Total No. of Questions : 7]

SEAT No. : ____

PA-3135

[Total No. of Pages : 3

[5908]-101

M.Sc. (Physics)

PHCT - 111: MATHEMATICAL METHOD IN PHYSICS

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

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

Instructions to the candidates:

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

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

a) Let $V = R^3$, Determine whether W is a subspace of V where,

$W = \{(a, b, c) : a^2 + b^2 + c^2 \leq 1\}$ **[2]**

b) Find Laplace transform of sinh (at). **[2]**

c) Determine the residue of $\frac{z e^{zt}}{(z-3)^2}$ at $z = 3$. **[2]**

d) State the generating function for Legendre polynomials ($P_n(x)$). **[2]**

e) State Cauchy - Riemann conditions. **[2]**

f) Define eigen values and eigen vectors. **[2]**

Q2) a) i) State and prove Laurents theorem. **[4]**

ii) Show that the vectors {(1, –2, 3), (2, 3, 1) (–1, 3, 2)} form a basis of the vector space V_3 over real numbers. **[3]**

b) Show that $P_n(1) = 1$ and $P_n(-1) = (-1)^n$. **[5]**

P.T.O.

Q3) a) i) Find Fourier transform of the function $f(x) = e^{-x^2/2}$. **[4]**

ii) Find a series expansion for $f(z)=\frac{1}{(1+z)^m}$ about the origin. **[3]**

b) Find eigen values and eigen vectors of the matrix $A=\begin{bmatrix} 2 & -2 & 0 \\ -2 & 1 & -2 \\ 0 & -2 & 0 \end{bmatrix}$ **[5]**

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

ii) Find the Laplace transform of $f(t)=\begin{cases} c\cos(t-\frac{2\pi}{3}) & , t>\frac{2\pi}{3} \\ 0 & , t<\frac{2\pi}{3} \end{cases}$ **[3]**

b) If $f(z)$ is an analytic function, regular within a closed contour C, and continuous within C and on C, and if z = a be any point within C, then prove that $f(a)=\frac{1}{2\pi i}\int_C \frac{f(z)\,dz}{(z-a)}$ **[5]**

Q5) a) Reduce the matrix $A=\begin{bmatrix} 1 & 2 & -2 \\ 2 & 1 & 2 \\ -2 & 2 & 1 \end{bmatrix}$ to a diagonal form. **[6]**

b) Prove that $J_{n+1}(x)+J_{n-1}(x)=\frac{zn}{x}J_n(x)$ **[6]**

Q6) a) State and prove the convolution theorem for Fourier transform. **[6]**

b) State and prove Taylor's theorem **[6]**

Q7) Attempt any three of the following:

a) For Hermite polynomial show that $H_n(0) = 0$ when n is odd **[4]**

$H_n(0) = \dfrac{(-1)^{n/2} n!}{\left(\dfrac{n}{2}\right)!}$ when n is even

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

c) Prove the recurrence relation for Legendre polynomial **[4]**

$P'_{n+1}(x) + P'_{n-1}(x) = 2x\, P'_n(x) + P_n(x)$

d) Using Laplace method solve the differential equation **[4]**

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

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Total No. of Questions : 7]

SEAT No. :

PA-3136

[Total No. of Pages : 2

[5908]-102

M.Sc. (Physics)

PHCT - 112 : CLASSICAL MECHANICS

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

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Solve any five questions from Q.2 to Q.7.***
3) ***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) Calculate the reduced mass of H_2 molecule assume mass of hydrogen atom is M. **[2]**

b) Give the classification of constraints. **[2]**

c) Draw configuration space and phase space for simple pendulum oscillating in x-y plane. **[2]**

d) What do you mean by Inertial frame of reference. **[2]**

e) State Kepler's first law. **[2]**

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

Q2) a) Derive the equation for one body problem into equivalent one body problem. **[7]**

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

P.T.O.

Q3) a) Define Euler's angles? Obtain an expression for complete transformation matrix. **[7]**

b) Write a note on Foucalt's pendulum. **[5]**

Q4) a) Explain normal co-ordinates and normal frequencies. **[7]**

b) Explain the effect of Coriolis force on **[5]**

i) Anticyclones

ii) River flow

Q5) a) Prove that two constant of motion is itself a constant of motion. **[6]**

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

Q6) a) Show that the transformation **[6]**

$Q = in\ (1/9 \sin p)$, $P = 9\ (\cot p)$ is canonical.

b) Explain the Brachistochrone problem. **[6]**

Q7) Solve any three of the following:

a) State and prove virial theorem. **[4]**

b) Prove that $[u + v, w]_{q,p} = [u, w]_{q,p} + [v, w]_{q,p}$ in case of Poisson bracket. **[4]**

c) Write down the Lagrangian for a particle of mass M under central force field. $F = -k/r^2$. Obtain its equation of motion. **[4]**

d) Solve the projectile motion problem by lagrange's equation of motion. **[4]**

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Total No. of Questions : 7]

SEAT No. : ____

PA-3137

[Total No. of Pages : 2

[5908]-103

M.Sc. (Physics)

PHCT - 113 : ELECTRONICS

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

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

Instructions to the candidates:

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

Q1) Solve any Five of the following:

a) Define holding and latching current of SCR. **[2]**

b) State the need of modulation in communication system. **[2]**

c) State advantages and disadvantages of k- map. **[2]**

d) List the specifications of DAC. **[2]**

e) State advantages and disadvantages of SMPS. **[2]**

f) How many flip-flops are required to construct each of the following counters : i) Mod - 3 ii) Mod - 9 **[2]**

Q2) a) Explain the working of astable multivibrator using IC 741. Draw it's waveform. Derive the formula for frequency. **[4]**

b) Explain the counter type ADC. **[3]**

c) In VCO circuit, supply voltage V = 12 V, R_2 = 1.5 k Ω, C_1= 0.001μf, R_1= R_3= 10 k Ω.

i) Determine the nominal frequency of the output waveforms.

ii) Compute the modulation in the output frequencies if Vc is varied between 9.5V to 11.5V. **[5]**

P.T.O.

Q3) a) Explain the operation and V-I characteristics of TRIAC. **[4]**

b) Explain 3 bit asynchronous counter with neat diagram. **[3]**

c) Determine the free - running frequency fout, the lock range f_L, and the capture range f_c. **[5]**

Given : V= 10V, R_1 = 12 kΩ, C_1 = 0.01μf, C_2 = 10 μf

Q4) a) Explain the working of dual slope ADC. Draw it's circuit diagram. **[4]**

b) Explain the working of pulse width modulation using IC 555. Draw it's waveform. **[3]**

c) Simplify the following expression: **[5]**

$f = A\bar{B} + AB\bar{C} + ABCD + ABC\bar{D}$

Q5) a) Explain the working of SCR. Draw it's V - I characteristics. **[6]**

b) Explain the operation of successive approximation type ADC and discuss it's merits and demerits. **[6]**

Q6) a) Draw the circuit diagram of monostable multivibrator using IC 741 and explain it's working. Draw it's waveforms. **[6]**

b) Design the square wave oscillator using IC 741 for fo = 1 KHz.

Given: V= ± 15 V, C= 0.05 μf.

Draw the circuit diagram of square wave oscillator using IC 741. **[6]**

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

a) Phase Locked Loop **[4]**

b) DIAC **[4]**

c) R - 2 R DAC **[4]**

d) SCR as half wave rectifier. **[4]**

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Total No. of Questions : 7]

SEAT No. :

PA-3138

[Total No. of Pages : 2

[5908]-104

M.Sc.

PHYSICS

CBOP - 1(PHOT - 114A4) : Physics of Thin Films

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

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

Instructions to the candidates:

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

Q1) Solve any Five of the following:

a) Differentiate between Hot Wall and Cold Wall reactor. **[2]**

b) Define capillary model. **[2]**

c) Write the advantages and disadvantages of sputtering. **[2]**

d) Write the application of Thin Films (any four). **[2]**

e) What is mean by TCR? **[2]**

f) Define condensation. **[2]**

Q2) a) Explain in details chemical vapour deposition method. Discuss various chemical reaction involved it. **[7]**

b) Explain Fuch - Sondhemir theory in detail. **[5]**

Q3) a) Explain Tolansky method with it's advantages and disadvantages. **[7]**

b) Explain Nucleation and it's types. **[5]**

P.T.O.

Q4) a) Explain Dip Coating and Spin Coating with its advantages and disadvantages. **[7]**

b) Explain photolithograph in detail. **[5]**

Q5) a) i) Explain influence of the thickness on resistivity of Thin Films. **[4]**

ii) Write the application of Thin Film as a capacitor. **[3]**

b) Explain solar cells and it's types. **[5]**

Q6) a) Draw a neat diagram of Molecular Beam Epitaxy and explain it's working. **[7]**

b) Explain Quartz crystal microbalance. **[5]**

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

a) Spray pyrolysis technique. **[4]**

b) Thin Film application in information storage and telecommunication. **[4]**

c) Physical vapour deposition method. **[4]**

d) Hall Effect in Thin Films. **[4]**

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Total No. of Questions : 7]

SEAT No. : ____

PA-3139

[Total No. of Pages : 2

[5908]-105
M.Sc.
PHYSICS
CBOP-I (PHOT-124 B4) : Physics Of Nanomaterials
(2020 Pattern) (4 Credits) (Group-I)

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) ***Use of log-table or non-programmable electronic calculator is allowed.***
5) ***Figures to the right indicate full marks.***
6) ***Neat diagrams must be drawn where necessary.***

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

a) Define the term nanotechnology.

b) What is top-down approch?

c) What is effect of grainsize on hardness of materials in nanometer range?

d) What is Graphene?

e) What are application of PVD?

f) Determine maximum value of energy gap of photosensitive semiconductor which is Sensitive for weve length of light is 600nm.

