram, state and explain the lever rule. **[5]**

Q5) a) Considering the mixture of N_A atoms of solid A and N_B atoms of solid B as the process changes from

State 1 $\rightarrow$ State 2

i.e. unmixed A & B $\rightarrow$ Mixed A & B

Then prove that $\Delta G^M = RT\ (X_A\ ln\ X_A + X_B\ ln\ X_B)$. **[7]**

b) There are 19% copper at the surface of some aluminium and 18% copper underneath of that surface. What will be the flux of copper atoms be from the surface at 500°C.

[Aluminium is FCC and a = 0.4049 nm] **[5]**

Q6) a) Tabulate the various invarient reactions along with name of reaction, details of reaction and phase boundaries at invarient line for rutective, perictive, monotective and syntective reactions. **[6]**

b) Explain the diffusion mechanism in carburization and decarburization of steel, in brief. **[6]**

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

a) Surface imperfections **[4]**

b) Experimental determination of diffusion coefficient 'D'. **[4]**

c) Measurement of changes in enthalpy and entropy. **[4]**

d) Thermodynamic origin of phase diagrams. **[4]**

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Total No. of Questions : 7]

SEAT No. :

P304

[Total No. of Pages : 2

[5829]-5001

M.Sc.

PHYSICS

(PHOT - XXXA4) (CBOP - I) (PHOT - 114/124 A4) (CBOP -I) (PHOT - 243 A4) : Physics of Thin Films

(2020 CBCS Pattern) (Group- I) (Semester - IV) (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 diagram must be drawn where necessary.***

Q1) Solve <u>any five</u> questions of the following:

a) What is mean by Island layer? **[2]**

b) Define super saturation growth mechanism. **[2]**

c) Define dip coating and also write step involved in it. **[2]**

d) Write principle of photolitho graphy. **[2]**

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

f) What is mean by Hall effect in thin film. **[2]**

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

b) Define sputtering. Explain any one type of spattering. **[5]**

Q3) a) What is chemical vapour deposition? Explain various chemical reactions involved in it. **[7]**

b) Write short note on thin film capacitor. **[5]**

P.T.O.

Q4) a) i) Write applications of thin films as a resistor. **[4]**

ii) Write short note on absorption of optical properties. **[3]**

b) Explain in brief Pulsed Laser Abalation. **[5]**

Q5) a) What is capillary model and Atomistic model? Write difference between capillary and Atomistic model. **[7]**

b) Write applications of thin films in information storage, electro acoustics and telecommunication. **[5]**

Q6) a) Draw neat diagram of Molecular Beam Epitaxy and Explain its construction and working. **[7]**

b) Explain Quarts crystal microbalance for measurement of thickness of thin film. **[5]**

Q7) Write a short notes on following (any three):

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

b) E-beam deposition. **[4]**

c) Nucleation. **[4]**

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

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Total No. of Questions : 7]

SEAT No. :

P305

[Total No. of Pages : 2

[5829]-5002

M.Sc.

PHYSICS

(Group-I) (PHOT - XXXB4) (CBOP - I) (PHOT - 114/124 B4) (CBOP - I) (PHOT - 243 B4) : Physics of Nanomaterials

(2020 CBCS Pattern) (4 Credits) (Semester - IV) (Common to Semester I & 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 indicate full marks.*
5) *Use of log-table or non-programmable electronic calculator is allowed.*
6) *Neat diagams must be drawn wherever necessary.*

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

a) What is mean by bottom up approach?

b) What are applications of PVD?

c) State various significance of nanomaterials?

d) Define Nanotechnology?

e) Write application of Metal reduction method?

f) State any two applications of nanomaterials?

Q2) a) Explain in detail sol gel method with neat diagram. Write advantage of it? **[7]**

b) Write down in detail mechanical properties of nanomaterials? **[5]**

Q3) a) Explain in brief physical vapour deposition method with neat diagram write its advantages and disadvantages. **[7]**

b) What is Aerogel? Explain its properties and application. **[5]**

P.T.O.

