SLR-SQ-1

Seat No.	

Set P

M.Sc. (Semester - I) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Mathematical Physics (MSC5101)

Day & Date: Wednesday, 19-07-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) Question no. 1 and 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7.
3) Figure to right indicate full marks.

Q.1 A) Choose correct alternatives. **10**

1) A point at which a Function $f(z)$ is not analytic is known as a _____ or singularity of the Function.
   a) Scalar point b) Singular point
   c) Non - Singular d) None of these

2) In Cauchy's Residue theorem $\oint_{\Gamma} f(z)dz =$ _____.
   a) $2\pi i \sum_{j=1}^{n} a - 1 z_j$ b) $2\pi i$
   c) $2\pi i \sum_{j=1}^{n}$ d) $2\pi i \sum_{j=1}^{n} a + 1\, z_j$

3) In complex variable theory $\int_c f(z)/dz$ is called a _____ of $f(z)$ along the contour c from $Z_0\ to\ Z'$.
   a) Contour integral b) Residue
   c) Contour d) None of these

4) What are the eigen value of $\begin{pmatrix} 1 & -i \\ i & 1 \end{pmatrix}$?
   a) Both are 0 b) 0 and 1
   c) 0 and -1 d) 0 and 2

5) If A, B and C are non-zero Hermitian operator which of the following relations must be false?
   a) $[\,A, B\,] = C$ b) $AB + BA = C$
   c) $A\,B\,A = C$ d) $A + B = C$

6) Which of the following is on even function of t?
   a) $t^2 - 4t$ b) $t^3 + 6$
   c) t^2 d) $\sin(2t) + 3t$

7) The degree of $x\frac{d^2y}{dx^2} + \sin\frac{dy}{dx} = 0$ is _____.
   a) 1 b) 2
   c) 3 d) Not defined

8) A square matrix, conjugate transpose of which coincide with the matrix itself is called _____.
   a) Unitary b) Hermitian
   c) Orthogonal d) Skew Hermitian

9) Laplace transform of $f(t)$ is defined for _____.
   a) +ve value of t b) -ve value of t
   c) Both +ve & -ve value of t d) None of these

10) A square matrix A is idempotent if _____.
   a) $A' = A$ b) $A' = -A$
   c) $A^2 = A$ d) $A^2 = A^2$

B) State true or false. **06**

1) A square matrix is called orthogonal if $A = A^{-1}$.
2) The function $|\bar{z}|^2$ is not analytic at any point.
3) $x\frac{\partial u}{\partial x} + t\frac{\partial u}{\partial t} = 2u$ is an ordinary differential equation
4) The Function $y = 0$ is always a solution to a linear homogeneous ordinary differential equation.
5) If $y(x)$ is solution to an n[th] order ODE and contain arbitrary constant, then it must be the general solution to the ODE.
6) In matrix with 9 elements then the possible ordered pair are (3,3) (1,9) (9,1)

Q.2 Answer the following **16**

a) Show that any square matrix can be expressed as the sum of two matrices, one symmetric and the other antisymmetric.

b) Solve $\left(1 + e^{x/y}\right)dx + e^{x/y}(1 - x/y)dy = 0$

c) Find the poles of $f(z) = \frac{\sin(z-a)}{(z-a)4}$

d) Verify that :
$A = \frac{1}{3}\begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ -2 & 2 & -1 \end{bmatrix}$ is orthogonal

Q.3 Answer the following.

a) Show that the transformation **08**
$y_1 = 2x_1 + x_2 + x_3, \quad y_2 = x_1 + x_2 + 2x_3, \quad y_3 = x_1 - 2x_3$ is regular, write down the inverse transformation.

b) Expand the function in square wave $f(x) = 0;\ -\pi \le x \le 0$ **08**
$f(x) = h;\ 0 \le x \le \pi$ Fourier series

Q.4 Answer the following.

a) Show that the eigen value of Hermitian matrix are real. **08**

b) Evaluate the integral $\int_0^{2\pi} \frac{d\theta}{5 - 3\cos\theta}$ **08**

Q.5 Answer the following.

a) Explain Gaussian distribution function with example. **08**

b) Explain the first order linear differential equation. **08**

Q.6 Answer the following.

a) Use Residue calculus to evaluate the following integral. **08**
$\int_0^{2\pi} \frac{1}{5 - 4\sin\theta}\, d\theta$

b) Solve $y'' - 2y' + y = 2\cos x$ by use of successive integration. **08**

Q.7 Answer the following.

a)	Explain the details of Parseval Theorem.	**08**
b)	Explain Laplace transform of Derivatives.	**08**

SLR-SQ-2

Seat No.	

Set P

M.Sc. (Semester - I) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Solid State Physics (MSC5102)

Day & Date: Thursday, 20-07-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) Q. Nos. 1 and. 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7
3) Figure to right indicate full marks.

Q.1 A) Fill in the blanks by choosing correct alternatives given below. 10

1) Packing fraction of BCC is _____.
   a) 74% b) 68%
   c) 52% d) 58%

2) Miller indices of a plane parallel to X and Z axes are _____.
   a) (001) b) (100)
   c) (010) d) (101)

3) Intrinsic concentration of charge carriers in a semiconductor varies as _____.
   a) T b) T^2
   c) T^3 d) T^{-1}

4) What is relative permittivity?
   a) Equal to the absolute permittivity
   b) Ratio of actual permittivity to absolute permittivity
   c) Ratio of absolute permittivity to actual permittivity
   d) Equal to the actual permittivity

5) Which crystal structure has the maximum packing fraction?
   a) BCC b) HCP
   c) FCC d) both FCC and HCP

6) The superconducting state is perfect _____ in nature.
   a) Diamagnetic b) Paramagnetic
   c) Ferromagnetic d) None of these

7) Below transition temperature, the London penetration depth.
   a) Almost constant b) Increases exponentially
   c) Decreases exponentially d) None

8) Which one of the following is an application for a hall effect sensor?
   a) Position sensing b) DC transformer
   c) Automatic fuel level indicator d) All of these

9) Phonon is Quantum of _____.
   a) Longitudinal wave b) Elastic wave
   c) Transverse wave d) Electromagnetic wave

10) Why is water used in automobiles as a coolant?
   a) It is not toxic to the environment
   b) It has a high specific heat capacity
   c) It has a high lubricating property which in turn keeps the engine cool by reducing friction
   d) It is available in abundance

B) Write True or False **06**

1) Rectifier rectifies internal resistance.
2) Fermi energy level in the case of a p-type semiconductor is close to the conduction band.
3) Superconductor is ferromagnetic.
4) X-rays are more visible than lasers.
5) For type I superconductors, the surface energy is always positive.
6) Insulators have a negative temperature coefficient of resistance.

Q.2 Answer the following **16**

a) What is Meissner's effect?
b) Explain the BCC structure.
c) Type I and type II superconductors.
d) Direct and Indirect bandgap semiconductors.

Q.3 Answer the following

a) What is a superconductor? Write the London equations. **08**
b) Write the Clausius - Mosotti equation. **08**

Q.4 Answer the following

a) What is dielectric polarization? Give the expression for orientational polarization. **08**
b) Write about Josephson tunneling. **08**

Q.5 Answer the following

a) What is the internal field? Write the expression of the internal field. **08**
b) Explain the geometrical construction of Brillion Zones in 2D. **08**

Q.6 Answer the following

a) Write about the behavior of electrons in a periodic potential. **08**
b) What is the Hall effect? Write about the expression for the mobility of the charge carriers. **08**

Q.7 Answer the following

a) Write about the thermodynamics of a superconductor. **08**
b) Write about carrier concentration in an intrinsic semiconductor. **08**

SLR-SQ-3

Seat No.	