(Given: $h=6.626\times10^{-34}$ Js, $c=3\times10^{8}$m/s)

Q2) a) Explain in detail of high energy ball milling method for synthes is of nanomaterials and give it's disadvantages. **[7]**

b) Write detail mechanical properties of nanomaterials. **[5]**

P.T.O.

Q3) a) Describe the sol-gel method for preparation of nano material. Give its advantages & disadvantages. **[7]**

b) What is nanomaterial? How it's classified on the basis of dimension? **[5]**

Q4) a) Explain carbon nanotube and types of carbon nanotubes. **[7]**

b) Explain the mechanism of nucleation and growth of nanoparticles. **[5]**

Q5) a) Explain optical and eletronics properties of nanomaterials. **[6]**

b) What is fullerene? Explain structure properties and application of fullerene. **[6]**

Q6) a) Explain in detail of synthesis of nanomaterials by microorganism. **[6]**

b) What are application of nanomaterials in space and defence field. **[6]**

Q7) **Write a short note on any <u>Three</u> out of Four question.** **[12]**

a) Aerogel

b) Nanocomposite and it's type

c) Surface and interface effect.

d) Difference between PVD and CVD.

Total No. of Questions : 7]

SEAT No. : ____

PA-3140

[Total No. of Pages : 2

[5908]-106
F.Y. M.Sc.
PHYSICS
CBOP - I (PHOT - 124C4/114C4) : Lasers & Applications
(2020 Pattern) (CBCS) (4 - Credits) (Group - I)

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

Instructions to the candidates:

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

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

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

b) What is pumping in lasers? What is optical pumping? **[2]**

c) Define the term laser. Describe important characteristics of lasers. **[2]**

d) What do you mean by threshold gain? **[2]**

e) What do you mean by round trip gain? **[2]**

f) Write any two industrial applications of lasers. **[2]**

Q2) a) i) What is laser cavity? Explain g-parameters for laser cavity. **[4]**

ii) What is line broadening? Explain any two line broadening mechanisms. **[3]**

b) With neat diagram, explain construction, working and energy level diagram of Ruby laser. **[5]**

P.T.O.

Q3) a) i) Derive the expression for the threshold condition for lasers. **[4]**

ii) The length of a laser tube is 150 mm and the gain factor of the laser material is 0.0005/cm. If one of the cavity mirror reflects 100% light incident on it, what is the required reflectance of the other cavity mirror. **[3]**

b) With neat diagram, explain the construction, working & energy level of He - Ne laser. **[5]**

Q4) a) With neat diagrams explain principle, construction & working with energy level diagram of CO_2 laser. **[7]**

b) Define Einsteins coefficients & derive the relations between them. **[5]**

Q5) a) Explain the 4 - level pumping scheme & derive the expression for the necessary condition for population inversion. **[6]**

b) What are laser cavity modes? Explain longitudinal & transverse modes in details. **[6]**

Q6) a) i) The half width of the 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 8328 A°. **[4]**

ii) Explain why 2-level laser is practically not possible. **[3]**

b) With neat diagram, explain the construction working & energy levels of Nd - YAG laser : **[5]**

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

a) Medical applications of lasers. **[4]**

b) Military applications of lasers. **[4]**

c) Scientific applications of lasers. **[4]**

d) Relative merits and de-merits of 3-level and 4-level lasers. **[4]**

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Total No. of Questions : 7]

SEAT No. : ____

PA-3141

[Total No. of Pages : 3

[5908]-107
M.Sc.
PHYSICS
PHOT - 124D4/114D4 : Physics of Semiconductor Devices
(2020 Pattern) (Group - I) (CBCS) (4 - Credits) (CBOP - I)

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

Instructions to the candidates:

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

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

a) Write down expression for carrier concentration of doped semiconductor at thermal equillibrium. **[2]**

b) Derive an expression for Ohm's law, resistivity and conductivity of p - type and n - type semiconductors. **[2]**

c) State and explain Fick's law. **[2]**

d) Obtain carrier concentration of holes. P_o

(Given $n_i = 1.5 \times 10^{10}$/CC ; $n_o = 1 \times 10^{16}$/CC) **[2]**

e) Explain thermal breakdown of PN junction. **[2]**

f) Write a note on Schottky effect. **[2]**

Q2) a) i) Derive an expression for Diffusion capacitance of P-N junction. **[4]**

ii) Write a note on Junction break down. Explain four ways of junction breakdown. **[3]**

P.T.O.

b) The Hall coefficient of semiconductor specimen was found to be -7.35×10^{-5} m^3/c from 100k to 400k. Determine the nature of semiconductor, if conductivity was found to be 200 Siemens/m. Obtain the density and mobility of charge carriers.

[Given, $e = 1.6 \times 10^{-19}$ C] **[5]**

Q3) a) i) Write a note on current gains in transistor. **[4]**

ii) Describes 'second breakdown' in power transistor. **[3]**

b) Assume that, in n type semiconductor at T = 300k, the electron concentration varies linearly from 1×10^{18} to $7 \times 10^{+17}$ /CC over a distance of 0.1 cm. Obtain diffusion current density, if diffusion coefficient of electron is $D_n = 22.5$ cm^2/s [$q = 1.6 \times 10^{-19}$C]. **[5]**

Q4) a) i) Explain Schottky Effect in detail with the help of neat diagram. **[4]**

ii) Explain basic device technology of PN junction formation. **[3]**

b) For Silicon one sided abrupt junction with acceptor impurity $N_A = 10^{19}$/CC and donar impurity $N_D = 10^{16}$/CC obtain the depletion layer width and maximum electric field at zero bias voltage at 300k.

Given $n_i = 9.65 \times 10^9$/CC **[5]**

Q5) a) Explain the construction of SCR [Semiconductor controlled Rectifier] also draw the I-V plot of SCR. **[6]**

b) For a silicon one sided abrupt junction with $N_A = 2 \times 10^{19}$/CC and $N_D = 8 \times 10^{15}$/CC obtain built in potential width of depletion layer, capacitance at zero bias voltage and at reverse bias of 4V. **[6]**

Q6) a) Explain basic equations for semiconductor device operation. **[6]**

b) Calculate the ideal reverse saturation current in PN junction diode with a cross-sect^n area of 2×10^{-4} cm^2 the parameters of the diode are

$N_A = 5 \times 10^{16}$/CC; $N_D = 10^{16}$/CC ; $n_i = 9.65 \times 10^9$/CC

$D_n = 21$ cm^2/s ; $D_p = 10$cm/s ; $\tau_p = \tau_n = 5 \times 10^{-7}$ sec. **[6]**

Q7) Any three of the following :

a) Explain Radiative and non radiative recombination. **[4]**

b) Explain Basic characteristics of UJT construction. **[4]**

c) Write a note on IMPATT diode. **[4]**

d) Explain the concept of Band origin in semiconductor with the help of diagram. **[4]**

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Total No. of Questions : 5]

SEAT No. :

PA-3144

[Total No. Of Pages : 2

[5908]-110
M.Sc.(Physics)
PHOT 114 A2: Physics of Thin Films
(CBCS) (Group - I) (2020 Pattern) (2 Credits) (CBOP-I)

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) ***Questions 2 to 4 carry equal marks.***
4) ***Use of log-table or non-programmable calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***
6) ***Figures to the indicate full marks.***

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

i) Define Condensation. **[2]**

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

iii) Define solar cell. **[2]**

iv) Define principle of photolithography. **[2]**

v) What does meant by super saturations? **[2]**

b) What are the advantages / disadvantages of sputtering method? **[3]**

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

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

P.T.O.

Q3) a) Draw neat diagram of molecular beam Epitaxy and explain its construction and working, **[7]**

b) Explain Tolansky technique for measurment of thickness of thin film. **[5]**

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

a) Physical Vapour deposition. **[4]**

b) Thin film sensors. (gas and humidity) **[4]**

c) Spray pyrolysis. **[4]**

d) Talystep (styles) method. **[4]**

Total No. of Questions : 4]

SEAT No. :

PA-3145

[Total No. of Pages : 2

[5908]-111

M.Sc. (Physics)

CBOP - I (PHOT - 124 B 2) : PHYSICS OF NANOMATERIALS

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

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

Instructions to the candidates:

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

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

i) Define the term nanotechnology

ii) Define the nanocrystal

iii) What is top-down approach

iv) What is disadvantages of Hydrothermal method

v) What is effect of particle size on hardness of nanomaterials.

b) Determine maximum value of energy gap of photosensitive semiconductor which is sensitive for wavelength of light is 600 nm. **[3]**

(Give : $h = 6.626 \times 10^{-34}$ Js)

Q2) a) Describe Sol-gel method for synthesis of nanomaterials? Give it's advantages and disadvantages. **[7]**

b) Write down the optoelectronic application of nanomaterials? **[5]**

Q3) a) Explain the carbon nanotube and types of carbon nanotube. **[7]**

b) Explain physical vapour deposition method for synthesis of nanomaterials. **[5]**

P.T.O.

Q4) Write short note on any three out of four question : **[12]**

a) Graphene

b) Biomedical Application of nanomaterials

c) Chemical bath deposition

d) Significance of Nanomaterials

Total No. of Questions : 4]

SEAT No. : ____

PA-3146

[Total No. of Pages : 2

[5908]-112
M.Sc.
PHYSICS
CBO1-PHOT - 124C2 /114 C2: Lasers & Applications
(2020 Pattern) (CBCS) (2 Credits) (Group - I)

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

Instructions to the candidates:

1) ***Q.1 is compulsory.***
2) ***Attempt /Solve <u>any two</u> 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 or non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Solve any four of the following:

i) What is metastable state? **[2]**

ii) What is the gain of laser? **[2]**

iii) Give classification of laser? **[2]**

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

v) Differentiate between spontaneous emission & stimulated emission. **[2]**

b) Find the ratio of population of the two states in the He-Ne laser that produces light of wavelength 6328Å at 27^{o}C. **[3]**

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

OR

a) i) Explain the principle, construction & working of Excimer laser. **[4]**

ii) Explain the three Einestein coefficients. **[3]**

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

P.T.O.

