

Total No. of Questions : 7]

SEAT No. :

PE-5226

[Total No. of Pages : 2

[6509]-101

First Year M.Sc.

PHYSICS

PHCT-111 : Mathematical Methods in Physics

(2020 Pattern) (Semester - I)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question No.1 is compulsory.
- 2) Solve any five questions from Q.No.2 to Q.No.7.
- 3) Q.No. 2 to Q.No.5 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of log-table and non-programmable calculator is allowed.

Q1) Solve any five of the following:

[10]

- a) State the Parseval's identity.
- b) Find Laplace transform of $\cos(wt)$.
- c) Determine the region in the z plane represented by $|2 + 2i| \leq 2$.
- d) State the generating function for legendre polynomials ($P_n(x)$).
- e) Define linear combination of vectors and linear span of the set of vectors.
- f) Define eigen values and eigen vectors.

Q2) a) i) Show that $P_n(1) = 1$ and $P_n(-1) = (-1)^n$.

[4]

ii) Find an analytic function whose real part is $u = y^3 - 3x^2y$.

[3]

b) Find complex Fourier transform of $f(x) = e^{-\alpha|x|}$ where $\alpha > 0$ and x belongs to $(-\infty, \infty)$.

[5]

P.T.O.

Q3) a) i) Prove that $L_{n+1}(x) = (2n+1-x)L_n(x) - n^2L_{n-1}(x)$. **[4]**

ii) Prove that $nP_n = xP'_n = P'_{n-1}$. **[3]**

b) Find eigen value and eigen vectors of the matrix. **[5]**

$$A = \begin{bmatrix} 2 & -2 & 0 \\ -2 & 1 & -2 \\ 0 & -2 & 0 \end{bmatrix}$$

Q4) a) i) For Bessel function of the first kind show that $J_n(x) = (-1)^n J_n(-x)$. **[4]**

ii) Show that the vector $\{(1, -2, 3), (2, 3, 1), (-1, 3, 2)\}$ form a basis of the vector space V over real numbers. **[3]**

b) Evaluate by contour integration $\int_C \frac{5z-2}{z(z-1)} dz$, where C is a circle $|z|=3$ taken counter clockwise. **[5]**

Q5) a) Find Fourier series of $f(x) = x$ in $(0, \pi)$. **[6]**

b) Reduce the matrix $A = \begin{bmatrix} 1 & 2 & -2 \\ 2 & 1 & 2 \\ -2 & 2 & 1 \end{bmatrix}$ to a diagonal form. **[6]**

Q6) a) State and prove Taylor's theorem. **[6]**

b) State and prove the orthogonality property of Legendre polynomials. **[6]**

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

a) Rodrigue's formula for laguerze polynomials is $L_n(x) = \frac{e^x}{n!} \frac{d^n}{dx^n} (x^n e^{-x})$, find $L_0(x)$, $L_1(x)$ and $L_2(x)$. **[4]**

b) State and prove Cauchy-Riemann equations in carlehan co-ordinate system. **[4]**

c) Determine whether the set $B = \{(3, 1, -4), (2, 5, 6), (1, 4, 8)\}$ is basis for $\mathbb{R}^3$. **[4]**

d) Find complex Fourier transform of Dirac delta function $\delta(t-a)$. **[4]**



Total No. of Questions : 7]

SEAT No. :

PE-5227

[Total No. of Pages : 2

[6509]-102

First Year M.Sc. (Physics)

PHYSICS

PHCT-112 : Classical Mechanics

(2020 Pattern) (Semester - I)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following:

- a) Calculate the reduced mass of H_2 molecule, assume mass of hydrogen atom is M . [2]
- b) Give the classification of constraints. [2]
- c) State Kepler's first law. [2]
- d) Define cyclic coordinate and give one example. [2]
- e) Define Poisson Bracket. [2]
- f) What do you mean by Geostationary orbit? [2]

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

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

Q3) a) Prove that Poisson's bracket of two constant of motion is itself a constant of motion. [7]

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

P.T.O.

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

$$Q = \sqrt{2g} e^q \cos p, P = \sqrt{2g} e^{-q} \sin p \text{ is canonical.}$$

b) Explain the effect of coriolis force on [5]

i) Cyclones formation.

ii) River flow.

Q5) a) State and prove Kepler's third law. [6]

b) Write the Hamiltonian for compound pendulum, obtain its equation of motion. [6]

Q6) a) Explain the Brachistochrone problem. [6]

b) Solve the projectile motion problem by Lagrangian method. [6]

Q7) Solve any three of the following:

a) State and prove virial theorem. [4]

b) In case of Poisson's bracket Find $[p_x, p_y]$. [4]

c) Write a note on Inertia tensor. [4]

d) Find the horizontal component of coriolis force acting on a body of mass 1.5 kg moving northward with a horizontal velocity of 100 m/s, at 30° N Latitude on earth. [4]



Total No. of Questions : 7]

SEAT No. :

PE-5228

[Total No. of Pages : 2

[6509]-103
First Year M.Sc. (Physics)
PHYSICS
PHCT-113 : Electronics
(2020 Pattern) (Semester - I)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question No.1 is compulsory.*
- 2) *Solve any five questions from Q.No.2 to Q.No.7.*
- 3) *Q.No.2 to Q.No.7 carries equal marks.*
- 4) *Use of non-programmable calculator and log table is allowed.*
- 5) *Figures to the right indicate full mark.s*

Q1) Answer any FIVE of the following questions:

- a) What is the reverse blocking mode in SCR? [2]
- b) State Boolean laws. [2]
- c) A 8-bit DAC (R-2R) produces output voltage of 5V for a binary input of 0110 0100. What will be the output voltage for a binary input of 1011 0011? [2]
- d) What are the applications of timer IC 555? [2]
- e) Convert (1011 1100) gray into binary code. [2]
- f) What are types of shift register. [2]

- Q2)** a) $f = ABC + AB\bar{C} + \bar{A}\bar{B}\bar{C} = \bar{A}BC$. Place the given function on the truth table and map the function and obtain its reduced expression. Also draw an equivalent diagram. [5]
- b) Distinguish between binary weighted and R-2R ladder types D to A converters. [4]
 - c) Define flip flop. How many flip flops are required to construct each of the following counters: [3]
 - i) mod - 5
 - ii) mod - 16

P.T.O.

- Q3)** a) Design a FSK generator of the frequencies 240 kHz and 180 kHz for bit 1 and bit 0 respectively. Find the appropriate values of R_1 , R_2 and R_3 while assuming $C_1 = 2nF$. [5]
- b) Explain the working principle of the ring counter to count pulses? Give its applications. [4]
- c) What will be the output voltage produced by a D/A converter whose output is 0 to 5V and whose input binary number is $(10\ 11\ 1100)_2$. [3]
- Q4)** a) Explain the operation of Dual slope ADC. [5]
- b) Design a VCO circuit, supply voltage $V = 12V$, $R_2 = 1.5k\Omega$, $G = 1\ \mu f$, $R_1 = R_3 = 10\ k\Omega$. Determine the nominal frequency of the output wave forms. Also compute the modulation in the output frequencies if V_c is varied between 9.5 to 11.52 V. [4]
- c) Which shift registers are the fastest in operation? Why? [3]
- Q5)** a) Explain the successive approximation A/D type converter. Give its applications. [6]
- b) What is PLL? Define its capture range and lock range frequency. [3]
- c) What are the applications of shift registers? [3]
- Q6)** a) With the help of block diagram, explain the construction and working principle of half wave precision rectifier using op-amp. What are its advantage? [6]
- b) Explain the application of silicon controlled Resistor as a full wave rectifier. Give its applications. [6]
- Q7)** Write short note on ANY THREE of the following:
- a) DC - DC converter. [4]
- b) Calculate the free frequency and duty cycle for IC 555 of Astable multivibrator. [4]
(Given: $R_A = 6.8\ k\Omega$, $R_B = 3.3\ k\Omega$, and $C = 0.1\ \mu F$)
- c) Use a K-map to design BCD to 7-segment decoder. [4]
- d) Single slope A to D converter. [4]



Total No. of Questions : 4]

SEAT No. :

PE-5229

[Total No. of Pages : 2

[6509]-104

S.Y. M.Sc.

PHYSICS

**PHOT-243A2 : Physics of Thin Films
(2020 Pattern) (Semester - IV)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

Q1) a) Solve any four of the following:

- i) Explain the steps involved in dip coating. [2]
 - ii) Give applications of thin films in ICs. [2]
 - iii) Compare between thick and thin films. [2]
 - iv) State the working principle of atomistic model. [2]
 - v) Give the steps involved in Talystep method. [2]
- b) Distinguish between thick and thin films. [3]

Q2) a) Explain the working principle of Tolansky method with the help of schematic diagram. Give its advantages. [7]

b) Explain in detail physical vapour deposition. [5]

Q3) a) Explain the working principle of spray pyrolysis. Give its applications. [7]

b) State the applications of thin films resistors and capacitors over normal ones. [5]

P.T.O.

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

- a) Molecular beam epitaxy [4]
- b) Photolithography [4]
- c) Quartz micro balance [4]
- d) Thin film solar cells [4]



Total No. of Questions : 7]

SEAT No. :

PE-5230

[Total No. of Pages : 2

[6509]-105

S.Y. M.Sc.

PHYSICS

**PHOT-243A4 : Physics of Thin Films
(2020 Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following:

- a) Which optical method is used for the stress measurements? State its principle. [2]
- b) What are different sources of resistivity in thin films? [2]
- c) What is magneto resistance in thin film? [2]
- d) What do you mean by condensation? [2]
- e) How the molecular path is affecting in growth mechanism under vacuum conditions? [2]
- f) State the applications of thin film in electro-acoustic. [2]

Q2) a) What is the use of Tolansky's technique in thickness measurement? Explain with the help of schematic diagram. [7]

- b) Explain in detail, why capillarity model is suitable for homogenous growth of thin film? [5]

Q3) a) Explain which theory has overcome the shortcoming in Thomson model for scattering of electron from thin film surface? [7]

- b) Explain the different types of defects contributing to residual resistivity in thin films. Describe any two. [5]

P.T.O.

- Q4)** a) i) Why it is important to understand gas transport nature during CVD growth mechanism? Explain. [4]
ii) Write a short note on absorption of optical properties. [3]
b) Write a note on dielectric losses in thin film. [5]
- Q5)** a) What is capillary model and atomistic model? Write difference between capillary and atomistic model. [6]
b) i) What is the use of adatoms in the thin film growth. [3]
ii) Write applications of thin films in information storage, electro acoustics and telecommunication. [3]
- Q6)** a) Explain in detail the applications of thin film for gas and humidity sensors. [6]
b) Distinguish between thick and thin films. [6]
- Q7)** Write a short notes on any three of the following:
- a) Spin coating [4]
b) Molecular beam epitaxy [4]
c) Nucleation [4]
d) Hall effect in solar cell [4]



Total No. of Questions : 4]

SEAT No. :

PE-5231

[Total No. of Pages : 2

[6509]-106

First Year M.Sc.

PHYSICS

**CBOP-1 (PHOT-124B2) : Physics of Nanomaterials
(2020 Pattern) (Semester - 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 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 nanotechnology. [2]
- ii) What is top-down approach? [2]
- iii) What are disadvantages of physical vapour deposition. [2]
- iv) What is effect of particle size on Hardness of nanomaterials? [2]
- v) Write down any two application of nanotechnology in defense field. [2]

b) Calculate the wavelength of an energy is 1.9 eV. [3]

Q2) a) i) Explain signiface of nanomaterial. [4]

ii) Explain Graphene with their application. [3]

b) Explain in brief sol-gel method for synthesis of nanomaterials. [5]

Q3) a) Describe the carbon nano tube and their application. [6]

b) Explain the Hydrothermal method in brief. [6]

P.T.O.

