SLR-IK – 1

Seat No.	

M.Sc. (Part – I) (Semester – I) Examination, 2014
APPLIED ELECTRONICS (Physics) (Paper – I)
Mathematical Techniques (New)

Day and Date : Friday, 14-11-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

Instructions *: 1) Q. No.* ***1*** *and Q. No.* ***2*** *are* ***compulsory****.*
2) Answer ***any three*** *questions from Q. No.* ***3*** *to Q. No.* ***7****.*
3) ***Use*** *of non programable calculator is* ***allowed****.*
4) ***All*** *questions carry* ***equal*** *marks.*

1. a) Choose the correct alternative : **6**

i) The Cauchy Rieman equations are _____

A) $u_x = v_y$ and $v_x = u_y$ B) $u_x = -v_y$ and $v_x = u_y$

C) $u_x = v_y$ and $v_x = -u_y$ D) $u_x = u_y$ and $v_x = v_y$

ii) A function u is said to be Harmonic if it satisfy

A) $u_{xx} + v_{yy} = 0$ B) $u_{xy} - v_{xy} = 0$

C) $u_{xx} - v_{yy} = 0$ D) None of these

iii) The general solution of the ordinary differential equation is the solution in which the number of arbitrary constants equals _____

A) degree of differential equations

B) order of differential equations

C) no. of terms on LHS of differential equations

D) total no. of terms of the differential equation

iv) Matrix digitalization of symmetric matrix is possible only if it has

A) repeated eigen values B) non-repeated eigen values

C) non zero eigen values D) zero eigen values

P.T.O.

v) The Fourier series of f(x) in (– a, a) will involve _____ if f(x) is odd.

A) only cosine terms B) constants

C) both sine and cosine terms D) only sine terms

vi) The vectors X_1, X_2 and X_3 are said to be orthogonal if _____

A) $X_1.X_2 = 0$, $X_2.X_3 = 0$, and $X_3.X_1 = 0$

B) $X_1.X_2 = 1$, $X_2.X_3 = 1$, and $X_3.X_1 = 1$

C) $X_1.X_2 = X_3$, $X_2.X_3 = X_1$, and $X_3.X_1 = X_2$

D) None of the above

b) State **true** or **false** : **8**

i) Both real and imaginary parts of an analytic functions are Harmonic.

ii) Fourier series of the function exists if it satisfy Dirichlets condition.

iii) Laplace transform is derived from Integral transform by taking $t < 0$.

iv) *Cosecx* can be expressed as Fourier series in $(-\pi, \pi)$.

v) Fourier Sine transform of $\frac{1}{x}$ is $\sqrt{2/\pi}$.

vi) If $L\{f(t)\} = \phi(s)$ then $L\{e^{at}f(t)\} = \phi(s + a)$.

vii) If the vectors are Linearly dependent then one vector can be expressed as linear combination of others.

viii) A differential equation is said to be linear if the independent variable is having degree atmost one.

2. Write short notes on :

a) State and Prove De Moivers Theorem. **5**

b) Define Linear dependence and Independence of the vectors. **4**

c) Write a note on integral Transform. **5**

3. a) Show that the function $e^x(\cos y + i \sin y)$ is an analytic function, and hence find its derivative. Prove that real and imaginary parts of the above function are harmonic. **8**

b) Find the eigen values and eigen vectors corresponding to negative eigen values.

$$\begin{pmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -2 \end{pmatrix}$$ **6**

4. a) Solve $(1+x)^2 \frac{d^2y}{dx^2} + (1+x)\frac{dy}{dx} + y = \sin 2[\log(1+x)]$ **6**

   b) Find the Fourier Series of $f(x) = x^2$ in $[0, 2\pi]$. **8**

5. a) Find Laplace transform of $e^{-4t} \int_0^t u \sin 3u\,du$. **8**

   b) Use Cauchy Integral formula to evaluate $\int_C \frac{e^2 z}{(z+1)^2} dz$ where C is the circle $|z| = 2$. **6**