Q3) a) Explain the construction & working of He-Ne laser with neat energy level diagram. Give its applications. **[7]**

b) Explain in brief: absorption, spontaneous emission & stimulated emission. **[5]**

OR

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

b) What is the threshold condition for lasing action? Explain. **[6]**

Q4) Write short note on any three of the following: **[4 marks each]**

a) Population inversion

b) CO_2 laser

c) Stimulated emission cross section

d) Semiconductor laser

OR

Write short note on any two of the following: **[6 marks each]**

a) Nd YAG laser

b) Absorption coefficient

c) Comparison between solid, liquid & gas lasers

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Total No. of Questions : 4]

SEAT No. : ____

PA-3147

[Total No. of Pages : 2

[5908]-113

M.Sc. (Semeser - II)

PHYSICS

CBOP-1 (PHOT-124D2) : Physics of Semiconductor Devices (2020 Pattern) (CBCS) (2 Credits) (Group - I)

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 4 carry equal marks.***
4) ***Figures to the right indicate full marks.***
5) ***Use of log table or non-programmable calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

Q1) a) Solve any four of following :

i) Write a note on diffusion method of Junction formation. **[2]**

ii) Explain inversion stage of heterojunction. **[2]**

iii) Intrinsic carrier density is $1.5 \times 10^{16}/m^3$ mobility of electron and holes are 0.B and $0.05 m^2/V\text{-}s$, calculate conductivity. **[2]**

iv) State Hall effect. **[2]**

v) State Ficks Law. **[2]**

b) What is the Pinch-off of JFET? **[3]**

Q2) a) i) Write a note on basic device technology of PN junction. **[4]**

ii) What is inversion stage and Depletion stage in Heterojunction. **[3]**

b) Obtain the intrinsic concentration of change carriers at

$300\ \text{K}\left(\text{given } m_e^* = 0.12 m_0\ m_n^* = 0.28 m_0\right)\ \text{E}_g = 0.67 e\text{V}$

$m_0 = 9.1 \times 10^{-31}$ kg T = 300 K **[5]**

P.T.O.

Q3) a) Explain Static characteristics of SCR (Semiconductor Controlled Rectifier). **[6]**

b) Calculate ideal reverse saturation current in a silicon p-n junction diode with a cross section of 2×10^{-4} cm^2, the parameters diode are $N_A = 5 \times 10^{16}$/cc $N_D = 10^{16}$/CC $n_i = 9.65 \times 10^9$/CC $D_n = 21$ cm^2/s $D_p = 10$ cm^2/s $\tau_p = \tau_n = 5 \times 10^{-7} s$. **[6]**

Q4) Write a short note on any <u>three</u> of following :

a) Explain Radiative and Non-radiative Recombination. **[4]**

b) Explain construction of n-channel UJT. **[4]**

c) What is power transistor. Explain construction. **[4]**

d) Write a note on Heterojunction. **[4]**

□□□

Total No. of Questions : 4]

SEAT No. : ____

PA-3148

[Total No. of Pages : 2

[5908]-114

M.Sc.

PHYSICS

CBOP - 1 (PHOT - 124E2/114E2) : Communication Electronics

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

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) ***Figures to the right indicate full marks.***
4) ***Q.2 to Q.4 carry equal 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) What is digital communication? State the advantages of digital communication. **[2]**

ii) What is the time duration of one bit if data rate is 800 bits/s. **[2]**

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

iv) What is the Angle of Elevation? **[2]**

v) Explain the touch tone DTMF. Which are the two sine wave frequencies produced when the 4 key is pressed? **[2]**

b) What is the duty cycle of a radar with a PW of 3μs and a PRT of 6ms? **[3]**

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

ii) Define "modem". Give the classification of modem. **[3]**

b) Explain the cylindrical scanning in Facsimile transmission. Also explain importance of scanning spot. **[5]**

P.T.O.

Q3) a) Derive the basic radar range equation, as governed by minimum receivable echo power P_{min}. **[6]**

b) Draw the block diagram of digital communication system & explain function of each block. **[6]**

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

a) Public Telephone system. **[4]**

b) Different codes used for data transmission. **[4]**

c) Basic pulsed radar system. **[4]**

d) Satellite communication **[4]**

◆ ◆ ◆

Total No. of Questions : 7]

SEAT No. :

PA-3149

[Total No. of Pages : 2

[5908]-201
M.Sc.
PHYSICS
PHCT - 121 : Electrodynamics
(CBCS 2020 Pattern) (Semester - II) (4 Credits)

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

Instructions to the candidates:

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

Q1) Solve any five of the following.

a) Write the Maxwell's Equations in conducting Medium. **[2]**

b) Write Lorentz and Coulomb's condition for magnetic vector potential A. **[2]**

c) What is skin depth? **[2]**

d) What is meant by Homogeneous and isotropic medium? **[2]**

e) Write postulates of special theory of relativity. **[2]**

f) State any four properties of Maxwell's equations. **[2]**

Q2) a) i) State and explain Gauge Transformation in EM Theory. **[4]**

ii) Find the phase velocity and magnitude of the attenuation constant of plane waves at frequency $10GH_z$ in poor conductor (polyethelene). Given : $\mu = \mu_0, \in_r = 2.3$ and $\delta = 2.56 \times 10^{-4}$ mho/m **[3]**

b) Derive the Maxwell equation in differential and integral from. **[5]**

P.T.O.

Q3) a) With neat diagram, explain the magnetic interaction between two current loops. **[7]**

b) Write short note on Poynting vector. **[5]**

Q4) a) Write inhomogeneous wave equation in terms of scaler potential ϕ and vector potential A. **[7]**

b) Derive an expression for potential at a point due to small linear quadrapole. **[5]**

Q5) a) Obtain on expression for electromagnetic field tensor $\tau_{\alpha\beta}$. **[7]**

b) Explain the terms Lorentz gauge and coulomb gauge. **[5]**

Q6) a) Write the boundary condition at the interface between two media for $\vec{B}$ and $\vec{D}$. **[6]**

b) A plane e.m. wave is incident obliquely on an interface between the two non-conducting dielectric medium. Obtain an expression for Fresnel's equation and snell's law. **[6]**

Q7) Solve any three of the following.

a) Show that the ratio of electrostatic and magnetostatic energy densities is equal to unity. **[4]**

b) Show that (E.B) is invarient under Lorentz transformation. **[4]**

c) Prove that the self product of electromagnetic field tensor is given by

$$\tau_{\alpha\beta}^2 = 2\left[B^2 - \frac{E^2}{C^2}\right]$$ **[4]**

d) Prove that

$$\vec{E}\cdot\frac{\partial\vec{D}}{\partial t} = \frac{\partial}{\partial t}\left(\frac{1}{2}\vec{E}.\vec{D}\right)$$ **[4]**

and $\vec{H}\cdot\frac{\partial\vec{B}}{\partial t} = \frac{\partial}{\partial t}\left(\frac{1}{2}\vec{H}.\vec{B}\right)$

Total No. of Questions :6]

SEAT No. : ____

PA-3150

[Total No. of Pages : 2

[5908]-202

M.Sc.-I

PHYSICS

PHCT-122 : Atoms and Molecules

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

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

Instructions to the candidates:

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

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

a) Explain the two distinct features of vector atom model. **[2]**

b) Calculate the total number of electrons in a shell if principle quantum number 'n' is 4 **[2]**

c) Obtain the term symbol for L=2 and S=½ **[2]**

d) Explain the role of electric dipole moment in rotational, vibrational and electronic spectra of a molecule. **[2]**

e) Define dissociation energy D_o in diaatiomic molecule. Write the relation between equilibrium dissociation energy D_e and D_o **[2]**

f) What is the nuclear g_N factor for 19_F nucleus which has a magnetic moment of $2.6273\mu_N$. Nuclear spin quantum number I=½ **[2]**

Q2) a) Obtain the different spectroscopic term symbols for P.P configuration and show the different energy levels associated with them using the relations of Γ_1, Γ_2 and $\Gamma_3 + \Gamma_4$ **[7]**

b) What is sodium triplet? Show the allowed and for bidden energy levels using energy level diagram and selection rules. **[5]**

P.T.O.

Q3) a) Explain the difference between normal Zeeman effect, Anomalous Zeeman effect and Paschen. Bach effect. Obtain the relation for interaction energy 'Δ_E' in case of Paschen. Bach effect. Also state the selection rules for transitions for ΔM_L and ΔM_s. **[7]**

b) Calculate the minimum energy (in joule) of a bom barding electron must have to knock out a K shell electron of a tungsten atom (Z=74), (n_i=1; $n_f = \infty$) **[5]**

Q4) a) Explain the molecular orbital method for the treatment of hydrogen molecule. **[7]**

b) Explain the vibrational course structure. Hence draw the band formed during electronic absorption. **[5]**

Q5) a) Define polarizability. What is Raman scattering? Draw and explain the schematics of Raman spectrometer. What are the importance of fourier transform Raman spectrometer over Raman Spectrometer. **[7]**

b) Calculate the amplitude of vibrations in ν=0 level of co molecule which has force constant of 1870 Nm^{-1}. **[5]**

Q6) a) What is electron spin resonance (ESR)? Explain the block diagram of ESR spectrometer. **[7]**

b) A system of protons at a temperature of 25°C is placed in a magnetic field of 2T. What is the ratio of number of proton spins in the lower State to the number of Proton in upper state? (g_N=5.585; $\mu_N = 5.051 \times 10^{-27}$ JT^{-1}) **[5]**

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

a) Production of X-rays and their Properties. **[4]**

b) State and explain stark effect. **[4]**

c) Applications and limitations of IR spectroscopy. **[4]**

d) Resonance condition in ESR. **[4]**

● ● ●

Total No. of Questions : 7]

SEAT No. : ____

PA-3151

[Total No. of Pages : 3

[5908]-203

M.Sc. - I (Physics)

PHCT - 123 : QUANTUM MECHANICS

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

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

Instructions to the candidates:

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

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

a) Explain the De-Broglie Wave.

b) State any two postulates of Quantum Mechanics.

c) Define orthonormal vectors in Dirac's bra and ket notation form.

d) Calculate the uncertainity in the momentum of a particle if uncertainity in the displacement is 10^{-14}m.