Set P

M.Sc. (Semester - I) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Analog and Digital Electronics (MSC5103)

Day & Date: Friday, 21-07-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) Question no. 1 and 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7.
3) Figure to right indicate full marks.

Q.1 A) Select Correct Alternatives. **10**

1) _____ signal is used to demultiplex address/ data bus in 8085 microprocessors.
   a) RD b) WR
   c) ALE d) INTR

2) Decade counter requires _____ number of flip flops.
   a) 3 b) 5
   c) 4 d) 2

3) Symbolic address in microprocessors is recorded in the _____ field.
   a) Label b) Opcode
   c) Operand d) Comment

4) Op-Amp is _____ coupled voltage type of amplifier.
   a) AC b) DC
   c) ADC d) DAC

5) The decrease in the frequency makes the phase-shift _____ in the Wien bridge oscillator.
   a) Lead b) Lag
   c) Lead-Lag d) None of the above

6) The NOR gate output will be high if the two inputs are _____.
   a) 00 b) 01
   c) 10 d) 11

7) The output of a particular Op-amp increases 8V in 12μs. The slew rate is _____.
   a) $90\ \mathrm{V/\mu s}$ b) $0.67\ \mathrm{V/\mu s}$
   c) $1.5\ \mathrm{V/\mu s}$ d) None of these

8) The no-change conditions occur when _____ in JK flip flop.
   a) J=1, K=1 b) J=0, K=0
   c) J=1, K=0 d) J=0, K=1

9) The output impedance of Op amp is decreases due to _____ feedback.
   a) Negative b) Positive
   c) Negative + Positive d) None on these

10) The _____ gates are mainly used for checking parity of data.
   a) NOR b) NAND
   c) EX-OR d) EX-NOR

B) Fill in the blanks /State True or False. **06**

1) In JK flip flop race around condition arises due to _____.
2) A demultiplexer is used to perform _____ conversion.
3) In the oscillator circuit the total phase shift of the loop gain must be _____.
4) Negative feedback is used in oscillator circuits. (True/False)
5) The sawtooth waveform has a rise time many times than the fall time. (True/False)
6) An ideal operational amplifier has infinite input impedance. (True/False)

Q.2 Attempt following. **16**

a) RS Flip flop.
b) Addressing modes of 8085 microprocessor.
c) Op Amp as Comparator
d) Adjustable voltage regulators.

Q.3 a) Write an ALP with flow diagram for addition of two 8 bit numbers using 8085 Microprocessor Immediate addressing mode. **10**

b) Reduce the following logical expressions using Boolean laws: **06**
$(\overline{A}B + AB)(\overline{A}BC + ABC)$
Draw logic diagram of reduced expression.

Q.4 a) What is shift register? Draw and explain logic diagram of PIPO shift register. **10**

b) Draw and explain 8:1 multiplexer using AND gate. **06**

Q.5 a) Describe Non-inverting configuration of 3 input Op Amp as a summing. Scaling and averaging amplifier. **10**

b) Elucidate effect of negative feedback on output resistance of Op Amp. **06**

Q.6 a) Describe functional block diagram of Intel 8085 microprocessor. **10**

b) Demultiplexing of AD0- AD7 signals. **06**

Q.7 a) What is Oscillator? Describe phase shift oscillator, obtain an expression for frequency of oscillation. **10**

b) Design a phase shift oscillator for f_0=1 KHz, using IC741. **06**
(Supply voltage = $\pm$15V)

SLR-SQ-4

Seat No.	

Set P

M.Sc. (Semester - I) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Classical Mechanics (MSC5108)

Day & Date: Saturday, 22-07-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) Question Nos.1 and 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7.
3) Figure to right indicate full marks.

Q.1 A) Choose the correct alternatives from the options. **10**

1) The energy of a particle of mass M and E its momentum is p, then the relation between E and P is _____.
   a) $E = \frac{P}{2M}$ b) $E = \sqrt{2PM}$
   c) $P = \sqrt{2\,ME}$ d) $P = \frac{2M}{E}$

2) The path of the particle is _____ when it is moving under the constant conservative force field.
   a) Cycloid b) Hyperbolic
   c) Parabolic d) straight line

3) The reduced mass μ = _____.
   a) $(m_1 + m_2)/m_1 m_2$ b) $m_1 m_2/(m_1 - m_2)$
   c) $m_1 m_2/(m_1 + m_2)$ d) $(m_1 - m_2)/m_1 m_2$

4) In equations of motion $\dot{P}_j$ = _____.
   a) $-\partial H/\partial P_j$ b) $\partial H/\partial P_j$
   c) $\partial H/\partial q_j$ d) $-\partial H/\partial q_j$

5) If eccentricity $\epsilon = 1$, then the shape of the orbit, which is formed due to motion under central force field will be_____.
   a) Ellipse b) Circle
   c) Hyperbola d) Parabola

6) [u, vw] = _____.
   a) [u, v]w + v[u, w] b) [u, w]v + [w, u]v
   c) [u, v]w + [v, w]u d) [u, v]w + v[w, u]

7) The generating function $F_1(q, Q, t)$ generates _____ transformations.
   a) Exchange b) Identity
   c) None d) infinite

8) The Phase space is _____ dimensional space.
   a) 3N b) 2N
   c) 6N d) N

9) The Poisson bracket of [u, p_j] = _____.
   a) $-\partial u/\partial p_j$ b) $\partial u/\partial q_j$
   c) $+\partial u/\partial p_j$ d) $-\partial u/\partial q_j$

10) The point transformation is the transformations of _____.
   a) Phase space b) configuration space
   c) both a & b d) point space

B) State True or False: **06**

1) The Poisson bracket of [u,c] = u where c is constant.
2) The areal velocity of the particle in a central force field is zero.
3) The Poisson bracket of the function with itself is zero.
4) Newtonian mechanics is based on the concept of Force.
5) In Phase space, the system is having a unique path.
6) Lagrangian is based on the function L=T+V

Q.2 Answer the following. **16**

a) Write note on Rutherford's scattering.

b) The particle describes a circular orbit given by r = 2a cos θ under the influence of an attractive central force. Show that the force varies as inverse 5th power of the distance.

c) State the variational principle and derive Hamilton's canonical equations using the variational principle.

d) Explain the work-energy theorem in brief.

Q.3 Answer the following.

a) What is meant by real and pseudo forces? Give an example of each. Show that the angular acceleration is the same in fixed and rotating frames. **10**

b) State and explain the laws of conservation of linear momentum & angular momentum of a single particle system. **06**

Q.4 Answer the following.

a) What are the main features of the motion of a particle under the action of central force? Show that the area swept per unit time i.e. dA/dt remains constant in such a motion. **10**

b) Distinguish between the configuration space and phase space. **06**

Q.5 Answer the following.

a) What is Poisson Bracket? List its properties. Explain Jacobi's identity with its proof. **10**

b) Show that the transformation $Q = 2q^{1/2}\, e^{a} \cos p$ and $P = (2q)^{1/2} e^{-a} \sin p$ is canonical. **06**

Q.6 Answer the following.

a) Explain the term differential scattering cross section and derive the formula for the same. **10**

b) Write a note on Hamilton's - Jacobi Theory. **06**

Q.7 Answer the following.

a) Show that the generating function $F = \sum q_k Q_k$ produces exchange Transformation. **10**

b) Explain the different shapes of orbits formed due to motion under a central force field. **06**

SLR-SQ-6

Seat No.	

Set P

M.Sc. (Semester - II) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Quantum Mechanics (MSC5201)

Day & Date: Wednesday, 19-07-2023 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

Instructions: 1) Q. Nos. 1 and. 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7
3) Figure to right indicate full marks.