6. a) Define Adjoint of the matrix. Hence find A^{-1} of the matrix using adjoint matrix method for $\begin{pmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{pmatrix}$. **8**

   b) Solve $(D^2 - 4D + 4)\, y = 8(x^2 + \sin 2x + e^{2x})$. **6**

7. a) Express the function $f(x) = \begin{cases} 1, & |x| < 1; \\ 0, & |x| > 1 \end{cases}$

   Hence evaluate $\int_0^\infty \frac{\sin \omega \sin \omega x}{\cos \omega} d\omega$. **8**

   b) Evaluate the integral using Laplace transform method $\int_0^\infty \frac{e^{-at} - e^{-bt}}{t} dt$. **6**

SLR-IK – 2

Seat No.	

M.Sc. (Part – I) (Semester – I) Examination, 2014
APPLIED ELECTRONICS (Physics)
Paper – II : Condensed Matter Physics (New)

Day and Date : Monday, 17-11-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

Instructions : *1) Attempt **five** questions.*
*2) Q. **1** and Q. **2** are **compulsory**.*
*3) Attempt **any three** from Q. **3** to Q. **7**.*
*4) Figures to the **right** indicate **full** marks.*
*5) **Use** of non-scientific calculator is **allowed**.*

1. A) Select correct alternatives : **8**

1) Numbers of tetrad axis in simple cubic system are _____
a) 2 b) 3 c) 4 d) 8

2) Coordination number in case of BCC structure is _____
a) 8 b) 6 c) 10 d) 12

3) Plane parallel to negative x-axis have the miller indices _____
a) 011 b) 001 c) 110 d) 100

4) Penetration depth (λ) is given by the relation _____
a) $\frac{\lambda_0}{(1-t^2)}$ b) $\frac{\lambda}{(1-t^2)}$ c) $\frac{\lambda}{(1-t^4)}$ d) $\frac{\lambda_0}{(1-t^4)}$

5) The Fermi Energy (E_F) in case of p-type semiconductor at T = 0 K is _____
a) $\frac{E_V + E_A}{2}$ b) $\frac{E_c + E_d}{2}$ c) $\frac{E_A - E_V}{2}$ d) $\frac{E_c + E_a}{2}$

6) Elemental solid dielectric has only _____ polarization.
a) Electronic b) Ionic c) Orientational d) All

7) Ewald sphere is drawn with a radius _____
a) a b) a/λ c) λ d) $1/\lambda$

8) Intrinsic concentration of charge carriers in a semiconductor varies as _____
a) T b) T^2 c) $T^3/2$ d) 1/T

P.T.O.

B) State **true** or **false** : **6**

1) In an ionic polarization electronic cloud is coming to one side.
2) FCC structure contains the contribution of four atoms.
3) Lattice constant is double the atomic radius.
4) Conductivity in metal depends on electron mobility.
5) In monoclinic lattice a, b, c and α, β and γ are not equal.
6) According to mass action law product of hole and electron concentration is unequal.

2. Attempt following : **14**
   1) What is critical current ? Explain Silsbee's rule. **5**
   2) Symmetry operations. **5**
   3) Dielectric loss. **4**

3. a) What is Josephson's effects ? Show that for identical superconductor $\frac{d}{dt}(\theta_2 - \theta_1) = 0$. **10**
   b) Explain Meissner's effect. **4**

4. a) What is dielectric polarization ? Give the expression for electronic polarizability. **10**
   b) Calculate electronic polarizability of an isolated Se atom of atomic radius 0.12 nm. Given : $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m. **4**

5. a) Explain HCP, FCC crystal structures in detail. **8**
   b) For a simple cubic crystal, calculate the number of atoms per square mm for the atomic planes (010), (110) and (111). **6**

6. a) What is intrinsic semiconductor ? Calculate the concentration of holes in valance band of intrinsic semiconductor. **10**
   b) Write about the Fermi level in n-type semiconductor. **4**

7. a) Explain the behaviour of electron in periodic potential. **10**
   b) Explain Brillion zone. **4**

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SLR-IK – 3

Seat No.	