(Given : Plancks' constant h = 6.624×10^{-34} J-s)

e) Write any two examples of Hermitian operator.

f) What do you mean by transition probability?

Q2) a) The step potential for infinite width is given by.

$V = 0$ if $x \leq 0$

$V = V_0$ if $x > 0$

Discuss the wave function and current density for transmitted wave when energy of particle is $E > V_0$ and $E < V_0$.

b) Find the normalised ground state wave function and energy of one dimenssional harmonic oscillator using ladder operators.

[12]

P.T.O.

Q3) a) Derive an expression of first order correction to wave function and energy of non degenerate perturbed system of one dimenssional infinite square well potential.

b) Using pauli spin matrices σ_x, σ_y and σ_z prove that $[\sigma_x,\sigma_y] = 2i\sigma_z$, $[\sigma_y,\sigma_z] = 2i\sigma_x$, $[\sigma_z,\sigma_x] = 2i\sigma_y$.

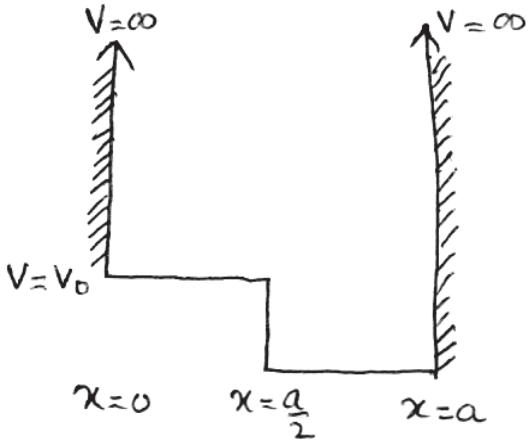
[12]

Q4) a) i) Obtain the eigen value of angular momentum operator L^2 using ladder operators.

ii) Explain unitary transformation.

b) Calculate the first order correction to energy and eigen function for an infinite square well potential perturbed system shown below:

[12]



Q5) a) Define self adjoint operator. Prove that:

i) $(AB)^+ = B^+A^+$ and

ii) $(A^+)^+=A$

A and B are adjoint operators.

b) Express total angular momentum operator J_z and J^2 in matrix form if $j = \frac{1}{2}$.

[12]

Q6) a) Explain eigenstate of S_z and S^2 for addition of two spin angular momenta when $S_1 = S_2 = \frac{1}{2}$.

b) Explain projection operator and idempotent operator.

[12]

Q7) Attempt any two of the following. **[12]**

a) Explain transformation matrix $[u]$ by change of basis from set $\{|\phi_n\rangle\}$ to set $\{|\phi'_n\rangle\}$.

b) Find the energy eigen value and eigen function of the momentum operator using dirac delta function.

c) Using WKB approximation, derive an expression of wave function of a particle with energy E < V, where V is polential energy.

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Total No. of Questions : 7]

SEAT No. :

PA-3152

[Total No. of Pages : 3

[5908]-301
M.Sc.
PHYSICS
PHCT - 231 : Statistical Mechanics
(CBCS 2020 Pattern) (4 Credits) (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 $K_B = 1.38\times10^{-23}$ J/k
2) Planck's constant $h = 6.625\times10^{-34}$ Js
3) Arogadro's number $N = 6.023\times10^{23}$/gm mole
4) Mass of electron $m_e = 9.1\times10^{-31}$kg
5) Velocity of light $c = 3\times10^{8}$ m/s
6) Charge on electron $e = 1.6\times10^{-19}$ C

Q1) Attempt <u>any five</u> of the following.

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

b) A system in thermal equilibrium, two states of energy difference 8.28×10^{-21} J occur with relative probability e^2. Determine the equilibrium temperature. **[2]**

P.T.O.

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

Given : Concentration of electrons in copper, $n = 8.5 \times 10^{28} / m^3$ **[2]**

d) Show that entropy of the composite system is equal to the sum of entropies of all sub-systems $S = S_1 + S_2 + S_3 + ...$ **[2]**

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

f) A body of mass m is held at a height *h* above the ground. It is just released and allowed to fall under gravity. Determine the phase space trajectory of the body. **[2]**

Q2) a) For grand canonical ensemble, show that the probability of finding the system in a particular microstate *r*, having energy E_r is given by

$$P_r = \frac{e^{-\beta E_r - \alpha N_r}}{\sum_r e^{-\beta E_r - \alpha N_r}}$$ **[7]**

b) Show that $PV = \frac{2}{3}E$ is satisfied by a gas of free mono atomic particles irrespective of statics it obeys. **[5]**

Q3) a) i) Given that single partition function for 1 - D harmonic oxillator is $Z = \left[2 \sinh\left(\frac{\hbar w}{2KT} \right) \right]^{-1}$. Obtain the expression for average energy of oxillator and show that at high temperature limit it is equal to KT. **[4]**

ii) The table given below shows the energy parameters and accessible states for system 1 and 2 :

System 1	System 2
E_1 = 2, 3, 4 units	E_2 = 5, 6, 7 units
Ω_1 = 5, 25, 75	Ω_2 = 100, 150, 200

The systems are kept in contact and undergo thermal interaction only. Obtain the distribution for 9 units of energy in the equilibrium state. **[3]**

b) Show that the mean pressure $\bar{P}$ is given by $\bar{P} = \frac{1}{\beta}\frac{\partial \ln z}{\partial v}$, where z is the partition function. **[5]**

Q4) a) Two macroscopic systems A and A' are in thermal interaction with each other forming a combined system $\mathring{A}$. Show that $S = K \ln \Omega(E)$. **[7]**

b) Show that the energy fluetuation in a canonical distribution is given by $\overline{(\nabla E)^2} = KT^2Cv$ **[5]**

Q5) a) State and prove Liouville's theorem. **[6]**

b) Show that when $T << \theta_r$, where θ_r is the rotational characteristic temperature in the lowest approximation $(C_v)_{rot} = 12NK\left(\frac{\theta_r}{T}\right)^2 e^{-2\theta r/T}$ **[6]**

Q6) a) State and prove equipartition theorem. **[6]**

b) Obtain stefan's law of radiation, $E = \sigma T^4$ in caseof black body radiation. **[6]**

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

a) White Dwarts **[4]**

b) Rediation density **[4]**

c) Phase space **[4]**

d) Boltzmann limit of Boson and Fermion gases. **[4]**

Total No. of Questions : 7]

SEAT No. :

PA-3153

[Total No. of Pages : 3

[5908]-302
M.Sc. - II
PHYSICS
PHCT - 232 : Solid State Physics
(CBCS 2020 Pattern) (4 Credits) (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.***

Gives :

Plank's constant = 6.626×10^{-34} Js

Mass of electron = 9.1×10^{-31} kg

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

Avogadro's Number = 6.023×10^{26}/k mole

Permeability of free space = $4\prod\times10^{-7}$ Henry/m

Charge on electron = 1.6×10^{-19} C

Permittivity of free space = $8.85\times10^{-12}c^2$/N m^2

Bohr magneton = $9.27\times10^{-24}/m^2$

Q1) Solve any five of the following (2 Marks each). **[10]**

a) What are type I & type II superconductor's? **[2]**

b) What is cyclotron resonance? **[2]**

P.T.O.

c) State the difference between ferromagnetism and antiferromagnetism. **[2]**

d) Explain the cause of paramagnetism in a material. **[2]**

e) Define the following terms: **[2]**

i) Fermi energy

ii) Fermi velocity

f) A superconducting tin has a critical temperature of 3.7k at zero magnetic field & a critical field of 0.0306 Telsa at 0k. Find the critical field at 2k. **[2]**

Q2) a) i) Describe the assumption's of BCS theory. **[4]**

ii) Explain with neat diagram's reduced, periodic & extended zone schemes. **[3]**

b) Distinguish bet^{n} metal's semiconductor's & insulator's on the basis of band theory of solids. **[5]**

Q3) a) Derive London equation for superconducting state and obtain expression for the penetration depth. **[7]**

b) Explain Josephson effect in superconductors. **[5]**

Q4) a) Explain the term's anisotropy energy & Bloch wall with reference to magnetization. **[7]**

b) A paramagnetic salt contains 10^{28}ions/m^3 with magnetic moment of one Bohr magneton, calculate the paramagnetic susceptibility and the magnetisation produced in a uniform magnetic field of 10^6 A/m, at room temperature. **[5]**

Q5) a) Describe the motion of electron in a one dimensional periodic potential. Hence explain the concept of effective mass m*. Explain the meaning of negative mass (effective) with the help of m*k - curve. **[7]**

b) A magnetic material has a magnetization of 3300 A/m & flux density of 0.0044 wb/m^2. Calculate the magnetizing force & the relative permeability of the material. **[5]**

Q6) a) State the assumption's of the Kronig-Penney model. Show that the energy spectrum of an electron consists of allowed & forbidden energy band's on the basis of these assumption's. **[7]**

b) Explain the formation of energy gap on the basis of nearly free electron model. **[5]**

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

a) Cooper pair's **[4]**

b) Meissner effect **[4]**

c) Quantum theory of paramagnetism **[4]**

d) Critical field & critical temperature in superconductor's **[4]**

Total No. of Questions : 7]

SEAT No. :

PA-3154

[Total No. of Pages : 2

[5908]-303

M.Sc. - II

PHYSICS

PHCT-233 : Experimental Techniques in Physics-I

(CBCS 2020 Pattern) (Semester-III) (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) ***Figures to the right indicates full marks.***
4) ***Use of log table or non-programmable electronic calculator is allowed.***
5) ***Draw neat diagrams wherever necessary.***

Q1) Solve any Five of the following. **[5×2=10]**

a) Differentiate between systematic error and random error.

b) What is outgasing and backstreaming?

c) Differentiate between viscous flow regime and molecular flow regime.

d) Why Helium is used as a test gas in Leak detection techniques?

e) A vacuum chamber is connected to a pump of speed 100 lit./sec. by a pipe of conductance 400. Calculate the pumping speed at the chamber.

f) Define pumping speed & pump down time.