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

[12]

- a) Optoelectronic application
- b) Electrical properties
- c) Biomedical application
- d) Chemical bath deposition



Total No. of Questions : 7]

SEAT No. :

PE-5232

[Total No. of Pages : 2

[6509]-107

First Year M.Sc.

PHYSICS

**CBOP-I (PHOT-124B4) : Physics of Nanomaterials
(2020 Pattern) (Semester - 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 right indicate full marks.*
- 5) *Neat diagrams must be drawn where necessary.*
- 6) *Use of log-table or non-programmable electronic calculator is allowed.*

Q1) Solve any five of the following.

[10]

- a) State significance of nanomaterials.
- b) State the applications of CVD.
- c) Define the nanocrystals.
- d) What are nano-composites?
- e) Write applications of metal reduction method.
- f) Explain effect of reduction of dimensions of nanomaterial.
- g) What is fullerene.

Q2) a) Describe sol-gel method for synthesis of nanomaterials. Give its advantages and disadvantages. **[7]**

b) Explain surface and interface effect of nanomaterials. **[5]**

Q3) a) Explain in details the synthesis of nanomaterials by biological method. **[7]**

b) What is nanomaterial? How it is classified on the basis of dimensions. **[5]**

P.T.O.

- Q4)** a) Explain the mechanism of nucleation and growth of nanoparticles. [7]
b) Explain opto-electronic applications of nanomaterials. [5]
- Q5)** a) Explain top-down and bottom-up approach for nanomaterials synthesis. [7]
b) Write a note on Carbon nanotubes and their types. [5]
- Q6)** a) Describe synthesis of nanomaterials by using physical vapour deposition method with suitable diagram. [7]
b) What is the mechanism of hydrothermal method? [5]
- Q7)** Write short note on any three of following. [12]
a) Graphene
b) Aerogel
c) Quantum size effect
d) Metal reduction method



Total No. of Questions : 4]

SEAT No. :

PE-5233

[Total No. of Pages : 2

[6509]-108

First Year M.Sc.

PHYSICS

**CBOP-I (PHOT-124C2) : Lasers and Applications
(2020 Pattern) (Semester - 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 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 the term LASER. What is stimulated emission. [2]
- ii) What is population inversion? [2]
- iii) What is metastable state? [2]
- iv) State the principle of optical fibre. [2]
- v) Calculate the coherence length of CO₂ laser whose line width is 1×10^{-5} nm of IR emission wavelength of 10.6 μ m. [2]

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

Q2) a) What are the properties of laser light? Explain in brief each of them. [7]

b) Explain construction and working of Nd-YAG laser with neat diagrams. [5]

Q3) a) Explain the construction and working of He-Ne laser with neat diagram. [7]

b) Find the relative population of the two states in a ruby laser that produces a light beam of wavelength 6943Å at 300 K and 500 K. (Given : Boltzmann constant = $K = 1.38 \times 10^{-23}$ J/K) [5]

P.T.O.

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

- a) Characteristics of laser [4]
- b) Ruby laser [4]
- c) Comparison between solid and gas lasers [4]
- d) Absorption and gain coefficients [4]



Total No. of Questions : 7]

SEAT No. :

PE-5234

[Total No. of Pages : 2

[6509]-109

First Year M.Sc.

PHYSICS

**CBOP-I (PHOT-124C4) : Lasers and Applications
(2020 Pattern) (Semester - II)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following.

[10]

- a) What are the main properties of laser light?
- b) Explain spontaneous emission of radiation.
- c) What is population inversion? Why it is important in lasers?
- d) What is metastable state? How it is useful in lasers?
- e) Write any two medical applications of lasers.
- f) Define pumping in lasers and give its types.

Q2) a) Define Einstein coefficients and derive the relation between them.

[7]

b) Explain the construction and working of He-Ne laser.

[5]

Q3) a) What are laser cavity modes? Explain longitudinal and transverse modes.

[6]

b) With neat diagram, explain the construction, working and energy level diagram of CO₂ laser.

[6]

P.T.O.

- Q4)** a) i) The half width of gain profile of a He-Ne laser material is about 2×10^{-3} nm. If the length of the cavity is 30 cm. How many longitudinal modes can be excited? The emission wavelength of He-Ne laser is 8328Å. [4]
- ii) Explain the applications of lasers in defence. [3]
- b) Derive an expression for threshold condition for lasers. [5]
- Q5)** a) Describe construction and working of Nd-YAG laser. [6]
- b) Find the relative population inversion of the two stages in ruby laser that produces a light beam of wavelength 6943Å at 300°K and 500°K. [6]
- Q6)** a) Explain the action of optical resonator and obtain the expression for threshold condition. [6]
- b) Explain the construction and working of semiconductor diode laser. [6]
- Q7)** Write short note on any three of following.
- a) Ordinary light and lasers [4]
- b) Applications of lasers in industry [4]
- c) Scientific applications of lasers [4]
- d) Gas lasers [4]



Total No. of Questions : 4]

SEAT No. :

PE-5235

[Total No. of Pages : 2

[6509]-110

First Year M.Sc.

PHYSICS

Physics of Semiconductor Devices

CBOP-I (PHOT-114D2/124D2/243D2)

(2020 Pattern) (Semester - I,II&IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) Question 1 is compulsory.
- 2) Attempt any two questions from Q2 to Q4.
- 3) Q.2 to Q.4 carry equal marks.
- 4) Use of calculator is allowed.
- 5) Neat diagrams must be drawn wherever necessary.

- Q1)** a) Solve any Four of the following: [8]
- i) What is Schottky contact? [2]
 - ii) Draw a neat diagram of JFET with biasing. [2]
 - iii) What do you mean by Ohmic contact? [2]
 - iv) Write mobility equations for p-type and n-type semiconductors. [2]
 - v) State Hall Effect. [2]
- b) Explain with neat diagram the pinch-off of JFET. [3]
- Q2)** a) Explain in detail the different equations for semiconductors. Give brief account of each term. [7]
- b) What is generation and recombination of carriers? State their various types. [5]
- Q3)** a) Explain Static characteristics of SCR. [7]
- b) Describe in detail the types of semiconductors. [5]

P.T.O.

- Q4)** Write a short note on any three of the following: [12]
- a) Depletion region in semiconductor devices [4]
 - b) General technique of fabrication of PN-junction [4]
 - c) Biasing of transistor [4]
 - d) Current gain in Transistor [4]



Total No. of Questions : 7]

SEAT No.

PE-5236

[Total No. of Pages : 2

[6509]-111

First Year M.Sc.

PHYSICS

Physics of Semiconductor Devices

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

(2020 Pattern) (Semester-I,II&IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question 1 is compulsory.*
- 2) *Attempt any five questions from Q2 to Q7.*
- 3) *Q.2 to Q.7 carry equal marks.*
- 4) *Use of calculator is allowed.*
- 5) *Neat diagrams must be drawn when necessary.*
- 6) *Figures to the right side indicate full marks.*

Q1) Solve any Five of the following:

- a) Give the device configuration of SCR. [2]
- b) Define drift velocity and emitter injection efficiency. [2]
- c) Define direct and indirect band gap. [2]
- d) State Hall Effect. Write down the equation of Hall mobility. [2]
- e) Draw neat diagram of metal-semiconductor contact energy band with an interfacial layer. [2]
- f) Write a note on Schottky effect. [2]

Q2) a) Explain the construction of SCR also draw I-V plot of SCR. [7]

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

Q3) a) Explain carrier diffusion and obtain Einstein equation. [7]

b) Write a note on current gains in transistor. [5]

P.T.O.

- Q4)** a) Describe direct and indirect band gap semiconductor. [7]
b) Explain, how to obtain Schottky barrier height? [5]
- Q5)** a) Explain construction and working of metal semiconductor. [7]
b) Explain the working of junction field effect transistor. [5]
- Q6)** a) What do you mean by recombination of carriers? Explain any two recombination of carriers. [7]
b) Describe carrier concentrations for resistivity and obtain expression for the resistivity of n-type & p-type semiconductor. [5]
- Q7)** Attempt any three of the following.
- a) Write a note on IMPATT diode. [4]
b) Explain basic characteristics of UJT construction. [4]
c) Explain Radiative and Non-radiative recombination. [4]
d) Explain the concept of band origin in semiconductor. [4]



Total No. of Questions : 4]

SEAT No. :

PE-5237

[Total No. of Pages : 2

[6509]-112
First Year M.Sc.
PHYSICS
Communication Electronics

(CBOP-I(PHOT-114E2/124E2/243E2) (2020 Pattern) (Semester-I,II&IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Question 1 is compulsory.*
- 2) *Write any two questions from Q2 to Q4.*
- 3) *Figures to the right indicate full marks.*

Q1) a) Solve any Four of the following:

- i) What is digital communication? [2]
- ii) Define Signal-to-Noise Ratio (SNR) [2]
- iii) Differentiate between Baudot code and ASCII code. [2]
- iv) Explain the concept of synchronous satellite system. [2]
- v) Define facsimile transmission. [2]
- b) Draw the block diagram of basic pulsed radar set. [3]

Q2) a) Explain network organization. Determine the number of links required between 6 PCs. [7]

- b) Calculate the capacity of a standard 4 kHz telephone channel has 3100 Hz bandwidth with 30 dB signal to noise ratio. [5]

Q3) a) Draw the block diagram of digital communication system and explain function of each block. [7]

- b) What is Facsimile? Give the principle of facsimile. Explain its eye in telecommunication. [5]

P.T.O.

Q4) Attempt any three of the following:

- a) What is Distortion in digital communication, and how can it be minimized? [4]
- b) Explain how data circuits are interconnected to telephone loops? [4]
- c) Explain the working of four-wire transmission system. [4]
- d) How does path loss affect satellite communication? [4]



Total No. of Questions : 7]

SEAT No.

PE-5238

[Total No. of Pages : 2

[6509]-113

First Year M.Sc.

PHYSICS

Communication Electronics

CBOP-I (PHOT-114E4/124E4/243E4) (2020 Pattern) (Semester-I,II&IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question 1 is compulsory.
- 2) Solve any five questions from Q2 to Q7.
- 3) Q.2 to Q.7 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of log tables and non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) Solve any Five of the following:

- a) Define Signal-to-Noise Ratio (SNR). [2]
- c) What is Crosstalk in digital communication? [2]
- c) What is a two-wire repeater? [2]
- d) Define geostationary orbit. [2]
- e) Define the principle of light transmission in fiber optics. [2]
- f) What is multiplexing? [2]

Q2) a) Explain different satellite scanning methods and their role in communication and imaging. [7]

- b) Explain the working principle of an echo suppressor and its importance. [5]

Q3) a) Describe four different code used for data transmission and state their advantages and limitations. [7]

- b) What is Facsimile? Give the principle of Facsimile. Explain its use in telecommunication. [5]

Q4) a) Draw the block diagram of digital communication system & explain function of each block. [7]

- b) Derive the radar range equation and explain its significance. [5]

P.T.O.

- Q5)** a) Discuss how modern interfacing techniques improve digital communication system? [6]
b) Discuss different type of losses in optical fibers and methods to minimize them. [6]
- Q6)** a) Compare the working principles of wire telephone and mobile telephone systems. [6]
b) Discuss different type of radar system and their applications in modern technology. [6]
- Q7)** Write a short note on any three of the following:
- a) Basic pulsed radar [4]
 - b) Network organization [4]
 - c) Fiber communication system [4]
 - d) Telephone subscribe loop circuit [4]



Total No. of Questions : 4]

SEAT No. :

PE-5239

[Total No. of Pages : 2

[6509]-114
First Year M.Sc.
PHYSICS
CBOP-I [PHOT-124F2] : Microwave Physics and
Applications
(2020 Pattern) (Semester - II)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Question 1 is compulsory.*
- 2) *Attempt any two questions from Q2 to Q4.*
- 3) *Q.2 to Q.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Attempt any Four of the following:

- i) What is the significance of the Smith Chart in Microwave engineering? [2]
- ii) Difference between TE and TM modes in waveguides. [2]
- iii) Principle of microwave generation. [2]
- iv) Define the bunching process in Klystron. [2]
- v) Define the Applegate diagram. [2]
- b) What are admittance resonant lines? [3]

- Q2) a)**
- i) How does a Magnetron generate microwave energy? [4]
 - ii) Differentiate between a rectangular and a circular waveguide. [3]
 - b) Discuss the role of cavity resonators in microwave circuits. [5]

P.T.O.

