(Pages : 3) **N – 7360**

Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, June 2022

Physics

PH: 241 CONDENSED MATTER PHYSICS

(2014 – 2017 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

I. Answer any **five** questions. Each question carries **3** marks.

(a) Explain AC and DC Josephson's effect.

(b) Distinguish between Type I and II superconductors?

(c) Write down any four properties of Reciprocal lattice?

(d) Discuss Piezo-pyro and ferroelectric properties of crystals.

(e) What is meant by sputtering?

(f) Discuss the Wess molecular exchange field.

(g) Explain Wiedmann and Franz Law?

(h) What is meant by Fermi level in metals? How does it vary with temperature in metals?

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **all** questions. **Each** question carries **15** marks

II. A. Discuss how the specific heat of solid was explained in 'Classical model' What are its limitations? Explain how Einsteins Explain the specific heat capacity using quantum mechanics. Also give the draw backs of Einstein's model.

OR

B. Discuss the thermal conductivity in crystalline material. Briefly discuss Normal and Umklapp process with the help of a diagram.

III. A. (a) What are Intrinsic and extrinsic semiconductors?

(b) Obtain expressions for carrier concentration and Fermi energy in intrinsic semiconductors?

OR

B. (a) Explain the quantum theory of paramagnetism?

(b) Briefly explain the Hall Effect in semiconductors?

IV. A. (a) With necessary theory, explain London's theory of Superconductors.

(b) Briefly discuss the term 'coherence length.

OR

B (a) List the main techniques used for the preparation of nanomaterials. Briefly explain any one of the techniques in detail.

(b) Distinguish between bulk and nanomaterials? Explain the salient features of nanomaterials.

(3 × 15 = 45 Marks)

PART – C

V. Answer any **three** questions. **Each** question carries **5** marks.

(a) Assuming that the polarizability of Kr atom is 2.18×10^{-40} Fm^2 Calculate its dielectric constant at 0ºC and 1 atmosphere.

(b) A uniform silver wire has a resistivity of 1.54×10^{-8} ohm.meter at room temperature. For an electric field along the wire of 1 V/cm, compute the average drift velocity of the electrons assuming that there are 5.8×10^{28} conductionelectrons/m^3.
Also calculate the mobility and the relaxation time of the electron.

(c) A magnetizing field 100 A/m produces a flux density $4\pi\times10^{-3}$ T in a bar of materials Calculate the relative permeability and susceptibility of the materials.

(d) Prove that for the Kronig-Penny Potential with $P<<1$, then energy of the lowest energy band at k=0 is $E=h^2p/4\pi^2ma^2$.

(e) Find the resistance of an intrinsic germanium rod which is 1 cm long, 1mm wide and 1mm thick at 300 K. The intrinsic carrier density at 300 K is $2.5\times10^{19}/m^3$ and the mobilities of electron and hole are 0.39 of electron and hole are 0.39 and 1.19 $m^2V^{-1}S^{-1}$, respectively.

(f) If the velocity of sound in a solid is of the order of 10^3m/s, compare the frequency of sound wave $\lambda=10A^\circ$ for (i) a monoatomic system, and (ii) acoustic waves and optical waves in a diatomic system containing two identical atoms (M=m) per unit cell of interatomic spacing 2.5 A°

(3 × 5 = 15 Marks)

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(Pages : 3) **P – 5275**

Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree Examination, September 2022

Physics

PH 221 : MODERN OPTICS AND ELECTROMAGNETIC THEORY

(2018 & 2019 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

Answer **any five** questions. Each question carries **3** marks.

I. (a) Define radiation resistance of an antenna.

(b) Explain the term characteristic impedance.

(c) What are proper time and proper velocity?

(d) What is depth of penetration?

(e) Write a short note on energy and momentum in electromagnetic waves.

(f) Discuss Raman Nath and Bragg regimes of diffraction.

(g) Explain multiquantum photoelectric effect.

(h) What do you meant by wave guide and distinguish TE and TM waves?

(5 × 3 = 15 Marks)

PART – B

Answer **all** questions. Each question carries **15** marks.

II. (a) What is Fraunhofer diffraction and derive diffraction formula.

OR

(b) Explain harmonic generation, second harmonic generation and third harmonic generation.

III. (a) Discuss

(i) Electrodynamics in tensor notation

(ii) Relativistic potentials.

OR

(b) Discuss electric dipole radiation.

IV. (a) What are transmission lines? Derive the transmission line equations and explain any two losses in transmission lines.

OR

(b) Derive the field equation for the TE waves in the rectangular wave guides.

($3 \times 15 = 45$ Marks)

PART – C

Answer **any three** questions. Each question carries **5** marks.