Q2) Solve the following.

a) i) What are the different types of signals? Explain signal to noise ratio. **[4]**

ii) A vessel of volume 4 m^3 has to be evacuated from 1000 mbar to 1mbar in 20 minutes. What pumping speed (m^3/hour) is required? **[3]**

b) Discuss the applications of vacuum pumps for various experimental techniques in physics. **[5]**

Q3) Solve the following.

a) i) What is the principle of operation of getter pump? Describe the function of Titanium sublimation pump. **[4]**

ii) What is Chi-square test for reliability? **[3]**

b) What is throttling process? What are the different throttling devices? **[5]**

P.T.O.

Q4) Solve the following.

a) i) Explain how Bayard- Alpert gauge over comes the limitations of triode ionization gauge? **[4]**

ii) A mean free path of Nitrogen molecule is 64 mm at 10^{-3}mbar. What will be it at 0.3 mbar? **[3]**

b) With the help of neat diagram explain the function of diffusion pump. What is the need of cold trap? **[5]**

Q5) Solve the following.

a) Give the classification of sensors. Explain the principle of operation of temperature and humidity sensors. **[6]**

b) Explain the working of rotary-vane pump. Describe the concept of roughing and backing pump. **[6]**

Q6) Solve the following.

a) Discuss the gas transport properties at low pressure. **[6]**

b) Explain in details, the characteristics of sensors. **[6]**

Q7) Write a short notes on any Three of the following. **[3×4=12]**

a) Write a short note on conductance and impedance of vacuum line.

b) Write a short note on

i) Fourier Transform and

ii) Discrete fourier transform

c) Write a short note on Penning gauge.

d) Explain the working of Orbitron pump.

Total No. of Questions : 7]

SEAT No. : ____

PA-3155

[Total No. of Pages : 3

[5908]-304

M.Sc.

PHYSICS

Group-II : PHOT 234G4 : Acoustics-I

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

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

Instructions to the candidates:

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

Q1) Solve any Five of the following.

a) Define Acoustic Intensity. Give its unit. **[2]**

b) Define specific acoustic impedence with its unit. **[2]**

c) Give formula and unit for Intensity Level and Sound Power Level. **[2]**

d) What do you mean by live room and dead room. **[2]**

e) With its formula and unit define Acoustic compliance. **[2]**

f) Define phon and sone. **[2]**

Q2) a) i) Draw a diagram showing longitudinal displacements in a plane sound wave.

Derive expression for equation of continuity $S = -\frac{\partial \xi}{\partial x}$ **[4]**

ii) A rectangular hall has dimensions l0 ft × 15 ft × 30 ft having interior boundaries with average absorption coefficient $\bar{\alpha} = 0.1$. What is reverberation time of the hall? **[3]**

P.T.O.

b) Given a beam of plane wave in water to contain 100 w of acoustic power distributed uniformly over a circular cross-section of 40cm diameter. The frequency of the waves is 24 KHz. **[5]**

Determine:

1) The Intensity of the beam
2) The sound pressure amplitude
3) The Acoustic particle velocity amplitude
4) Effective Pressure
5) Sound Pressure Level (re l micro bar)

Q3) a) i) Show that IL= (4.35 ln I)dB+120 dB and SPL=(8.7 ln Pe) dB+20dB **[4]**

ii) The resonator frequency of flanged Helmholtz resonator is 330 Hz. Determine its volume if length and radii are 0.0068m and 0.0073m respectively. Also find its Quality factor. [C = 343 m/s] **[3]**

b) Starting with the equation for decay of sound energy in a live room $V\frac{d\varepsilon}{dt}+\frac{ac\varepsilon}{4}=0$, derive equation for reverberation time. **[5]**

Q4) a) i) Sketch and explain hearing mechanism along with its schematic representation. **[4]**

ii) Determine the energy density and effective pressure of a plane wave in air at 70 dB intensity level. [C=343 m/s] **[3]**

b) Starting with differential equation for decay of sound in live room, derive the equation $T_{60}=\frac{3t}{\log_{10}\left(\frac{a0}{a}\right)}$ **[5]**

Q5) a) Derive the expression for sound power reflection coefficient in case of 'transmission from one fluid medium to another' at normal incidence. Hence compare the limiting cases $\rho_2 C_2/\rho_1 C_1 \to \infty$ and $\rho_2 C_2/ \rho_1 C_1 \to 0$ **[7]**

b) A rectangular room 12 ft high, 23 ft wide and 34 ft long has reverberation time of 0.77 sec. The walls are of plaster, wood and glass having an average absorption coefficient 0.055. The floor is covered with a carpet (α=0.22) and ceiling with an acoustical tile. Eleven people are present in the room, each equivalent to 4.5 Sabins. Calculate the absorption coefficient for the acoustic tile that covers the ceiling. **[5]**

Q6) a) Explain the analogies between electrical, mechanical and acoustical systems. **[6]**

b) Following are the SPL (dB) observations. Collected at traffic junction. Calculate LAeqT. **[6]**

Time	9 am	10 am	11 am	12 noon	1 pm
SPL(dB)	73	75	77	82	85
Time	2 pm	3 pm	4 pm	5 pm	6 pm
SPL(dB)	68	72	64	89	76

Q7) Write short notes on any three.

a) Haas Effect **[4]**

b) Helmholtz resonator **[4]**

c) Audiometry **[4]**

d) Sound Transmission class **[4]**

Total No. of Questions : 7]

SEAT No. : ____

PA-3156

[Total No. of Pages : 2

[5908]-305

Second Year M.Sc.

PHYSICS

Group-II - PHOT-234H4 : Energy Studies-I

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

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

Instructions to the candidates:

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

Q1) Solve any Five of the following.

a) What are the various forms of energy? **[2]**

b) What is thee use of pyranometer? **[2]**

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

d) What is solar Pond? **[2]**

e) What is Green house? **[2]**

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

Q2) a) i) Explain energy consumption and its impact on environmental climate change. **[4]**

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

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

Q3) a) i) Explain laws of thermodynamics. **[4]**

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

b) Explain construction and working principle of sunshine recorder with neat 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 titled surfaces. **[5]**

Q5) a) Explain in brief about essential factors for sustainable developments. **[6]**

b) Explain in brief about the structure of sun with a suitable diagram. What is solar constant. **[6]**

Q6) a) What are Fossil fuels? What are the Impacts of excessive use of fossil Fuels. **[6]**

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

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

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

b) Types of Heat transfer **[4]**

c) Major Harmful effects of acid rain. **[4]**

d) Terrestrial and extraterrestrial solar radiaiton **[4]**

Total No. of Questions : 7]

SEAT No. : ____

PA-3157

[Total No. of Pages : 2

[5908]-306

M.Sc.

PHYSICS

(Group-II) PHOT-234I4 : Electronic Instrumentation-I

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

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

Instructions to the candidates:

1) ***Questions 1 is compulsory.***
2) ***Attempt/Solve any two 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 or non-programmable calculator is allowed.***
6) ***Neat diagams must be drawn where necessary.***

Q1) Solve any Five of the following:

a) How are the displays classified list different types of display device. **[2]**

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

c) State different types of thermocouple. **[2]**

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

e) Define the term : Accuracy, Precision. **[2]**

f) List different materials used to radiate differenet colour. **[2]**

Q2) a) Discuss response of first order instrument for step input in details. **[7]**

b) Explain thermocouple laws. **[5]**

Q3) a) Explain methods of corrections for interfering and madifying inputs. **[7]**

b) Explain LVDT displacement sensor in details How the direaction of motion can be sensed from this sensor? **[5]**

Q4) a) Draw a block diagram of instrumentation amplifier using three op-amp. Derive equation for its output. **[7]**

b) Explain in details the use of microprocessor in improving fuel efficiency of petrol engine. **[5]**

P.T.O.

Q5) a) Compare LCD and LED display for their advantage and limitation. **[7]**

b) Draw block diagram of Laser printer and explain its working. **[5]**

Q6) a) Derive an expression for gauge factor for bonded resistance wire strain gauge. **[7]**

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

Q7) Write a note on any three of following.

a) Data logger **[4]**

b) Orifice meter **[4]**

c) Inc-jet printer **[4]**

d) Capacitive displacement Transducer **[4]**

Total No. of Questions : 7]

SEAT No. :

PA-3161

[Total No. of Pages : 2

[5908] - 310
M.Sc.
PHYSICS
PHOT-234 M4 : Material Science-I (Group-II)
(2020 CBCS Pattern) (4 Credits) (Semester-III)

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

Instructions to the candidates:

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

Given:

i) Avogadro's number = 6.0225×10^{26} (kilomole)$^{-1}$

ii) Boltzmann constant $k_B = 1.38 \times 10^{-23}$ J/K.