- Q3)** a) Explain in detail the concept of standing waves and their effect on transmission lines. [7]
- b) Derive the expression for the reflection coefficient in a transmission line. [5]

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

- a) The function of a Travelling Wave Tube Amplifier (TWTA) [4]
- b) Significance of the Q-factor in cavity resonators [4]
- c) Frequency limitations of microwave transistors [4]
- d) Concept of single stub and double stub matching [4]



Total No. of Questions : 7]

SEAT No. :

PE-5240

[Total No. of Pages : 2

[6509]-115

First Year M.Sc.

PHYSICS

CBOP-I [PHOT-124F4] : Microwave Physics and Applications

(2020 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question 1 is compulsory.*
- 2) *Solve any five questions from Q2 to Q7.*
- 3) *Q.2 to Q.7 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any Five of the following:

- a) What are microwave and their frequency range? [2]
- b) Define a single stub and double stub matching. [2]
- c) Define Standing Wave Ratio (SWR). [2]
- d) Define the Q-factor of a cavity resonator. [2]
- e) State the principles of microwave generation. [2]
- f) Define a bolometer. [2]

Q2) a) Discuss applications of microwaves in industries, medicine and defense. [7]

- b) Derive the equation for the reflection coefficient and explain its physical significance. [5]

Q3) a) Explain the concept of frequency limitation in microwave transistors and the factors affecting it. [7]

- b) Explain the use of a Smith chart for impedance matching with an example. [5]

P.T.O.

- Q4)** a) Explain in detail the working principle of microwave isolators and their role in preventing signal reflections. [7]
b) Explain the Applegate diagram and its importance in the bunching process. [5]
- Q5)** a) Describe the role of transmission lines in microwave communication and their applications. [6]
b) Compare the working principles and applications of MOSFET and PIN diode. [6]
- Q6)** a) Explain in detail the working of a single and double stub impedance matching technique. [6]
b) Discuss the importance of power gain and maximum available gain in microwave transistors. [6]
- Q7)** Solve any three of the following.
- a) Derive the general transmission line equation. [4]
b) Compare rectangular and circular waveguides in terms of structure and applications. [4]
c) Explain the working principle of a reflex klystron with a diagram. [4]
d) Describe the working of a microwave isolator with a diagram. [4]



Total No. of Questions : 7]

SEAT No. :

PE-5241

[Total No. of Pages : 2

[6509]-201

First Year M.Sc.

PHYSICS

PHCT-121 : Electrodynamics

(2020 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following :

[5×2=10]

- a) Explain the significance of $\vec{\nabla} \cdot \vec{J} + \frac{d\rho}{dt} = 0$.
- b) State two postulates of theory of relativity.
- c) Write differential form of Maxwell's equations in free space.
- d) Write Lorentz condition for magnetic vector potential.
- e) State Poynting theorem.
- f) Explain D-Alembertian operator.

Q2) a) Explain linear quadrapole system. Derive an expression of electric potential at any point P due to linear quadrapole. [7]

b) Obtain wave equations in terms of electromagnetic potential. [5]

P.T.O.

- Q3)** a) Describe Michelson-Morley experiment with suitable diagram. Discuss the negative results of the experiment. [7]
- b) Derive an expression of force acting on current carrying circuit due to magnetic interactions between two current loops. [5]
- Q4)** a) Explain Lorentz gauge and Coulomb's gauge. [7]
- b) Discuss Faraday's law for stationary and moving media. [5]
- Q5)** a) Obtain electromagnetic wave equations in a homogeneous, isotropic conducting medium. [7]
- b) Using relativistic addition prove that any -velocity added relativistically to the velocity of light reproduces the velocity of light. [5]
- Q6)** a) Obtain Snell's law if a plane electromagnetic C wave is incident obliquely on an interface between the two non conducting dielectric medium. [6]
- b) What is meant by skin depth? Obtain an expression of skin depth and discuss the factors affecting on skin depth. [6]
- Q7)** Attempt any Three of the following: [12]
- a) Write a note on Minkowski's space time diagram.
- b) Discuss Hertz potential.
- c) State Poynting theorem. Give physical significance of it.
- d) Discuss Maxwell's displacement current.
- e) Write the boundary conditions at the interface between two media for $\vec{E}, \vec{D}, \vec{B}$ and $\vec{H}$.



Total No. of Questions : 7]

SEAT No. :

PE-5242

[Total No. of Pages : 2

[6509]-202

First Year M.Sc.

PHYSICS

PHCT-122 : Atoms and Molecules

(2020 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Q.No.1 is compulsory.
- 2) Attempt / Solve any five questions from Q.No.2 to Q.No.7.
- 3) Q.No.2 to Q.No.7 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of logarithmic or non programmable electronic calculator is allowed.

Given:

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

Charge an electron : 1.602×10^{-19} coulomb

Plank's constant : 6.626×10^{-34} Joule-sec

Boltzmann constant : 1.381×10^{-23} Joule / °K

Ayogadr's number : 6.023×10^{23} atoms / mole

1 eV : 1.602×10^{-19} Joule

Bohr magneton μ_B : 9.274×10^{-24} Joule / Tesla

Q1) Solve any five of the following :

[5×2=10]

- a) State Anomalous Zeeman effect.
- b) State Pauli exclusion principle.
- c) Define principle of NMR.
- d) State selection rule for L, J and S.
- e) Determine the spectral notation $(2S+1)_{L_J}$ for Al atom.
- f) Define four application of IR spectroscopy.

P.T.O.

- Q2)** a) State principle of ESR spectroscopy. Explain it's construction and working with neat diagram. [7]
b) Define coupling schemes. Explain LS coupling scheme for 'Pd' configuration. [5]
- Q3)** a) Explain construction, working and application of Raman spectroscopy. [7]
b) Electron spin resonance is observed in atomic hydrogen at a magnetic field $B = 0.34$ Tesla. Calculate ' g ' value for the electron in the hydrogen atom, If the operating frequency is 9.5 GHz. [5]
- Q4)** a) Explain normal Zeeman effect. Determine the formula for wave number shift in spectral line. [7]
b) State and explain Franck-Condon principle. [5]
- Q5)** a) Explain experimental arrangement and working of NMR spectroscopy. [6]
b) Discuss vibrational analysis of band system. [6]
- Q6)** a) Draw a block diagram of IR spectrophotometer and explain it's working. [6]
b) Explain Paschen-Back effect for 2S-2P transition. [6]
- Q7)** Write a short note on any three of the following : [3×4=12]
a) Application of NMR.
b) Total Hamiltonian and Hyperfine structure of ESR.
c) Vibrational course structure.
d) Physical interpretation of four quantum numbers.



Total No. of Questions : 7]

SEAT No. :

PE-5243

[Total No. of Pages : 2

[6509]-203

First Year M.Sc.

PHYSICS

PHCT-123 : Quantum Mechanics

(2020 Pattern) (Semester - II)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question No.1 is compulsory.
- 2) Attempt any five questions from Q.No.2 to Q.No.7.
- 3) Figures to the right indicate full marks.
- 4) Use of log-tables and calculators allowed.
- 5) Q.No.2 o Q.No.7 carry equal marks.
- 6) Neat diagrams must be drawn wherever necessary.

Q1) Solve any five of the following:

[5×2=10]

- a) Explain wave packet.
- b) Show that momentum operator is self adjoint.
- c) Explain Hilbert space.
- d) Show that $[L^2, L_x] = 0$.
- e) What is meant by harmonic perturbation.
- f) Explain projection operator.

Q2) a) i) When a set of functions $\{\phi_a\}$ is said to be orthonormal and complete?

Hence obtain the closure property $\sum \phi_a(\vec{x})\phi_a^*(\vec{x}') = \delta(\vec{x} - \vec{x}')$. [4]

ii) State physical significance of Eigen values and Eigen functions of an observable. [3]

b) Define spin angular momentum operator. Hence obtain Pauli spin matrices. [5]

P.T.O.

- Q3)** a) i) Obtain the first order correction in energy using time independent perturbation theory. [4]
 ii) State fundamental postulates of quantum mechanics. [3]
 b) Explain Fermi Golden rule. [5]
- Q4)** a) i) What is Unitary operator? Show that the norm of any state $|\psi\rangle$ does not change under unitary transformation. [4]
 ii) Explain condition of validity of WKB approximation. [3]
 b) Obtain Eigen values of L^2 and L_z operator. [5]
- Q5)** a) Using operator method obtain the energy Eigen value of one dimensional harmonic oscillator. [6]
 b) Evaluate the Clebsch-Gordan coefficient matrix equation for a system having $j_1 = \frac{1}{2}, j_2 = \frac{1}{2}$. [6]
- Q6)** a) Obtain first order transition amplitude $a_n^1(t)$ in time dependent perturbation theory. [7]
 b) Let $\alpha = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and $\beta = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Show that α and β are the Eigen vectors of Pauli spin matrix σ_z . [5]
- Q7)** Write short note on any three of the following:
- a) Explain Zeeman effect. [4]
 b) Explain principle of variational method. [4]
 c) Explain: [4]
 i) State vectors
 ii) Norm and Scalar product
- d) For $j = \frac{1}{2}$, obtain matrix j_x . [4]



Total No. of Questions : 7]

SEAT No. :

PE-5244

[Total No. of Pages : 2

[6509]-301

S.Y. M.Sc.

PHYSICS

**PHCT-231: Statistical Mechanics
(2020 Pattern) (Semester -III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question 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 table or non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Constants:-

- | | |
|-----------------------|---|
| 1. Boltzmann constant | $K_B = 1.38 \times 10^{-23} \text{ J/k}$ |
| 2. Planck's constant | $h = 6.623 \times 10^{-34} \text{ J.sec}$ |
| 3. Avogadro's number | $N = 6.023 \times 10^{23} / \text{gm-mole}$ |
| 4. Mass of electron | $M_e = 9.1 \times 10^{-31} \text{ kg}$ |
| 5. Velocity of light | $c = 3 \times 10^8 \text{ m/s}$ |
| 6. Charge on electron | $e = 1.6 \times 10^{-19} \text{ c}$ |

Q1) Attempt any five of the following

- a) What is meant by ensemble? Discuss microcanonical ensemble. [2]
- b) Explain microstate and macrostate. [2]
- c) Calculate mean value $\overline{E^2}$ for canonical ensemble in terms of partition function. [2]
- d) Write the postulates of equal priori probability. [2]
- e) Define phase space and mu-space [2]
- f) The energy state of a particle moving in a rigid cubical box is specified

by the equation $n_x^2 + n_y^2 + n_z^2 = \frac{2mL^2 E}{\pi^2 \hbar^2} = 14$ Determine the number of microstates accessible to the particle. [2]

P.T.O.