V. (a) Derive the expression for the efficiency of an antenna in terms of radiation resistance and ohmic loss resistance.

(b) Derive the expression for the cut off frequency of TM waves in rectangular wave guide.

(c) Find the radiation resistance in terms of λ and b for the oscillating magnetic dipole.

(d) A point charge q is at rest at the origin in the system S_1. What is the electric field of the same charge in system S, which moves to the right at a speed v_0 relative to S_1.

(e) Explain multi photon process.

(f) Raman-Nath modulators can be used at relatively low acoustic frequencies. Why?

($3 \times 5 = 15$ Marks)

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(Pages : 3) **M – 7121**

Reg. No. : .....

Name : .....

Third Semester M.Sc. Degree Examination, March 2022

Physics

Special Paper I

PH 233 E : ADVANCED ELECTRONICS I

(2020 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

I. Answer **any five** questions. Each question carries **3** marks.

(a) Discuss about double side band (DSB) scheme in carrier wave modulation.

(b) Give a block diagram schematic of a frequency modulated (FM) radio transmitter.

(c) State and explain sampling theorem of pulse modulated system.

(d) State time division multiplexing (TDM) with the help of a basic diagram.

(e) Briefly explain the operational principle of wave division multiplexing (WDM).

(f) Explain cell splitting in mobile communication.

(g) Briefly explain analog-to-digital conversion of signals.

(h) Derive Parseval's identity of Fourier series.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **all** questions from II to IV. Each question carries **15** marks.

II. (a) (i) Discuss linear carrier wave modulation scheme.

(ii) Explain different types of linear modulation schemes.

OR

(b) (i) Explain merits and demerits of microwave communication system.

(ii) With the help of a suitable block diagram explain Frequency Modulated (FM) receiver.

III. (a) (i) With the help of a basic diagram explain time division multiplexing of signals.

(ii) Explain time division multiplexing modulation (TDM) in pulse code modulation (PCM) telephone system.

OR

(b) (i) Explain the transmitter and receiver sections of optical fibre communication system with block diagram.

(ii) Differentiate between step index fibre and Graded index fibre.

IV. (a) (i) Explain the basic concept of cellular telephone.

(ii) Discuss personal communication satellite systems with the help of a block diagram.

OR

(b) (i) Discuss the properties of a transform.

(ii) Mention any two methods to find the inverse z transform.

(3 × 15 = 45 Marks)

PART – C

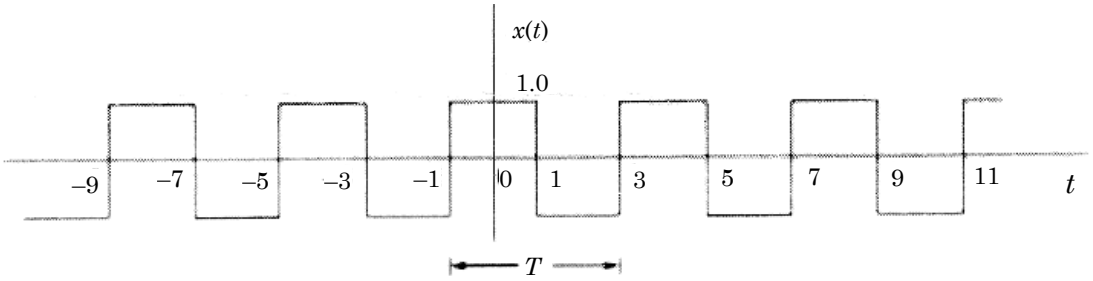
V. Answer **any three** questions. Each question carries **5** marks.

(a) Compare the overall output S/N ratio of 8-bit PCM and DM systems used for transmitting a baseband signal whose spectrum is confined from 300 to 3000 kHz. Assume both systems operate at a bit rate of 64 kbits/sec and use a PSK signalling scheme with $(s_{av}/\eta f_x) = 20\,dB$.

(b) Determine whether the system described by the differential equation $\frac{dy(t)}{dt} + 2y(t) = x(t)$ is linear.

(c) Explain soliton based optical communication system.

(d) Find the trigonometric Fourier series for a periodic signal x(t) given by,



(e) An FM signal is represented by $v = 12\sin(6 * 10^8 t + 5\sin 1250t)$. Find the carrier frequency and frequency deviation.

(f) Determine the bandwidth required for an FM signal having frequency 2kHz and maximum deviation 10 kHz.

(3 × 5 = 15 Marks)

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(Pages : 3) **M – 7127**

Reg. No. : .....

Name : .....