Q.1 A) Choose correct alternative. **10**

1) Which of the following is composed of electromagnetic waves with electric and magnetic fields perpendicular to each other and perpendicular to the direction of propagation of wave?
   a) Radiation b) Sound Wave
   c) Optical Wave d) Electric Wave

2) Which of the following provide the strong evidence in favour of the wave nature of radiations?
   a) Photoelectric effect
   b) Diffraction and interference of radiation
   c) Compton scattering
   d) Both Photoelectric effect and Compton scattering

3) In which of the following effect, increasing the intensity of the incident radiation at constant frequency does not affect the kinetic energy of emitted electrons but increases the number of electrons emitted per unit time.
   a) Compton scattering b) Diffraction
   c) Photoelectric effect d) Interference

4) Who proposed the idea of wave-particle duality in 1927?
   a) De Broglie b) Einstein
   c) Thompson d) Newton

5) The Schrodinger's wave equation for a particle moving in three dimensions is _____.
   a) $\frac{d^2\psi}{dx^2}+\frac{d^2\psi}{dy^2}+\frac{d^2\psi}{dz^2}+\frac{8\pi^2 m}{h^2}(E-V)\psi=0$
   b) $\frac{d^2\psi}{dx^2}-\frac{d^2\psi}{dy^2}+\frac{d^2\psi}{dz^2}+\frac{8\pi^2 m}{h^2}(E-V)\psi=0$
   c) $\frac{d^2\psi}{dx^2}+\frac{d^2\psi}{dy^2}-\frac{d^2\psi}{dz^2}+\frac{8\pi^2 m}{h^2}(E-V)\psi=0$
   d) $\frac{d^2\psi}{dx^2}+\frac{d^2\psi}{dy^2}+\frac{d^2\psi}{dz^2}-\frac{8\pi^2 m}{h^2}(E-V)\psi=0$

6) According to Heisenberg, if Δx and Δp represents the uncertainties in the measurement of position and momentum then
   a) $\Delta x\Delta p \leq \frac{h}{4\pi}$ b) $\Delta x\Delta p \geq \frac{h}{4\pi}$
   c) $\Delta x\Delta p < \frac{h}{4\pi}$ d) $\Delta x\Delta p \gg \frac{h}{4\pi}$

7) Which of the following is a symbol for a certain mathematical procedure, which transforms one function into another?
   a) Operator b) Operand
   c) Eigenvalue d) Eigen function

8) The energy of particle in one dimensional box is given by _____.
   a) $E = \frac{n^2h^2}{4m_ea^2}$ b) $E = \frac{n^2h^2}{2m_ea^2}$
   c) $E = \frac{n^2h^2}{8m_ea^2}$ d) $E = \frac{n^2h^2}{9m_ea^2}$

9) According to coulomb's law, the force between a pair of charged particles is operative in the direction of line joining the two charged particles and has the magnitude
   a) $F = 2\frac{e.Ze^*}{r^2}$ b) $F = 4\frac{e.Ze^*}{r^2}$
   c) $F = \frac{1}{8}\frac{e.Ze^*}{r^2}$ d) $F = -\frac{e.Ze^*}{r^2}$

10) The ionization potential of hydrogen atom is _____.
   a) $-13.6\ eV$ b) $13.6\ eV$
   c) $-16.3\ eV$ d) $-13.6\ MeV$

B) Fill in the blanks or Write true /false **06**

1) In _____ mechanics, one can simultaneously determine as many properties of a system of any particle as one wish, to any degree of accuracy.
2) To every _____ quantity like position, velocity, linear momentum, angular momentum, energy etc. of a system there corresponds an operator in quantum mechanics.
3) If ψ_2 and $\psi_2$be the eigenfunctions of a hermitian operator $\hat{A}$, with eigenvalues a_1 and a_2 respectively, then the eigenfunctions are orthogonal if _____.
4) Write whether following statement is true or false.
   The product of uncertainties in measurement of position and momentum is h.
5) Write whether following statement is true or false.
   If A and B are two operators then,
   $\hat{A}\hat{B}f(x) \neq \hat{B}\hat{A}f(x)$
6) Write whether following statement is true or false.
   The function on which the operation is carried out is called is often called an operator.

Q.2 Answer the following questions. **16**

a) State the properties of wave function ψ.
b) Explain the characteristics of the wavefunctions.
c) Write a note on the molecular orbital and the valence band approximations.
d) Write a note on space quantization.

Q.3 Answer the following

a) Obtain the Schrödinger's wave equation in three dimensions. **10**
b) Discuss the wave and particle nature of radiation. **06**

Q.4 Answer the following

a) Obtain the expression for energy of particle in one-dimensional box. **10**
b) Explain the total wave function of hydrogen- like atom. **06**

Q.5 Answer the following.

a) Calculate the ground state energy and wave functions of many electron atoms using Hartree and Hartree Fock self-consistent field methods. **10**

b) Discuss the electronic structure of many electron atoms. **06**

Q.6 Answer the following.

a) Explain the Born-Oppenheimer approximation. **10**

b) Apply the Born-Oppenheimer approximation and LCAO molecular orbital theory to Hydrogen molecule ion. **06**

Q.7 Answer the following.

a) Obtain the expression for energy of particle in hydrogen like atoms. **10**

b) Write a note on some important theorems of operators in quantum mechanics. **06**

SLR-SQ-7

Seat No.	

Set P

M.Sc. (Semester - II) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Electrodynamics (MSC5202)

Day & Date: Sunday, 23-07-2023 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

Instructions: 1) Q. Nos. 1 and. 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7
3) Figure to right indicate full marks.

Q.1 A) Fill in the blanks by choosing correct alternatives given below. **10**

1) Indicates that _____.
   a) Non-existance of magnetic dipole
   b) Non-existance of magnetic monopole
   c) Existance of magnetic monopole
   d) Existance of electric monopole

2) In vacuum divegence of electric field over a surface is _____.
   a) zero b) charge enclosed by surface
   c) one d) none of above

3) Faradays law shows that a changing magnetic field gives rise to _____.
   a) electric field b) magnetic force
   c) lorentz force d) none of above is correct

4) In free space the value of E, the electric field vector at any instant is _____ time the value of H, the magnetic field vector.
   a) 277 b) 577
   c) 477 d) 377

5) The normal component of magnetic field, above and below the surface _____.
   a) discontinuous b) continuous
   c) different d) independent of charges

6) The electric field inside a conductor is _____.
   a) Greater than zero b) Less than zero
   c) Zero d) none of these

7) The energy in magnetic field is proportional to _____.
   a) Square of magnetic field b) Square root of magnetic field
   c) Square of electric field d) Square root of electric field

8) The radiation from an oscillating electric dipole is generally _____.
   a) Transverse electric b) Zero
   c) Positive d) Transverse magnetic

9) The vector potential is, due to _____.
   a) Charge density b) Surface charge
   c) Charge d) Current density

10) Two particles with identical charges and mass collide, there is _____.
   a) Radiation b) No radiation
   c) Retardation d) None of these

B) Fill in the blanks OR Write true/false **06**

1) The parallel component of electric field, above and below the surface _____.
2) The angular distribution of radiation for accelerating particle is _____ direction.
3) As in electrostatics then $\mathrm{E} =$ _____.
4) In a monochromatic plane wave in free space, E and B at any instant _____.
5) The Lorentz force under electric and magnetic field is given by _____.
6) For normal incidence of EM wave at interface of two media having refractive indices $n_1 = n_2$ then _____.