- Q2) a)** On the basis of canonical distribution, obtain the law of atmosphere. [7]
- b)** Obtain stefan's law of radiation $E = \sigma T^4$ in case of black body radiation. [5]
- Q3) a)** Using canonical ensemble show that the pressure $\bar{p} = \frac{1}{\beta} \frac{\partial (\ln \psi)}{\partial z}$ [7]
- b)** State and prove Maxwell's first and second thermodynamic relations. [5]
- Q4) a)** State and prove Liouville's theorem. [6]
- b)** The molar mass of lithium is 0.00694 and its density is $0.53 \times 10^3 \text{ kg/m}^3$. Calculate Fermi energy and Fermi temperature of the electron. [6]
- Q5) a)** State the equipartition theorem. Hence find out mean energy for solid consisting of N molecules. [6]
- b)** In case of canonical ensemble, find mean square deviation or dispersion in Energy. [6]
- Q6) a)** Show that Maxwell distribution of speed is given by
- $$F(V)dV = 4\pi n \left[\frac{m}{2\pi kT} \right]^{3/2} V^3 e^{-\frac{mv^2}{2kT}} dV \quad [6]$$
- b)** Two macroscopic system A and A' are in thermal interaction with each other forming a combined system A°. Show that $S = K \ln \Omega(E)$. [6]
- Q7) Write short notes on Any three.**
- a) White Dwarf [4]
- b) Radiation density [4]
- c) Debye model [4]
- d) Gibb's paradox [4]



Total No. of Questions : 7]

SEAT No. :

PE-5245

[Total No. of Pages : 2

[6509]-302

S.Y. M.Sc.

PHYSICS

**PHCT-232: Solid State Physics
(2020 Pattern) (Semester -III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question 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-table or non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn wherever necessary.

Constants:-

- | | |
|-------------------------------|--|
| 1. Planck's constant | $= 6.626 \times 10^{-34} \text{ J.s}$ |
| 2. Mass of electron | $= 9.1 \times 10^{-31} \text{ kg}$ |
| 3. Boltzmann constant | $= 1.38 \times 10^{-23} \text{ J/k}$ |
| 4. Avogadro's Number | $= 6.023 \times 10^{23} / \text{mole}$ |
| 5. Permeability of free space | $= 4\pi \times 10^{-7} \text{ Henry/m}$ |
| 6. Charge on electron | $= 1.6 \times 10^{-19} \text{ C}$ |
| 7. Permittivity of free space | $= 8.85 \times 10^{-12} \text{ C}^2 / \text{Nm}^2$ |
| 8. Bohr magneton | $= 9.27 \times 10^{-24} \text{ J/T}$ |

Q1) Solve any five of the following

- | | |
|--|-----|
| a) Explain fermi sphere. | [2] |
| b) Explain crystal field splitting. | [2] |
| c) Define Anisotropy energy. | [2] |
| d) Distinguish between diamagnetism and paramagnetism. | [2] |
| e) Explain piezoelectricity. | [2] |
| f) What is paramagnetic susceptibility? | [2] |

P.T.O.

- Q2)** a) i) Describe the Langevin theory of paramagnetism. [4]
 ii) Write short note on saturation magnetization at absolute zero. [3]
 b) Give an account of Weiss theory of ferromagnetism. Hence obtain Curie-Weiss law. [5]
- Q3)** a) State and prove Bloch theorem. [7]
 b) The critical T_c for mercury with isotopic mass 199.5 is 4.185K. Calculate its critical temperature when its isotopic mass changes to 203.4. [5]
- Q4)** a) Explain Antiferromagnetism with reference to the Neel temperature and susceptibility. Hence describe ferrimagnetism. [7]
 b) Show that for a superconductor on the basis of Meissner effect and Maxwell's equation magnetic susceptibility is $\chi = -1$ [5]
- Q5)** a) Explain classical theory of paramagnetism, hence derive Curie law. [7]
 b) Describe motion of electron in 1-D periodic potential. [5]
- Q6)** a) On the basis of band theory of solids distinguish between metal, semiconductor and insulator. [7]
 b) Describe assumptions of BCS theory of superconductivity. [5]
- Q7)** Write short notes on Any three of the following. [12]
 a) Type I & Type II superconductors [4]
 b) Magnetic properties of rare earth ions and iron group ions. [4]
 c) Band structure of semiconductor crystal. [4]
 d) Ferromagnetic domains. [4]



Total No. of Questions : 7]

SEAT No. :

PE-5246

[Total No. of Pages : 3

[6509]-303

S.Y. M.Sc. (Physics)

PHYSICS

PHCT-233 : Experimental Techniques in Physics - I
(2020 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question No.1 is compulsory.*
- 2) *Solve any five questions from Q.No.2 to Q.No.7.*
- 3) *Q.No.2 to Q.No.7 carry equal marks.*
- 4) *Draw neat and labelled diagrams wherever necessary.*
- 5) *Figures to the right indicate full marks.*
- 6) *Use of logarithmic table and calculator is allowed.*

Q1) Solve any five of the following:

- a) Define the terms: systematic and random errors. [2]
- b) Name the sources of experimental error. [2]
- c) Give important sensor characteristics. [2]
- d) State important applications of vacuum. [2]
- e) Comment on impingement rate of molecules on a surface. [2]
- f) Define the terms: viscosity and diffusion. [2]

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

OR

- i) With the help of schematic diagram explain vacuum system design. [4]
- ii) Describe in detail about signal to noise ration. [3]
- b) Derive the relation for the effective speed of the vacuum pump. [5]

P.T.O.

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

OR

- i) Explain signal analysis in context with time and frequency domain. [4]
- ii) How much time it would require for a vacuum pump with speed 30 m³/hr and chamber capacity of 60 m³ to reduce the pressure from 1000 mbar to 500 mbar. [3]
- b) Write down the operation principle, construction and working with a neat diagram of any one electric sensor. [5]

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

OR

- 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 pump speed. [3]
- b) Discuss the basic principle, construction and working of a refrigeration system. [5]

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

- b) Discuss the operating principle, construction and working with a neat diagram of any one thermal sensor. [5]

OR

- a) With the help of a neat diagram, explain the principle, construction and working of Cryogenic getter ion pump. [6]
- b) Derive the relation for the down time of the vacuum pump. [6]

- Q6) a)** With the help of neat diagram, explain the principle, construction and working of Penning gauge. [6]

- b) With the help of neat diagram explain the construction and working of Titanium sublimation pump. [5]

OR

- a) With the help of a neat diagram, explain the principle, construction and working of Pirani gauge. [6]
- b) Describe the throttling process in detail and prove that entropy remains constant in this process. [6]

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

- a) Give the classification of sensors. [4]
- b) Explain thermal conductivity, viscosity and diffusion of gasses. [4]
- c) Comment in detail on Reliability-Chi square test. [4]
- d) Describe the terms: gas conductance and gas impedance of a vacuum line in detail [4]

OR

- a) With the help of a neat diagram, explain the principle, construction and working of Bayard-Alpert gauge. [6]
- b) Explain the flow of gases through apertures, elbows and tubes for viscous flow regime. [6]
- c) With the help of a neat diagram, explain the principle, construction and working of sputter ion pump. [6]



Total No. of Questions : 4]

SEAT No. :

PE-5247

[Total No. of Pages : 2

[6509]-304

S.Y. M.Sc.

PHYSICS

PHOT-234M2 : Material Science-I

(2020 Pattern) (Semester - III)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

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

- i) Define defect in solids.
 - ii) What is Solid solution?
 - iii) What is dislocation?
 - iv) Define the term vacancies and interstitials.
 - v) State twin boundary.
- b) Calculate the spacing between dislocation in tilt boundary in FCC crystal when angle of tilt is 2° . [Given: Burger's vector $b = 4.150 \text{ \AA}$] **[3]**

Q2) a) What is Dislocation? Distinguish between edge and screw dislocation. **[6]**

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

Q3) a) Describe Frank-Read generator for the multiplication of dislocation. **[7]**

b) Draw a flow chart of defects. **[5]**

P.T.O.

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

[3×4=12]

- a) Point defect
- b) Thermal properties
- c) Volume defect
- d) Solid solubility with few examples



Total No. of Questions : 7]

SEAT No. :

PE-5248

[Total No. of Pages : 2

[6509]-305

S.Y. M.Sc.

PHYSICS

PHOT-234M4 : Material Science-I

(2020 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following:

[10]

- a) What does mean by stacking fault?
- b) Write a short note on volume defect.
- c) Give the significance of Phase diagram.
- d) Discuss the types of solid solution.
- e) Discuss the magnetic properties of material.
- f) State and explain Vegard's law.

Q2) a) Explain in detail Type-I and Type-II phase diagrams with suitable examples. **[7]**

b) Discuss the thermodynamic properties of solid solution. **[5]**

Q3) a) What is meant by point defects in the material? Elaborate various types of point defects with suitable diagram. **[7]**

b) Write phenomenon of diffusion. Discuss various factors governing the diffusion in the material. **[5]**

P.T.O.

- Q4)** a) Explain Gibb's Phase rule. Obtain the degrees of freedom of a system of two components when number of phases is 1, 2 and 3. [7]
b) Explain the term miscibility gap with the help of free energy diagram. Give an example to support the answer. [5]
- Q5)** a) Describe Line defects. Derive an expression to obtain force on the dislocation. [6]
b) Write a note on solid solubility with examples. Explain various factors governing solid solubility using Hume-Rothery rule. [6]
- Q6)** a) State Fick's first and second law of diffusion and describe the experiment to determine D, Coefficient of diffusion. [6]
b) Explain phase diagram of type-III (pb-Sn). [6]
- Q7)** Write a short note on any three of the following: [12]
a) Discuss the grain boundaries due to surface defects.
b) Explain:
i) Extension rule
ii) Syntactic reaction in phase diagram
c) Richard's and Trouton's rule in thermodynamics.
d) Write a note on diffusion process in doping of semiconductors.



Total No. of Questions : 4]

SEAT No. :

PE-5249

[Total No. of Pages : 2

[6509]-306

S.Y. M.Sc.

PHYSICS

**PHOT-234N2 : Medical Physics-I
(2020 Pattern) (Semester - III)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

Q1) a) Attempt any four of the following:

- i) Define static equilibrium in biomechanics. [2]
- ii) State the Nernst equation and its importance in physiology. [2]
- iii) Define audibility. [2]
- iv) Define sound pollution. [2]
- v) What are photoreceptors in the human eye? [2]
- b) Differentiate between EMG and ECG signals. [3]

Q2) a) Compare and contrast the Nernst and Goldman equations with examples. [7]

- b) Explain the working of an ECG and its clinical significance. [5]

Q3) a) Describe the structure and function of photoreceptors in the human eye. [7]

- b) Describe the factors affecting the mechanics of joints. [5]

P.T.O.

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

- a) Physics of eur [4]
- b) MCG, MEG [4]
- c) Pressure in the body [4]
- d) Heat losses from body [4]



Total No. of Questions : 7]

SEAT No. :

PE-5530

[Total No. of Pages : 2

[6509]-307

M.Sc. - II

PHYSICS

PHOT-234-N4 : Medical Physics - I
(CBCS) (2020 Pattern) (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 indicate full marks.
- 5) Use of log-table of non-programmable electronic calculator is allowed.
- 6) Neat diagrams must be drawn where necessary.

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

- a) Define : Audibility.
- b) State properties of passive nerve membrane.
- c) State principle of EOG biopotential.
- d) Define aberration in lenses.
- e) Write frequency range of audibility of healthy human ear.
- f) Define : Resolution and magnification.

Q2) a) i) Explain human audibility curve. [4]

ii) Explain diffraction effect of eyes. [3]

b) Explain ECG biopotential with suitable diagram. [5]

Q3) a) i) Discuss the physics of ear. [4]

ii) Explain physics properties of bone. [3]

b) Discuss various instruments used in opthalmology. [5]

P.T.O.

- Q4)** a) i) Discuss effects of sound pollution on living body. [4]
ii) Explain the photoreceptors. [3]
b) Discuss Goldman equation to calculate membrane potential concentrations. [5]
- Q5)** a) Explain factors affecting on muscle contraction and regulation. [6]
b) Discuss heat losses from the body. [6]
- Q6)** a) Explain various methods to minimize sound pollution. [6]
b) Explain EMG biopotential with suitable diagram. [6]
- Q7)** a) Write short note on testing of hearing. [4]
b) Write short note on color vision. [4]
c) Write short note on EEG biopotential. [4]



Total No. of Questions : 4]

SEAT No. :

[Total No. of Pages : 2

PE-5250

[6509]-308

S.Y. M.Sc.