Q4) a) i) Explain the quantum size effect and effect of reduction in dimension. **[4]**

ii) Determine band gap of wavelength of light incidents 600 nm (Given $h = 6.626 \times 10^{-34}$ Js). **[3]**

b) What is Nanomaterial and explain their classification according to dimension. **[5]**

Q5) a) Explain in detail chemical bath deposition method with neat diagram. Write advantages and disadvantages of it. **[6]**

b) Explain in brief application of nanomaterial in medical and space field. **[6]**

Q6) a) Explain in detail high energy ball milling method with neat diagram. Write it's disadvantages. **[6]**

b) Explain in detail electrical and magnetic properties of nanomaterials. **[6]**

Q7) Write short note on any three out of Four questions: **[12]**

a) Fullerene.

b) Optical properties of Nanomaterials.

c) Graphene.

d) Nucleation and growth of nanoparticles.

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Total No. of Questions : 7]

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M.Sc.

PHYSICS

(CBOP-I) (PHOT-114/124 C4) (PHOT-243C4) : Lasers & Applications

(2020 CBCS Pattern) (Group- I) (4 Credits) (Semester - I & II)

(Common to Semester - IV)

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 calculator is allowed.*
6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five of the following:

a) What is population inversion? How it is achieved? **[2]**

b) Why a three level laser normally provides pulsed output? **[2]**

c) Calculate the coherence length of CO_2 laser whose line width is 1×10^{-5} nm of IR emission wavelength of 10.6 μm. **[2]**

d) Discuss the importance of doping in semiconductors. **[2]**

e) What is the optical fiber, on what principle it is based? **[2]**

f) What is an optical resonator? **[2]**

Q2) a) Explain the three processes absorption, spontaneous emission and stimulated emission of radiation and obtain a relation between Einstein's coefficients. **[7]**

b) Explain four level laser system with energy level diagram. Why it is more efficient than other systems? **[5]**

P.T.O.

Q3) a) i) What will be the reflectivity of first cavity mirror if the reflectance of second mirror is 97%? The length of the cavity is 15 cm and gain factor of laser material is 0.0005 per cm. **[4]**

ii) The half-width of gain profile of laser material device is 0.003 nm emitted of wavelength 6328 Å. Calculate the length of cavity in order to single mode of oscillations having refractive index is 1.**[3]**

b) What is line broadening? Explain the natural and collision broadening in details. **[5]**

Q4) a) Explain the action of optical resonator and obtain the expression for threshold condition. **[7]**

b) Explain the construction and working of semiconductor laser with neat diagram. **[5]**

Q5) a) Explain the construction, working and energy level diagram for He-Ne laser. State any four applications of He-Ne laser. **[6]**

b) Explain the process of cutting with lasers and process of laser welding.**[6]**

Q6) a) Describe any three medical applications of laser in details. **[6]**

b) Discuss with suitable diagram, explain construction, working and energy level diagram of Ruby laser. **[6]**

Q7) Write short notes on <u>any three</u> of the following:

a) Laser range finder application in defense. **[4]**

b) Explain principle and operation of dye laser. **[4]**

c) What do you mean by coherence? Explain spatial and temporal coherence in lasers. **[4]**

d) Construction & working of Excimer laser. **[4]**

Total No. of Questions : 7]

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M.Sc.

PHYSICS

Physics of Semiconductor Devices

(CBCS 2020 Pattern) (Group- I) (4 Credits) (Semester - I, II & IV)

(PHOT - XXXD4) (CBOP - I PHOT - 114/124D4) (CBOP - I PHOT - 243D4)

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 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 <u>any five</u> of the following: **[10]**

a) Write current density equations for electrons & holes. **[2]**

b) Electrons in undoped gallium arsenide have a mobility of 8800 cm^2/v-s. Calculate the average time between collisions. Calculate the distance travelled between two collisions (also called the mean free path). Use an average velocity of 10^7 cm/s. **[2]**

c) What is depletion layer capacitance? **[2]**

d) Draw connection & current component in common base configuration. **[2]**

e) What is Schottky contact? **[2]**

f) Calculate the ideal current densities of Schottky barrier diode & a p-n Junction diode. Consider a tungsten barrier on silicon with a measured barrier height of $e\phi_{Bn} = 0.67$. The effective Richardson constant is $A^* = 114\ A/K^2\ cm^2$ & T = 300K. **[2]**

Q2) a) What do you meant by recombination of carriers? Explain any two recombination of carriers. **[7]**

b) Describe carrier concentrations for resistivity and obtain expression for the resistivity of the n-type & P-type semiconductor. **[5]**

P.T.O.

