SLR-JR-349

Seat No.	

Set P

M.Sc. (Semester – I) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
MATHEMATICAL TECHNIQUES

Day & Date: Monday, 18-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) Which of the following is an analytic function of the complex variable $z = x + iy$ in the domain $|z| < 2$?
   a) $(3 + x - iy)^7$ b) $(1 + x + iy)^4\ (7 - x - iy)^3$
   c) $(1 - x - iy)^4\ (7 - x + iy)^3$ d) $(x + iy - 1)^{\frac{1}{2}}$

2) Let $u(x, y) = x + \frac{1}{2}(x^2 - y^2)$ be the real part of analytic function $f(z)$ of the complex variable, $z = x + iy$. The imaginary part of $f(z)$ is _____.
   a) $y + xy$ b) xy
   c) y d) $y^2 - x^2$

3) If C is the contour defined by $|z| = \frac{1}{2}$, the value of the integral $\oint_c \frac{dz}{\sin^2 Z}$ is _____.
   a) ∞ b) $2\pi i$
   c) 0 d) πi

4) The Cauchy – Riemann equation in polar form is given as _____.
   a) $\frac{\partial u}{\partial r} = \frac{\partial v}{\partial \theta}\ and\ \frac{\partial u}{\partial \theta} = \frac{\partial v}{\partial r}$ b) $\frac{\partial u}{\partial r} = r\frac{\partial v}{\partial \theta}\ and\ \frac{\partial u}{\partial \theta} = -\frac{\partial v}{\partial r}$
   c) $\frac{\partial u}{\partial r} = \frac{1}{r}\frac{\partial v}{\partial \theta}\ and\ \frac{1}{r}\frac{\partial u}{\partial \theta} = -\frac{\partial v}{\partial r}$ d) $\frac{\partial u}{\partial r} = \frac{\partial v}{\partial \theta}\ and \frac{1}{r}\frac{\partial u}{\partial \theta} = -\frac{\partial v}{\partial r}$

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

6) A unitary matrix is defined by the expression: _____.
   a) $U = U^T$, where superscript T means transpose
   b) $U = U^\dagger$
   c) $U = U^*$
   d) $U^{-1} = U^\dagger$

7) Any set of linearly independent vectors can be orthonormalized by the _____.
   a) Pound – smith procedure b) Gram – Schmidt procedure
   c) Sobolev method d) Sobolev – P method

8) What are the eigenvalues 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

9) The differential equation of all parabolas having axis parallel to y- axis is _____.

a) $\frac{d^3x}{dy^3} = 0$ b) $\frac{d^3y}{dx^3} = 0$

c) $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} = 0$ d) $\frac{d^2y}{dx^2} = 0$

10) The degree of $x\frac{d^2y}{dx^2} + \sin\frac{dy}{dx} = 0$ is _____.

a) 1 b) 2

c) 3 d) Not defined

11) Which of the following is an "even" function of t?

a) $t^2 - 4t$ b) $t^3 + 6$

c) t^2 d) $\sin(2t) + 3t$

12) What are the conditions required for a signal to fulfill to be represented as Fourier series?

a) Dirichlet's conditions b) Gibbs phenomenon

c) Fourier conditions d) Fourier phenomenon

13) Which of the following pairs of the given function f(t) and it's Laplace transform f(s) is NOT CORRECT?

a) $f(t) = \delta(t), f(s) = 1, (singularity\ at + 0)$

b) $f(t) = 1, f(s) = {}^{1}/_{s}, (s > 0)$

c) $f(t) = \sin kt, f(s) = \frac{s}{s^2 + k^2}, (s > 0)$

d) $f(t) = t\, e^{kt}, f(s) = \frac{1}{(s-k)^2}, (s > k, s > 0)$

14) The Fourier transform $\int_{-\infty}^{\infty} dx\, f(x)e^{ikx}$ of the function $f(x) = \frac{1}{x^2+2}$ is ___.

a) $\sqrt{2}\pi e^{-\sqrt{2}|k|}$ b) $\sqrt{2}\pi e^{-\sqrt{2}K}$

c) $\frac{\pi}{\sqrt{2}} e^{-\sqrt{2}K}$ d) $\frac{\pi}{\sqrt{2}} e^{-\sqrt{2}|K|}$

Q.2 A) Answer the following questions. (Any Four) **08**

1) Find the solution of the differential equation. $\frac{d^2y}{dx^2} - 7\frac{dy}{dx} + 6y = 0$

2) Classify the singularities and calculate the residue for $f(z) = \frac{A(z)}{\sin Z}$, where $A(z)$ is analytic and contains no zeros.

3) Find the eigenvectors of $H = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{pmatrix}$

4) Expand $f(x) = x$ for $-\pi \le x \le \pi$ in a Fourier series.

5) From the convolution theorem show that

$$\frac{1}{s}f(s) = \mathcal{L}\left\{\int_0^t F(x)dx\right\}$$

Where $f(s) = \mathcal{L}\{f(t)\}$

B) Write short notes. (Any Two) **06**

1) The Cauchy Principal Value
2) Properties of Fourier series
3) Linear dependent and independent set of vectors

Q.3 A) Answer the following questions. (Any Two) **08**

1) Show that the eigenvalues of a Hermitian matrix are all real.
2) State and prove Cauchy's Integral theorem.
3) Solve the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 2\cos x$

B) Answer the following (Any One) **06**

1) Using partial fraction expansion, show that for $a^2 \neq b^2$,

$$\mathcal{L}^{-1}\left\{\frac{s^2}{(s^2+a^2)(s^2+b^2)}\right\} = \frac{1}{a^2-b^2}[a\sin(at) - b\sin(bt)]$$

2) By use of the residue theorem, evaluate $\int_0^{2\pi} \frac{d\theta}{(a+b\cos\theta)^2}$

where $a > b > 0$.

Q.4 A) Answer the following questions. (Any Two) **10**

1) Find the eigenvalues and eigenvectors of $A = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$
2) Find the Fourier transform of Gaussian distribution functions.
3) Solve the differential equation, $y^3\frac{dy}{dx} + \frac{1}{x}y^4 = x$

B) Answer the following questions. (Any One) **04**

1) If $f(x) = x + x^2$ is expanded in a Fourier series then show that

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

2) Find the value of integral $P\int_{-\infty}^{\infty} \frac{e^{ix}}{x}dx$

Q.5 Answer the following questions. (Any Two) **14**

a) Develop the Fourier expansion for $f(t) = \begin{matrix} \sin\omega t & 0 \le \omega t \le \pi \\ -\sin\omega t & -\pi \le \omega t \le 0 \end{matrix}$

b) Find a matrix s that diagonalizes.

$$A = \begin{pmatrix} 3 & -2 & 0 \\ -2 & 3 & 0 \\ 0 & 0 & 5 \end{pmatrix}$$

c) By use of the three-dimensional Fourier transform method, solve poisson's equation for the electrostatic potential function.

$$\nabla^2\phi(\vec{r}) = -\frac{\varrho(\vec{r})}{\epsilon}$$

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Set P

M.Sc.(Semester – I) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
CONDENSED MATTER PHYSICS

Day & Date: Tuesday, 05-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) Relative permittivity (ε_r) of the air is _____.
   a) 2 b) 0.5
   c) 1 d) 0

2) Reciprocal lattice vector G = _____.
   a) K'-K b) K - K '
   c) K ' + K d) $(K'+K)^2$

3) The electronic polarizability α_e of a monoatomic gas is _____.
   a) $4\pi\varepsilon_0$ b) $4\pi\varepsilon_0 R$
   c) $4\pi\varepsilon_0 R^3$ d) $4\pi\varepsilon_0^2$

4) Elemental solid dielectric has only _____ polarization.
   a) electronic b) ionic
   c) orientational d) all

5) The Fermi energy of intrinsic semiconductor is _____.
   a) $\frac{Ec+Ev}{2}$ b) $\frac{Ec+Ed}{2}$
   c) $\frac{Ec-Ev}{2}$ d) $\frac{Ec+Ea}{2}$