PHYSICS

PHOT-234G2 : Acoustics-I

(2020 Pattern) (Semester - III)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) Question No.1 is compulsory.
- 2) Solve/Attempt any two questions from Q.No.2 to Q.No.4.
- 3) Q.No.2 to Q.No.4 carry equal marks.
- 4) Figures to the right indicate full marks.
- 5) Use of log-tables and 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 Eyring approach of standing wave ratios? [2]
- ii) Define Sound Pressure Level (SPL). [2]
- iii) Give formula and unit for sound intensity level. [2]
- iv) What is Sabine's formula? Write its equation. [2]
- v) What is equivalent continuous sound pressure level (LAeq). [2]

b) Find reverberation time for an office which has volume of 1600 m³ and total sound absorption of 80 metric sabine. What is sound absorption required for an optimum reverberation time of 1.2 sec? [3]

Q2) 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 1 W of power assuming spherical propagation of sound waves in case of following reference intensity. [3]

1) 10^{12} W/m²

2) 10^{-12} W/m²

P.T.O.

- b) Determine the room modes (800), (302), (122) and (222) for a seminar hall $54 \times 36 \times 15$ cubic ft. What do you conclude? [5]

[Given: $C = 1130$ ft/sec].

- Q3)** a) Explain the analogies between electrical, mechanical and acoustical systems. [7]

- b) Determine the energy density and effective pressure of a plane wave in air of 70 dB intensity level. Determine the energy density and effective pressure of a plane wave in water, if its sound pressure level is 70 dB re 1 microbar. [5]

- Q4)** Write a short notes on any three of the following: [12]

- a) Helmholtz Resonator
- b) Hass effect
- c) Sound absorption coefficient
- d) Standing wave ratio and its significance



Total No. of Questions : 7]

SEAT No. :

PE-5251

[Total No. of Pages : 2

[6509]-309

S.Y. M.Sc.

PHYSICS

PHOT-234G4 : Acoustics-I

(2020 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question No.1 is compulsory.
- 2) Solve/Attempt any two questions from Q.No.2 to Q.No.7.
- 3) Q.No.2 to Q.No.7 carry equal marks.
- 4) Figures to the right side 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 specific acoustic impedance. Give it's unit. [2]
- b) What do you mean by live and dead rooms? [2]
- c) Find sound power level in an enclosure which emits 1 W of acoustic power. [$W_0 = 10^{-12}$ W] [2]
- d) Define reverberation time and give it's formula. [2]
- e) Write formula and unit for sound intensity level. [2]
- f) What do you mean by Standing Wave Ratio (SWR)? [2]

- Q2) a) i) Write a note on Hass Effect. [4]
- ii) Find the reverberation time of an office which has a volume of 1600 m^3 and a total sound absorption of 100 metric sabines. What would be the sound absorption required for an optimum reverberation time of 1.2 sec? [3]
- 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 the effective stiffness constant and quality factor. [Given: $C=343 \text{ m/s}$] [5]

P.T.O.

- Q3)** a) i) Discuss the term velocity of sound in fluids. [4]
 ii) The decrease in intensity level of a plane wave passing from medium A to medium B is 35 dB. Determine the corresponding sound power reflection coefficient. [3]
 b) Explain Sound Transmission Class (STC). [5]
- Q4)** a) i) Discuss the conditions under which one should use Eyring's or Millington's equation rather than Sabine's for reverberation time estimation. [4]
 ii) In case of 'Reflection at the surface of a solid', the SWR is 2.0 and the first node is located at a distance of $\frac{3}{8} \lambda$ from the reflecting surface. Determine the magnitude of normal specific acoustic impedance of the solid. [3]
 b) Discuss types of room modes in details. [5]
- Q5)** a) Explain the analogies between electrical, mechanical and acoustical systems. Give acoustical equivalent electrical circuit of Helmholtz resonator. [6]
 b) With the help of a neat diagram explain human hearing mechanism. [6]
- Q6)** a) i) Define Phon and Sone. Derive relation between them. [4]
 ii) Determine the acoustic intensity level at a distance of 10 m from a source that radiates 1 W 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
 b) With the help of a neat diagram, explain working of an expansion chamber muffler. [5]
- Q7)** Write a short note on any three of the following: [12]
 a) Audiometry
 b) Decibel scale
 c) Decay of sound in dead rooms
 d) Sound absorption coefficient



Total No. of Questions : 4]

SEAT No. :

PE-5252

[Total No. of Pages : 2

[6509]-310

S.Y. M.Sc.

PHYSICS

**PHOT-234H2 : Energy Studies-I
(2020 Pattern) (Semester - III)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Question No.1 is compulsory.*
- 2) *Solve any two questions from Q.No.2 to Q.No.4.*
- 3) *Q.No.2 to Q.No.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log-tables 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 latent heat storage? [2]
- ii) What is sensible heat storage? [2]
- iii) State the 1st and 2nd law of thermodynamics. [2]
- iv) What is sunshine recorder? [2]
- v) What is meant by non-renewable energy source? [2]
- b) Explain the wind energy as a renewable energy source. [3]

Q2) a) i) Discuss the concept of biomass and solar as renewable energy sources. [4]

ii) Explain the concept of latent heat storage system in the context of energy storage. [3]

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

P.T.O.

Q3) a) Draw the systematic diagram of pyrheliometer and explain its construction and working principles. **[6]**

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

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

a) Radiation on horizontal and tilted surfaces **[4]**

b) Green house as energy storage **[4]**

c) Beam and diffuse radiation **[4]**

d) Fourier's law and Stefan's Boltzmann relation **[4]**



Total No. of Questions : 7]

SEAT No. :

PE-5253

[Total No. of Pages : 2

[6509]-311

S.Y. M.Sc.

PHYSICS

**PHOT-234H4 : Energy Studies-I
(2020 Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following:

- a) What are the various forms of energy? [2]
- b) What is the use of pyranometer? [2]
- c) What is latent heat storage? [2]
- d) What is Solar pond? [2]
- e) What is air mass? [2]
- f) What are the Green House gases? [2]

Q2) a) i) Explain laws of thermodynamics. [4]

ii) Explain the difference between beam, diffuse and global radiation. [3]

b) Explain the different types of heat transfer. [5]

Q3) a) i) Explain energy consumption and its impact on environmental climate change. [4]

ii) Explain Stefan-Boltzmann relation and Fourier's law. [3]

b) Describe the hydro storage system with diagram. [5]

P.T.O.

- Q4)** a) i) Write difference between renewable and non-renewable energy. [4]
ii) Define the terms Hour angle, Inclination angle Zenith angle. [3]
b) Explain in brief about radiation on horizontal and tilted surfaces. [5]
- Q5)** a) What is Global warming? Explain in brief about essential factors for sustainable development. [7]
b) Explain the electrical energy storage system. [5]
- Q6)** a) What are Fossil fuels? What are the impacts of excessive use of fossil fuels. [6]
b) Explain the working principle and construction of sunshine recorder with neat diagram. [6]
- Q7)** Write a short note on any three of the following:
- a) Geothermal energy and its applications [4]
 - b) Characteristics of sun [4]
 - c) Green house and its advantages [4]
 - d) Solar pond as energy storage [4]



Total No. of Questions : 4]

SEAT No. :

PE-5254

[Total No. of Pages : 2

[6509]-312

S.Y. M.Sc.

PHYSICS

PHOT-234I2 : Electronics Instrumentation-I

(2020 Pattern) (Semester - III)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

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

- i) What do you understand by static characteristics? [2]
- ii) List out the different types of transducers. [2]
- iii) A platinum resistance thermometer has a resistance of 140.5 and 100Ω at 100 and 0°C respectively. If it's resistance becomes 305.3Ω when it is in contact with hot gas, determine the temperature of gas. (Temperature co-efficient of platinum is $0.003\text{g}^\circ\text{C}^{-1}$) [2]
- iv) What is ratiometric conversion? [2]
- v) List the objective of data acquisition system. [2]

b) Write a note on Data loggers. [3]

Q2) a) i) Explain principle, construction and working of LVDT displacement sensor. [4]

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

b) Explain microprocessor based data acquisition system in detail. [5]

P.T.O.

- Q3)** a) Draw circuit diagram of instrumentation amplifier using three Op-Amps and obtain its output voltage equation. [6]
- b) Derive an expression for gauge factor for bonded resistance wire strain gauge. [6]

Q4) Attempt any three of the following:

- a) Explain construction and working of selective radiation pyrometer. [4]
- b) Draw sample and hold circuit and explain it in detail. [4]
- c) For a certain thermistor, $\beta=3140\text{K}$ and the resistance at 27°C is known to be 1050Ω . The thermistor is used for temperature measurement and the resistance measured is as 2330Ω . Find the measured temperature. [4]
- d) Draw electrical circuit using LM35 temperature sensor and explain it in details. [4]



Total No. of Questions : 7]

SEAT No. :

PE-5255

[Total No. of Pages : 2

[6509]-313

S.Y. M.Sc.

PHYSICS

PHOT-234I4 : Electronic Instrumentation-I

(2020 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following:

- a) Define first order system. [2]
- b) What is the difference between NTC and PTC? [2]
- c) Define Gauge factor. [2]
- d) What is Thermoelectric effect? [2]
- e) How are the displays classified list different types of display device? [2]
- f) List different materials used to radiate different colour. [2]

Q2) a) Explain methods of correction for interfacing and modifying inputs. [7]

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

Q3) a) Explain the principle and operation of ink-jet printers. [7]

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

P.T.O.

- Q4)** a) Explain LVDT displacement sensor in detail. How the direction of motion can be sensed from this sensor? [7]
b) Derive the expression for induced EMF in a variable reluctance type of transducer. [5]
- Q5)** a) Draw a structure of an LED and explain it's operation. What are the conditions to be satisfied by the device for emission of light? [7]
b) Define principle operation of thermocouple and explain types of thermocouples. [5]
- Q6)** a) State the significance of performance characteristics of instrument. Distinguish between static and dynamic characteristics of instruments. [7]
b) Discuss zero order system with suitable example. [5]
- Q7)** Write a short note on any two of the following:
- a) Data logger [6]
 - b) Piezo electric transducer [6]
 - c) Optical pyrometer [6]



Total No. of Questions : 4]

SEAT No. :

PE-5256

[Total No. of Pages : 2

[6509]-314

S.Y. M.Sc.

PHYSICS

**PHOT-234J2 : Biomedical Instrumentation-I
(2020 Pattern) (Semester - III)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

- 1) *Question No.1 is compulsory.*
- 2) *Solve/Attempt any two questions from Q.No.2 to Q.No.4.*
- 3) *Q.No.2 to Q.No.4 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Q1) a) Solve any four of the following:

- i) Write any four properties of bioelectrodes. [2]
- ii) Why Right Leg (RL) is used at ground potential? [2]
- iii) What is systolic and diastolic blood pressure? [2]
- iv) State the amplitude range and frequency range of ECG. [2]
- v) What is systemic circulation? [2]
- b) State any three differences between internal & external pacemaker. [3]

Q2) a) What are Biosignals? What are the various sources of it? [7]

- b) Draw the ECG waveform showing amplitude and time interval of each wave. Explain ECG waveform. [5]

Q3) a) What are the different types of ECG leads? Explain them with neat labelled diagram. [7]

- b) Explain principle, construction and working of LVDT. [5]

P.T.O.

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

- a) Basic medical instrumentation system. [6]
- b) Methods of measuring blood pressure. [6]
- c) Any two temperature transducers. [6]



Total No. of Questions : 7]

SEAT No. :

PE-5257

[Total No. of Pages : 2

[6509]-315

S.Y. M.Sc.