M.Sc. (Part – I) (Semester – I) Examination, 2014
PHYSICS (Applied Electronics) (New)
Analog and Digital Electronics (Paper – III)

Day and Date : Wednesday, 19-11-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

***Instructions** : 1) Q. **1** and **2** are **compulsory**.*
*2) Answer **any three** questions from Q. **3** to Q. **7**.*
*3) **All** questions carry **equal** marks.*

1. Objective questions : **14**

a) Select correct alternatives : **6**

1) The unity gain bandwidth of 741 OPAMP is typically

a) 4 MHz b) 2 MHz
c) 6 MHz d) 1 MHz

2) The number of pins of the IC741 op-amp is

a) 8 b) 12 c) 16 d) 24

3) For which of the following flip-flops, the output is clearly defined for all combinations of two inputs

a) D type flip-flop b) R-S flip-flop
c) J-K flip-flop d) None of these

4) A device which converts BCD to Seven Segment is called

a) Encoder b) Decoder
c) Multiplexer d) Demultiplexer

5) Data bus is _____

a) Unidirectional b) Bi-directional
c) tridirectional d) none of these

6) The 8085 microprocessor has _____ number of flags.

a) 4 b) 5 c) 16 d) 10

b) State **true** or **false**/Justify/**One** line answer : **8**

P.T.O.

1) Why is input offset voltage applied to an op-amp ?
2) Why is the square-generator called as a stable multivibrator ?
3) The output voltage of a summing amplifier is proportional to the sum of the input voltages.
4) Convert XOR gate into inverter.
5) Design AND gate using 2×1 mux.
6) DeMorgan's first theorem shows the equivalence of.
7) Can ROM be used as stack ?
8) 8085 is a 16-bit processor.

2. Write short notes on : **14**
   a) Constant current bias. **5**
   b) Master Slave JK Flip-flop. **5**
   c) Write an assembly language program to find biggest element in an array using 8085 µ p instructions. **4**

Long Answer Questions : **42**

3. a) What is an instrumentation amplifier ? Explain with neat diagram. **10**
   b) Explain the difference between inverting and differential summing amplifier. **4**

4. a) With neat circuit diagram explain Wein bridge oscillator using op-amp. **8**
   b) Write a brief note on switching regulators. **6**

5. a) Using a suitable logic diagram explain the working of a 1-to-16 demultiplexer. **8**
   b) With relevant logic diagram and truth table explain the working of a two input EX-OR gate. **6**

6. a) What do you understand by a race around condition ? Draw the circuit diagram of D flip flop and explain its operation. **6**
   b) Using D flip flops and waveforms explain the working of a 4-bit SISO shift register. **8**

7. a) Draw the pin diagram of 8085 and explain the functions of each pin. **8**
   b) What is an addressing mode ? Write about the addressing modes of 8085 microprocessor with examples. **6**

SLR-IK – 4

Seat No.	

M.Sc. (Part – I) (Semester – I) Examination, 2014
PHYSICS (Applied Electronics)
Paper – IV : Classical Mechanics (New)

Day and Date : Friday, 21-11-2014 Total Marks : 70

Time : 11.00 a.m. to 2.00 p.m.

Instructions** : 1) Q. **(1)** and **(2)** are **compulsory.