6) Number of tetrad axis in simple cubic system are_____.
   a) 2 b) 3
   c) 4 d) 8

7) Plane cut to negative x axis have the miller indices _____.
   a) 011 b) 001
   c) 110 d) 100

8) Which of the following cannot actually move?
   a) Majority carriers b) Ions
   c) Holes d) Free electron

9) Effective mass is equal to _____ mass for free electron.
   a) mean b) real
   c) residual d) zero

10) In an _____ polarization, electronic cloud is coming to one side to form dipole.
   a) orientational b) ionic
   c) electronic d) optical

11) FCC structure contains the contribution of _____ atoms.
   a) Two b) four
   c) nine d) six

12) In monoclinic lattice _____ are equal.
   a) a, b, c b) α, β, γ
   c) h, k, l d) none of these

13) Conductivity in metal depends on _____ mobility.
   a) proton b) neutron
   c) electron d) none of these

14) Penetration depth varies with _____.
   a) pressure b) temperature
   c) volume d) width

Q.2 A) Answer the following (Any Four) **08**
1) Define packing fraction.
2) Define coordination number.
3) What is dielectric loss?
4) What is penetration depth?
5) What is rectification?

B) Write short notes (Any Two) **06**
1) Brillion zones.
2) Effective mass of the electron.
3) Schottky barrier.

Q.3 A) Answer the following (Any Two) **08**
1) Derive the rectifier equation.
2) Write about orientational polarization.
3) Explain thermal properties of the superconductor.

B) Answer the following (Any One) **06**
1) Explain dielectrics loss angle and power factor.
2) Explain the defects in solids.

Q.4 A) Answer the following (Any Two) **10**
1) Show the absence of fivefold symmetry.
2) Explain Missner's effect.
3) Write about Reciprocal Lattice.

B) Answer the following (Any One) **04**
1) Distinguish direct and indirect band gap semiconductors.
2) Write about London equation.

Q.5 Answer the following (Any Two) **14**
a) Write about the behavior of electron in a periodic potential.
b) Give the theory of DC Josephson's effect.
c) Give the expression for inter planer spacing (d).

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Set P

M.Sc. (Semester - I) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
ANALOG & DIGITAL ELECTRONICS

Day & Date: Thursday, 07-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives. **14**

1) In a differential amplifier, the configuration is said to be an 'unbalanced output', if _____
   a) Output voltage is measured between two collectors
   b) Output is measured with respect to ground
   c) Two input signals are used
   d) All the above

2) An ideal operational amplifier has _____
   a) infinite output impedance b) zero input impedance
   c) infinite bandwidth d) all of the above

3) Another name for a unity gain amplifier is _____
   a) difference amplifier b) comparator
   c) single ended d) voltage follower

4) What should be the value of input resistance for an ideal voltage amplifier circuit?
   a) Zero b) Unity
   c) Infinity d) Unpredictable

5) The use of negative feedback _____
   a) reduces the voltage gain of an Op-amp
   b) makes the Op-amp oscillate
   c) makes linear operation possible
   d) answers (a) and (b)

6) Hartley oscillator is commonly used in _____
   a) Radio receivers b) Radio transmitters
   c) TV receivers d) None of the above

7) A Wein-bridge oscillator uses which feedback?
   a) only positive b) only negative
   c) both negative and positive d) none of the above

8) Circuit which consist of a quasi-stable state is called _____
   a) bistable circuit b) monostable circuit
   c) tri stable circuits d) tristate circuit

9) What is the range of the voltage level of the LM317 adjusted voltage regulator?
   a) 0 V to 5 V b) 1.2 V to 37 V
   c) -5 V to -24 V d) 5 V to 24 V

10) Simplify Y = AB'+ (A' + B) C
   a) AB' +C
   b) (A + B') (C'+D)
   c) (A'+B) (C'+D)
   d) (A+B') (C+D')

11) The EXCLUSIVE NOR gate is equivalent to which gate followed by an inverter.
   a) OR
   b) AND
   c) NAND
   d) XOR

12) The basic latch consists of _____
   a) two inverters
   b) two comparators
   c) two amplifiers
   d) two adders

13) Which is the 16-bit register for 8085 microprocessor?
   a) stack pointer
   b) accumulator
   c) register B
   d) register C

14) A bus connected between the CPU and main memory that permits transfer of information between main memory and CPU is known as _____
   a) DMA bus
   b) memory bus
   c) address bus
   d) control bus

Q.2 A) Answer the following questions. (Any Four) **08**

1) Define open loop and closed loop amplifier circuits.
2) Explain CMRR.
3) Explain the conditions of the sustainable oscillator.
4) Define AND gate. Write its logic symbol and truth table.
5) State and prove De Morgan's theorem.

B) Write Notes. (Any Two) **06**

1) Fixed regulators.
2) Explain the concept of virtual ground.
3) Dual input balance output differential amplifier.

Q.3 A) Answer the following questions. (Any Two) **08**

1) Discuss the effect of feedback on closed loop gain.
2) Draw the circuit diagram and output wave forms of triangle wave generator.
3) Explain registers in 8085.

B) Answer the following question. (Any One) **06**

1) Derive an expression for input resistance and bandwidth of voltage series negative feedback amplifier.
2) Write logic diagram and truth table of RS flip flop and explain its working.

Q.4 A) Answer the following questions. (Any Two) **10**

1) A phase shift oscillator uses register R=220 Ohms, what should be the capacitance value if the capacitor required for a phase shift oscillator of frequency of 120 Hz and 1 KHz.
2) Derive an expression for output resistance with feedback in a closed loop amplifier.
3) Write an assembly language program to add two 8 bit numbers.

B) Answer the following questions. (Any One) **04**

1) Derive an expression for op. amp as integrator.
2) With a neat circuit diagram explain switching regulator.

Q.5 Answer the following questions. (Any Two) **14**

1) With a near circuit diagram explain master slave JK flip flop.

2) With a near circuit diagram explain the working of LC tunable shift oscillator.

3) Write an assembly language program for 2's complement of two 16-bit numbers.

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Set P

M.Sc.(Semester – II) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
QUANTUM MECHANICS

Day & Date: Monday, 04-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) Classically, the concept of "tunneling" is impossible. Why?
   a) The kinetic energy of the particle would be negative
   b) The total energy of a particle is equal to the kinetic and potential energies
   c) The kinetic energy must be equal to the potential energy
   d) The total energy for the particle would be negative

2) When a particle approaching a potential step has a total energy that is greater than the potential step, what is the probability that the particle will be reflected?
   a) P < 0 b) P = 0
   c) P = 1 d) P > 0

3) A particle has a total energy that is less than that of a potential barrier, when the particle penetrates the barrier, it's wave function is _____.
   a) A positive constant b) Exponentially decreasing
   c) Exponentially increasing d) Oscillatory

4) A rigid diatomic molecule is free to rotate in a fixed plane. The rotational energy eigen values are given by _____.
   a) $\frac{\hbar \mathrm{m}^2}{2\mathrm{I}}$ b) $\frac{2\mathrm{mI}}{\hbar^2}$
   c) $\frac{\hbar^2 \mathrm{I}}{2\mathrm{m}}$ d) $\frac{\mathrm{mI}}{2\hbar^2}$

5) The degree of degeneracy for 3-D isotropic harmonic oscillator is _____.
   a) n^2 b) $2n+1$
   c) $\left(n+\frac{1}{2}\right)(2n+2)$ d) $\frac{1}{2}(n+1)(n+2)$

6) An electron is an infinite square well that is 9.6 nm wide. The electron makes the transition from the n=14 to the n=11 state. The wavelength of the emitted photon is closet to _____.
   a) 3400 nm b) 4100 nm
   c) 2800 nm d) 4700 nm

7) How does the probability of an electron tunneling through a potential barrier vary with the thickness of the barrier?
   a) It is independent of the barrier thickness
   b) It decreases exponentially with thickness
   c) It decreases inversely with thickness
   d) It decreases sinusoidally with thickness

8) For partial described by the wave function $\psi(x,t)$
   a) $|\psi(x_0,t)|^2$ is the probability of finding the particle at x_0
   b) The prob. of finding the particle between x_0 and x_0+dx is proportional to $|\psi(x_0,t)|^2$
   c) The prob. of finding the particle at x_0 is either 0 or 1.
   d) No information can be given about the particle's position.