PHYSICS

**PHOT-234J4 : Biomedical Instrumentation-I
(2020 Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question No.1 is compulsory.*
- 2) *Attempt any five questions from Q.No.2 to Q.No.7.*
- 3) *Q.No.2 to Q.No.7 carry equal marks.*
- 4) *Figures to the right side indicate full marks.*
- 5) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five of the following:

- a) What is an action potential? [2]
- b) What is biosensor? [2]
- c) Define Lead. [2]
- d) Define biomedical Instrumentation. [2]
- e) What is the function of pacemaker? [2]
- f) Define Bio signals. [2]

Q2) a) Describe the different lead system used in ECG recording. [7]
b) Describe different types of electrodes used in biomedical application. [5]

Q3) a) Explain the importance of patient safety in Biomedical Instrumentation. [7]
b) Explain the function and types of Pacemaker. [5]

P.T.O.

- Q4)** a) Describe different biomedical safety measures that should be taken while handling biomedical instruments. [7]
b) Explain block diagram of ECG machine & its components. [5]
- Q5)** a) What are the different types of transducers & their functions? [7]
b) How do artifacts effect ECG recording? Describe methods to minimize them. [5]
- Q6)** a) Explain the working principle & applications of phonocardiograph. [6]
b) Describe the different types of bioelectrodes used for ECG, EEG & EMG. [6]
- Q7)** Write a short note on any three of the following:
- a) Passive and active conduction in nerve signals [4]
 - b) Pulse oximeter [4]
 - c) Motion transducer [4]
 - d) Amplifier in biomedical instrumentation [4]



Total No. of Questions : 4]

SEAT No. :

PE-5258

[Total No. of Pages : 2

[6509]-316

S.Y. M.Sc.

PHYSICS

**PHOT-234K2 : Nuclear Techniques-I
(2020 Pattern) (Semester - III)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

Q1) a) Attempt any four of the following:

- i) Discuss the various types of directly ionizing radiation and give examples. [2]
 - ii) Give the general characteristics of organic scintillator. [2]
 - iii) Discuss the relationship between absorbed dose and dose equivalent. [2]
 - iv) What is the working principle of an ionization chamber? [2]
 - v) Define RBE and explain its applications in radiation therapy. [2]
- b) An experiment involves measuring the activity of a radioactive sample using a G.M counter. If the counter records an average of 50 counts in 10 minutes, calculate the activity of the sample in becquerels. [3]

Q2) a) i) Discuss the principle, construction and working of semiconductor detectors. [4]

- ii) A person receives a dose of 5 gray of alpha radiation. What is the dose equivalent in sieverts, if the RBE for alpha radiation is 20? [3]

b) Discuss the interaction of gamma radiation with matter. [5]

P.T.O.

Q3) a) Discuss the construction and working of G.M counter. Give its advantages and limitations. [7]

b) What is Attenuation coefficient? Derive an expression for attenuation of gamma rays in a materials. [5]

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

a) Classification of nuclear detectors. [4]

b) Effects of radiation on the human body [4]

c) NaI-(Tl) scintillation detector [4]

d) Discuss different units of radiation dosimetry. [4]



Total No. of Questions : 7]

SEAT No. :

PE-5259

[Total No. of Pages : 2

[6509]-317

S.Y. M.Sc.

PHYSICS

**PHOT-234K4 : Nuclear Techniques-I
(2020 Pattern) (Semester - III)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following:

- a) Why is stopping power important in radiation shielding? [2]
- b) What are the main advantages of a proportional counter over an ionization chamber? [2]
- c) What information can be obtained from a pulse height spectrum? [2]
- d) What is the function of a coincidence unit in radiation detection? [2]
- e) What does Sievert (SV) measure? [2]
- f) Define Roentgen (R) in terms of radiation measurement. [2]

Q2) a) Explain the concept of particle range in matter. How does the range of electrons, protons and heavy ions differ in various materials? [7]

- b) Explain the concept of energy transfer in radiation interactions. How does energy transfer differ for direct and indirect ionizing radiation? [5]

Q3) a) Explain the working principle and advantages of HPGe detectors in gamma-ray spectroscopy. [7]

P.T.O.

- b) The paralysis time of a G.M tube is 400 μ sec. What is the true count rate for measured count rates of 1000 and 10,000 counts per min. [5]
- Q4)** a) Describe the function of Multi-Channel Analyzer (MCA) in radiation spectroscopy and its advantages over Single-Channel Analyzer (SCA). [7]
- b) Explain the principle of pulse height analysis and its significance in nuclear spectroscopy. [5]
- Q5)** a) Define energy deposit and energy imparted in the context of radiation interactions. How do they influence the absorbed dose? [6]
- b) Define absorbed dose and explain its significance in radiation protection and medical applications. [6]
- Q6)** a) Explain the working principle and advantages of semiconductor detectors. [6]
- b) Differentiate between true and accidental coincidences in radiation detection. [6]
- Q7)** Write short note on any three of the following:
- a) Stopping power [4]
- b) Ionization chamber [4]
- c) Pulse stretchers networks [4]
- d) Quality factor [4]



Total No. of Questions : 4]

SEAT No. :

PE-5260

[Total No. of Pages : 2

[6509]-318

S.Y. M.Sc.

PHYSICS

**PHOT-234L2 : Micro Controller Based Instrumentation
System-I**

(2020 Pattern) (Semester - III)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

Q1) a) Solve any four of the following:

- i) What is Stack Pointer? [2]
- ii) What is assemble directives? [2]
- iii) Define an Interrupt Service Routine (ISR). [2]
- iv) What is an 8-bit microprocessor? Give an example. [2]
- v) How many I/O parts are available in the 8051 microcontroller? [2]
- b) Write difference between microprocessor and microcontroller. [3]

Q2) a) Draw functional block diagram of microcontroller 8051 and explain it's different sections. [7]

b) Explain parallel port structure in 8051 μ l. [5]

Q3) a) Explain various addressing modes in microcontroller 8051. [7]

b) Write an assembly language program to add first 100 natural numbers. [5]

P.T.O.

Q4) Attempt any three of the following:

- a) Compare the working of Timer 0 and Timer1 in 8051 microcontroller. [4]
- b) Explain the dual role of Port 0 and Port 2 in the 8051 microcontroller. [4]
- c) Write a program to generate a delay of 100 μ s using any register of 8051. [4]
- d) If processor clock frequency is 12 MHz. Calculate the needed to execute
MOV A, #01H
MOV R2, #02H
Add A, R2 [4]



Total No. of Questions : 7]

SEAT No. :

PE-5261

[Total No. of Pages : 2

[6509]-319

S.Y. M.Sc.

PHYSICS

**PHOT-234L4 : Micro Controller Based Instrumentation
System-I**

(2020 Pattern) (Semester - III)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following:

- a) What is the primary function of a microprocessor? [2]
- b) What is the role of the stack in the 8051 microcontroller? [2]
- c) Define bit addressability in the context of 8051 I/O parts. [2]
- d) What are interrupts in the 8051 microcontroller. [2]
- e) Explain the basic working principle of ADC 0809. [2]
- f) What are the key difference between ADC and DAC? [2]

Q2) a) Explain various addressing modes in microcontroller 8051. [7]

b) Explain the interrupt structure of microcontroller 8051 in details. [5]

Q3) a) Explain in detail the addressing modes of the 8051 microcontroller with suitable example. [7]

b) Explain parallel port structure in 8051 μ l. [5]

P.T.O.

- Q4)** a) Compare the different I/O ports of the 8051 microcontroller with respect to their functionality. [7]
- b) How do you handle multiple interrupt in 8051 C programming? Explain with an example. [5]
- Q5)** a) Explain the dual role of Port 0 and Port 2 in the 8051 microcontroller. [6]
- b) Write an assembly language program for code conversion in the 8051 microcontroller. [6]
- Q6)** a) Discuss the bit-addressable feature of the I/O ports in the 8051 microcontroller. [6]
- b) Explain the complete process of data conversion from BCD to ASCII in 8051 C programming. [6]
- Q7)** Attempt any Two of the following:
- a) Parallel port structure of 8051 microcontroller. [6]
- b) Describe how the interrupt vector table is used in 8051 C programming? [6]
- c) Write a c program to toggle an LED connected to port 2 using a time delay. [6]



Total No. of Questions : 7]

SEAT No. :

PE-5262

[Total No. of Pages : 2

[6509]-401

S.Y. M.Sc.

PHYSICS

**PHCT-241 : Nuclear Physics
(2020 Pattern) (Semester - IV)**

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following :

[5×2=10]

- a) Define Binding energy. Write its formula.
- b) Calculate the packing fraction of U^{238} .
- c) What is the main work of controlled rod in nuclear reactors?
- d) Define nuclear fission with examples.
- e) Write any two limitations of shell model.
- f) What is law of radioactive disintegration.

Q2) a) Derive an expression for Q values of the Nuclear Reactor with suitable examples. [7]

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

Q3) a) State the principle of scintillation detector. Describe with diagram construction and working of scintillation detector. [7]

b) Describe the decay scheme and half life of ^{60}Co gamma source. [5]

P.T.O.

Q4) a) Explain the construction and working of microtron accelerator. Show that the difference in periods must be integral multiple of oscillator frequency. [7]

b) Find the energy release if two ${}^2_1\text{H}$ nuclei can fuse together to form ${}^4_2\text{He}$ nucleus, the binding energy per nucleon of ${}^2\text{H}$ and ${}^4\text{He}$ is 1.1 meV and 7.00 MeV respectively. [5]

Q5) a) Describe the conservation law's in nuclear reactions. [7]

b) If the frequency of the oscillator potential to the dees of a cyclotron is 8 MHz, what must be the magnetic flux density B to accelerate alpha particles? [5]

Given : Mass of alpha particle (M) = 6.643×10^{-27} kg.

Q6) a) Explain the Nuclear Magnetic dipole moment. Show that $\mu = \mu_s + \mu_i$. Where the symbol have their usual meanings. [7]

b) On the basis of baryon number, lepton number, charge, spin and strangeness, which of the following reaction is violated? [6]

i) $\pi^- + p \rightarrow n + \nu$

ii) $n \rightarrow p + e^- + \bar{\nu}_e$

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

- a) Van de Graff accelerator.
- b) Light Hydron Collidor (LHC)
- c) Shell Model - Square well potential
- d) Classification of elementary particles.



Total No. of Questions : 7]

SEAT No. :

PE-5263

[Total No. of Pages : 2

[6509]-402

S.Y. M.Sc.

PHYSICS

PHCT-242 : Experimental Techniques in Physics - II
(2020 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following :

[5×2=10]

- a) Define Bragg's law and write Bragg's condition for diffraction.
- b) What is the principle of optical microscopy?
- c) What is the wavelength of microwave radiation that has a frequency of 4.2×10^8 Hz.
- d) Write the difference between optical and electron microscopy.
- e) Enlist different types of microscopes?
- f) What is the principle of SQUID techniques?

Q2) a) i) Write a note on UV-VIS spectroscopy.

[4]

ii) What are advantages of AFM over STM microscopy?

[3]

b) With the help of neat diagram, explain Differential Thermal Analysis (DTA) technique.

[5]

P.T.O.

- Q3) a) i)** What are different types of electromagnetic radiation and their sources? [4]
- ii)** Calculate the angles for first, second and third order diffraction. [3]
- [Given : Wavelength - 154 nm, Interplanar distance - 0.3 nm]
- b)** What is electron spin resonance (ESR)? Explain in detail with neat labelled diagram. [5]
- Q4) a) i)** Write a note on analysis of Hysteresis loop. [4]
- ii)** Calculate the wavelength of electron in an electron microscope, if the accelerating voltage is 20 kV. [3]
- b)** Explain the principle, construction and working of Atomic Force Microscope (AFM). [5]
- Q5) a)** With neat labelled diagram explain principle, construction and working of scanning electron microscope (SEM). [6]
- b)** What is nuclear magnetic resonance (NMR)? Explain in detail with neat labelled diagram. [6]
- Q6) a)** Define X-ray diffraction and derived Scherrer relation to determine crystallite size of nanoparticle. [6]
- b)** What is detector? Explain different types of nuclear detectors. [6]
- Q7) Answer any three of the following :** [12]
- a)** Write a short note on Vibrating Sample Magnetometer (VSM).
- b)** An X-ray tube operated at 30 kV emits a continuous X-ray spectrum with $\lambda_{\min} = 0.0414 \text{ nm}$. Calculate the Planck's constant.
- c)** Explain the principle and working of Fourier Transform Infra-red (FTIR) spectrometer.
- d)** Write a short note on effect of electromagnetic radiation on Human Health.