*2) Answer **any three** questions from Q. **3** to Q. **7.***

*3) **All** questions carry **equal** marks.*

1. Objective questions : **14**

a) Choose correct alternatives : **8**

1) If $\frac{\partial L}{\partial q_n} = 0$, where L is the Lagrangian for a conservative system without constraints and q_n is a generalized coordinate, then the generalized momentum p_n is

a) An ignorable coordinate b) Constant

c) Undefined d) Equal to Hamiltonian of the system

2) A particle of mass m on the Earth's surface is confined to move on the parabolic curve $y = ax^2$, where y is up. Which of the following is the Lagrangian of the particle ?

a) $L = \frac{1}{2} m\dot{y}^2\left(1 + \frac{1}{4ay}\right) - mgy$ b) $L = \frac{1}{2} m\dot{y}^2\left(1 - \frac{1}{4ay}\right) - mgy$

c) $L = \frac{1}{2} m\dot{x}^2\left(1 + \frac{1}{4ax}\right) - mgy$ d) $L = \frac{1}{2} m\dot{y}^2\left(1 + \frac{1}{4ay}\right) + mgy$

P.T.O.

3) How many degrees of freedom two particle system can have ?

a) 6 b) 3 c) 2 d) 9

4) Which of the following statement or statements is or are true ?

a) Force of constraint does no work in any possible displacement

b) Force of constraint does work in any possible displacement

c) If the constraint depends on time, then force of constraint is not zero in any possible displacement

d) Even if the constraint depends on time, then also force of constraint is zero in any possible displacement

5) Suppose that the gravitational force law between two massive objects were

$\vec{F} = \frac{\hat{r}_{12}\, Gm_1m_2}{r_{12}^{2+\varepsilon}}$, where ε is a small positive number. Which of the following statement would be false ?

a) The total mechanical energy of the planet sun system would be conserved

b) The angular momentum of a single planet moving about the sun would be conserved

c) A single planet could move in a stationary non circular elliptical orbit about the sun

d) A single planet could move in a stationary circular orbit about the sun

6) Which of the following defines a conservative force F ?

a) $dF/dt = 0$ b) $\nabla . F = 0$

c) $\nabla \times F = 0$ d) $\oint F . dr \neq 0$

7) A block of mass m sliding down an inclined at constant speed in initially at a height h above the ground. The coefficient of kinetic friction between the mass and the incline is μ. If the mass continues to slide down the incline at a constant speed, how much energy is dissipated by friction by the time the mass reaches the bottom of the incline ?

a) mgh/μ b) mgh c) $Mghsin\theta$ d) Zero

8) Poisson Bracket are _____ under canonical transformation.

a) Variant b) Nullified

c) Anti-symmetric d) Invariant

b) **True/false** : **6**

1) Scleronomic constraint do not explicitly depends on time.

2) Generalized coordinates are dependent on one another.

3) The area swept out by the radius vector per unit time is constant.

4) In a central motion the orbit of a particle always lie in a plane which is parallel to the fixed direction of angular momentum.

5) The transformation is canonical if pdq – PdQ is an exact differential.

6) q_j's which are absent in L are called cyclic coordinates.

2. Write short answers **any three** : **14**

a) A shell of mass 12 Kg is fired with muzzle velocity of 400 m/s at an angle of elevation 45°. **4**

a) Find range use g = 10 m/s^2.

b) When it is at the highest point of the trajectory, it splits into two halves because of the internal explosion. One half lands at a point 20 km on x-axis from origin. Where will the other half lands and when ?

b) Prove that forces acting on a particle are conservative then the total energy E of a particle is conserved. **5**

c) Show that the momentum conservation theorems are closely connected with the symmetry properties of the system. **4**

d) What are the degrees of freedom needed to describe a double pendulum oscillating in vertical plane. Explain briefly. **5**

3. a) Derive Lagrange's equation of motion. **8**

   b) Write Lagrange's equation of motion for a particle moving in 3 D under potential V(x, y, z). **6**

4. a) Derive Canonical equations of Hamilton. Also write the procedure for constructing Hamiltonian. **8**

   b) Obtain Hamilton's equation for one dimensional simple harmonic oscillator. **6**

5. a) What is Poisson Bracket ? Write all the properties of Poisson Bracket. **8**

   b) Show that $Q = \sqrt{2q}\ e^{a} \cos P$ and $P = \sqrt{2q}\ e^{-a} \sin P$ is a canonical transformation. **6**

6. a) Derive and explain the classification of orbits. **8**

   b) Obtain the conservation theorems using Lagrange's equation of motion. **6**

7. a) Show that central force motion of two bodies about their centre of mass can always be reduced to an equivalent one body problem. **8**

   b) Write a note on D'Alembert's Principle. **6**

SLR-IK – 6

Seat No.	