9) Probability current density $\vec{J}(x,t)$ is always _____.
   a) A real quantity.
   b) A purely imaginary quantity.
   c) Can be either real or purely imaginary depending on $\psi(x,t)$
   d) A complex quantity with possibly non-vanishing imaginary part.

10) The ionization potential of hydrogen atom is 13.6 volt. The energy required to remove an electron from the second orbit of hydrogen is _____.
   a) 3.4 eV b) 6.8 eV
   c) 13.6 eV d) 27.2 eV

11) The de-Broglie hypothesis associated with _____.
   a) Wave nature of electrons only
   b) Wave nature of ∝-particles only
   c) Wave nature of radiations
   d) Wave nature of all material particles

12) The de-Broglie wavelength of material particles which are in thermal equilibrium at temperature T is _____.
   a) $h/(2mKT)^{\frac{1}{2}}$ b) $\hbar/(2mKT)^{\frac{1}{2}}$
   c) $\hbar/(mKT)^{\frac{1}{2}}$ d) $\hbar/(2KT)^{\frac{1}{2}}$

13) In case of wave function, $\psi = \frac{e^{ikr}}{r}$; the probability current density is _____.
   a) $\frac{V}{r}$ b) $\frac{V}{r^2}$
   c) $\frac{V}{r^3}$ d) V

14) The wave function in the ground state of hydrogen atom is given as-
   $\psi = A\, e^{-\frac{r}{a}}$
   r: Measures distance from nucleus and
   a: Constant
   The Value of A is _____.
   a) $1/\sqrt{\pi a}$ b) $1/\sqrt{\pi a^3}$
   c) $1/a\sqrt{\pi}$ d) $1/\sqrt{\pi a^5}$

Q.2 A) Answer the following questions.(Any Four) **08**

1) Explain the terms :
   i) Stationary state
   ii) Bound state
2) Calculate the de-Broglie wavelength of a 0.05 eV ("thermal") neutron.
3) What is the interpretation of wave function ψ?
4) Show that the product of two hermitian operators is hermitian if they commute.

5) Calculate the mean value of the potential energy experienced by an electron in the 1s-orbital of the hydrogen atom.

B) Write notes (Any Two) **06**

1) Third postulates of quantum mechanics.
2) Linear operator and commutator.
3) One Dimensional Box.

Q.3 A) Answer the following questions.(Any Two) **08**

1) Show that if ψ is an eigen function of operator $\hat{A}$ with the eigen value a, then it is also an eigen function of exp(A) with eigen value exp(a).
2) Consider an electron in a macroscopic box of size, a = 2 cm.
   i) What value of n corresponds to energy of 1.5 eV? **02**
   ii) What is the difference in energies of the state n and n+1 in that energy region? **02**
3) Discuss the tunneling for a potential barrier in 1 – D.

$$v(x) = \begin{cases} 0 & \ldots\ldots x < 0 \\ \dfrac{A}{x} & \ldots\ldots x > 0 \end{cases}$$ (A: a +ve constant)

B) Answer the following questions.(Any One) **06**

1) How does the electronic structure of many - electron atoms can be qualitatively explained in terms of hydrogen like orbitals.
2) Show that a particle in a 1 - D box cannot have a definitely known momentum that the average value of the momentum is zero.

Q.4 A) Answer the following questions.(Any Two) **10**

1) Establish the following indentifies for the Dirac δ - function.
   i) $x\,\delta'(x) = -\delta(x)$
   ii) $\delta(x^2 - a^2) = \frac{1}{2|a|}[\delta(x-a) + \delta(x+a)]; a \neq 0$ and is real constant
2) A particle moves in a spherically symmetric attractive potential,
   $V(r) = \begin{cases} -V_0 & \ldots\ldots r < a \\ 0 & \ldots\ldots r > a \end{cases}$ $(V_0 > 0)$
   Obtain the bound state solutions to the Schrödinger equation if $l = 0, l \neq 0$. Is there always a bound - state guaranteed.
3) Discuss the normalization and the characteristics of the Eigen functions of a Harmonic oscillator.

B) Answer the following questions.(Any One) **04**

1) Explain the space Quantization of Electronic orbits.
2) Discuss the many-electron atom with the help of probability density as a function of distance from the nucleus.

Q.5 Answer the following questions.(Any Two) **14**

a) Discuss the case of molecular orbitals of the heteronuclear diatomic molecules.
b) What is the Hydrogen Molecule Ion? Explain in detail.
c) How does the Hartree and Hartree - Fock self-consistent field methods are helpful to estimate the ground state energy and wave functions of many electron atoms? Explain.

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Seat No.	

Set P

M.Sc. (Semester – II) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
ELECTRODYNAMICS

Day & Date: Wednesday, 06-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) The electrostatic potential (v) due to octopole varies as _____.
   a) $v \sim \frac{1}{r^2}$ b) $v \sim \frac{1}{r^3}$
   c) $v \sim \frac{1}{r^4}$ d) $v \sim \frac{1}{r^1}$

2) The energy (U) of an ideal dipole having dipole moment P in electric field E is given by _____.
   a) $U = -P.E$ b) $U = B.E$
   c) $U = -q.E$ d) $U = q.E$

3) Which of the Maxwell's following equations is corrected on the basis of equation of continuity _____.
   a) $\nabla.E = \frac{\rho}{\epsilon_0}$ b) $\nabla.B = 0$
   c) $\nabla \times E = -\frac{\partial B}{\partial t}$ d) $\nabla \times B = \mu_0 J + \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$

4) Maxwell's equation, $\nabla.B = 0$ is obtained from _____.
   a) Gauss law in electro-statics
   b) Faraday law in electromagnetic induction
   c) Ampere's Law.
   d) Gauss law in magneto-statics.

5) Poynting's vector S is _____.
   a) parallel to electric field vector
   b) parallel to magnetic field vector
   c) parallel to propagation vector $\vec{K}$
   d) perpendicular to propagation vector $\vec{K}$

6) Newton's third law does not hold good in _____.
   a) electro-statics b) magneto-statics
   c) electro-dynamics d) all above three

7) The expression for coefficient of reflection (R) is _____.
   a) $\frac{(n_1 - n_2)^2}{(n_1 + n_2)^2}$ b) $\frac{(n_1 + n_2)^2}{4n_1 n_2}$
   c) $\frac{(n_1 - n_2)^4}{4n_1 n_2}$ d) $\frac{(n_1 - n_2)^2}{2n_1 n_2}$

8) The expression for coefficient of transmission (T) is _____.

a) $\frac{(n_1 - n_2)^2}{(n_1 + n_2)^2}$ b) $\frac{4n_1 n_2}{(n_1 + n_2)^2}$

c) $\frac{(n_1 - n_2)^4}{4n_1 n_2}$ d) $\frac{(n_1 - n_2)^2}{2n_1 n_2}$

9) In the definition of skin depth, it is distance over which field amplitude reduces to _____.

a) nearly one fifth b) $\frac{1}{e}$

c) one half d) one fourth

10) For physical dipole the distance (d) between the charges is related to distance (r) of point of observation _____.

a) $d \ll r$ b) $d \gg r$

c) $d \simeq r$ d) $d = r$

11) In case of electric dipole, the radiation zone approximation is expressed as _____.

a) $r \gg \frac{c}{\omega}$ b) $r \ll \frac{c}{\omega}$

c) $r \approx \frac{c}{\omega}$ d) $r = \frac{c}{\omega}$

12) The plot of power radiated (P) against acceleration (a) of a charged particle in $(v \ll c)$ limit is _____.

a) parabola b) ellipse

c) hyperbola d) straight line

13) The direction of Poynting vector in case of electromagnetic wave propagating in vacuum is _____.

a) perpendicular to both Electric field and Magnetic field
b) parallel to both Electric field and Magnetic field
c) perpendicular to Electric field but not to Magnetic field
d) perpendicular to Magnetic field but not to Electric field

14) The graph of Intensity of electromagnetic wave against electric field amplitude is _____.

a) straight line b) parabola

c) ellipse d) hyperbola

Q.2 A) Answer the following questions (Any Four) **08**

1) Explain in detail Biot and Savart's Law with example.
2) Give significance of Poynting's Theorem.
3) Give single application of Faraday's law in electro-magnetism.
4) Obtain the approximate potential at a point far from dipole.
5) Calculate the total charge on a thin ring of diameter one meter if linear charge density is $p(x) = \alpha x$ where $\alpha = 1.6$. How many electrons are there on the ring?