Q.2 Answer the following **16**

a) Write the Maxwell's equations in integral form.
b) Define and explain Biot-Savart law.
c) State and prove Gauss's law.
d) Prove that magnetic force do no work on particle.

Q.3 Answer the following

a) Show that vector potential for dipole is $\mathrm{A_{dip}} = \frac{\mu_0}{4\pi}\frac{\mathrm{m}\times\hat{\mathrm{r}}}{\mathrm{r}^2}$. **10**

b) Derive and show that the electric field is the gradient of a scalar potential. **06**

Q.4 Answer the following

a) Solve for static magnetic field. **10**
b) Discuss magneto static boundary conditions in detail. **06**

Q.5 Answer the following

a) State and prove Poyntings theorem. **08**
b) Explain skin effect and skin depth. **08**

Q.6 Answer the following

a) Obtain the Fresnel's relation for the polarization perpendicular to the plane of incidence. **08**
b) Obtain plane wave equation of electromagnetic field in vacuum. **08**

Q.7 Answer the following

a) What is radiation from half wave antenna and explain it. **08**
b) Explain the concept of radiation damping. **08**

SLR-SQ-8

Seat No.	

Set P

M.Sc. (Semester - II) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIEDEL ECTRONICS)
Statistical Physics (MSC5206)

Day & Date: Tuesday, 25-07-2023 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

Instructions: 1) Question 1and 2 are compulsory.
2) Attempt any Three from Q.3 to Q.7.
3) Figure to right indicate full marks.

Q.1 A) Choose correct alternative. **10**

1) In which thermodynamics process, there is no flow of heat between the system and its surroundings?
   a) isothermal b) isochoric
   c) isobaric d) adiabatic

2) In a micro-canonical ensemble, the system exchange.
   a) only matter b) only energy
   c) both energy and matter d) neither energy nor matter

3) It never happens that heat by itself flows from ____ body to a ____ body.
   a) cold, cold b) hot, cold
   c) cold, hot d) hot, hot

4) The equation of state for an ideal gas is represented as _____.
   a) PV = R/T b) PV = nRT
   c) P/V = R/T d) PV = RT

5) The heat or energy consumed or emitted during a phase change of a material is known as _____.
   a) latent heat b) specific heat
   c) phase heat d) none of the above

6) Entropy in thermodynamics is a measure of _____.
   a) order of system b) pressure of the system
   c) volume of system d) disorder of the system

7) The value of the universal gas constant is _____.
   a) 8.2353 b) 8.3143
   c) 8.5123 d) 8.2352

8) Phase equilibrium curve terminates at _____.
   a) boiling point b) sublimation point
   c) triple point d) critical point

9) Louisville's equation gives the rate of change in
   a) pressure b) temperature
   c) density d) volume

10) Which of the following statement is correct for the perfect black body?
   a) It can transmit entire radiation incidents on it
   b) It can absorb entire radiation incidents on it
   c) The emissive power of the black body is less than an ordinary body
   d) All the above statements are correct for the black body.

B) Fill in the blanks or write true/ false. **06**

1) Gibb's free energy determines The relative stability of a system for transformation at constant temperature and pressure.
2) Photon, Phonon, etc. obeys the Fermi Dirac distribution function.
3) In a microcanonical ensemble both energy and mass are conserved.
4) Louisville's equation gives the rate of change in pressure.
5) The unit of mass in the S.I. unit is _____.
6) Entropy is a _____ function.

Q.2 Answer the following (any four) **16**

a) Calculate the increase in entropy when 746 gm of water is converted into vapor at 100°C. The latent heat of vaporization of water = 540 Cal/ gm.
b) How the properties of matter change near the triple point.
c) Write a note on grand canonical ensembles.
d) Explain the difference between microstates and macrostates.
e) Write a note on a PT diagram.

Q.3 Answer the following.

a) State thermodynamic potential and Maxwell's equations. **10**
b) Explain the concept of statistical equilibrium. **06**

Q.4 Answer the following.

a) Explain the 2nd order phase transition phenomenon with on example. **08**
b) Derive Ehrenfest equations. **08**

Q.5 Answer the following.

a) Give the condition for B E condensation. **10**
b) By using the Vander Waals equation at reduced states calculate the values of critical constants. **06**

Q.6 Answer the following.

a) What is the Gibbs paradox and how it is resolved? **10**
b) Write a note on black body radiations. **06**

Q.7 Answer the following.

a) Derive Clausius Clapeyron equation. **10**
b) Obtain Plank's law for black body radiation. **06**

SLR-SQ-10

Seat No.	

Set P

M.Sc. (Semester - III) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIEDEL ECTRONICS)
Semiconductor Physics (MSC5301)

Day & Date: Monday, 10-07-2023 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

Instructions: 1) Q. No. 1 & 2 are compulsory.
2) Attempt any three questions from Q. 3 to 7.
3) Figures to the right indicate full marks.

Q.1 A) Choose correct alternatives. **10**

1) P-type semiconductor the Fermi energy level is ____.
   a) Near the conduction band b) Near the valance band
   c) at the center d) not available

2) In semiconductors the motion of the charge carrier under the influence of the _____ is called as drift.
   a) electric field b) magnetic field
   c) gravitational field d) None of these

3) In intrinsic semiconductor the Fermi energy level is _____.
   a) Near the conduction band b) Near the valance band
   c) At the center d) Not available

4) The depletion region is created by _____.
   a) Ionization b) Diffusion
   c) Recombination d) All of these

5) Molecular Beam Epitaxy is a _____ process.
   a) Physical vapor deposition
   b) Chemical vapor deposition
   c) Chemical bath deposition
   d) Hydrothermal deposition

6) The equilibrium number of electron-hole pairs in pure Si at room temperature is _____.
   a) 10^{10} EHP/m^3 b) 10^{12} EHP/cm^3
   c) 10^{10} EHP/cm^3 d) 10^{12} EHP/m^3

7) What is the role of seed crystal in crystal growth?
   a) Nucleation center b) Catalyst
   c) Solvent d) Solution

8) The shape of E-K diagram of the conduction band and valance band is _____.
   a) Horizontal b) Vertical
   c) Parabolic d) Elliptical

9) The conductivity of a sample due to excess carriers created by phonon vibration is called _____.
   a) Thermal conductivity b) Electrical conductivity
   c) Photoconductivity d) None of these

10) At the absolute zero temperature (−273° C), an intrinsic semiconductor has _____
   a) A few free electrons b) Many Holes
   c) No holes or free electrons d) Many free electrons

Q.1 B) Fill in the blanks OR write True /False **06**

1) if σ is the conductivity, the relation between the electric field E and the current density J in a conducting medium is ____.
2) Liquid-phase epitaxy (LPE) uses _____ to grow crystals on a substrate.
3) In Czochralski crystal growth process, the material is heated up to _____.
4) In a semiconductor, the energy gap between the valence band and conduction band is about 1eV. (True/False)
5) Electron-hole pairs are produced by Thermal energy. (True/False)
6) Ohm's law is not obeyed by Insulator. (True/False)

Q.2 Answer the following. **16**

a) Optical absorption
b) Effective mass of an electron
c) Hydrothermal process
d) Fermi level pinning

Q.3 a) Describes variation of energy bands with alloy composition with suitable example. **10**

b) Elucidate effective mass of an electron. **06**

Q.4 a) What is Luminescence? Describe different type of Luminescence with example. **10**

b) A 0.5 μm thick sample of Indium (In) is illuminated with monochromatic light of $h\upsilon$=1.5eV. The absorption coefficient $10^4 cm^{-1}$. The power incident on the sample in 15mW. Find the total energy absorbed by the sample per second (J/sec). **06**

Q.5 a) Explain MS structure with band diagram. Explain current flow mechanism in MS junction. **10**

b) Show the equilibrium energy band diagram for a metal to an p-type semiconductor where **06**
1) $\Phi M < \Phi S$ and
2) $\Phi M > \Phi S$

Q.6 a) Describe crystal growth by Czochralski method. **10**

b) Explain Chemical vapor deposit with suitable example. **06**

Q.7 a) Describe crystal growth by Molecular Beam Epitaxy. **10**

b) Explain vapor phase epitaxy. **06**

SLR-SQ-11

Seat No.	