M.Sc. (Part – I) (Semester – I) Examination, 2014
PHYSICS (Applied Electronics) (Old)
Condensed Matter Physics (Paper – II)

Day and Date : Monday, 17-11-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

***Instructions** : 1) Questions **1** and **2** are **compulsory**.*
*2) Answer **any three** questions from Q. **3** to Q. **7**.*
*3) **All** questions carry **equal** marks.*

1. a) Choose the correct alternative : **8**

1) The width of energy gap in a superconductor at 0°K is nearly

i) $k_B T_C$ ii) $35\ k_B T_C$
iii) $3.5\ k_B T_C$ iv) $300\ k_B T_C$

2) A plane intercepts at a, b/2, 3c in a simple cubic unit cell. The Miller indices of the plane are

i) [1 3 2] ii) [2 6 1] iii) [3 6 1] iv) [1 2 3]

3) A beam of X-ray of wavelength 0.25 nm is incident on a crystal of inter planar separation 0.30 nm. The glancing angle for first order diffraction is

i) 24.6° ii) 36.0° iii) 56.4° iv) 54.8°

4) The c/a ratio for an ideal hexagonal closed packed structure is

i) $\frac{2}{\sqrt{3}}$ ii) $\sqrt{8}$ iii) $\sqrt{5}$ iv) $\sqrt{\frac{8}{3}}$

5) The effective mass of an electron in a semiconductor

i) can never be positive ii) can never be negative
iii) can be positive or negative iv) depends on its spin

6) Diamond structure is composed of

i) two S.C ii) a S.C. and F.C.C.
iii) two F.C.C. iv) none of these

7) Below critical temperature, the superconductor behaves as _____ material.

i) magnetic ii) ferromagnetic
iii) paramagnetic iv) diamagnetic

P.T.O.

8) A lattice is characterized by following primitive vectors $\vec{a} = 2\left(\hat{i} + \hat{j}\right)$, $\vec{b} = 2\left(\hat{j} + \hat{k}\right), \vec{c} = 2(\hat{k} + \hat{i})$. The reciprocal lattice corresponding to this lattice is

i) bcc with cube edge π ii) bcc with cube edge 2π

iii) fcc with cube edge π iv) fcc with cube edge 2π

b) Fill in the gaps with appropriate word : **6**

i) The packing fraction of F.C.C. structure is _____

ii) The depletion region in an open circuited p-n junction contains _____

iii) The first Brillion zone lies between _____ of k value.

iv) Volume of primitive cell of bcc structure having conventional lattice parameter a is _____

v) The Miller indices of the plane parallel to y and z axes are _____

vi) Relative permeability of a medium is the permeability relative to that of _____

2. Attempt the following : **14**

i) How energy bands are formed ? Explain with examples in detail. **5**

ii) What is meant by polarization in dielectrics ? Obtain the relation between the dielectric constant and atomic polarizability. **5**

iii) Derive the London equations and explain the term coherence length. **4**

3. a) Write short notes on the followings : **8**

i) Reduced zone schemes. ii) Fermi surfaces.

b) Write a note on Josephson effect. **6**

4. a) What is meant by dielectric loss ? Discuss the mechanism that leads to electric breakdown. **8**

b) Explain what is meant by N and P type semiconductors. **6**

5. a) Derive the susceptibility expression for ferromagnetic material. **10**

b) In a p-type semiconductor, the Fermi level lies 0.4 eV below the valance band. If the concentration of the acceptor atom is tripled, find the new position of the Fermi level. **4**

6. a) Write a note on thermodynamics of superconductor. **8**

b) Give a brief account of Type II superconductors. **6**

7. a) How is the cooper pairs formed ? Explain the BCS theory of superconductivity. **7**

b) Discuss the behavior of an electron in a periodic potential. **7**

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SLR-IK – 8

Seat No.	