B) Write short notes (Any Two) **06**

1) Maxwell's equations in dielectric medium
2) Multi-pole expansion of electrostatic potential
3) Dipole moment of continuous charge distribution

Q.3 A) Answer the following questions (Any Two) **08**

1) Derive an expressions for energy stored in electric and magnetic field.
2) Discuss in detail Lorentz and Coulomb gauge.
3) Express the electromagnetic wave equations in D' Almbertian Operator.

B) Answer the following questions (Any One) **06**

1) For $\Phi(x, y, z) = 0.5xyz + 0.7yz + 0.9xy^2$, Calculate electric field $\overrightarrow{E}$ at point P(2,4,6).
2) Calculate the coefficient of Transmission (T) at the interface for pair of media having refractive indices $n_1 = 1.50$ and $n_2 = 1 \cdot 33$

Q.4 A) Answer the following questions (Any Two) **10**

1) Give full account of Maxwell's equations for moving medium.
2) Give Maxwell's correction to fourth equation on the basis of equation of continuity.
3) Explain the concept of Displacement current.

B) Answer the following questions (Any One) **04**

1) Give brief account of magnetic interaction of two current loops.
2) Discuss the case of oblique incidence of electromagnetic wave at boundaries.

Q.5 Answer the following questions (Any Two) **14**

a) Derive an expression for coefficient of Reflection (R) and Transmission (T).
b) Explain in detail the concept of radiation damping.
c) Derive an expression for linear and angular momentum associated with electromagnetic wave.

SLR-JR-355

Seat No.	

Set P

M.Sc. (Semester - II) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
STATISTICAL MECHANICS

Day & Date: Friday, 08-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of non-programmable calculator is allowed.

Q.1 A) Fill in the blanks by choosing correct alternatives given below. **08**

1) The state of a molecule of an ideal gas in a vessel is represented by a point in a phase space of _____.
   a) One dimension b) Two dimensions
   c) Four dimensions d) Six dimensions

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

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

4) The thermal inertia of a thermodynamic system is known as _____.
   a) its enthalpy b) its entropy
   c) its isothermal condition d) its adiabatic condition

5) A quantitative explanation of Brownian motion was given by _____.
   a) Albert Einstein b) Maxwell
   c) Robert Brown d) Boltzmann

6) The condition for thermal equilibrium is given by _____.
   a) $(\partial S_1/\partial U_1) = (\partial S_2/\partial U_1)$ b) $(\partial S_1/\partial N_{i1}) = (\partial S_2/\partial N_{i2})$
   c) $(\partial S_1/\partial T_1) = (\partial S_2/\partial T_1)$ d) $(\partial S_1/\partial V_1) = (\partial S_2/\partial V_1)$

7) The flow of heat from hot body to cold body is an example of _____ process.
   a) adiabatic b) irreversible
   c) reversible d) isothermal

8) The phonon is called as _____.
   a) Fermion b) Boson
   c) Antiparticle d) Boltzman particle

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

1) In viral expansion for gas, the second viral coefficient is zero at the Boyle temperature.
2) The transition in $BaTiO_3$ is an example of second order phase transition.
3) Temperature should change in isothermal process.
4) The chemical potential for ideal bose gas is less than zero.
5) When heat propagates like a wave with a infinite velocity through the liquid helium. This phenomenon is called as second sound.
6) Photon, Phonon etc. obeys Fermi Dirac distribution function.

Q.2 A) Answer the following (Any Four) **08**

1) Calculate the equation of state of ideal Fermi gas and its classical limit.
2) State and derive most probable distribution for a quantum ideal gas.
3) Derive the equation for particle function in Grand Canonical Ensemble.
4) Distinguish between 1^{st} and 2^{nd} order phase transition graphically.
5) Show that during the second order phase transition $(\partial^2 \mathrm{G}_1 / \partial \mathrm{T}^2) \neq (\partial^2 \mathrm{G}_2 / \partial \mathrm{T}^2)$

B) Write Notes on (Any Two) **06**

1) Explain the concept of microstate and macrostates
2) Explain the concept of statistical equilibrium.
3) How will you explain the contact between thermodynamics and statistical mechanics?

Q.3 A) Answer the following (Any two) **08**

1) Show that in Bose-Einstein condensation all the particles accumulate in ground stat.
2) Establish Fokker Pank equation and solve it.
3) What is an energy fluctuation? Explain it in terms of canonical ensemble?

B) Answer the following (Any One) **06**

1) How the paradoxical situation arises when we mix the samples of same gas.
2) Write a note on Critical Indices.

Q.4 A) Answer the following (Any Two) **10**

1) Distinguish between Classical and Quantum statistics.
2) Write note on Fluctuation-Dissipation theorem.
3) Explain the second order phase transition with an example of $\mathrm{BaTiO_3}$.

B) Write Notes on (Any Two) **04**

1) What is an ensemble? Explain the concept of Canonical Ensemble.
2) State Liouville's theorem. What is the principle of conservation of density in it?

Q.5 Answer the following (Any two) **14**

a) What is Brownian motion? Set up the diffusion equation and solve it. Show that $< \mathrm{r}^2(\mathrm{t}) > = 6Dt$, where D is the diffusion coefficient.

b) Derive Ehrenfest equation for second order phase transition.

c) 1 kg of water at temperature $30^0\mathrm{C}$ is mixed with 2 kg of water at $90^0\mathrm{C}$ in a calorime of negligible heat capacity at constant pressure of 1 atm. Find the change in entropy of the system.

SLR-JR-357

Seat No.	

Set P

M.Sc. (Semester – III) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
SEMICONDUCTOR DEVICES

Day & Date: Monday, 18-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of Non-programmable calculator is allowed.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) The basic advantage of the CMOS technology is _____.
   a) it is easily implemented
   b) considerable reduction in size
   c) low power consumption
   d) better switching capabilities

2) The V_{GS} (on) of an n- channel E-MOSFET is _____.
   a) Less than the threshold voltage
   b) Equal to the gate - source cut off voltage
   c) Greater than V_{DS}(on)
   d) Greater than-V_{GS} (th)

3) In recent MOSFET's the material used for the gate is _____.
   a) high purity silicon
   b) high purity silica
   c) heavily doped poly crystalline silicon
   d) Epitaxial grown silicon

4) A MOS capacitor made using P type substrate in the accumulation mode. The dominant charge is due to the presence of _____.
   a) Holes
   b) Electrons
   c) Positively charged ions
   d) Negatively charged ions

5) The drain current of a MOSFET in saturation is given by $I_D = K(V_{GS} - V_T)^2$ where K is a constant. The magnitude of the trans-conductance gm is given by _____.
   a) $\frac{K(V_{GS} - V_T T)^2}{V_{DS}}$
   b) $\frac{I_d}{(V_{GS} - V_{DS})}$
   c) $2K(V_{GS} - V_T T)^2$
   d) $\frac{K(V_{GS} - V_T T)^2}{V_{GS}}$