Set P

M.Sc. (Semester - III) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Atomic, Molecular Physics(MSC5302)

Day & Date: Tuesday, 11-07-2023 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

Instructions: 1) Q. Nos. 1 and. 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7
3) Figure to right indicate full marks.

Q.1 A) Choose correct alternative. (MCQ) **10**

1) In the $L-S$ coupling scheme, the terms arising from two non-equivalent p –electrons are _____.
   a) ^3S, ^1P, ^3P, ^1D, ^3D b) ^1S, ^3S, ^1P, ^1D
   c) ^1S, ^3S, ^3P, ^3D d) ^1S, ^3S, ^1P, ^3P, ^1D, ^3D

2) The spectral term separation ΔT is expressed in terms of cm^{-1} which is caused due to spin-orbit interaction is related to the atomic number Z by _____
   a) Z^4 b) Z^3
   c) Z^{-4} d) Z^{-1}

3) The total number of 'd' electrons in Fe^{2+} (Atomic No. of Fe is 26) is NOT equal to that of the total number of _____.
   a) p – electrons in Ne (Atomic No. 10)
   b) d – electrons in Fe atom
   c) p – electrons in Cl^- ion (Atomic no. of Cl is 17)
   d) s – electrons of Mg (Atomic no. of Mg is 12)

4) The outer electronic configuration of Mn^{2+} is $3d^5 4s^0$. By employing the Hund's rules of $L-S$ coupling the ground state of Mn^{2+} is characterized by the spectroscopic term _____.
   a) $^6S_{5/2}$ b) $^2D_{5/2}$
   c) $^2F_{5/2}$ d) $^6H_{5/2}$

5) At 0 K, the vibrational energy of a molecule is_____
   a) 0 b) $\hbar\omega$
   c) $\hbar\omega/2$ d) $\hbar\omega/3$

6) The bond order for the O_2 molecule is _____.
   a) 1 b) 2
   c) 2.5 d) 0

7) The transition of longer wavelength observed in the case of Orthohelium is _____.
   a) $2^3P_{0,1,2} \longrightarrow 2^3S_1$ b) $2^1P_1 \longrightarrow 2^1S_0$
   c) $3^3P_{0,1,2} \longrightarrow 2^3S_1$ d) $3^1P_1 \longrightarrow 1^1S_0$

8) The total number of emission lines observed during the transition of electrons from $3^2P_{3/2}$ to $3^2S_{3/2}$ are _____
   a) 2 b) 4
   c) 6 d) 8

9) The spectroscopic symbol for the ground state of $A1$ $(Z = 13)$ is $^2P_{1/2}$ Under the action of a strong magnetic field (when L-S coupling can be neglected) the ground state energy level will split into _____.
   a) 3 levels b) 4 levels
   c) 5 levels d) 6 levels

10) The fine structure of atomic spectral lines arises from _____.
   a) Electron spin-orbit coupling
   b) Interaction between electron and nucleus
   c) Nuclear spin
   d) Stark effect

B) Fill in the blanks or Write true /false. **06**

1) According to Moseley's law, the frequency of a spectral line in an X-ray spectrum varies as a square of the atomic number of the element. - (True/False)
2) The shortest wavelength observed in the Paschen series of hydrogen spectra is 8201 Å.
3) The spectral term separation ΔT is expressed in terms of cm^{-1} which is caused due to spin orbit interaction and is related to the atomic number Z by Z^{-4}. – (True/False)
4) The Lande's g-factor for $^7G_1$ is ½. – (True/False)
5) There are 9 bands observed in the IR spectrum of water due to fundamental vibrations. – (True/ False)
6) The Raman shift is expressed in cm^{-1}. – (True/False)

Q.2 Answer the following questions. **16**

a) Deduce the ground state term symbol for sodium (Z = 11). Why sodium exhibit doublets of yellow color. With neat labelled diagram explain the Zeeman effect for sodium atom when it is placed in weak magnetic field.

b) Using Hund's rules, find the ground-state term symbol for
   1) fluorine (Z = 9)
   2) titanium (Z = 22)
   3) Nickel (Z = 28)
   4) magnesium (Z=12)

c) What is Stark effect? discuss the weak-field Stark effect in hydrogen for Hα line.

d) From the following data, find the energy required to dissociate a KCI molecule into a K atom and a Cl atom. The first ionization potential of K is 4.34 eV; the electron affinity of Cl is 3.82 eV; the equilibrium separation of KC1 is 2.79 Å. (Hint: Show that the mutual potential energy of K^+ and Cl^- is — (14.40/R) eV if R is given in Angstroms).
$\left(\frac{e^2}{4\pi\varepsilon_0} = 1.44 \times 10^{-9} eV.m\right)$

Q.3 Answer the following

a) 1) Discuss the basic foundation behind the magnetic spin resonance spectroscopy Techniques? **08**
2) Differentiate between nuclear magnetic resonance and electron paramagnetic resonance spectroscopic techniques.
3) Show how many signals you will see in the electron spin resonance spectrum of H-atom considering nuclear hyperfine interaction. Sketch the predicted spectrum in first derivative form and label it properly.
4) If the observed chemical shift of a proton is 200 Hz from tetramethyl silane $(CH_3)_4Si$ and instrument frequency is 60 MHz, what is the chemical shift in terms of δ? Express it in τ value.

b) 1) Explain Raman effect and origin of Raman spectroscopy with the help of energy level diagram. Why anti-Stokes lines are less intense than Stokes line. **08**

2) In a linear molecule the Raman shift of the first Stokes/anti-Stokes line from the exciting one is 6B cm^{-1} whereas separation between adjacent lines is 4B cm^{-1}. why?

3) With which type of spectroscopy would one observe the pure rotational spectrum of H_2? If the bond length of H_2 is 0.07417 nm, what would be the spacing of the first three lines in the spectrum?

Q.4 Answer the following

a) 1) In a multielectron atom, consider two identical particles (electrons, noninteracting). Let ψ_α and ψ_β be the eigenfunctions corresponding to the states α and β, in which the two particles can be found. Considering total eigenfunctions, show that the two particles can not be in a state with the same set of quantum numbers. **08**

2) Evaluate the Lange' g factor for the $^3P_1$ state in $2p3s$ configuration of ^6C. On the application of a magnetic field B = 0.1 tesla, calculate the Zeeman splitting of the state ΔE in joules. ($\mu_b = 9.2740 \times 10^{-24} J/T$)

3) Nitrogen ($Z = 7$) has three electrons in the $2p$ level (in addition to two electrons each in the $1s$ and $2s$ levels),

i) Consistent with the Pauli principle, what is the maximum possible value of the total Ms of all seven electrons?

ii) List the quantum numbers of the three $2p$ electrons that result in the largest total Ms.

iii) If the electrons in the $2p$ level occupy states that maximize Ms, what would be the maximum possible value for the total M_L?

iv) What would be the maximum possible total M_L if the three $2p$ electrons were in states that did not maximize Ms?

b) Distinguish conceptually between the splitting of fine structured spectral lines under the action of external weak (< 0.1 T) and high (> 1 T) magnetic field strength. An atom with the states $^2G_{9/2}$ and $^2H_{11/2}$ is placed in a weak (< 0.1 T) magnetic field. Draw the energy levels and indicate the possible allowed transitions between the two states with π and σ components. **08**