Q1) Solve any five of the following:

a) Define the terms: stress and strain. **[2]**

b) Explain the term vacancy. **[2]**

c) Find the equilibrium concentration of vacancies in nickel at 0K, 300K [E_{Ni} = 1.74eV] [R = 8.314 J/mole - K] **[2]**

d) Give two importance of phase diagram. **[2]**

e) State lever rule. **[2]**

f) Write the Gibb's phase rule for two component or binary system. **[2]**

Q2) a) For a regular solution using simple statistical model show that $\Delta H^M = \Omega \times A \times B$ **[7]**

b) Show that Fick's second law leads to Fick's first law under certain condition also write the certain condition. **[5]**

Q3) a) Draw the topological diagram for binary system. Discuss the extension rule. **[7]**

b) What is dislocation? Distinguish between edge and screw dislocation. **[5]**

P.T.O.

Q4) a) i) A rod of copper should not be stressed to more than 70 MPa (or $N.m^2$) in tension. What diameter is required if it is to carry a load of 2000 kg? (Given $g=9.8m/s^2$) **[4]**

ii) Copper has a resistivity of 17×10^{-9} ohm-m calculate: **[3]**

1) End to end resistance of copper strip 2cm long by 5mm wide×1mm thick.

2) What is conductivity?

b) Explain the term miscibility gap with the help of free energy diagram. Write an example. **[5]**

Q5) a) Explain Gibb's phase rule. What are the degrees of freedom of a system of two components when the number of phases is one, two and three. **[7]**

b) At 1000°C, there can be 1.7 w/o carbon is solid solution with FCC iron. How many carbon atoms will there be every 100 unit cells?

[Given: At. wt. of Fe = 55.85 a.m.u.

At. wt. of C=12.01 a.m.u.] **[5]**

Q6) a) What is solid solution & explain interstitial & substitutional solid solution with an example. **[6]**

b) Explain five different invariant equation with the help of neat diagram. **[6]**

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

a) Electrical properties of material **[4]**

b) Hume- Rothery role **[4]**

c) Type I and type II phase diagram **[4]**

d) Henry's law & Raoult's law **[4]**

Total No. of Questions : 4]

SEAT No. :

PA-3164

[Total No. of Pages : 1

[5908] - 313
M.Sc.
PHYSICS
(Group-II) PHOT-234H2: Energy Studies-I
(2020 CBCS Pattern) (Semester-III) (2 Credits)

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

Instructions to the candidates:

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

Q1) a) Attempt <u>any four</u> of the following:

i) What are renewable energy of sources? **[2]**

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

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

iv) What is air mass? Calculate it at Zenith. **[2]**

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

b) Determine the declination of sun on 19th June of 1980. **[3]**

Q2) a) i) Explain the spectral distribution of extraterrestrial radiation. **[4]**

ii) Define the terms: Hour angle, Zenith angle and Altitude angle. **[3]**

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

Q3) a) What are the diffeerent types energy storage systems? Explain with neat diagram, the working of solar pond as an energy storage. **[7]**

b) Explain with niat diagram, the measurement of solar radiations by pyranometer. **[5]**

Q4) a) Write a short note on <u>any three</u> of following:

i) Non-Renewable Energy sources and their disadvantages. **[4]**

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

iii) Green House and its merits and demerits. **[4]**

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

Total No. of Questions : 4]

SEAT No. :

PA-3165

[Total No. of Pages : 1

[5908] - 314
M.Sc.
PHYSICS
PHOT234I2 : Electronic Instrumentation-I
(2020 CBCS Pattern) (2 Credits) (Semester-III) (Group-II)

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

Instructions to the candidates:

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

Q1) a) Solve any four of the following:

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

ii) Define the terms: Accuracy and Precision. **[2]**

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

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

v) State different types of thermocouple. **[2]**

b) Draw block diagram of instrumentation amplifier using three op-amp and write its output voltage equation. **[3]**

Q2) a) Explain unbounded strain gauge as displacement transducer with the help of suitable diagram. **[7]**

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

Q3) a) Explain data logger with necessary block diagram. **[7]**

b) What is main advantage of electrical transducer? **[5]**

Q4) Write a short note on any two of following.

a) Data Acquisition system **[6]**

b) Thermocouple **[6]**

c) Variable Reluctance type transducer **[6]**

Total No. of Questions : 4]

SEAT No. : ____

PA-3166

[Total No. of Pages : 1

[5908]-315

M.Sc.-II

PHYSICS

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

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

Time : 3 Hours] ***[Max. Marks : 35***

Instructions to the candidates:

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

Q1) a) Solve any four of the following.

i) Define depolarizaiton. **[2]**

ii) Define perfectly polarizable electrode with example. **[2]**

iii) Explain ECG waveform. **[2]**

iv) State the amplitude & frequency range of EMG. **[2]**

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

b) The distance between two consecutive R waves is 30 mm and paper speed is 50 mm/sec. What is the heart rate? **[3]**

Q2) a) What is pulse oximetry? Explain it's working with block diagram. **[7]**

b) Define Gauge factor, Poisson's ratio and derive relation between them. **[5]**

Q3) a) Explain performance characteristics of transducer. **[7]**

b) Distinguish between external and internal pacemaker. **[5]**

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

a) Effects of artefacts on ECG recording. **[6]**

b) Microshock and macroshock. **[6]**

c) Structure and working of heart. **[6]**

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Total No. of Questions : 4]

SEAT No. : ____

PA-3168

[Total No. of Pages : 2

[5908]-317

M.Sc.

PHYSICS

Group-II : PHOT234L2 : Microcontroller Based Instrumentation System-I

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

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

Instructions to the candidates:

1) ***Question 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 indicate full marks.***
5) ***Use of log-table, non-programmable calculator is allowed.***
6) ***Neat diagam must be drawn wherever necessary.***

Q1) a) Solve any four of the following.

i) What is PSW register? Draw its format. How will you select register bank 3? Explain. **[2]**

ii) Compare ACALL & LCALL instructions. How processor returns to the main program when it completes a CALL subroutine. **[2]**

iii) What is a stack pointer register. Give its size. What are its contents when processor Resets? Can we increment/decrement S.P. register using any instructions? **[2]**

iv) What is long form of TMOD register. Draw its format. Write instructions to select timer ∅ in mode 2. **[2]**

v) How many interrupts microcontroller 8051 has? List them. Provide their vector locations. **[2]**

b) Write a program to generate a delay of 100 μ seconds using any register of 8051. **[3]**

(Assume crystal attached to μ controller clock is 12 MHz)

P.T.O.

Q2) a) Draw functional block diagram for 8051 microcontroller. Explain its **[7]**

i) bus structure

ii) ALU

iii) Interrupt handling block

b) Draw flowchart and write an assembly language program to move 50 (decimal) numbers stored sequentially from memory location 0050 H to memory location 0060H. Add appropriate comments to your program. **[5]**

Q3) a) Explain by giving atleast two numerical examples how microcontroller 8051 handles BCD arithmetics? What role the AC flag has in BCD arithmetics? Explain. **[7]**

b) Explain with illustrations (minimum 2 different examples) register indirect addressing method. Explain the instructions MOV C & MOV X.....with one example for each. Give advantages of indirect addressing techniques. **[5]**

Q4) Write a short note on any two.

a) Timerl counter section of 8051. Mention in brief the registers associated with, how to use them to program the timers/ counters, in Different modes & their advantages & limitations. **[6]**

b) Explain with one example the instructions. **[6]**

i) SWAP A

ii) XCH A, data address

iii) JBC bit address, code address.

c) Parallel port structure of 8051 microcontroller. **[6]**

Total No. of Questions : 4]

SEAT No. : ____

PA-3169

[Total No. of Pages : 2

[5908]-318

M.Sc.

PHYSICS

Group-II - PHOT-234M2 : Material Science-I

(2020 CBCS Pattern) (2 Credits)

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

Instructions to the candidates:

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

Given:

i) ***Avogadro's number = 6.025×10^{26}(kilomole)$^{-1}$***

ii) ***Boltzman constant $K_B=1.38\times10^{-23}$ J/K***

Q1) a) Solve any four of the following.

i) Define the term specific heat and thermal conductivity. **[2]**

ii) Give various appliction of diffusion. **[2]**

iii) What are the factors governing solid solubility. **[2]**

iv) Define the term, hardness, and toughness. **[2]**

v) What is Shottky Defect? **[2]**

b) Calculate the spacing between dislocations in a tilt boundary in FCC crystal when angle of tilt is 2° [given: burgers vector b=4.150 A°]. **[3]**

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

b) Explain ficks first and second law of diffusion also obtain expression for ficks second law. **[5]**

P.T.O.

Q3) a) What is atomic diffusion? on what factors it depends? Explain process of mechanism of atomic diffusion in detail. **[6]**

b) What is Frenkel Defect? Obtain an expression for equillibrium concentration of frenkel defect in crystals. **[6]**

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

a) Electrical properties of material. **[4]**

b) Twin boundary **[4]**

c) Hume-Rothery rule **[4]**

d) Vegard's law of solid solution. **[4]**

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Total No. Of Questions : 7]

SEAT No. :

PA-3170

[Total No. Of Pages : 2

[5908]-401
M.Sc. (Physics)
PHCT-241 - Nuclear Physics
(CBCS) (2020 Pattern) (Semester - IV) (4 Credits)

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

Instructions to the candidates :

1) ***Q.1 is compulsory***
2) ***Attampt 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 logtables of non-programmable electronic calculator is allowed.***
6) ***Neat diagrams must be drawn wherever necessary.***

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

a) Draw B.E./A curve, state its two characteristics. **[2]**

b) Define the unit of radioactivity curie (c). **[2]**

c) State any two achievements of shell model. **[2]**

d) List the main components of Nuclear reactors. **[2]**

e) What are the three main categories of elementary particles **[2]**

f) What is conserved during lepton decay. **[2]**

Q2) a) Derive the four factor formula for steady state chain reaction. **[7]**

b) Discuss principle, construction and working of cyclotron. **[5]**

Q3) a) What is the working principle of bubble chamber? Discuss its construction. What are its merits. **[7]**

b) Describe Fermi gas model and obtain the expression for Fermi energy. **[5]**

P.T.O.