6) The peak inverse current I_p for a power diode is given by the expression _____.
   a) $I_p = t + di/dt$
   b) $I_P = t^* \log I$
   c) $I_p = t^* di/dt$
   d) $I_p = t^* \int t^* i \, dt$

7) A Traic is equivalent to two SCRs _____.
   a) in parallel
   b) in series
   c) in inverse parallel
   d) None of the above

8) Latching current for the GTOs is _____ as compared to conventional thyristors.
   a) more b) less
   c) constant d) none of these

9) The controlling parameter in IGBT is the _____.
   a) I_G b) V_{GE}
   c) I_C d) V_{CE}

10) The number of modes of operation for n type GaAs is: _____.
   a) Two b) Three
   c) Four d) Five

11) The internal quantum efficiency of LEDs decreasing _____ with _____ temperature.
   a) Exponentially, decreasing b) Exponentially, increasing
   c) Linearly, increasing d) Linearly, decreasing

12) _____ has more sophisticated structure than p-i-n photodiode.
   a) Avalanche photodiode b) p-n junction diode
   c) Zener diode d) Varactor diode

13) The detection mechanism in _____ relies on photo excitation of electrons from confined states in conduction band quantum wells.
   a) p-i-n detector b) Quantum-dot photo detector
   c) p-n photodiode d) Avalanche photodiodes

14) _____ is less than or unity for photo detectors.
   a) Absorption coefficient b) Band gap energy
   c) Responsivity d) Quantum efficiency

Q.2 A) Attempt any four of the following question. **08**

1) What are MIS structures? Mention their significance.
2) Give the applications of Light activated thyristors.
3) Define Dark current.
4) Define avalanche effect.
5) List the applications of TR LED.

B) Write short notes. (Any Two) **06**

1) With neat schematic, discuss the construction and working of MIS capacitors.
2) Write a note on CMOS devices.
3) Distinguish between DIAC and TRIAC.

Q.3 A) Attempt any two of the following question. **08**

1) Briefly explain the trapping and flat band voltages.
2) What is a thyristor? List the types.
3) Define Transferred Electron Effect with an example.

B) Write Short notes. (Any One) **06**

1) Silicon Unidirectional Switch (SUS).
2) Emission spectra of LED.

Q.4 A) Attempt any two of the following question. **10**

1) With necessary theory and diagram, discuss the two transistor analogy of SCR. Draw the characteristics.
2) Briefly explain the working of PUT. Mention its applications.
3) Calculate the wavelength of emission from GaAs semiconductor laser whose band gap energy is 1.44 ev (plank's constant is 6.625×10^{-34} Js and charge of an electron is 1.6×10^{-19} C.

B) Attempt any one of the following question. **04**

1) With a neat schematic, describe the working principles of GUNN diode. Draw and explain its I-V characteristics.
2) Explain the charge transfer mechanisms in CCD.
3) Describe the structure, construction and working of LEDs. List its applications.

Q.5 Attempt any two of the following question. **14**

1) Define Quantum efficiency. Describe the detection mechanism in photo detectors. List types of photo detectors and their applications.
2) A double heterojunction InGaAsP LED emitting at a peak wavelength of 1310 nm has radiative and non - radiative recombination times of 30 and 100 ns respectively. The drive current is 40 mA, then find
   i) Bulk recombination lifetime
   ii) Internal quantum efficiency
   iii) Internal power.

3) Discuaibss the working principles of solarcells and draw its I- V characteristics.

SLR-JR-358

Seat No.	

Set P

M.Sc. (Semester – III) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
ATOMIC, MOLECULAR & NUCLEAR PHYSICS

Day & Date: Tuesday, 05-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of Non-programmable calculator is allowed.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) Spherical tops type of molecules have all moment of _____.
   a) $I_A = I_B = I_C$ b) $I_A = I_B \neq I_C$
   c) $I_A \neq I_B = I_C$ d) $I_A = 0, I_B \neq I_C$

2) The Lande g factor single state is for $^5F_2$ state.
   a) 0 b) 2
   c) 1 d) 3

3) The magic number in nuclear physics arises mainly due to _____.
   a) Short character of nuclear force
   b) Dipole-dipole interactions
   c) Coulomb interaction
   d) Spin orbit interaction

4) The Scattering amplitude of n-p interaction is _____.
   a) $F(\theta) = \frac{e^{-i\delta\theta} \sin\delta\theta}{k}$ b) $F(\theta) = \frac{e^{i\delta\theta} \sin\delta\theta}{k}$
   c) $F(\theta) = \frac{e^{-2i\delta\theta} \sin\delta\theta}{k}$ d) $F(\theta) = \frac{\sin\delta\theta}{k}$

5) For an atom in the state of $^2D_{5/2}$ the Lande 'g' factor should be _____.
   a) 1.00 b) 2.20
   c) 1.20 d) 1.02

6) According to the shell model of the nucleus which is incorrect?
   a) Nucleons in a nucleus interact with a general force field
   b) Magic number exists
   c) Nucleons interact with their nearest neighbours only
   d) Large electronic quadruple moment exists for certain nuclei

7) According to the single particle nuclear shell model, the spin parity of the ground state of $^{17}_{8}O$ is _____.
   a) $\frac{1^-}{2}$ b) $\frac{3^-}{2}$
   c) $\frac{5^+}{2}$ d) $\frac{3^+}{2}$

8) The binding energy of deuteron is _____.
   a) 2.226 MeV b) 0.226 MeV
   c) 1.226 MeV d) 3.226 MeV

9) In case of jj Coupling spin s_i* of each electron is quantized with respect to _____ to form a resultant j_i*.
   a) its own l_i* b) another electron's l_i*
   c) its own s_i* d) another electron's s_i*

10) If Q value of nuclear reaction is positive the reaction is _____.
   a) Exothermic b) Endothermic
   c) Endergonic d) None of these

11) Transition rule for the vibrational-rotational spectra are _____.
   a) $\Delta j = \pm 1, \pm 2 \ldots..$ b) $\Delta j = \pm 1$
   c) $\Delta n = \pm 1, \Delta j = \pm 1$ d) None of these

12) The electric quadrupole moment Q is zero for _____ nuclei.
   a) Oblate b) Spherical
   c) Prolate d) None of these

13) In case of LS coupling l_1=1 and l_2=2, then J= _____.
   a) 1,2,3,4 b) 0,1,2,3
   c) 2,3,4 d) 0,1,2,3,4

14) What is the moment of inertia I_B, of $^{1}H^{79}Br$ if the bond distance is 142 pm? Atomic masses are: ^{1}H = 1.008 u, ^{79}Br = 78.92 u.
   a) 3.33×10^{-47} kg.m^2 b) 3.00×10^{46} kg.m^2
   c) 2.34×10^{-37} kg.m^2 d) 1.22×10^{-7} kg.m^2

Q.2 A) Answer the following questions. (Any Four) **08**

1) How molecules are distinguish based on moment of inertia?
2) Explain the significance of the Q-Value of a nuclear reaction.
3) What is the range of the nuclear force? Why is it so short?
4) What is meant by Q values of nuclear reactions?
5) Define Hund's rule.

B) Write short notes. (Any Two) **06**

1) Calculate Lande g factor for $^{3}S_1$ and $^{3}P_1$ levels.
2) What are assumptions of liquid drop model of the nucleus?
3) Draw and label the vibrational energy levels for a diatomic molecule undergoing anharmonic oscillations.

Q.3 A) Answer the following questions. (Any two) **08**

1) State and explain Pauli's exclusion principle.
2) What is the moment of inertia (IB) of $^{1}H^{79}Br$ if the bond distance is 142 pm? (Given: Atomic masses are: ^{1}H = 1.008 amu, ^{79}Br = 78.92 amu.).
3) Distinguish between symmetric top and asymmetric top molecules.