Third Semester M.Sc. Degree Examination, March 2022

Physics

Special Paper I

PH 233 E : ADVANCED ELECTRONICS — I

(2018 & 2019 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

I. Answer **any five** questions. Each question carries **3** marks.

(a) Explain about angle modulated signal.

(b) Write a note on terminal FM microwave radio station.

(c) Explain about sampling and quantization of analog signals.

(d) What is information rate?

(e) What are solitons and explain soliton based optical communication Systems?

(f) Explain cell splitting in mobile communication.

(g) Define z transform and explain mention properties.

(h) Explain Parseval's theorem for Fourier transform, for energy signals?

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **all** questions from II to IV. Each question carries **15** marks.

II. (a) (i) How Delta modulation is developed over pulse code modulation? **5**

(ii) Explain the principle of PCM. Differential PCM Transmitter. **10**

OR

(b) (i) Distinguish between advantages and disadvantages of side band modulation (SBM). **7**

(ii) Illustrate double side band suppressed carrier system (DSBSC) with the help of block diagram? **8**

III. (a) (i) What are the applications of optical heterodyne detection? **5**

(ii) Explain heterodyne and homodyne detection in optical communication. **10**

OR

(b) (i) What is error control coding in digital communication? **5**

(ii) Discuss the synchronization methods in digital communication. **10**

IV. (a) (i) What are the benefits of frequency reusing? Explain cell splitting? **7**

(ii) Explain roaming and handoffs in mobile cellular communication. **8**

OR

(b) (i) Explain power spectrum of a periodic function. **5**

(ii) Explain the Fourier transform of power and energy signals. **10**

(3 × 15 = 45 Marks)

PART – C

V. Answer **any three** questions. Each question carries **5** marks.

(a) A sample produces one of four possible signals during each interval having probabilities $P(x_1)=1/2$, $P(x_2)=1/4$, $P(x_3)=P(x_4)=1/8$. Obtain the information content of each of these symbols.

(b) Determine the peak phase deviation (m) for a PM modulator with a deviation sensitivity K = 2.5 rad/V and a modulating signal $v_m(t)=2\cos(2\pi 2000_t)$.

(c) Explain the z transform including the region of convergence of

$$X(n)=\begin{Bmatrix} a^n, n \geq 0 \\ 0, \ n \geq 0 \end{Bmatrix}$$

(d) Determine the number of channels per cluster and the total channel capacity for a cellular telephone area comprised of 10 clusters with seven cells in each duster and 10 channels in each cell.

(e) A 20 MHz carrier is frequency modulated by a sinusoidal signal such that the peak frequency deviation is 100 kHz. Determine the modulation index and the approximate bandwidth of the FM signal if the frequency of the modulating signal is: (i) 1 kHz; (ii) 50 kHz; (iii) 500 kHz.

(f) By applying time shifting property, determine the Z transform of the $x(z)=\dfrac{Z^{-2}}{1-2z^{-2}}$.

(3 × 5 = 15 Marks)

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(Pages : 3) **N – 5403**

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree Examination, May 2022

Physics

PH 211 : CLASSICAL MECHANICS

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 75

PART – A

(Answer **any five** questions, **3** marks each)

1. When is a force field is said to be conservative?

2. How does the amplitude of oscillation vary around the resonant frequency?

3. What are cyclic coordinates? Show that the generalised momentum corresponding to a cyclic coordinate is a constant of motion.

4. What are Euler angles? Draw a neat diagram showing these angles. What will happen if their order is not maintained?

5. Explain the meaning of generating function and give example of it.

6. Speed of light is same for all observers regardless of the state of motion. Explain.

7. What is Hamilton's characteristic function? Give the physical significance of Hamilton's characteristic function.

8. Define Poisson's bracket and discuss their properties.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

(Answer **All** questions **15** marks each)

1. (A) (a) Explain Hamilton's principle.

(b) What are different symmetry properties and conservation laws in Lagrangian formulation?

OR

(B) Discuss the scattering of a particle in a central force field and derive Rutherford's scattering formula.

2. (A) (a) Explain canonical transformation.

(b) Obtain different transformation equations using generating functions of type F_1, F_2 and F_3

OR

(B) (a) Explain Hamilton-Jacobi equation.

(b) Obtain the solution of Harmonic oscillator using Hamilton-Jacobi equation.

3. (A) State and prove force and energy equations in relativistic mechanics.

OR

(B) (a) Explain the phase space diagram of linear oscillator and dissipative linear pendulum and obtain the condition for a conservative and dissipative system.

(b) What is fractal and its dimension?

($3 \times 15 = 45$ Marks)

PART – C

(Answer any **three** questions **5** marks each)

1. A particle of mass m can move without friction on the surface of a paraboloid of revolution $\Phi = x^2 + y^2 - z = 0$ under the action of a uniform gravitational field in the negative Z direction. Obtain the equation of motion using D'Alembert's principle.