Q4) a) What is quark? Give qualitative description of quark model **[7]**

b) What are leptons? Name any three leptons. Briefly discuss the properties of leptons. **[5]**

Q5) a) What do you mean by solid state detectors? Draw and explain surface barrier detector. **[7]**

b) State different conservation laws in particle physics. **[5]**

Q6) a) In a mass spectrometer a single charged +ve ion is accelerated through a potential difference of 1000 volts. It then travels through a uniform magnetic field at 1000 gauss and is deflected through a circular path of radius 18.2cm find

i) Speed of the ion

ii) Mass of the ion **[7]**

b) Describe any method for measuring nuclear size.

The radius of $_{29}^{64}Cu$ is measured to be 4.8×10^{-13} an.

Find the radius of $_{12}^{27}Mg$. **[5]**

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

a) A compound nuclear theory. **[4]**

b) Shell model. **[4]**

c) Power reactors. **[4]**

d) Giger Nuttal law of radioactivity. **[4]**

Total No. Of Questions : 7]

SEAT No. :

PA-3171

[Total No. Of Pages : 2

[5908]-402

M.Sc. (Physics)

PHCT-242: EXPERIMENTAL TECHNIQUES IN PHYSICS-II

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

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

Instructions to the candidates :

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

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

a) State basic principle of semiconductor detector for detection of X-ray photon. **[2]**

b) Distingwish the optical and electron microscopy. **[2]**

c) What kind of thermal event took place during thermal process? **[2]**

d) State importance of electron diffraction pattern. **[2]**

e) What is wavelength of a microwave that has a frequency of 4.2×10^8Hz? **[2]**

f) State the physical significance of hysteresis loop. **[2]**

Q2) a) i) State the basic mechanism of molecule for microwave and infra -red spectroscopy. **[4]**

ii) State advantages of field - emission scanning electron microscope (FESEM) over scanning electron microscope (SEM). **[3]**

b) What is nuclear magnetic resonance (NMR)? Explain in detail with neat labelled diagram. **[5]**

P.T.O.

Q3) a) i) Differentiate the characteristic and continuous X-rays **[4]**

ii) State brief mechanism of electron matter interaction. **[3]**

b) Write range of wavelengths and corresponding energies for electromagnetic radiations. **[5]**

Q4) a) i) Write short note on vibrating sample magnetometer [VSM] **[4]**

ii) Calculate the wavelength of photon in nm having energy 1.5eV. **[3]**

b) With the help of neat diagram explain differential thermal analysis (DTA) **[5]**

Q5) a) State various electromagnetic radiations, their sources and detectors. **[6]**

b) With neat labelled diagram, explain principle, construction and working of transmission electron microscope (TEM) **[6]**

Q6) a) Explain the powder (Debye-Scherrer) method for determining crystal structure. **[6]**

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

Q7) **Attempt <u>any three</u> of the following.**

a) What is the frequency of an electromagnetic wave that has wavelength of 4.55×10^{-3}m? Which type of radiation would this correspond too? **[4]**

b) Write short note on electron spin resonance. **[4]**

c) Explain importance of energy dispersive spectroscopy (EDS) in SEM. **[4]**

d) Write short note on Thermogravimetric analysis (TGA) **[4]**

Total No. Of Questions : 7]

SEAT No. : ____

PA-3172

[Total No. Of Pages : 3

[5908]-403
M.Sc. (Physics)
PHOT-244G4 - ACOUSTICS-II
(CBCS) (2020 Pattern) (Semester - IV) (4 Credits) (Group-II)

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

Instructions to the candidates :

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

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

a) What is volume expander? **[2]**

b) Define/State Electro acoustic Reciprocity Theorem. **[2]**

c) Define cut off frequency of exponential horn. **[2]**

d) Give circuit diagram for 6dB/octane and 12dB/octane first and second order respectively band pass filter. **[2]**

e) Give classification of microphones. **[2]**

f) What do you mean by cavitation. **[2]**

Q2) a) Draw a diagram showing cross-section of a condenser microphone. Derive the expression for its sensitivity. **[7]**

b) Two identical reversible microphones are setup for reciprocity type of calibration. The spacing between microphones is 2m.for a frequency of 2KHz, the measured open circuit voltage output for one microphone is 0.0001V for an input current of 0.01A to the other. Determine open circuit voltage response of the microphone in $V/N/m^2$ and in dB. **[5]**

P.T.O.

Q3) a) Draw a diagram showing Direct radiater loudspeaker. Derive the expression for motional impedence Zm of Direct radiator loudspeaker. **[7]**

b) Determine the phase velocity of a 350HZ plane wave progressing through an exponential horn of flare constant of 5.0 at a temperature of 35°C **[5]**

Q4) a) i) Derive the expression for sensitivity of carbon microphone. **[4]**

ii) Determine the cut-off frequency of an exponential horn having a flare constant of 4.8 on being empolyed out doors at a temperature of 112°F. **[3]**

b) The open circuit voltage response of a carbon microphone is -52dB when connected to a 12V battery and its internal impedence is 120 Ω . Its diaphragm has radius of 0.01m and stiffness of 10^6N/m. **[5]**

i) Determine the numerical value of the resistance constant 'h' for this microphone.

ii) For an incident sound wave of 100 microbars pressure amplitude, what will be the ratio of second harmonic to fundamental voltage developed in this microphone.

Q5) a) The equation for plane waves in axponential horn is $\frac{\partial^2 \xi}{\partial t^2} = c^2 \left[\frac{\partial^2 \xi}{\partial x^2} + m \frac{\partial \xi}{\partial x} \right]$

Show that, for $\xi = Ae^{j(wt+\gamma x)}$ to be a solution to the equation, γ must satisfy the relation $\gamma^2 - jmr - k^2 = o$ where $K = \frac{w}{c}$ **[7]**

b) A direct radiator loudspeaker has total mass of 0.01kg and operated in magnetic field of 2wb/m^2. The radius of the speaker is 0.1m. The mechanical resistance is 1 kg/sec. The radiation resistance and reactance each are 2kg/Sec, The stiffness of cone system is 2500 N/M, the voice coil is 3.8m long, has a resistance of 10Ω,
Calculate.

i) Frequency of mechanical resonance.

ii) Efficiency at 200Hz frequency. **[5]**

Q6) a) Give steps involved in the reciprocity calibration of a microphone. Hence derive formula for M_A. State advantages of this method. **[6]**

b) A velocity ribbon microphone has an aluminium strip of width 2×10^{-3}m, length 3×10^{-2}m and mass 1.5×10^{-6} kg. The strip moves in the magnetic field of flux density 0.2 wb/m^2 inside a circular baffle of radius 0.04m. It a plane acoustic wave of frequency 200Hz and pressure 3N/m^2 is in cident normally on the face of the ribbon. Determine 1) voltage generated in the ribbon 2) Sensitivity 3) velocity and displacement amplitude. (c=330m/s). **[6]**

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

a) Strengths and weaknesses of sonography. **[4]**

b) MP3 Audio format **[4]**

c) Graphic Equalizer **[4]**

d) Cross over Network **[4]**

Total No. Of Questions : 7]

SEAT No. :

PA-3173

[Total No. Of Pages : 2

[5908]-404
M.Sc. (Physics)
PHOT-244H4 : Energy Studies - II
(Group - II) (CBCS) (2020 Pattern) (4 Credits) (Semester-IV)

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

Instructions to the candidates :

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

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

a) Explain following parameters. **[2]**

i) Fill Factor

ii) Open circuit voltage

b) What is the difference between direct bandgap and indirect bandgap. **[2]**

c) Explain following parameters. **[2]**

i) Short Circuit Current

ii) Bandgap

d) What is Energy Farming? **[2]**

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

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

Q2) a) What are the various hydrogen production method? Explain any one of them. **[7]**

b) What is a biomass? How is biomass used to produce electric power. **[5]**

P.T.O.

Q3) a) Explain wind turbine types and their construction. **[7]**

b) What are the characteristics of biogas and write any one in brief. **[5]**

Q4) a) Explain how the performance of a flat plate collector depends on solar irradiance (I), inlet temperature (Ti) and ambient air temperature (Ta) **[7]**

b) How are metals insulators and semiconductors classified? Give an example of each category **[5]**

Q5) a) Explain the solar cell characteristics terms. Draw a typical plot of a Solar cell I-V curve. The P-n junction solar cell has 750 w/m^2 input power radiation and l cm^2 area. The calculated efficiency of cell is 20%. Find fill factor if short circuit current and open circuit voltage of given solar cell are 50mA and 0.5V respectively. **[7]**

b) Explain working principle of solar dryer with a suitable diagram. **[5]**

Q6) a) What is biomass gasification? Describe various types of Biomass gasifiers **[7]**

b) Explain working principle of solar cell with a neat diagram. **[5]**

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

a) Selective coatings **[4]**

b) Importance of Hydrogen **[4]**

c) Origin of wind **[4]**

d) Solar dryers **[4]**

Total No. Of Questions : 7]

SEAT No. :

PA-3174

[Total No. Of Pages : 2

[5908]-405
M.Sc. (Physics)
PHOT-244I4 : Electronic Instrumentation - II
(Group - II) (CBCS) (2020 Pattern) (4 Credit) (Semester-IV)

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

Instructions to the candidates :

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

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

a) Write a purpose of command window and Figure window. **[2]**

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

c) Define total scan time of PLC **[2]**

d) Write the equation for integral and proportional controller mode. **[2]**

e) Draw circuit symbol for NC and No type of physical limit and level limit switches. **[2]**

f) Why derivative controller mode is never used alone? **[2]**

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

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

Q3) a) Explain 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.