Total No. of Questions : 7]

SEAT No. :

PE-5264

[Total No. of Pages : 2

[6509]-404

S.Y. M.Sc.

PHYSICS

PHOT-244G4 : Acoustics - II
(2020 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any Five of the following:

[10]

- a) What is volume limiter?
- b) Find effective stiffness in case of loudspeaker mounted in a cabinet of $V = (0.5 \times 0.5 \times 0.2)m^3$ and radius of speaker $0.1m$. $[\rho_0 = 1.21kg / m^3]$.
- c) What is monaural SRS?
- d) Define phase velocity C' of exponential horn.
- e) Distinguish between frame and sector of a digital audio CD.
- f) Define directivity factor and directivity index.

Q2) a) i) Derive an expression for sensitivity of carbon microphone. [4]

ii) An infinite exponential horn of length $0.75m$ has radius of $0.02 m$ at the throat and a radius of $0.2 m$ at its mouth. Determine its flare constant and cut-off frequency. [3]

b) Discuss the effect of voice coil parameters on the acoustic output of direct radiator loudspeakers. [5]

Q3) a) i) Derive the expression for motional impedance Z_m of direct radiator loudspeaker. [4]

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

P.T.O.

- b) Determine the phase velocity of a 354 Hz plane wave progressing through an exponential horn of flare constant 5.1 at a temperature of 38°C. [5]
- Q4)** a) Derive an expression for pressure response of a loudspeaker. Draw a neat diagram. [4]
- ii) A direct radiator dynamic loudspeaker has radiation resistance 2.1 kg/sec, its voice coil is 7.4m in length and suspended in a magnetic field of 1.1 Wb/m². Its mechanical impedance is 13.2 kg/sec and current of 1.9 Amp. Determine its acoustic power output. [3]
- b) The frequency of mechanical resonance for a cone speaker is 57 Hz. The stiffness of the cone system is 2000 N/m. Determine the radiation reactance, if the total mass of the diaphragm and voice coil is 0.01 kg.[5]
- Q5)** a) i) With the help of a neat diagram, explain working of a condenser microphone. [4]
- ii) Write a note on MIDI (Musical Instruments Digital Interface). [3]
- b) Write a note on different types of loudspeaker cabinets. [5]
- Q6)** a) With the help of neat diagrams, explain polar pattern characteristics of a microphone. [7]
- b) Write a note on Dolby Noise reduction. [5]
- Q7)** Write a note on any three of the following:
- a) Stereophonic Sound Reproducing Systems (SRS) [4]
- b) Graphic Equalizer [4]
- c) Anechoic Chamber [4]
- d) Audio CD parameters [4]



Total No. of Questions : 4]

SEAT No. :

PE-5265

[Total No. of Pages : 2

[6509]-405

S.Y. M.Sc.

PHYSICS

**PHOT244-H2 : Energy Studies - II
(2020 Pattern) (Semester - IV)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

Q1) a) Attempt any four of the following:

[4×2=8]

- i) What is solar distillation?
- ii) Explain the basic principle of solar photovoltaic conversion.
- iii) How wind mills are classified?
- iv) Define solar concentrator.
- v) What is bio-gas.

b) Give the different factor which affect the power of wind.

[3]

Q2) a) Explain with neat diagram, the construction working of a typical liquid flat plate collector. **[7]**

b) Explain the solar still with a suitable diagram.

[5]

Q3) a) Explain with neat diagram, the domestic hot water system.

[6]

b) Describe the various types of bio-mass gasifiers.

[6]

P.T.O.

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

- a) Methods of production of Hydrogen. [4]
- b) Thermal losses of flat plate collector. [4]
- c) Solar Dryer. [4]
- d) Energy balance equation of steady state. [4]



Total No. of Questions : 7]

SEAT No. :

PE-5266

[Total No. of Pages : 2

[6509]-406

S.Y. M.Sc.

PHYSICS

PHOT244-H4 : Energy Studies - II
(2020 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following:

[5×2=10]

- a) What is the working principal of solar cell?
- b) What are the different sources of hydrogen?
- c) Define selective coating.
- d) Explain the following parameters:
 - i) Open circuit voltage
 - ii) Fill factor
- e) What is solar still?
- f) What is Biomass?

Q2) a) i) Explain the different factors which affects the distribution of wind energy on the surface of earth. **[4]**

ii) Discuss the advantages and disadvantages of vertical axis wind mill. **[3]**

b) Describe various types of biomass gasifiers. **[5]**

P.T.O.

- Q3)** a) What are the different types of solar Hot Water Systems? Explain the working principal of any one. [7]
- b) How are metals, insulators and semi conductors classified? Explain each with an examples. [5]
- Q4)** a) What are the various hydrogen production method? Discuss any one of the them. [7]
- b) What are the different characteristics of biogas. Explain any one of them. [5]
- Q5)** a) Discuss the different characteristics of solar cell. Draw a typical I-V curve of solar cell. Find the fill factor (FF) of a given solar cell if short circuit current and open circuit voltage are given 50 mA and 0.5 V respectively. Efficiency of the solar cell is calculated 20% and input power radiation is 750 w/m². [7]
- b) Write major applications of wind power and explain them. [5]
- Q6)** a) Explain with neat diagram, box type solar cooker. [6]
- b) Explain aerobic and anaerobic bioconversion process. [6]
- Q7)** Write short note on any three of the following:
- a) Solar Dryers [4]
- b) Solar Pond [4]
- c) Importance of Hydrogen [4]
- d) Wind Mills - Different Types [4]



Total No. of Questions : 4]

SEAT No. :

PE-5267

[Total No. of Pages : 2

[6509]-407

S.Y. M.Sc.

PHYSICS

PHOT-244I2 : Electronic Instrumentation - II
(2020 Pattern) (Semester - IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

Q1) a) Solve any four of the following:

- i) Give the applications of discontinuous controller modes. [2]
 - ii) What is the objectives of control system. [2]
 - iii) State the principle of servomechanism. [2]
 - iv) Write the input-out relationship in P-D control mode. [2]
 - v) What is cyclic response in control system. [2]
- b) Explain the proportional control mode. [3]

Q2) a) What is script file in matlab? Write rate formula using scalar variables in matlab. [6]

b) A liquid-level control system linearly converts a displacement of 2 to 3 m into 4 to 20 mA control signal. A relay serves as the two-position controller to open or close an inlet valve. The relay closes at 12 mA and opens at 10 mA Find: [6]

- i) the relation between displacement level and current.
- ii) the neutral zone in meters.

P.T.O.

- Q3)** a) Explain the integral mode op-amp controller with the help of neat labelled diagram. [7]
- b) Explain the first and second order sensor response and obtain an expression for gain in first order sensor response. [5]

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

- a) P-I-D controller. [6]
- b) Derivative control mode. [6]
- c) Process control block diagram. [6]



Total No. of Questions : 4]

SEAT No. :

PE-5268

[Total No. of Pages : 2

[6509]-408

S.Y. M.Sc.

PHYSICS

PHOT-244I4 : Electronics Instrumentation - II
(2020 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) *Question No.1 is compulsory.*
- 2) *Solve any five questions from Q.No.2 to Q.No.7.*
- 3) *Questions 2 to 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 labelled diagram must be drawn wherever necessary.*

Q1) Solve any five of the following:

- a) Level is to be maintained in tank by controlling out flow rate by opening/closing an output valve. Which type of controller you will use? Explain. [2]
- b) Draw circuit symbol for NC & MO type [2]
 - i) Thermal switch
 - ii) Position limit switch
- c) Define neutral zone for a controller highlight it's significance of a controller. [2]
- d) Define scan time of PLC. Mention factor affecting scan time. [2]
- e) Why derivative controller mode never use alone? [2]
- f) What is process control principle? [2]

- Q2)**
- a) Explain derivative mode op-amp controller with the help of neat circuit diagram. [7]
 - b) What is script file in matlab? Write rules for defining scalar variable in matlab? [5]

P.T.O.

- Q3)** a) With neat diagram explain PLC operation in details. Draw neat diagram for input and output module and explain it's features. [7]
 b) Explain process characteristics with special reference to process equation with suitable example, draw necessary diagram. [5]
- Q4)** a) With neat circuit diagram explain PI controller mode. Derive output voltage equation. [7]
 b) A sensor measures temperature linearly with a static transfer function of $33\text{mV}/^{\circ}\text{C}$ and has a 1.5-5 time constant. Find output 0.755 after the input changes from 20° to 41°C . Find the error in temperature this represents. [5]
- Q5)** 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]
- Q6)** a) With neat circuit diagram explain PD controller mode. Derive output voltage equation. [7]
 b) Level measurement in a sump tank is provided by transducer scaled as 0.2V/m . A pump is to be turned on by application of $+5\text{V}$. When the sump level exceeds 2.0m . The pump is to be turned back off when the sump level drops to 1.5m . Develop two position controller. [5]
- Q7)** Write a short note on any two of the following:
 a) Discrete process control [6]
 b) Damped response and cyclic response evaluation. [6]
 c) Two position controller mode [6]



Total No. of Questions : 4]

SEAT No. :

PE-5269

[Total No. of Pages : 2

[6509]-409

S.Y. M.Sc.

PHYSICS

PHOT-244J2 : Biomedical Instrumentation-II

(2020 Pattern) (Semester - IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

Q1) a) Solve any four of the following:

- i) What are the basic functions of nervous system? [2]
- ii) Define the term hypercapnia and hypoxia. [2]
- iii) What are the types of Neurons? [2]
- iv) What is spirometer and spirogram? [2]
- v) State different types of brain waves with their frequency values. [2]

b) Find the energy of X-ray in eV, when wavelength of diagnostic X-ray is $1\text{\AA}$. [3]

Q2) a) Why ultrasonic waves are preferred for imaging? What are its characteristics? [7]

b) Explain the semiconductor memories in detail. [5]

Q3) a) What are the biomedical computer application, explain in detail? [7]

b) What are the types of ultrasonic imaging? [5]

P.T.O.

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

- a) Computer Hardware [4]
- b) Role of microprocessor in biomedical instrumentation [4]
- c) Characteristics of ultrasound [4]
- d) Lung volume and lung capacities [4]



Total No. of Questions :7]

PE5531

SEAT No. :

[Total No. of Pages : 2

[6509]-410

M.Sc.-II

PHYSICS

**PHOT-244J4 : Biomedical Instrumentation-II
(2020 Pattern) (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 tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five of the following:

- a) State different types of Brain waves. [2]
- b) What are pneumograph? [2]
- c) What are the types of EMG? [2]
- d) List different respiratory therapy equipments. [2]
- e) What are the types of neurons [2]
- f) Calculate the wavelength of a 2MHz ultrasound beam (velocity of tissues = 1540 m/s) [2]

Q2) a) Explain in detail block diagram of EEG [7]

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

Q3) a) Why ultrasonic wave are preferred for imaging? What are its characteristics? [7]

b) Explain in short working of respiratory system. [5]

P.T.O.