2. Show that the kinetic energy is a quadratic function of generalized velocities.

3. Obtain the Lagrange's equation of motion for a spherical pendulum, that is, a mass point suspended by a rigid weightless rod.

4. The Lagrangian for a simple harmonic oscillator is $L = \frac{1}{2}m\dot{q}^2 - \frac{1}{2}kq^2$. Obtain Hamiltonian and Hamilton's equations of motion.

5. A particle of mass 'm' moves along the axis under the influence of the potential energy $V(x) = -kxe^{-\beta x}$ where k, β are constants. Find the equilibrium position.

6. Show that the curve of minimum length joining a pair of point in a plane is straight line.

($3 \times 5 = 15$ Marks)

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(Pages : 3) **N – 5404**

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree Examination, May 2022

Physics

PH 212 : MATHEMATICAL PHYSICS

(2020 Admission onwards)

Time : 3 Hours Max. Marks : 75

PART – A

Answer **any five** questions and each question carries **3** marks.

1. Prove $\left|\vec{u}\times\vec{v}\right| = \left|\vec{u}\right|\left|\vec{v}\right|\sin\theta$.

2. Find the fourier sine transform of e^{-x}.

3. State and prove Cauchy's principle value theorem.

4. Distinguish between the Continuous and discrete variables.

5. Find the Laplace transform of $F(t) = \cosh(kt)$.

6. Define Green's function for a differential operator and explain the reciprocity relation.

7. Prove that, the metric tensor is a fundamental tensor of rank two.

8. Discuss the properties of Special Unitary Group, $SU(n)$.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **all** the questions and each question carries **15** marks.

9. (a) Using divergence theorem calculate the flux emerging from a vector field $\vec{A} = k\dfrac{\hat{i}x + \hat{j}y + \hat{k}z}{(x^2 + y^2 + z^2)^{\frac{3}{2}}}$ through surface enclosed by a hemisphere meant by the equations $x^2 + y^2 + z^2 = a^2$ and $z = 0$. **6**

(b) What is residue and derive the general expression for finding the residue of function and evaluate the given integration Evaluate the integral using Cauchy's residue theorem $\int_{-\infty}^{\infty} \dfrac{dx}{1+x^2}$. **9**

OR

10. (a) Find the Fourier transform of $f(x) = \dfrac{e^{-ax}}{x}$ and use it to evaluate $\int_0^{\infty} \tan^{-1}\left(\dfrac{x}{a}\right)\sin x dx$. **7**

(b) Derive an expression for the probability of POISSON DISTRIBUTION? **8**

11. (a) Find the solution of Bessel's differential equation order n is $x^2\dfrac{d^2y}{dx^2} + x\dfrac{dy}{dx} + (x^2 - n^2)y = 0$ by Forbenious method. **9**

(b) Deduce the Rodrigue's Formula for Hermite's Function. **6**

OR

12. (a) Solve, by Green's function method, the initial value problem

$$\ddot{x} + 2\beta\dot{x} + w_0^2 x = F(t)$$

with β positive and small, $x(0) = x_0$, $\dot{x}(0) = v_0$ and $F(t) = \begin{cases} 0, & t < 0 \\ F_0, & 0 \le t \le T \\ 0, & t > T \end{cases}$. **7**

(b) Solve the Poission's equation by Green Function method. **8**

13. (a) Deduce the Differential form of a mixed tensor. **9**

(b) Derive an expression for Riemann curvature tensor. **6**

OR

14. (a) Define a group and explain the properties of a group with a set of matrices. **6**

(b) Define the elements of symmetry transformation of a square and find out the representation of matrix elements to the corresponding group. **9**

(3 × 15 = 45 Marks)

PART – C

Answer **any three** questions and each question carries **5** marks.

15. Prove $\nabla \cdot (\vec{r}\, r^{n-1}) = (n+2) r^{n-1}$.

16. State and Prove Chebychev inequality.

17. State and Prove Laplace convolution theorem.

18. Deduce the Recurrence relations in Legendre Function, $l P_l(x) = x P_l'(x) - P_{l-1}'(x)$.

19. Deduce the Ricci Scalar tensor from the Riemann Christoffel tensor.

20. Prove that any finite-dimensional representation of a group of finite order is equivalent to a unitary representation.