Q3) a) What are the different types of junction break down? Explain any two junction breakdowns. **[7]**

b) Describe direct & indirect band gap semiconductors using suitable diagram. **[5]**

Q4) a) Draw neat labelled diagram of common base configuration for n-p-n transistors & Explain in detail input & output characteristics of common base configuration for p-n-p transistor. **[7]**

b) Explain the working of Junction field effect transistor. **[5]**

Q5) a) Explain Schottky effect. Also explain how to obtain Schottkey barrier height? **[7]**

b) Describe energy band relation for metal semiconductor contacts with suitable diagram. **[5]**

Q6) a) Explain carrier diffusion & obtain Einstein's Relations. **[6]**

b) Explain construction & working of metal semiconductor. **[6]**

Q7) Write short notes on <u>any three</u>:

a) High injection condition. **[4]**

b) Diffusion Junction Method. **[4]**

c) Unijunction Transistor. **[4]**

d) Formation of Transistor. **[4]**

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Total No. of Questions : 4]

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M.Sc.

PHYSICS

(Group- I) (PHOT - XXXA2) (CBOP - I) (PHOT - 114/124 A2) (CBOP - I) (PHOT - 243 A2) : Physics of Thin Films

(2020 CBCS Pattern) (2 Credits) (Semester - IV) (Common to Sem. - I & II)

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 side 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 steps involved in dip coating. **[2]**

ii) Comparison of thick and thin films. **[2]**

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

iv) What is thin film gas sensor? **[2]**

v) What are the applications of thin film? **[2]**

b) Write the various stages of thin film growth. **[3]**

Q2) a) Explain in detail physical vapour deposition method. **[7]**

b) Explain in brief Talstep (Styles) method for measurement of thickness of thin film. **[5]**

Q3) a) Explain construction and working of spray pyrolysis. **[7]**

b) Explain optical coating with it's properties and applications. **[5]**

Q4) Write a short notes on any three of the following:

a) Pulsed Laser Ablation. **[4]**

b) Tolansky Technique. **[4]**

c) Photolithography. **[4]**

d) Quartz crystal microbalance. **[4]**

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Total No. of Questions : 4]

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M.Sc.

PHYSICS

(Group-I) (PHOT - XXXB2) (CBOP - I) (PHOT - 114/124 B2) (CBOP - I) (PHOT - 243 B2) : Physics of Nanomaterials

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

(Common to Semester - I & II)

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 side 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: **[8]**

i) What are the disadvantages of physical vapour deposition? **[2]**

ii) What are the steps involved in physical vapour deposition? **[2]**

iii) What factor affect on chemical bath deposition method? **[2]**

iv) State any two applications of nanomaterials. **[2]**

v) Define nanotechnology. **[2]**

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

Q2) a) i) Explain optoelectrical properties of nanomaterial. **[4]**

ii) Calculate the optical energy band gap of a wavelength is 400 nm. **[3]**

b) Give the classification of synthesis method of nano materials. **[5]**

Q3) a) Describe synthesis of nanomaterials using hydrothermal method with suitable diagram. **[7]**

b) Explain the significance of nanosize materials. **[5]**

Q4) Write a short notes on <u>any three</u> of the following: **[12]**

a) Graphene and its application.

b) Carbon nanotube and its application.

c) Biological Method.

d) Magnetic properties.

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Total No. of Questions : 4]

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M.Sc.

PHYSICS

Lasers & Applications

(2020 CBCS Pattern) (Group- I) (2 Credits) (Semester - I, II & IV) (PHOT - XXXC2) (CBOP-I PHOT - 114/124C2) (CBOP - I PHOT - 243C2)

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 calculator is allowed.*
6) *Neat diagams must be drawn wherever necessary.*

Q1) a) Solve any four of the following:

i) Define active medium. What is active medium used in Ruby laser? **[2]**

ii) What is difference between electrical pumping & optical pumping.**[2]**

iii) What is metastable state? Why it is important in lasers? **[2]**

iv) Define the term lifetime of the state. **[2]**

v) Define the term LASER. What is spontaneous emission. **[2]**

b) Distinguish between 3-level & 4-level Lasers. **[3]**

Q2) a) i) Derive the expression for the threshold condition for laser. **[4]**

ii) What is mean by population inversion? Why it is important in lasers. Explain the method of achieving it. **[3]**

b) Explain construction & working of Nd-YAG Lasers with neat diagrams.**[5]**

Q3) a) i) Find the ratio of population of the two states in a He-Ne laser that produces light of wavelength 6328Å at 300 K. (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 0.117 eV. 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) With neat diagram explain the construction & working of semiconductor lasers. **[5]**

Q4) Write short notes on <u>any three</u> of the following:

a) Gas lasers. **[4]**

b) Excimer lasers. **[4]**

c) Characteristics of lasers. **[4]**

d) Absorption & Gain coefficients. **[4]**

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Total No. of Questions : 4]

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M.Sc.