B) Answer the following questions. (Any One) **06**

1) What is the evidence for shell structure of the nucleus? Explain the shell model of the nucleus.
2) The fundamental vibration frequency of HCl is 2989 cm^{-1}. Find the force constant of HCl bond. (Given: the mass of Hydrogen and Chlorine atoms are 1.673×10^{-27} kg and 58.06×10^{-27} kg respectively).

Q.4 A) Answer the following questions. (Any Two) **10**

1) Distinguish between the energy levels of a rigid and a non rigid rotor.
2) Calculate the magnetic moment and term shift of atom corresponding to the state $^{2}P_{1/2}$.

3) Rotational and centrifugal distortion constant of HCl molecule are 10.593 cm^{-1} and 5.3×10^{-4} cm^{-1} respectively. Estimate the vibrational frequency and force constant of molecule. (Given the mass of Hydrogen and Chlorine atoms are 1.673×10^{-27} kg and 58.06×10^{-27} kg respectively).

B) Answer the following questions. (Any One) **04**

1) What are types of nuclear reactions and discuss the nuclear reaction kinematics?
2) Discuss n-n scattering at high energy.

Q.5 Answer the following questions . (Any two) **14**

a) Why HCl molecule is microwave active and obtains the expression for moment of inertia for diatomic molecule as rigid rotator.

b) How the discrepancies caused in shell model is overcome in collective model?

c) Give the schematic representation of interaction energies between ps electrons in L-S coupling.

SLR-JR-359

Seat No.	

Set P

M.Sc. (Semester - III) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
COMMUNICATION SYSTEM

Day & Date: Thursday, 07-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives. **14**

1) The process of impressing information on the carrier signal is called
   a) impressing b) mixing
   c) modulation d) detection

2) In FM, the amplitude of the modulated frequency wave at all times remains
   a) dependent b) varying
   c) high d) constant

3) The circuit that has the function of demodulating the frequency modulated signal is
   a) detector b) AFC
   c) discriminator d) envelop detector

4) Envelop detection is concerned with the process of
   a) mixing b) rectification
   c) modulation d) heterodyning

5) One of the advantages of base modulation over the collector modulation of a transistor class C amplifier is
   a) lower modulating power required
   b) higher power output per transistor
   c) better efficiency
   d) better linearity

6) ASK is the result of combination of shift keying and _____ modulation
   a) digital b) amplitude
   c) analog d) none of these

7) The binary values are represented by two different frequencies in
   a) ASK b) PSK
   c) FSK d) DPSK

8) The modulation index of an AM signal is changed from zero to one. The transmitter power is
   a) unchanged b) halved
   c) doubled d) increased by 50%

9) The PAM signal can be detected by
   a) low pass filter b) high pass filter
   c) band pass filter d) band stop filter

10) The main advantage of TDM over FDM is that, it
   a) needs less power b) gives better S/N ration
   c) needs less BW d) needs simple circuit

11) Multiplexing means
a) one input, many outputs b) many inputs and many outputs
c) one output and many inputs d) none of the above

12) If the binary pulse is maintained for the entire bit time, then the data transmission is called
a) unipolar b) bipolar
c) non-return to zero d) return to zero

13) Probability of error in DPSK is _____ PSK
a) less than b) more than
c) comparable to d) Incomparable to

14) CDMA technology is inherently resistant to
a) interference b) jamming
c) Both(a) and (b) d) none of the above

Q.2 A) Answer the following question. (Any Four) **08**
1) Define high level modulation
2) Define low pass and high pass signals.
3) What is meant by delta modulation?
4) What is meant by sideband transmission?
5) Explain simplex communication system.

B) Write Notes. (Any Two) **06**
1) Balanced modulator
2) PLL as FM detector.
3) Advantage of FM over AM.

Q.3 A) Answer the following question. (Any Two) **08**
1) Explain the generation of PTM.
2) Give a brief explanation on TDM.
3) Explain the process of PDMA.

B) Answer the following question. (Any One) **06**
1) With a neat diagram, explain frequency shift keying.
2) Give a brief explanation on cross talk in TDM.

Q.4 A) Answer the following question. (Any Two) **10**
1) Write a brief note on CDMA.
2) Explain the working of an AM detector circuit.
3) Explain, frequency doubler and tripler circuits.

B) Answer the following question. (Any One) **04**
1) Write the advantages of multiplexing in communication.
2) Write the advantages of FM over AM.

Q.5 Answer the following question. (Any Two) **14**
1) Describe with the help of neat diagram, the working of FM receiver circuit.
2) With a neat diagram, explain DPSK modulation and demodulation.
3) Write a detailed note on multiple access techniques.

SLR-JR-361

Seat No.	

Set P

M.Sc. (Semester - IV) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
MICROELECTRONICS

Day & Date: Monday, 04-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) In wet etching, material is removed by _____.
   a) absorption
   b) sublimation
   c) chemical reaction
   d) the force exerted due to flow of solvent

2) Repeatable entity of a crystal structure is known as _____.
   a) crystal b) lattice
   c) unit cell d) miller indices

3) To obtain crystal structure while fabricating the integrating circuits the commonly used method is _____.
   a) oxidation b) epitaxial growth
   c) photolithography d) silicon wafer preparations

4) Oxidation process in Silicon planer technology is also called as _____.
   a) photo oxidation b) silicon oxidation
   c) vapor oxidation d) thermal oxidation

5) Photoresist layer is formed using.
   a) high sensitive polymer b) light sensitive polymer
   c) polysilicon d) silicon di oxide

6) Lithography is a process used to _____.
   a) transfer a pattern to a layer on the chip
   b) develop an oxidation layer on the chip
   c) develop a metal layer on the chip
   d) produce the chip

7) Heavily doped polysilicon is deposited using _____.
   a) chemical vapor decomposition b) chemical vapor deposition
   c) chemical deposition d) dry deposition

8) Fick's first law of diffusion is expressed as,
   a) $j = -D * \partial C(x,t)$ b) $j = -\frac{\partial c(x,t)}{\partial x}$
   c) $j = -D\frac{\partial C(x,t)}{\partial x}$ d) $j = -\partial N/\partial x$

9) To suppress unwanted conduction ____ is used.
   a) phosphorus b) boron
   c) silicon d) oxygen

10) The advantage of E-beam mask is _____.
   a) small feature size b) larger feature size
   c) looser layer d) complex design

11) Glassivation is usually done by _____.
   a) Chemical Vapor Deposition b) Chemical Bath Deposition
   c) Electro Chemical Deposition d) Molecular Beam Epitaxy

12) The most commonly used material for the interconnection is _____.
   a) boron b) oxygen
   c) aluminum d) silicon

13) As die size shrinks, the complexity of making the photomasks _____.
   a) increases b) decreases
   c) remains the same d) cannot be determined

14) nMOS devices are formed in _____.
   a) p-type substrate of high doping level
   b) n-type substrate of low doping level
   c) p-type substrate of moderate doping level
   d) n-type substrate of high doping level

Q.2 A) Answer the following questions. (Any Four) **08**
1) List the prominent characteristics of the substrates.
2) Mention the salient features of ion implantation.
3) Define Etch back effect.
4) Give the reasons for the failure mechanisms in interconnects.
5) Mention the types of bonding techniques.

B) Write Notes. (Any Two) **06**
1) Clean room and safety requirements
2) Effects of annealing
3) Photo resists

Q.3 A) Answer the following questions. (Any Two) **08**
1) Distinguish between epitaxy and diffusion.
2) Discuss the salient features of CVD technique.
3) Write a note on thermal oxidation.

B) Write Notes. (Any Two) **06**
1) Mask generation using co-ordination graph.
2) Printed Grid Array and Ball Grid Array.

Q.4 A) Answer the following questions. (Any Two) **10**
1) Compare and contrast VBE and LPE techniques.
2) Explain briefly the mass transport limited and surface reaction limited reactions.
3) Write a note on orientation dependence of oxide growth rate.