(3 × 5 = 15 Marks)

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(Pages : 3) **N – 5405**

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree Examination, May 2022

Physics

PH 213 — BASIC ELECTRONICS

(2020 Admission onwards)

Time : 3 Hours Max. Marks : 75

PART – A

(Answer any **five** questions. Each question carries **3** marks)

1. Derive the relation between the power gain, current and voltage gain of an amplifier.

2. What are the basic building blocks of an op-amp?

3. Draw the equivalent circuit diagram of an ideal op-amp.

4. What is meant by programmable logic array?

5. Briefly explain the operation of a decade counter.

6. What are the main differences between LED and laser diode?

7. How flow is measured?

8. Differentiate between active and passive transducers.

($5 \times 3 = 15$ Marks)

P.T.O.

PART – B

(Answer **three** questions. Each question carries **15** marks)

9. What are active filters? Briefly explain the working principles and design of low pass and high pass (first and second order) Butterworth filters.

OR

10. Discuss the theory and operation of sine wave, square wave and triangular wave generators using op-amps.

11. How are binary adder, subtractor, multiplier and divider constructed? Explain.

OR

12. Explain the working principle of various counters.

13. Give a brief account of the theory of modes in optical fibers.

OR

14. Discuss with block diagram the working principle of a CRO. Explain in detail the horizontal and vertical deflection systems.

($3 \times 15 = 45$ Marks)

PART – C

(Answer any **three** questions. Each question carries **5** marks)

15. Consider an ac amplifier with midband voltage gain of 200. If the cutoff frequencies are 20Hz and 20KHz, what does the frequency response look like? What are the voltage gain if the input frequency is 5Hz and 200 KHz?

16. Design a second order bandpass filter with a midband voltage gain of 50(34dB), a centre frequency of 160 Hz, and a 3dB bandwidth B=16 Hz.

17. Give the connection diagram of a BCD to decimal decoder and discuss its operation.

18. Verify that the *J-K* FLIP-FLOP truth table is satisfied by the difference equation $Q_{n+1} = J_n\overline{Q}_n + \overline{K}_n Q_n$.

19. Calculate the total number of guided modes propagating in the step-index fiber having a diameter of core equal to 60 micro-meters and numerical aperture of 0.25, operating at a wavelength of 2.7 micro-meter?

20. An LED emitting at a peak wavelength of 1310 nm has radiative and non radiative recombination time of 30 and 100 ns respectively. Calculate the internal quantum efficiency and internal power level, given the drive current equals to 40 mA.

(3 × 5 = 15 Marks)

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(Pages : 3) **N – 5407**

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree Examination, May 2022

Physics

PH 212 — MATHEMATICAL PHYSICS

(2018 & 2019 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **five** questions. **Each** question carries **3** marks.

I. (a) Find constants a, *b,* and *c* such that the vector field $\overline{A} = (x + 2y + az)\hat{i} + (bx - 3y - z)\hat{j} + (4x + cy + 2z)\hat{k}$ is irrotational.

(b) Find the principal value of $\log(-3)$.

(c) Explain the concept of Fast Fourier transform. Discuss one application.

(d) A radioactive material emits on an average 10 particles per minute. Calculate the probability that the material will emit at least 1 particle in a given minute.

(e) Explain Hermitian and Unitary matrices. Give an example of each.

(f) Write down the Legendre differential equation. Find and classify its singular points.

(g) What is meant by contravariant and covariant vectors? Give an example for each.

(h) What is a group? Is the set of all integers excluding 0 form a group under ordinary multiplication? Explain.

($5 \times 3 = 15$ Marks)

P.T.O.

PART – B

Answer **all** questions. **Each** question carries **15** marks.

II. (A) (a) Define general orthogonal curvilinear coordinates. **3**

(b) Derive the expression for Gradient in general orthogonal curvilinear coordinates. **7**

(c) Obtain the expression for Gradient in cylindrical coordinate system. **5**

OR

(B) (a) Evaluate $\oint \frac{\exp(2z)}{(z+1)^4} dz$ where the integral is over a closed circle in the complex plane around the point $z = -1$. **10**

(b) Derive the Cauchy - Riemann conditions for analyticity of a complex function. **5**

III. (A) Solve the transport equation $\frac{\partial u}{\partial t} + 3\frac{\partial u}{\partial x} = 0$ with $u(x,0) = f(x)$ where $f(x)$ is an arbitrary function of x.

OR

(B) Solve the first order differential equation $y' + 2xy = 0$ using Frobenius series method.

IV. (A) (a) Define metric tensor and show that it is covariant in both its indices. **5**

(b) What is meant by raising and lowering of indices of a tensor? **5**

(c) Obtain metric tensor for cylindrical polar coordinate system. **5**

OR

(B) (a) Discuss the relation between symmetry and groups. **3**

(b) What is meant by reducible and irreducible representations of a group? **5**

(c) Discuss $SO(2)$ group. **7**

($3 \times 15 = 45$ Marks)

PART – C

Answer any **three** questions. **Each** question carries **5** marks.