PHYSICS

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

(CBCS 2020 Pattern) (Group- I) (2 Credits) (Semester - I and II) (Common to Semester - IV)

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 side indicate full marks.*
5) *Use of log-table or non-programmable electronic calculator is allowed.*
6) *Neat diagams must be drawn wherever necessary.*

Q1) a) Solve any four of the following:

i) If the material is in electrostatically neutral condition, write the space charge neutrality equation for semiconductor. **[2]**

ii) Represent graphically the temperature dependence of mobility with both lattice and impurity scattering. **[2]**

iii) The n-type Si bar has resistivity 0.001 Ω.cm and majority carrier concentration 1.32×10^{18} cm^{-3}. Calculate the mobility of electrons. **[2]**

iv) Define, emitter injection efficiency and the common base current gain of transistor. **[2]**

v) What is the IMPATT diode? **[2]**

b) Draw **[3]**

i) current components,

ii) doing profile, and

iii) energy band diagram of common base n-p-n BJT. Label all the figures appropriately.

P.T.O.

Q2) a) What is the Hall effect? Find the Hall coefficient, and Hall mobility of a semiconducting sample. **[6]**

b) Define generation, recombination and lifetime of carriers. Draw I-V characteristics of a practical diode indicating (i) generation-recombination current region, (ii) diffusion current region, (iii) high injection region, and (iv) series resistance effect and reverse leakage current. **[6]**

Q3) a) Draw Schematic structure and I-V characteristics of SCR. Explain the operation of SCR in forward blocking, reverse blocking and forward conduction mode. **[6]**

b) Consider a semiconducting bar with dimensions of 0.02 cm wide, 8 mm thick and 0.6 cm long. In its Hall coefficient measurement, a current of 0.2 mA is passed in the sample and a magnetic field of 10^{-4} wb/cm^2 is generated in Z-direction. If the voltage at the two end is V_{AB} = +2 mV and V_{CD} = 60 mV, then find the charge carrier concentration, its type and its mobility. **[6]**

Q4) Write a short note on <u>any three</u> of the following:

a) Junction Breakdown. **[4]**

b) ON and OFF states of BJT. **[4]**

c) Excess carriers in the Semiconductor. **[4]**

d) Barrier height and its different measurement methods. **[4]**

e) Diffusion capacitance of p-n junction. **[4]**

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Total No. of Questions : 4]

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M.Sc.

PHYSICS

(CBOP - I) (PHOT - 114/124 E2) (PHOT - 243 E2) : Communication Electronics

(2020 CBCS Pattern) (Group- I) (Semester - I & II) (Common to 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 <u>any four</u> of the following:

i) Explain the Bandwidth Requirements characteristics of data transmission. **[2]**

ii) What is the time duration of one bit if data rate is 400 bits/s. **[2]**

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

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

v) What is Angle of Inclination? **[2]**

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

P.T.O.

Q2) a) i) What is facsimile? Give the principle of facsimile. Explain its uses in telecommunication. **[4]**

ii) Calculate the capacity of a standard 4-kHz telephone channel has 3100 Hz bandwidth with a 30 dB signal to noise ratio. **[3]**

b) Describe four different codes used for data transmission and discuss their merits and demerits. **[5]**

Q3) a) Explain Network Organization. Determine the number of links required between 6 PCs. **[6]**

b) Calculate the maximum range of a radar system which operates at 3 cm with a peak pulse power of 500 kW, if its maximum receivable power is 10^{-13} W, the capture area of its antenna is 5 m^2, and the radar cross sectional area of the target is 20 m^2. **[6]**

Q4) Write a short notes on <u>any two</u> of the following:

a) "Different characteristics of data transmission". **[6]**

b) "Public Telephone System". **[6]**

c) "Four wire terminating set in telephony". **[6]**

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