B) Answer the following questions. (Any One) **04**
1) Discuss briefly on the optical lithography technique.
2) Write a note on package sealing and encapsulation.

Q.5 Answer the following questions. (Any Two) **14**
a) Discuss Deal and Groves model for kinetics of Si-oxidation.
b) With a neat schematic, explain the magnetron sputtering technique.
c) With relevant diagrams, explain the masking sequence and process flow of n-MOS devices.

SLR-JR-362

Seat No.	

Set P

M.Sc. (Semester - IV) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
MICROWAVE DEVICES & CIRCUITS

Day & Date: Wednesday, 06-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 A) Fill in the blanks by choosing correct alternatives given below. **05**

1) Electric field only is transverse to the direction of propagation and magnetic field in not transverse is indicated by.
   a) TE waves b) TM waves
   c) TEM waves d) HE waves

2) The wavelength of an electromagnetic wave in a waveguide is.
   a) less than in free space
   b) greater than in free space
   c) inversely proportional to the phase velocity
   d) directly proportional to the group velocity

3) In a perfect dielectric, wave propagation occurs
   a) with zero attenuation b) with large attenuation
   c) with small attenuation d) with infinite attenuation

4) The reflex Klystron is a.
   a) single cavity klystron b) transit time
   c) two cavity klystron d) None of the above

5) In a phase shifter, change in phase can be obtained with the help of
   a) vacuum b) conductor
   c) dielectric d) None of the above

6) Reflection of microwaves cannot be observed from
   a) short circuit b) open circuit
   c) matched load d) any other load

B) State true or false 08

1) The electric and magnetic wave equations are derived from Maxwell's equations.
2) TWT is used as broadband amplifier in microwave applications.
3) The solution of Maxwell's equation involves three space variables in addition to the time variable.
4) The quality factor Q, of a microstrip line is very high which may be required for high quality resonant MICS.
5) The impedance matching is very desirable in transmission lines.
6) The passive elements used to control the amount of microwave power in a transmission line are called as isolators.
7) In a two-cavity klystron, the cavity close to the cathode is known as the buncher cavity.
8) In wave polarization, the orientation of magnetic field changes.

Q.2 A) Answer the following questions. (Any Four) **08**

1) Explain the characteristic impedance of a transmission line.
2) What is wave polarization?
3) List the advantages and disadvantages of microwave transmission.
4) What are TEM waves?
5) Write a note on matched loads.

B) Write Notes. (Any Two) **06**

1) What are the advantages of waveguides at microwave frequencies?
2) Explain basic concepts of strip type transmission lines.
3) What is a Gunn Diode? Explain.

Q.3 A) Answer the following questions. (Any Two) **08**

1) Obtain an expression for attenuation in parallel plane guides.
2) Explain equations for power and energy associated with electromagnetic waves.
3) Write a note on standard mismatches.

B) Answer the following questions. (Any One) **06**

1) Explain the construction and working of TWT.
2) Discuss the theory of rectangular waveguide transmission.

Q.4 A) Answer the following questions. (Any Two) **10**

1) What are phase shifters? Explain.
2) Give a detailed account on standard coaxial connectors.
3) Derive equations for losses in coaxial lines.

B) Answer the following questions. (Any One) **04**

1) Discuss the planar transmission lines.
2) Write a note on modes in waveguides.

Q.5 Answer the following questions. (Any Two) **14**

a) Starting from Maxwell's equations, explain the propagation of plane electromagnetic waves in free space.

b) Describe the construction and working of a multi cavity Klystron.

c) Discuss the various types of waveguides with necessary equations.

SLR-JR-363

Seat No.	

Set P

M.Sc. (Semester - IV) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
MICROPROCESSORS & INTERFACING

Day & Date: Friday, 08-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) In memory mapped I/O the devices are considered as?
   a) one of the memory location b) I/O device
   c) direct memory access device d) None of these

2) If the programmable counter timer 8253 is set in mode 3 then it is.
   a) square wave generator b) rate pulse generator
   c) software triggered d) hardware triggered

3) Which pins are general purpose I/O pins during mode-2 operation of the 8255?
   a) PB0-PB7 b) PA0 - PA7
   c) both A &B d) PC0-PC2

4) If the Port A address of 8255 is 80H then the control word register address is.
   a) 81H b) 82H
   c) 83H d) 84H

5) If A0 & A1 pin of 8253 is connected to A0 and A1 address line and remaining address line i.e. from A2 to A7 connected to ground then the address of control word register.
   a) 00H b) 01H
   c) 02H d) 03H

6) ADC 0809 is of _____type.
   a) Flash b) Dual Slope
   c) Successive Approximation d) R-2R Ladder Type

7) 16 bit address bus can provides access to total memory of capacity.
   a) 64 KB b) 32 KB
   c) 1 MB d) 8 KB

8) The register in 8259 that stores all the interrupt requests in it in order to serve them one by one on a priority basis is
   a) Interrupt Request Register b) In-Service Register
   c) Priority resolver d) Interrupt Mask Register

9) Commonly the IC interfaced to 8085 to drive the keyboard and display is.
   a) 8259 b) 8279
   c) 8255 d) 8253

10) In 8279, the keyboard entries are debounced and stored in an _____, that is further accessed by the CPU to read the key codes.
   a) 8-bit FIFO b) 8-byte FIFO
   c) 16 byte FIFO d) 16 bit FIFO

11) How many analog input channels present in ADC 0809?
   a) 4 b) 10
   c) 16 d) 8

12) How many IR lines can be able to connect to PIC 8259 in normal mode.
   a) 08 b) 16
   c) 32 d) 64

13) In I/O mapped I/O; address width is ____.
   a) 64 bit b) 32 bit
   c) 16 bit d) 8 bit

14) The operation that can be performed on Command word register is _____.
   a) read and write b) read only
   c) write only d) none of these

Q.2 A) Answer the following questions.(Any Four) **08**

1) In I/O mapped I/O the address line from A_7 to A_3 are connected to +5V supply. Determine all port addresses of 8255.
2) Explain the characteristics of DAC 1408.
3) Explain the features of BSR mode of 8255.
4) Explain the hardware interrupt INTR.
5) How to demultiplex the lower order address and data bus?

B) Answer the following questions.(Any Two) **06**

1) Explain the software interrupts of 8085.
2) Explain the Flash type of ADC.
3) Explain the control word format of 8255.

Q.3 A) Answer the following questions.(Any Two) **08**

1) Explain the Mode-I of 8255.
2) Draw interfacing diagram of DAC (1408) with 8085.
3) Describe the concept of two key lockout and N-Key rollover in case of 8279.

B) Answer the following questions.(Any One) **06**

1) Interface 8255 to 8085 in memory mapped I/O. Determine the addresses of all ports.
2) Explain the operational command words (OCWs) of PIC (8259).

Q.4 A) Answer the following questions.(Any Two) **10**

1) Explain how the interrupts are processed in 8085 with example.
2) Differentiate between the hardware and software interrupts of 8085.
3) Interface the 8253 to 8085 in memory mapped I/O. Identify the port addresses of control word register and counter 1.

B) Answer the following questions.(Any One) **04**

1) Explain the features of 8279.
2) Explain the R-2R ladder type of DAC.

Q.5 Answer the following questions.(Any Two) **14**

a) Draw and explain the block diagram of 8259.
b) Interface 8K x 8 RAM to 8085. Determine its initial and final address.
c) Explain the interrupt structure of 8085.

SLR-JR-364

Seat No.	

Set P

M.Sc. (Semester - IV) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
FIBER OPTIC COMMUNICATIONS

Day & Date: Monday, 11-11-2019 Max. Marks: 70
Time: 03:00 PM To 05:30 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.