V. (a) A coin has probability of Heads 0.7 and probability of Tails 0.3. If 5 such coins are tossed, calculate the probability of getting at least two Heads.

(b) Find all values of $16^{1/4}$.

(c) Solve the differential equation $y'' - 5y' + 6y = 0$ with $y(0) = 2$ and $y'(0) = 2$ using Laplace transform.

(d) Show that the Legendre function satisfies the relation $P_5'(x) = 9P_4(x) + 5P_2(x) + P_0(x)$.

(e) Find the equation of the straight line which fits the data points (1, 1), (2, 3), (3, 5), (4, *5*) (6, 6) by the method of least-squares.

(f) Starting from the metric tensor components $g_{i,j} = \delta_{i,j}$ for the 2*D* space in the Cartesian system, obtain the components of the metric tensor for the polar coordinate system. (Hint : Write down the polar basis vectors in terms of the Cartesian basis vectors making use of the relations $x = r\cos(\theta)$ and $y = r\sin(\theta)$).

($3 \times 5 = 15$ Marks)

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(Pages : 3) **N – 6235**

Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, June 2022

Physics

PH : 241 : CONDENSED MATTER PHYSICS

(2020 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **five** questions. Each question carries **3** marks.

1. Explain the concept of reciprocal lattice.

2. Discuss Normal and Umklapp process.

3. Explain Hall effect.

4. Discuss the temperature dependence on the mobility of charge in semiconductors.

5. Write a short note on effective mass of an electron.

6. Explain ferromagnetic domains.

7. Explain flux quantization in superconductor.

8. Write a short note on sol-gel technique.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **all** questions. Each question carrying **15** marks.

9. Discuss three scattering mechanisms responsible for the thermal resistance of solids.

OR

10. Discuss Kroning Penny model of band theory and its inferences.

11. Discuss (a) Hall effect in semiconductors and (b) Electrical conductivity of semiconductors.

OR

12. Explain (a) ferroelectricity and derive curie Weiss Law (b) ferromagnetic domains.

13. Explain BCS theory of superconductivity and flux quantization.

OR

14. Discuss (a) Sol-gel technique (b) molecular beam epitaxy.

($3 \times 15 = 45$ Marks)

PART – C

Answer any **three** of the following questions. Each question carries **5** marks.

15. Copper has an atomic weight 63.5, the density 8.9×10^3 kg/m^3 $v_t = 2.32 \times 10^3$ and $v_1 = 4.76 \times 10^3$ Estimate Debye temperature and specific heat at 30 K

16. Show that five-fold rotation axis is not compatible with a lattice.

17. The intrinsic carrier density at 300 K in silicon is $1.5 \times 10^{16}/m^3$. If the electron and hole mobilities are 0.13 and 0.05 $m^2\ V^{-1}\ s^{-1}$ respectively. Calculate the conductivity of (a) intrinsic silicon and (b) silicon containing 1 donor impurity atom per 10^8 silicon atom.

18. The magnetic intensity in a piece of ferric oxide is 10^6 A/m. If the susceptibility of the material at room temperature is 1.5×10^{-3}, Calculate the flux density and magnetization of the material.

19. A superconducting lead has a critical temperature of 7.26 K at zero magnetic field and the critical field of 8.5×10^5 A/m at 0 K. Find the critical field at 5K.

20. Discuss the working principle of SEM.

($3 \times 5 = 15$ Marks)

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(Pages : 3) **N – 6242**

Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, June 2022

Physics

PH 241 : CONDENSED MATTER PHYSICS

(2018 – 2019 Admission)

Time : 3 Hours Max. Marks : 75

SECTION – A

Answer any **five** questions. **Each** question carries **3** marks.

1. (a) Distinguish between a linear lattice, plane lattice and space lattice.

   (b) Derive the dispersion relation between angular frequency ω and wave vector k for 1D periodic lattice?

   (c) Explain how the symmetry properties are satisfied by energy bands?

   (d) Explain how mobility of a given semiconductor varies with temperature.

   (e) What is ferroelectricity? Name any two ferroelectric materials and their applications.

   (f) Obtain an expression for paramagnetic susceptibility of free electrons on the basis of classical laws.

   (g) What are the important applications of Hall effect?

   (h) Write a note on relaxation time

($5 \times 3 = 15$ Marks)

P.T.O.

SECTION – B

Answer **all** questions. **Each** question carries **15** marks.