Q.5 Answer the following.

a) 1) Discuss the vibrational-rotational spectra of a diatomic molecule by showing P, Q and R branches with proper selection rules, **08**

2) Designate proper branches (P, Q and R) for the following type of vibrations of a heteronuclear diatomic molecule

i) Symmetric stretching mode in which dipole vibrate parallelly along the bond length.

ii) Bending mode in which dipole vibrate perpendicularly along the bond length,

3) Explain why vibrational-rotational spectra cannot be obtained for **homonuclear diatomic** molecules having identical nuclei?

b) Certain atom with two valence electrons is subjected to very strong magnetic field strength of the order of > 10 T. Draw the energy levels and indicate the possible allowed transitions between $^3S_1 \leftarrow {}^3P_{0,1,2}$ transitions in that atom. Justify the phenomenon of Paschen-Back effect by considering magnetic interaction energy i.e. ΔE as well as selection rules. **08**

Q.6 Answer the following.

a) Write down the allowed spectral terms for Germanium (Z = 32) and Oxygen (Z= 8) atoms in their normal and first excited state and by applying selection rules explain the emission spectra of Germanium (Z = 32) and Oxygen (Z= 8) (Consider Pauli's Exclusion Principle). **08**

b) Find the most probable radius for the electron of a hydrogen (Z =1) atom in the $1s$ states. Given, $P_{1,0}(r) = \frac{4r^2}{a_0^3}\, e^{\frac{-2r}{a_0}}$. Calculate the average orbital radius of a $1s$ electron in the hydrogen atom. What is the probability of the electron in the $1s$ state of the hydrogen atom being at a radius greater than the Bohr radius a_0? (Given, e =2.71818) **08**

Given: $\int_0^\infty x^m . e^{-ax^n} dx = \frac{1}{n} \frac{\Gamma(\frac{m+1}{n})}{a^{(m+1)/n}}$; $\Gamma(n) = (n-1)!$

Q.7 Answer the following.

a) Based on molecular orbital (MO) concept explain the nature of bond order and stability for O_2, O_2^+, O_2^- and O_2^{--} molecules. Also, explain the magnetic nature of each molecule. Why valence bond (VB) approach fails to explain the paramagnetic nature for O_2 and B_2 molecules, while molecular orbital approach explains the paramagnetic nature for O_2 and B_2 molecules. **08**

b) 1) What are non-equivalent and equivalent electrons? Is it possible to have two equivalent electrons in the same atom? Calculate the spectral terms for non-equivalent (s,s) (s,p) and (p,p) electrons and for two equivalent (s^2) and (p^2) electrons. **08**

2) What do you mean fine structure? With neat labelled diagram discuss the fine structure of doublets for

i) $^2P_{1/2}$ and $^2P_{3/2}$ and

ii) $^2D_{3/2}$ and $^2D_{5/2}$ states with justification based on magnitude of ΔT_{ls}.

3) Calculate the ESR frequency of an unpaired electron in a magnetic field of 3000 G (0.30 T).
$(g = 2.00, \mu_B = 9.273 \times 10^{-24}\ J/T,\ h = 6.626 \times 10^{-34} Js)$

SLR-SQ-12

Seat No.	

Set P

M.Sc. (Semester - III) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Communication System (MSC5306)

Day & Date: Wednesday, 12-07-2023 Max. Marks: 80
Time: 11:00 AM To 02:00 PM

Instructions: 1) Question no. 1 and 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7.
3) Figure to right indicate full marks.

Q.1 A) Multiple choice questions. **10**

1) In _____, the frequency of the carrier signal is varied to represent data. Both peak amplitude and phase remain constant.
   a) ASK b) PSK
   c) FSK d) QAM

2) Which of the following is not a digital-to-analog conversion?
   a) ASK B) PSK
   C) FSK D) AM

3) In High level Amplitude Modulation _____.
   a) Modulation is done at high power of carrier and modulating signal
   b) Collector modulation method is High level Amplitude Modulation
   c) Power amplifiers are used to boost the carrier and modulating signals before modulation
   d) All of the above

4) AM demodulation techniques are _____.
   a) Square law demodulator b) Envelope detector
   c) PLL detector d) Both a and b are correct

5) Which needs precise time coordination?
   a) CDMA b) TDMA
   c) CDMA & TDMA d) None of the mentioned

6) _____ signaling is also called as On-Off Keying.
   a) Unipolar b) Bipolar
   c) Both a and b d) None of these

7) In PAM information contained in ____variations.
   a) Amplitude b) Position
   c) Width d) All of the above

8) Guard bands are provided in FM signal to _____.
   a) Prevent interference from adjacent channels
   b) To increase the noise
   c) To increase bandwidth
   d) None of the above

9) Multiple access schemes are used to allow _____ mobile users to share simultaneously a finite amount of radio spectrum.
   a) Many b) One
   c) Two d) Ten-Fifteen

10) In _____ encoding, we use three levels: positive, zero, and negative.
   a) Unipolar b) Bipolar
   c) Polar d) none of the above

B) State true or false. **06**

1) Phase-locked loop can be used as FM demodulator.
2) Delta modulation is also considered as 1 bit DPCM.
3) VCO is used to generate direct FM.
4) The variable parameter of a pulsed carrier in PWM is width.
5) In synchronous transmission, we send bits one after another without start or stop bits or gaps.
6) The RZ (Return to Zero) signal transmission of a logic "1" will always begin at zero and end at zero.

Q.2 Answer the following **16**

a) Explain CDMA.
b) Explain block diagram of AM receiver
c) Explain FM radio frequency band?
d) What is sampling theorem?

Q.3 Answer the following.

a) With a neat block diagram, explain the following FM detector. **10**
   1) Slope detector
   2) dual slope detector

b) Explain balanced modulators. **06**

Q.4 Answer the following.

a) With a neat block diagram, explain AM transmitters. **10**
b) Discuss class A modulated power amplifier circuits of sidebands and sideband transmission. **06**

Q.5 Answer the following.

a) Discuss briefly: **10**
   1) ASK
   2) PSK

b) Briefly describe generation of PTM signal. **06**

Q.6 Answer the following.

a) What is TDM? Explain cross talk in TDM. **10**
b) Describe briefly Delta modulation. **06**

Q.7 Answer the following.

a) Explain different modes of transmission. **10**
b) Explain the following: **06**
   1) RZ
   2) NRZ

SLR-SQ-14

Seat No.	

Set P

M.Sc. (Semester - IV) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIEDEL ECTRONICS)
Semiconductor Devices (MSC5401)

Day & Date: Monday, 10-07-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) Question Nos.1 and 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7.
3) Figure to right indicate full marks.