Q4) a) With neat diagram explain PLC operation in details Draw neat diagram for input and output module and explain its features **[7]**

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

Q5) a) Draw a ladder diagram for elevator system. The global objective is to take a load in upward direction if start or up switch pressed. Down ward motion is to be initiated by pressing down switch provided up motion of platform is not in progress, for up motion vice a versa. **[7]**

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

Q6) 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 33mV/^{O}c and has a 1.5-S time constant find output 0.755 after the input changes from 20^{o} to 41^{o}c. Find the error in temperature this represent. **[5]**

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

a) Two position Controller **[6]**

b) Characteristics of system **[6]**

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

Total No. Of Questions : 7]

SEAT No. : ____

PA-3178

[Total No. Of Pages : 2

[5908]-409
M.Sc. (Physics)
PHOT-244M4 : Material Science - II
(Group - II) (CBCS) (2020 Pattern) (4 Credits) (Semester-IV)

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

Instructions to the candidates :

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

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

a) Describe in short field effect transistor. **[2]**

b) The electron concentration in an n-type semiconductor is $5x10^{+17}/m^3$. Calculate the conductivity of the material if drift velocity of electron is 350m/s in a field of 1000 v/m. **[2]**

c) What are multiple compounds? Explain. **[2]**

d) Explain Hexagonal ferrites. **[2]**

e) Write in short about piezoelectric materials. **[2]**

f) Differentiate between ferro-magnetic and ferrimagnetic materials. **[2]**

Q2) 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 impureity 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 where n_i is Intrinsic concentration. **[5]**

P.T.O.

Q3) a) Explain in detail different exchange interactions occuring in magnetic materials. **[7]**

b) Write a short note on High Tc superconductor. Explain with a diagram Yttrium Barium copper oxide (YBCO-123). **[5]**

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) Explain in detail about quasi -cystals which can be formed by 'penrose Rhombus? **[6]**

b) Explain in detail Intrinsic & Extrinsic semiconductor with well labelled diagrams. **[6]**

Q6) a) Draw and discuss subclasses of silicates. **[6]**

b) Draw well labelled diagrams showing temperature dependance of inverse susceptibility in paramagnetic regime of. **[6]**

i) Paramagnetic ii) Ferromagnetic

iii) Ferrimagnetic iv) Anti-ferromagnetic

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

a) Optical materials **[6]**

b) Avalanche breakdown and gunn effect **[6]**

c) Network modifiers **[6]**

Total No. of Questions : 7]

SEAT No. : ____

PA-3134

[Total No. of Pages : 2

[5908]-41

M.Sc.

PHYSICS

PHYUT - 242 : Material Science

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

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

Instructions to the candidates:

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

Q1) Attempt/Solve any Five of the following:

a) Give the thermal properties of materials. **[2]**

b) What are the different factors affecting diffusion? **[2]**

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

d) What do you mean by stacking faults? **[2]**

e) What is meant by carburization of steel? **[2]**

f) A rod of copper should not be stressed more than 70 Mpa in tension. Then calculate the diameter of this rod if it carries load of 2000 kg. **[2]**

Q2) a) i) Describe the Frank-Read generator for the multiplication of dislocations. **[4]**

ii) Explain the concept of regular solution behaviour. **[3]**

b) State and derive Fick's I^{st} and II^{nd} law. **[5]**

P.T.O.

Q3) a) i) With the help of neat diagram, explain Type - II (eutective) phase diagram, with one example. **[4]**

ii) Explain different diffusion mechanism occurring in solid solutions. **[3]**

b) Using Legendre transforms, derive **[5]**

$$dG_1 = -SdT + VdP + \sum \bar{G}_i \, dn_i$$

Q4) a) i) Explain the condition for the solution to be exhibit on Routlian ideal solution. **[4]**

ii) Draw Burger circuit around a negative screw dislocation and determine its burger vector. **[3]**

b) With neat diagram, describe in detail Type - III phase diagram. **[5]**

Q5) a) Explain the classification of defects according to dimensionality and enlist the various subclasses. **[6]**

b) Explain with the help of free energy diagrams, the thermodynamic origin of equilibrium lens shape phase diagram. **[6]**

Q6) a) Explain the concept grain boundaries with high and low angles as well as tilt and twist boundaries. **[6]**

b) Prove ΔH^M is a parabolic function of composition given by

$$\Delta H^M = \Omega \ \alpha_A X_B$$ **[6]**

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

a) Minima and Maxima in two phase regions. **[4]**

b) Type - I phase diagram. **[4]**

c) Corrosion resistance of duralium. **[4]**

d) Optical properties of materials. **[4]**

◆ ◆ ◆

Total No. Of Questions : 4]

SEAT No. : ____

PA-3181

[Total No. Of Pages : 2

[5908]-412
S.Y.M.Sc. (Physics)
PHOT-244H2 : Energy Studies - II
(Group - II) (CBCS) (2020 Pattern) (2 Credits) (Semester-IV)

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

Instructions to the candidates :

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

Q1) **A) Attempt any <u>Four</u> of the following:**

a) Explain the basic principle of solar photovolatic conversion. **[2]**

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

c) What is aerobic bioconversion? **[2]**

d) How wind mills are classified? **[2]**

e) What are the different types of solar cells? **[2]**

B) What are the merits and demerits of vertical axis and horizontal axis wind mills? **[3]**

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

b) What are the different methods of production of Hydrogen? Explain any one in brief. **[5]**

P.T.O.

Q3) a) Explain with neat diagram, a basic photovolatic system integrated with power grid. **[6]**

b) Explain the following process in brief **[6]**

i) Pyrolysis

ii) Gasification

iii) Fermenation.

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

a) Solar box type cooker **[4]**

b) Digestor Design **[4]**

c) Applications of SPV system **[4]**

d) Energy balance equation of steady state. **[4]**

Total No. Of Questions : 4]

SEAT No. : ____

PA-3182

[Total No. Of Pages : 2

[5908]-413
M.Sc. (Physics)
PHOT-244I2 : Electronic Instrumentation- II
(Group - II) (CBCS) (2020 Pattern) (2 Credits) (Semester-IV)

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

Instructions to the candidates :

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

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

i) Draw circuit symbol for NC and No type of level switch of ladder diagram. **[2]**

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

iii) Why derivative controller mode is never used alone? **[2]**

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

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

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 +5V when the sump level exceeds 2.om. The pump is to be turned back off when the sump level drop to 1.5m. Develop two - position controller. **[3]**

P.T.O.

Q2) a) Draw a block diagram for a programmable logic controller explain its functioning. **[7]**

b) Draw the general block diagram for process control loop. Explain each block in short. **[5]**

Q3) 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]**

Q4) **Write a short note on <u>any Two</u> of the following:**

a) Servomechanism **[6]**

b) Two position analog controller **[6]**

c) First order sensor time response. **[6]**

Total No. Of Questions : 4]

SEAT No. : ____

PA-3183

[Total No. Of Pages : 2

[5908]-414
S.Y.M.Sc. (Physics)
PHOT-244J2 : Biomedical Instrumentation- II
(Group - II) (CBCS) (2020 Pattern) (2 Credits) (Semester IV)

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

Instructions to the candidates :

1) ***Q.1 is compulsory.***
2) ***Attempt/solve any Two questions from Q.2 to Q.4.***
3) ***Q.2 to Q.4. carry equal marks.***
4) ***Figures to the right 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 <u>Four</u> of the following:**

a) What are the types of neuron? **[2]**

b) State any two limitations of EEG. **[2]**

c) Define the term Hypoventilation and Hyperventilation. **[2]**

d) List different respiratory therapy equipments. **[2]**

e) What is EEG? What is its typical amplitude. **[2]**

B) Calculate the wavelength of a 2MHz ultrasound beam.

(given:c for tissues = 1540m/s) **[3]**

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

b) Physiology of respiratory system. **[5]**

P.T.O.

Q3) a) What are the biomedical computer applications, explain in detail. **[7]**

b) What are the different tests used in mechanics of breathing. **[5]**

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

a) Generation and detection of ultrasound. **[6]**

b) Neuromuscular transmission. **[6]**

c) Physiology of nervous system. **[6]**

Total No. Of Questions : 4]

SEAT No. :

PA-3186

[Total No. Of Pages : 2

[5908]-417
S.Y.M.Sc. (Physics)
PHOT-244M2 : Material Science- II
(Group - II) (CBCS) (2020 Pattern) (2 Credits)(Semester - IV)

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

Instructions to the candidates :

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

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

a) State and explain first law of thermo dynamics. **[2]**

b) Define the term chemical reaction equilibrium and give it's example. **[2]**

c) Derive the expression for maxwell's first thermodynamic relation. **[2]**

d) Explain the change in entropy for a given gas system. **[2]**

e) Define phase diagram and give it's types **[2]**

B) Distinguish between unary and binary phase diagram. **[3]**

Q2) a) i) Explain Cu-Ni phase diagram with well labeled diagram. **[4]**

ii) Explain Henry's law for real solution. **[3]**

b) Give the proof and explanation of gibb's phase rule. **[5]**

P.T.O.

Q3) a) Explain eutectic & peritectic phase diagram with micro structures of phases **[6]**

b) State and explain Richard's role & trouton's role **[6]**

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

a) Eutectoid phase diagram. **[4]**

b) Type-II phase diagram. **[4]**

c) Maxima & minima in two phase region **[4]**

d) Auxiliary thermodynamic functions **[4]**