II. (a) What is meant by crystal imperfections? Classify them in the order of their geometry?

Or

(b) Explain Debye' s model and Einstein's model? Mention essential differences in the model and note the consequences of these differences.

III. (a) Based on Fermi- Dirac statistics, state the nature of Fermi distribution function. How does it varies with temperature?

Or

(b) Discuss the Kronig-Penney model for the motion of an electron in a periodic potential. Show from (E-K) graph that material can be classified into conductors, insulators and semi- conductors.

Iv. (a) Describe Langevin's theory for a paramagnetic gas and its limitations. Obtain paramagnetic susceptibility of a free electron gas employing quantum statics.

Or

(b) Explain how X-ray diffraction can be used as an effective tool to determine the structure of nano materials.

($3 \times 15 = 45$ Marks)

SECTION – C

Answer any **three** of the following questions. **Each** question carries **5** marks.

V. (a) Calculate the angle between [1111] and [001] directions in a cubic crystal.

(b) The unit cell parameter of NaCI crystal is 5.6 A° and the modulus of elasticity along [100] direction is 5×10^{10} N/m^2, Estimate the wavelength at which an Electromagnetic radiation is strongly reflected by the crystal. At.wt. of Na=23 and Cl=37.

(c) Explain why silver obeys Dulong-Petit law at room temperature but diamond does, not?

(d) If a dust particle of one μgm requires 100 s to cross a distance of 1mm which is the separation between two rigid walls of the potential, determine the quantum number described by this motion.

(e) Find the ratio between the kinetic energies of an electron in a two-dimensional square lattice(a) when $k_x = k_y = \frac{\pi}{a}$ and (b) when $k_x = \frac{\pi}{a}$ and $k_y = 0$

(f) Assuming that the polarizability of Kr atom is 2.18×10^{-40} Fm^2, calculate its dielectric constant at 0^oC and 1 atmosphere

($3 \times 5 = 15$ Marks)

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Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree Examination, September 2022

Physics

PH 223 : COMPUTER SCIENCE AND NUMERICAL TECHNIQUES

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **five** questions. Each question carries **3** marks.

1. Explain the terms: bit, word and address bus.

2. What is a list in Python? Discuss any two methods or functions for fist operations.

3. How is microcontroller5 different from microprocessor?

4. What is the difference between structure and class in C++?

5. How data is read from and written to files in C++?

6. Write forward, backward and central difference formula for the first order derivative.

7. Derive Simpson's 1/3 rule from general quadrature formula.

8. Explain how Schrodinger equation (one dimensional) is numerically solved.

(5 × 3 = 15 Marks)

P.T.O.

PART– B

Answer any **three** questions. Each question carries **15** marks.

9. (a) Explain the addressing modes in 8085 microprocessor.

   (b) Explain the different registers in 8085 microprocessor.

10. (a) Discuss various topologies.

    (b) Explain OSI model for computer networks.

11. (a) Discuss how multidimensional arrays are represented in C++ and how it is stored in memory.

    (b) Write a program to print the upper and lower triangles of an $N \times N$ matrix.

12. (a) How are files declared in C++? Explain the basic file operations.

    (b) Explain how arrays are passed as arguments of functions.

13. (a) Explain how Laplace's equation in two dimensions is numerically solved.

    (b) Derive Newton's backward difference interpolation formula.

14. (a) Discuss in brief Euler's method of solving ordinary differential equations.

    (b) Derive Lagrange interpolation formula.

($3 \times 15 = 45$ Marks)

PART – C

Answer any **three** questions. Each question carries **5** marks.

15. Differentiate RAM and ROM.

16. Explain Pin diagram in 8085 microprocessor.

17. Write a C++ program that implements the bisection method for finding the roots of a nonlinear equation.

18. Write a C++ program to find the factorial of an integer.

19. The velocity of a car running on straight road in the intervals of two minutes is given below

Time (Minutes)	0	2	4	6	8	10	12
Velocity (In Km/hr)	0	22	30	27	18	7	0

Apply Simpson's rule to find the distance covered by the car.

20. Derive Gauss's backward formula of interpolation.

($3 \times 5 = 15$ Marks)

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Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree Examination, September 2022

Physics

Special Paper II

PH 223 : COMPUTER SCIENCE AND NUMERICAL TECHNIQUES

(2018 & 2019 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **FIVE** questions. Each carries **3** marks.

I. (a) Explain the difference between machine language and assembly language.

(b) How does a microprocessor differentiate data and instruction code?

(c) Explain the 'jump' instruction in 8085.

(d) Explain the loop statement in python using the 'while' construct.

(e) What are data types in C++?

(f) Write down the precedence of arithmetic operations in C++.

(g) What is interpolation?

(h) Explain briefly the Simpson's 1/3 rule.