Q.1 A) Choose the correct alternatives from the options. **10**

1) CMOS is popular due to _____.
   a) Low noise immunity
   b) High power consumption
   c) Low power consumption
   d) High power dissipation

2) _____ devices are not a unipolar device
   a) DE-MOSFET b) MOSFET
   c) JFET d) BJT

3) The condition $h\upsilon > E_g$ causes _____ of light semiconductor.
   a) Absorption b) Transmission
   c) Reflection d) Modulation

4) A negative gate voltage to n - channel MOSFET causes _____ of carriers.
   a) Depletion b) Enhancement
   c) Saturation d) Induction

5) A potential well is created in p - semiconductor by applying ____ in CCD memory device to store charge.
   a) positive potential b) negative potential
   b) square negative pulse d) sinusoidal pulse

6) The output of LASER is _____.
   a) Polychromatic b) non – coherent
   c) Dispersed d) Monochromatic

7) Energy required to move electron from Fermi level to outside the metal is called as _____.
   a) Barrier b) work function
   c) Depletion d) dielectric constant

8) The switching ON behavior of SCR is based on _____.
   a) Regenerative b) Breakdown
   c) Blocking d) Etching

9) Anode voltage must be _____ V, if gate voltage is 0.3 V to switch on programmable unijunction transistor.
   a) 1.0 b) 0.3
   c) 0.8 d) 0.5

10) Sum of α_1 and α_2 must be _____ for SCR to become ON.
   a) zero b) unity
   c) half d) infinity

B) State True or False/Fill gaps. **06**

1) VLSI use CCDs for memory.
2) Forward blocking state in SCR is due to forward biased J1 junction.
3) Minimum current above which SCR becomes ON is holding.
4) Light emission is not possible in Si due to its _____
5) The barrier height of M – S contact is the difference between metal work function of semiconductor _____.
6) The drift of stable domains in TEDs is attainable in _____ loaded circuits.

Q.2 Answer the following. **16**

a) LED
b) CMOS devices
c) Digital IC
d) DIACs

Q.3 a) Describe MOS structure with emphasis on accumulation, depletion & inversion modes with band diagrams. **10**

b) Elucidate Depletion type MOSFET. **06**

Q.4 a) Describe p-i-n diode with doping profile and electric field distribution. **10**

b) LASCR **06**

Q.5 a) Explain GaAs Gun Oscillator modes with, **10**
   i) space charge accumulation
   ii) Quenched domain mode
   iii) Delayed domain mode.

b) Explain the periodic oscillating behavior of n- GaAs Gunn diode. **06**

Q.6 a) Describe the operating principle of photodiode based on multilayer hetrojunction with band diagrams and IV characteristics. **10**

b) What is Semiconductor Laser diode? Discuss the mechanism of stimulated emission of light in GaAs laser diode. **06**

Q.7 a) What is solar cell? Derive an expression for open circuit voltage and short circuit current. **10**

b) Explain quantum efficiency and response speed of solar cell. **06**

SLR-SQ-15

Seat No.	

Set P

M.Sc. (Semester - IV) (New) (CBCS) Examination: March/April-2023
PHYSICS(APPLIEDEL ECTRONICS)
Nuclear and Particle Physics (MSC5402)

Day & Date: Wednesday, 12-07-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) Q. Nos. 1 and. 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7
3) Figure to right indicate full marks.

Q.1 A) Choose the correct alternative. **10**

1) The ratio will be _____, Where, R is the mean nuclear radius.
   a) 0.8 b) 0.4
   c) 1.25 d) 8

2) Nuclear forces between the nucleons are _____.
   a) Central force b) Non-central forces
   c) Purely Coulombic forces d) Cohesive forces

3) What is the correct sequence of shell closure according to extreme single particle shell model?
   a) 2, 6, 10, 14, 18, 32
   b) 2, 8, 18, 32, 50, 86
   c) 2, 8, 20, 50, 82, 126
   d) 2, 8, 20, 40, 82, 126

4) In a typical nomenclature of nuclear reaction, _____.
   a) is parent, is incident photon, is daughter and n being outgoing particle
   b) is parent, n is incident particle, is daughter and photon is out-going
   c) is daughter, n is incident particle, is parent and photon is out-going
   d) is parent, is daughter, n and both are out-going particles

5) All the nucleii's available in nature are _____.
   a) Spherical shape and are symmetric
   b) Some are spherical, some ellipsoid shape
   c) All are ellipsoid shape
   d) No definite shape

6) Nucleons in the nucleus of an atom are _____.
   a) Uniformly distributed up to a certain distance and then falls off sharply at the boundary
   b) They are dense at the center and then distribution falls sharply at the boundary
   c) Distribution is even and uniform at the centre as well as at the boundary
   d) Distribution is uneven everywhere

7) The height of potential barrier faced by an alpha-particle inside the nucleus is _____.
   a) 27.87 MeV b) 27.87 KeV
   c) 27.87 GeV d) 27.87 eV

8) Simplest two nucleon system exists in nature is of ____
   a) p-p b) n-p
   c) n-n d) Does not exist

9) Beta particle is stopped in an ionization chamber producing ion-pairs. Average energy required to produce an ion pair is 35 eV. What is the kinetic energy of beta-particles entering the ionisation chamber.
   a) 35 MeV b) 3.5 MeV
   c) 3.5 GeV d) 35 GeV

10) The average binding energy per nucleon of nucleus is _____.
   [Given: neutron mass m_n= 1.008665 u, proton mass m_p=1.007825 u, where 1 u = 931.5 MeV/c^2]
   a) 5.60 MeV b) 21.4 MeV
   c) 8.5 MeV d) 36 MeV

B) Fill in the blanks OR Write true/ false. **06**

1) Nuclear density is constant for all nuclei.
2) Nucleon-nucleon forces are spin dependent forces.
3) Leptons are the only elementary particles that experiences all four fundamental forces of nature.
4) Baryons consist of three quark and Mesons consist of one quark and anti-quark.
5) Electron capture is one of the modes of beta decay process.
6) In radioactivity, after one half-life, activity of a radioactive substance reduces to half.

Q.2 Answer the following **16**

a) A sample of an ancient wooden sculpture piece gives 5 count/min/g of carbon due to ^{14}C present in it. If freshly cut wooden piece gives 16 counts/min, what is the age of sculpture? [Given Half-life of ^{14}C=5760 years]

b) Explain the working and basic principle of semiconductor detector. Draw neat schematic figure to mention each component of the counter.

c) Explain the gamma decay, internal conversion and internal pair conversion of gamma decay process.

d) Draw the Meson octate, identify the particles in it along with their quark structures, charges and spins.

Q.3 Answer the following

a) Calculate the value of proton separation energy (S_p) for (S_n) for in units of MeV. **08**
[Given M() =20.007344 u, M() =20.997651 u, M() =21.999574 u, neutron mass m_n =1.008665 u, proton mass m_p= 1.007825 u, where 1 u = 931.5 MeV/c^2]

b) Using semi-empirical mass formula, for given family of isobars, obtain the relation for most stable nuclei. **08**
[constants in semi-empirical formula: Volume term, Surface term, Coulomb term, asymmetry term, pairing term]

Q.4 Answer the following

a) Using Fermi gas model and its basic assumptions, estimate the potential depth for a nucleus. Assuming average binding energy per nucleon to be around 8.5 MeV, calculate the kinetic energy of the nucleons in the nucleus. **08**

b) Find the Q-value and the threshold for the following nuclear reaction. **08**
[Given M() =22.99097 u, M()= 19.999981 u, M() = 4.002603 u, neutron mass m_n =1.008665 u, proton mass m_p= 1.007825 u, where 1 u = 931.5 MeV/c^2]

Q.5 Answer the following

a) Write down the Schrodinger equation for deuteron (use simplest finite square well potential), i.e. n-p system with an attractive potential V(r) between them. Obtain the complete solution and draw the wavefunction inside and outside the potential well. **08**

b) From Gamma ray selection rule classify the following multipole transitions. **08**

i) $(1/2)^- \rightarrow (7/2)^-$

ii) $4^+ \rightarrow 2^+$

iii) $1^- \rightarrow 2^+$

iv) $(1/2)^- \rightarrow 3/2^+$

Q.6 Answer the following

a) Starting with the equation of Fermi-Golden's rule, derive the Fermi expression of beta-decay. **10**

b) Show that the energy of the triplet state (S=1) is not equal to the energy of the singlet state (S=0) for deuteron bound state. **06**

Q.7 Answer the following

a) Classify different types of accelerators. Explain basic principle and describe in detail working of linear accelerator. Draw a neat schematic diagram to show each component. **10**

b) With a suitable example explain what is nuclear fission and fusion reactions. Estimate the power released in Kilo-Watt-Day for the thermal neutron induced fission reaction of to and. **06**

[Given M() =235.043922 u, M()=146.922780 u, M() = 88.926400 u. neutron mass m_n= 1.008665 u, proton mass m_p= 1.007825 u, m_e= 0.00055 u where 1 u = 931.5 MeV/c^2]

SLR-SQ-16

Seat No.	