Q.1 Fill in the blanks by choosing correct alternatives given below. **14**

1) To achieve optical amplification the condition $N_2 > N_1$ (density of atoms in energy levels E_1 and E_2) known as _____.
   a) Amplification b) Polarization
   c) Population inversion d) Attenuation

2) The graded index profiles which produce the best results for multimode optical propagation have _____.
   a) Rectangular RI with $\propto = 0$ b) Triangular RI with $\propto = 1$
   c) Parabolic RI with $\propto = 2$ d) Step index RI with $\propto = 10$

3) In optical communication system, the optical detector is _____.
   a) Avalanche photo diode b) PIN code
   c) Phototransistor d) Either a or b

4) The phenomenon that leads to avalanche breakdown in ordinary reverse biased diode is _____.
   a) Zener breakdown b) Impact ionization
   c) Avalanche breakdown d) Avalanche multiplication

5) The technique used for the fiber absorption loss measurement is _____.
   a) Cut back method b) Differential method
   c) Calorimetric measurement d) Both a and b

6) Laser is _____ optical source.
   a) Coherent b) Non Coherent
   c) Both d) None of these

7) For an acceptance angle of 30°, NA should be _____.
   a) 0.5 b) 0.7
   c) 0.8 d) 1

8) The shadow method is used to measure _____.
   a) Core diameter b) Dispersion
   c) Field d) Attenuation

9) The core diameter of single mode step index fiber is about _____.
   a) 60 to 70 μm b) 8 to 10 μm
   c) 100 to 250 μm d) 50 to 200 μm

10) Intramodal dispersion is also known as _____ dispersion.
   a) Modal b) Chromatic
   c) Material d) Waveguide

11) LED are more preferable device for analog transmission because _____.
   a) Constant power
   b) Linearity
   c) Constant current
   d) none of these

12) The maximum bandwidth of optical fiber can be achieved by limiting ____.
   a) Attenuation
   b) Dispersion
   c) Modal noise
   d) Signal distortion

13) For a NA = 0.5, a core RI of 1.5, the coupling efficiency into the fiber when the LED is in close proximity to the fiber core is _____.
   a) 0.25
   b) 0.025
   c) 2.25
   d) 0.75

14) The optical power generated internally by LED is _____.
   a) $pint = \eta_{int}\left(i/e\right)ht$
   b) $pint = \eta_{int}\left(ci/e\lambda\right)$
   c) $pint = \eta_{int}\left(\frac{nci}{e}\right)ht$
   d) $pint = \eta_{int}\left(i/e\right)$

Q.2 A) Answer the following questions. (Any Four) **08**

1) Calculate required transit time for carrier velocity of approximately 10^7 cm/s of a depletion layer width of 10 μm.
2) Draw possible refractive index profiles for different values of $\propto = 1$, $\propto = 2\ and\ \propto = infinity$.
3) An optical fiber has a core RI of 1.5. Calculate the magnitude of the Fresnel reflection at the fiber air interface.
4) State the limitations of High impedance front end receiver structure.
5) Why indirect bandgap materials has to be preferred for manufacturing of optical sources.

B) Write Notes on (Any Two) **06**

1) Optical source characteristics
2) Fiber couplers
3) Preparation of optical fibers

Q.3 A) Answer the following questions. (Any Two) **08**

1) Define the relative RI difference for an optical fiber and show how it may be related to the NA.
2) GaAs has a bandgap energy of 1.43ev at 300k. Determine the wavelength above which an intrinsic photodetector fabricated from this material will cease to operate.
3) Explain the method used for measurement of fiber cut off wavelength.

B) Answer the following questions. (Any One) **06**

1) The velocity of light in the core of a step index fiber is 2.01 x 10^8 m/s and the critical angle at the core cladding interface is 80°. Determine the Numerical aperture and the Acceptance angle for the fiber in air.
2) State the techniques used for preparation of optical fiber. Explain vapour phase deposition techniques in detail.

Q.4 A) Answer the following questions. (Any Two) **10**

1) State the significance of Rayleigh scattering loss in optical fiber and explain it in detail.
2) Explain the time domain and frequency domain measurement of fiber dispersion.
3) The power generated internally within a double hetrojunction LED is 28.4 mw at a drive current of 60 MA. Determine the peak emission wavelength from the device when the radiative and non radiative lifetime of the minority carries in the active region are equal.

B) Answer the following questions. (Any One) **04**

1) Explain in detail application of fiber in public network.
2) Draw and explain equivalent circuit of noise in receiver.

Q.5 Answer the following questions. (Any Two) **14**

a) Why optical information carrying capacity is measured in terms of Bandwidth length product. Explain in detail intramodal dispersion occurs in optical fiber.

b) What is splicing in optical fiber. Explain the steps followed for splicing in fusion as well as mechanical splicing.

c) What is difference between PIN diode and APD diode? Explain the working of Avalanche Photodiode (APD) with electric field distribution profile.

SLR-JR-453

Seat No.	

Set P

M.Sc. (Semester – I) (CBCS) Examination Oct/Nov-2019
Physics (Applied Electronics)
CLASSICAL MECHANICS

Day & Date: Saturday, 09-11-2019 Max. Marks: 70
Time: 11:30 AM To 02:00 PM

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of non-programmable calculator is allowed.

Q.1 A) Fill in the blanks by choosing the correct alternatives given below. **08**

1) The configuration space is _____ dimensional space.
   a) 6N b) 3N
   c) 2N d) 4N

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

3) The generating function F_2(q, P, t) generates _____ transformations.
   a) exchange b) identity
   c) none d) infinite

4) The Hamiltonian is defined as _____.
   a) H = T-V b) H = T.V
   c) H = T+V d) H = T/V

5) In Lagrangian the motion of the system has been described by the _____ consideration.
   a) force b) momentum
   c) energy d) acceleration

6) If mi $\ll$ m_2, then the centre of mass of system coincides with the centre of mass of _____.
   a) m_1 b) m_2
   c) in between m_1 and m_2 d) away from m_1

7) If $\in > 1$, then the shape of the orbit formed will be _____.
   a) Ellipse b) Circle
   c) Hyperbola d) Parabola

8) In mechanics the action is _____.
   a) Σ q.p b) Σ q + p
   c) Σ q - p d) Σ $q^2.p^2$

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

1) The Lagrangian equation from D'Alembarts principle is based on Newton's laws.
2) [u , c] = 0 where c is constant.
3) The variational principle associated with Hamiltonian formulation is called the principle of least action.
4) The Hamiltonian formulation is more advantageous than Newtonian.
5) In the configuration space system is having unique path.
6) In mechanics the addition of q and p is called action.

Q.2 A) Answer the following questions (Any Four) **08**

1) What is phase space? Explain it with one example.
2) Define Poisson Bracket.
3) Show that the angular acceleration is the same in fixed and rotating frames.
4) Explain the concept of the inertial and non-inertial frames.
5) Explain the term differential scattering cross section.

B) Write short Notes. (Any Two) **06**

1) Holonomic and non- holonomic constraints
2) Properties of motion under central force field
3) Shapes of orbit formed under central force field

Q.3 A) Answer the following questions. (Any Two) **08**

1) State the Hamilton's variational principle and derive the Lagrange's equation of motion form it.
2) Show that the transformation P = q cot p and Q = log{(sin p)/q} is canonical.
3) Show that the poisson bracket obeys distributive law of algebra.

B) Write Short notes. (Any One) **06**

1) Rutherford scattering
2) Lagrange's equation of motion for one dimensional linear harmonic oscillator.

Q.4 A) Answer the following questions. (Any Two) **10**

1) Distinguish between the configuration space and phase space.
2) What is canonical transformation? Discuss the exact differential condition to show that the transformation is to be canonical.
3) Discuss the different types of generating functions useful for canonical transformations.

B) Write Short notes. (Any One) **04**

1) Advantages of Hamiltonian mechanics over the Lagrangian and Newtonian mechanics.
2) Principle of least action.

Q.5 Answer the following questions. (Any Two) **14**

1) Show that Poisson Brackets remains invariant under canonical transformations.

2) Show that the generating function $F = \sum q_k Q_k$ produce exchange transformation.

3) How a two body problem does reduce to a single body problem? Derive the equation of motion for it?