- Q4)** a) What are biomedical computer applications, explain in details. [7]
b) Explain the generation and detection of ultrasound. [5]
- Q5)** a) Describe the working principle of a ventilator in ICU [6]
b) Describe the measurement of lung compliance and its significance. [6]
- Q6)** a) Explain basic pulse echo apparatus with block diagram. [6]
b) Explain role of microprocessor in Biomedical instrumentation [6]
- Q7)** Attempt any three of the following:
- a) Computer software [4]
b) Lung volume and Lung capacities [4]
c) Neuromuscular transmission [4]
d) Spirometer [4]



Total No. of Questions : 4]

SEAT No. :

[Total No. of Pages : 2

PE5532

[6509]-411

M.Sc.-II

PHYSICS

**PHOT-244K2: Nuclear Techniques-II
(CBCS 2020 Pattern) (Semester-IV) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

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

- i) Define radioactive activity.
- ii) What is Neutron activation analysis?
- iii) Define cross-section of Nuclear reaction.
- iv) What is thermal reactor?
- v) State two uses of radioisotopes.

b) Explain the principle of activity measurement. **[3]**

Q2) a) Describe in detail the structure, working and control mechanisms of nuclear reactor. **[7]**

b) Explain carbon - 14 dating method and it's importance. **[5]**

P.T.O.

Q3) a) Discuss the radioactive disintegration process, decay law, half- life and mean - life with suitable equations. [7]

b) Describe Industrial applications of radioisotopes. [5]

Q4) Write a short notes on any three of the following. [12]

a) Medical application of radioisotopes

b) Proton Induced x-ray emission (PIXE)

c) Neutron sources and detectors

d) Measurement of Nuclear reaction cross-section



Total No. of Questions :7]

SEAT No. :

PE5533

[Total No. of Pages : 2

[6509]-412

M.Sc.-II

PHYSICS

**PHOT-244 K4 : Nuclear Techniques-II
(2020 CBCS Pattern) (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 diagrams must be drawn wherever necessary.*

Q1) Attempt any five of the following. [10]

- a) Write units of radioactivity.
- b) Calculate the disintegration constant of a certain radioactive substance whose half life is 20 days?
- c) What do you mean by radioisotopes?
- d) Define mean life time of nuclei.
- e) Enlist various neutron sources.
- f) Explain the term radio Therapy.

Q2) a) i) Discuss production of thermal neutrons. [4]

ii) Explain carbon-14 dating. [3]

b) Calculate the activity of one grame of radium ${}_{88}\text{Ra}^{226}$ whose life is 1622 years. [5]

Q3) a) i) Explain resonance nuclear reaction. [4]

ii) Discuss production of radioisotopes. [3]

b) Explain Rutherford scattering in detail. [5]

P.T.O.

- Q4)** a) i) Discuss proton induced x-ray Emission technique. [4]
ii) Explain delayed coincidence. [3]
b) Discuss medical uses of radioisotopes. [5]
- Q5)** a) Explain measurement of beta-beta and beta-gamma coincidence. [6]
b) Discuss elemental analysis by neutron activation technique. [6]
- Q6)** a) Discuss neutron scattering with various Applications. [6]
b) Discuss radioactive waste disposal applications of radioisotopes in industry and agriculture. [6]
- Q7)** a) Write a short note on proton induced x-ray emission techniques. [4]
b) Write a short note on potassium-argon dating. [4]
c) Derive an expression of mean life time of nuclei. [4]



Total No. of Questions : 4]

SEAT No. :

[Total No. of Pages : 2

PE5534

[6509]-413

S.Y. M.Sc.

PHYSICS

**PHOT-244L2: Microcontroller Based Instrumentation System-II
(CBCS 2020 Pattern) (Semester-IV) (2 Credits)**

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

Q1) a) Solve any four of the following

- i) Define Arduino [2]
- ii) Define a sensor [2]
- iii) Define ADC and DAC [2]
- iv) What is RTC Module? [2]
- v) What is boot loader? [2]

b) Explain the need for serial communication [3]

Q2) a) Explain the detailed architecture, block diagram, functional blocks and pin mapping of the Arduino UNO microcontroller (AT mega 328) [7]

b) Discuss interfacing a stepper motor and servo motor in embedded system. [5]

P.T.O.

- Q3)** a) Describe interfacing LED arrays, seven segment display and LCD module with an embedded processor. [7]
- b) Describe different types of Arduino modules with examples [5]

Q4) Attempt any three

- a) Explain the boot loading process for microcontrollers. [4]
- b) Describe the working principle of H×711 ADC module [4]
- c) Explain the functional block diagram of a Hall effect sensor [4]
- d) Explain the role of relay and stepper motor in embedded applications. [4]



Total No. of Questions :7]

PE5535

SEAT No. :

[Total No. of Pages : 2

[6509]-414

S.Y.M.Sc.

PHYSICS

**PHOT 244L4 : Microcontroller Based Instrumentation System-II
(CBCS 2020 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) *Questions 2 to Q.7 carry equal marks.*
- 4) *Figures to the right indicate full marks.*
- 5) *Use of log tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

Q1) Solve any five of the following:

- a) List any four Arduino UNO? [2]
- b) Define boot loader. [2]
- c) Define input signal conditioning and give two examples [2]
- d) What is ultrasonic sensor? State its output type. [2]
- e) Define LDR and mention one application. [2]
- f) Define poly house environmental control [2]

- Q2)** a) Explain the design of a smart coffee vending machine with three push button choice and cup defection mechanism. Write pseudo code or algorithm. [7]
- b) Describe the working principle of a car reverse alarm system using ultrasonic sensor [5]

- Q3)** a) Describe interfacing stepper motor and servo motor with Arduino Uno. Explain control mechanism and write example Arduino code for both. [7]
- b) Explain interfacing a temperature sensor for ON/OFF temperature control with example Arduino program. [5]

P.T.O.

- Q4)** a) Explain in detail the interfacing of Hy-711 ADC module with embedded system and its advantages [7]
b) Explain interfacing a two-digit seven-segment display with microcontroller [5]
- Q5)** a) Describe embedded system, their features and applications in detail. [6]
b) Explain serial communication UART and USART with examples [6]
- Q6)** a) Describe the working of LDR and how it is used for automatic light control. [6]
b) Describe interfacing an LED and LCD (16×2) with Arduino Uno with pin details [6]
- Q7)** Solve any three of the following
- a) Write the importance of serial communication in embedded system [4]
b) Describe programming Arduino Uno using Arduino IDE [4]
c) Explain DC motor speed control using PWM with neat diagram [4]
d) Write a short note on humidity and temperature control in poly house. [4]



Total No. of Questions : 4]

SEAT No. :

PE-5270

[Total No. of Pages : 2

[6509]-415

S.Y. M.Sc.

PHYSICS

PHOT-244M2 : Material Science-II

(2020 Pattern) (Semester - IV)

Time : 2 Hours]

[Max. Marks : 35

Instructions to the candidates:

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

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

- i) Explain change in enthalpy.
 - ii) State first law of thermodynamics.
 - iii) State lever rule.
 - iv) Explain activity coefficient.
 - v) Name the type of binary phase diagrams.
- b) What are the degrees of freedom of a system of two components when the numbers of phase is one. **[3]**

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

- ii) Explain unary diagram. **[3]**
- b) State and explain lever rule with the help of suitable diagram. **[5]**

Q3) a) i) Explain Gibbs phase rule. **[4]**

- ii) Explain binary phase diagram in brief. **[3]**
- b) With the help of neat diagram explain minima in two-phase regions. **[5]**

P.T.O.

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

[3×4=12]

- a) Limited mutual solid solubility
- b) Chemical reaction equilibrium
- c) Miscibility gap
- d) Change in entropy



Total No. of Questions : 7]

SEAT No. :

PE-5271

[Total No. of Pages : 2

[6509]-416

S.Y. M.Sc.

PHYSICS

PHOT-244M4 : Material Science-II

(2020 Pattern) (Semester - IV)

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Question No.1 is compulsory.
- 2) Attempt any five questions from Q.No.2 to Q.No.7.
- 3) Questions 2 to 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 wherever necessary.

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

- a) Draw structure of AX-type crystal structure. [2]
- b) What are the ceramic super conductors? [2]
- c) Write in short about Piezo-electric material. [2]
- d) Explain hysteresis in magnetic materials. [2]
- e) State difference between a diode and tunnel diode. [2]
- f) The resistivity of pure silicon at r.t. is $3000\Omega\text{m}$. Calculate the intrinsic carrier density $\mu_e = 0.14 \text{ m}^2/\text{vs}$, $\mu_n = 0.05 \text{ m}^2/\text{vs}$. [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]

Q3) a) Discuss Ax-type ceramic crystals with their prototypes according to their co-ordination number with an expression showing relation between lattice constant and ionic radii. [7]

b) As the concentration of electrons in a semiconductor is changed by changing the impurity level, the conductivity also changes. Show that it passes through a minimum when $n_e = n_i \sqrt{\mu_n / \mu_e}$ and find the minimum value when n_i is intrinsic concentration. [5]

P.T.O.

- Q4)** a) Draw a well labelled diagram of garnet structure unit and explain in detail contribution of spin. [7]
 b) Explain in detail processing of ceramic materials. [5]
 i) Sintering process
 ii) Single crystal preparation
- Q5)** a) Derive the equation for equilibrium electron and hole concentrations. [6]
 b) Draw crystal structure of Y_{BCO} , Y_{ttrium} barium cuprate high T_c superconductor and explain it. [6]
- Q6)** a) Discuss in detail AX-type and AX_2 -type ceramic materials. [6]
 b) Explain in detail Zener and Avalanche breakdown. [6]
- Q7)** Write short notes on any three: [12]
 a) Optical materials [4]
 b) Compensated semiconductors [4]
 c) Notch sensitivity [4]
 d) Hard and soft magnets [4]



Total No. of Questions :4]

PE5536

SEAT No. :

[Total No. of Pages : 2

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S.Y.M.Sc.

PHYSICS

PHOT-244N2: Medical Physics-II

(2020 Pattern) (Semester-IV) (Group-II) (CBCS) (4 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 tables and non-programmable electronic calculator is allowed.*
- 6) *Neat diagrams must be drawn wherever necessary.*

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

- i) Define Brachytherapy.
- ii) State two components of an x-ray machine.
- iii) What is MRI?
- iv) What are bioceramics?
- v) Define Fluoroscopy.
- vi) Give two examples of ionizing radiation.

b) Explain interaction of radiation with biological systems. **[3]**

Q2) a) Explain digital radiography with advantages and applications. **[7]**

b) Describe working of mobile x-ray unit. **[5]**

Q3) a) Explain scintillation detectors used for thyroid and renal studies. **[7]**

b) Discuss the concept of NMR signals in MRI. **[5]**

P.T.O.

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

[12]

- a) X-ray in diagnosis
- b) Bio-steel
- c) PET (Positron Emission Technology)
- d) Embedded systems in hospitals
- e) Biological effects of radiation



Total No. of Questions :7]

PE5537

SEAT No. :

[Total No. of Pages : 2

[6509]-418

S.Y.M.Sc.

PHYSICS

PHOT-244N4 : Medical Physics-II

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

Time : 3 Hours]

[Max. Marks : 70

Instructions to the candidates:

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

Q1) Solve any five of the following:

[10]

- a) Define ionizing radiation.
- b) What is x-ray dosimetry?
- c) Define radioactivity.
- d) Write any two types of biomaterials.
- e) What is MRI?
- f) State any two hazards of x-ray.
- g) What is brachytherapy?

Q2) a) Explain ionizing radiation and its sources.

[7]

b) Write a note on radiation protection in therapy.

[5]

Q3) a) Explain the production of X-rays with a neat diagram.

[7]

b) Describe the basic components of an X-ray machine.

[5]

P.T.O.

- Q4)** a) Explain the concept of radio activity and its units. [7]
b) Discuss Gamma ray scintillation camera. [5]
- Q5)** a) Describe biomaterials and their applications in medicine. [7]
b) Explain bio-nanomaterials briefly. [5]
- Q6)** a) Discuss interaction of radiation with biological systems. [7]
b) Explain CT scan with applications. [5]
- Q7)** Write short notes on any three of the following. [12]
a) Radiotherapy treatment planning
b) Positron Emission Tomography (PET)
c) X-ray detectors
d) Telemedicine
e) Laser in medicine