Set P

M.Sc. (Semester - IV) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Microwave Devices and Circuits (MSC5403)

Day & Date: Friday, 14-07-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) Question no. 1 and 2 are compulsory.
2) Attempt any three questions from Q. No. 3 to Q. No. 7.
3) Figure to right indicate full marks.

Q.1 A) Multiple choice questions. **10**

1) ____is a region of Electromagnetic spectrum having frequency ranging from 1GHz to 100 GHz.
   a) Microwave b) UV
   c) IR d) None of these

2) On which of the following principle does Klystron operates _____.
   a) Amplitude Modula b) Frequency Modulation
   c) Pulse Modula d) Velocity Modulation

3) Which of the following is the main advantage of microwave.?
   a) Highly direct
   b) Moves at the speed of light
   c) Greater S/N ratio
   d) High penetration power

4) The value of $'\alpha'$ for a lossless line is:
   a) 0 b) 1
   c) Infinity d) Data insufficient

5) The modes of propagation supported by a rectangular wave guide is:
   a) TM, TEM, TE modes b) TM, TE
   c) TM, TEM d) TE, TEM

6) Strip line can be compared to a:
   a) Flattened rectangular waveguide
   b) Flattened circular waveguide
   c) Flattened co axial cable
   d) None of the mentioned

7) In TM mode, what is the first propagating mode?
   a) TM01 mode b) TM11 mode
   c) TM12 mode d) TM10 mode

8) Microwave links are preferred for TV transmission because_____.
   a) they produce less phase distortion
   b) easy to transmit
   c) there is small S/N ratio
   d) there is no impulse noise

9) Which of the following are microwave sources_____?
   a) Magnetron b) TWTA
   c) Klystron d) IMPATT

10) Which of the following laws do not form a Maxwell equation?
   a) Planck's law b) Gauss's Law
   c) Faraday's law d) Ampere's Law

B) State true or false. **06**

1) Magnetic field can be produced by both conduction and displacement current.
2) Klystron works on reflections and oscillations in a single cavity, which has a variable frequency.
3) Microstrip line can support a pure TEM wave.
4) Waveguide supports TE and TM mode but not TEM waves.
5) A waveguide attenuator is an RF device designed to reduce the power of a signal without affecting the waveform of the signal.
6) TWT is used in microwave receivers as a low noise RF amplifier.

Q.2 Answer the following. **16**

a) What are different microwave applications?
b) What is Gunn Effect?
c) Explain basic concepts of the open two-wire line.
d) Differentiate between Rectangular and circular wave-guides.

Q.3 Answer the following.

a) Derive the expressions for the field components due to TE waves in rectangular wave guide. **10**
b) With the help of velocity diagram explain principle of two-cavity Klystron amplifier. **06**

Q.4 Answer the following.

a) Explain attenuators with neat diagram. **10**
b) Discuss briefly about Microwave spectrum. **06**

Q.5 Answer the following.

a) State and explain Maxwell’s equations in detail. **10**
b) Describe briefly Wave polarization. **06**

Q.6 Answer the following.

a) With a neat diagram, explain coaxial and strip line shifters. **10**
b) Explain waveguide phase shifters. **06**

Q.7 Answer the following.

a) With neat diagrams and relevant equations, explain about traveling wave tube. **10**
b) Explain strip type transmission lines. **06**

SLR-SQ-17

Seat No.	

Set P

M.Sc. (Semester - IV) (New) (CBCS) Examination: March/April-2023
PHYSICS (APPLIED ELECTRONICS)
Microcontrollers & Interfacing (MSC5406)

Day & Date: Sunday, 16-07-2023 Max. Marks: 80
Time: 03:00 PM To 06:00 PM

Instructions: 1) Q. Nos. 1 and 2 are compulsory.
2) Attempt any Three questions from Q.No.3 to Q.No.7.
3) Figures to the right indicate full marks.

Q.1 A) Choose the correct alternatives from the options. **10**

1) The addressing mode of the instruction MOV A, 30H is _____.
   a) Direct b) Indirect
   c) Immediate d) Register

2) On power up, 8051 uses bank _____ for register R0 to R7.
   a) 0 b) 1
   c) 2 d) 3

3) Vector location of INT1 interrupt is _____.
   a) 0003H b) 000BH
   c) 0013H d) 001BH

4) Which of the following is of bit addressable operations?
   a) POON b) P1
   c) SBUF d) TMOD

5) For X_{TAL}= 11.0592MHz and SMOD=0, what is the value of TH1 for the baud rate 9600?
   a) -3 b) -6
   c) -12 d) -1

6) Which register is used for framing the data?
   a) PCON b) SBUF
   c) SCON d) TCON

7) To increase the speed of stepper motor one should _____ the delay.
   a) Increase b) Decrease
   c) Scale d) None of these

8) In mode-2, the counter rolls over when counter goes upto _____ H.
   a) 00 b) FF
   c) 7F d) FFFF

9) Interfacing LCD with 8051 _____ data lines are used along with the _____ signals.
   a) 8, RS, R/W b) 8, RS, R/W, EN
   c) 8, RS, EN d) 8, R/W, EN

10) ISR (Interrupt Service Routine) ends with _____.
   a) IE b) RET
   c) RI, TI d) RETI

B) State the following statements are true or false **06**

1) MOV A, @R0 copy the data into the accumulator, from the external data memory specified by R0.
2) ADC0804 is type of successive approximation.
3) Combinational logic circuits can be built in 8051.
4) Stair case waveform can be generated by DAC0808.
5) To use timer as a counter, C/T bit from the TMOD register must be set to zero.
6) Internal pull up registers are not available for Port-1.

Q.2 Answer the following. **16**

a) Explain following instructions.
   i) AJMP 8000H
   ii) MOV C, b

b) Explain the data memory organization of 8051.

c) Explain any two commands of LCD.

d) Explain the function of the following pins of 8051.
   i) ALE
   ii) INT0

Q.3 Answer the following. **16**

a) Explain the interrupt structure of 8051.

b) Explain the stack operation of 8051 with example.

Q.4 Answer the following. **16**

a) Interface four pushbutton and four LEDs to Port-1. Write a program such that whenever the pushbutton is pressed its respective LED should glow.

b) Interface seven segment (common anode type) displays to 8051. Write a program to display the number from 00 to 99 continuously.

Q.5 Answer the following. **16**

a) Design a counter by using timer-1 of 8051 which will count the number from 00 to 99. Write a program to display the count in binary form on Port -1, where LEDs are connected.

b) Write a program to receive characters through RXD pin of 8051 with the baud rate of 9600 bits per second. Assume crystal frequency is 11.0592MHz and SMOD = 1.

Q.6 Answer the following. **16**

a) Write a program for block exchange of 10 numbers in between internal memory location 30H and external memory location 9000H onwards.

b) Write a program to generate a square wave of 2KHz on P1.5. Use Timer0 for delay purpose. Crystal frequency is 11,0592MHz.

Q.7 Answer the following. **16**

a) Implement the full adder in 8051.

b) Explain the port structure of 8051.