($5 \times 3 = 15$ Marks)

P.T.O.

PART – B

Answer **all** questions. Each carries **15** marks

II. A. (a) What is memory? Discuss its classification. **9**

(b) Distinguish between lists and tuples in python. **6**

OR

B. (a) Explain interrupts in 8085. **8**

(b) Write an assembly language programme for multiplication of two hexadecimal numbers in 8085. **7**

III. A. (a) What are functions in C++? **6**

(b) Using an example, distinguish calling function from called function in C++. **9**

OR

B. (a) What do you mean by scope of a variable in C++ **6**

(b) Explain the scope rule for functions and variables in C++. **9**

IV. A. (a) Given $dy/dx = y - x$, and y(0) = 2. Find y(0.l) using Runge-Kutta method, taking $h = 0.1$. **9**

(b) Derive second order Runge-Kutta formula and from Euler's formula. **6**

OR

B. (a) Solve the following equations Gauss elimination method

$27x + 6y - z = 85$

$6x + 15y + 2z = 72$

$x + y + 54z = 11$ **9**

(b) Compute the integral $\int_5^9 \frac{dx}{x}$ using Simpson's 3/8 rule. **6**

(3 × 15 = 45 Marks)

PART C

Answer any **three** questions. Each carries **5** marks

V. (a) What are peripherals?

(b) Explain a method to read contents from a text file using python.

(c) Explain the syntax of the 'switch' statement in C++.

(d) What is the difference between 'break' and 'continue' statements in C++?

(e) State and explain the trapezoidal rule.

(f) If $y_1 = 4$, $y_3 = 12$, $y_4 = 19$ and $y_x = 7$, find x using Lagrange's interpolation formula.

(g) Explain the Euler method for solving ordinary differential equation.

($3 \times 5 = 15$ Marks)

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Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree Examination, September 2022

Physics

PH 221 : MODERN OPTICS AND ELECTROMAGNETIC THEORY

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 75

PART – A

Answer any **five** questions. **Each** carries **3** marks.

1. Distinguish between Fresnel and Fraunhofer diffraction.
2. Give an account of third harmonic generation of non-linear optics.
3. Explain the propagation of EM waves through linear media.
4. What are vector and scalar potentials?
5. Obtain the expression for power radiated by an arbitrary charge.
6. Discuss the significance of Smith chart.
7. Write a short note on rectangular waveguides.
8. What are antenna arrays?

($5 \times 3 = 15$ Marks)

P.T.O.

PART – B

Answer **any three** questions. **Each** carries **15** marks.

9. (a) Demonstrate the first experiment to show the existence of second harmonic generation.

   (b) Elaborate the concept of phase matching.

OR

10. (a) Write a note on Raman Nath diffraction and Bragg diffraction.

    (b) How will you demonstrate the occurrence of interference with multibeam?

11. Explain the electric dipole radiation. Obtain the expressions for the fields due to oscillating electric dipole and deduce the power radiation.

OR

12. Discuss the propagation of electromagnetic waves in conductors and derive an expression for skin depth.

13. (a) List the advantages of waveguides over transmission lines.

    (b) Explain the propagation of waves through waveguides.

OR

14. (a) Explain the radiation from Hertzian dipole.

    (b) Explain EIRP and Friis equations of antenna.

($3 \times 15 = 45$ Marks)

PART – C

Answer **any three** questions. **Each** carries **5** marks.

15. A distortion less line has $Z_0 = 60\Omega$, $\alpha = 20mNp/m, u = 0.6c$, where c is the speed of light in vacuum. Find R and L at 100 MHz.

16. An electric field of strength $10\mu V/m$ is to be measured at an observation point $\theta = \pi/2{,}500\,km$ from a half-wave (resonant) dipole antenna operating in air at $50MHz.$ find the average power radiated by the antenna.

17. In a rectangular waveguide for which $a = 1.5\,cm$, $b = 0.8\,cm$, $\sigma = 0.\mu = \mu_0.$ and $\in = 4 \in_0$, $H_x = 2\sin\left(\frac{\pi x}{a}\right)\cos\left(\frac{3\pi y}{b}\right)\sin\left(\pi \times 10^{11} t - \beta z\right) A/m.$ Determine

    (a) The mode of operation

    (b) The cut off frequency

    (c) The phase constant β

18. Obtain gauge transformation conditions.

19. A beam of X-rays of wavelength 0.071 nm is diffracted by (110) plane of rock salt with lattice constant of 0.28 nm. Find the glancing angle for the second-order diffraction.

20. Obtain the expression for energy and momentum in electromagnetic waves.

(3 × 5 = 15 Marks)

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