M.Sc. (Part – I) (Semester – I) Examination, 2014
PHYSICS (Applied Electronics)
Paper – IV : Classical Mechanics (Old)

Day and Date : Friday, 21-11-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

Instructions : *1) Q.* ***1*** *and* ***2*** *are* ***compulsory****.*
2) Answer ***any three*** *questions from Q.* ***3*** *to Q.* ***7****.*
3) ***All*** *questions carry* ***equal*** *marks.*

1. A) Select correct alternatives : **8**

1) A small rigid rod of length l moves freely inside a balloon of radius R (R > l) such that both ends of the rod are always touching the inner surface of the balloon. The degree of freedom of the rod are

a) 01 b) 02 c) 03 d) 04

2) If angle θ is generalized coordinate, then the corresponding generalized force has dimensions of

a) force b) momentum c) energy d) torque

3) The plane of oscillations of a Foucault's pendulum rotates

a) 15° per hour at the pole
b) 15° per hour at the equator
c) 30° per hour at the pole
d) 30° per hour at the equator

4) The generalized momentum p_x of a particle of mass m with velocity v_x in an electromagnetic field is given by

a) $p_x = mv_x$ b) $p_x = qv_x \cdot A_x$
c) $p_x = mv_x - qA_x$ d) $p_x = mv_x + qA_x$

5) The phase space refers to

a) position co-ordinates only
b) momentum coordinates only
c) boths position and momentum coordinates
d) none of the above

P.T.O.

6) If v_1 and v_2 are the maximum and minimum velocities of a satellite, respectively, then the eccentricity of the orbit of satellite is given by _____

a) $e = \frac{v_1}{v_2}$ b) $e = \frac{v_1 + v_2}{v_1 - v_2}$ c) $e = v_2 / v_1$ d) $e = \frac{v_1 - v_2}{v_1 + v_2}$

7) The transformation defined as $F_1 = \sum_k q_k Q_k$

a) is not canonical transformation
b) generates exchange transformation
c) generates identity transformation
d) none of the above

8) $[L_x, p_x]$ =

a) 1 b) –1
c) p_y d) 0

B) State **true** or **false** : **6**

1) The force defined as $\overline{F} = yz\hat{i} + zx\hat{j} + xy\hat{k}$ is non-conservative.
2) For a system possessing rotational symmetry, its angular momentum is conserved.
3) Lagrangian of a given system is uniquely defined.
4) Geodesics are the curves that give shortest distance between two points on a surface.
5) Rutherford's differential scattering cross section has dimensions of area.
6) In a simple pendulum (θ) is the generalized coordinate.

2. Attempt **any two** : **14**

1) Write the Lagrangian of a free particle in Cartesian and spherical polar coordinate systems. State the advantages of Lagrangian formulation over the Newtonian formulation. **5**
2) Consider an object falling downward with an initial velocity v_0 from height L in a constant gravitational field. Find the velocity and displacement of the object, if the retarding force is proportional to its instantaneous velocity. **5**
3) State and prove Virial theorem. **4**

3. A) Find the Lagrangian for a particle in a uniformly rotating frame of reference and show that the resulting equation of motion is

$$\frac{m d\bar{v}}{dt} = \bar{F}_{ext} + 2m(\bar{v} \times \bar{w}) + m(\bar{w} \times \bar{r}) \times \bar{w} .$$ **8**

B) Use the D'Alembort's principle to describe the motion of a solid sphere rolling down an inclined plane (without slipping). **6**

4. A) Derive the Kepler's third law of planetary motion. **10**

B) Check whether the transformation defined as Q = ptanq, P = log (sinp) is canonical or not ? **4**

5. A) Derive the Hamilton's canonical equations of motion for a charge q, moving in electro magnetic field. **8**

B) A particle of mass m moves in spiral orbit defined by equation $r = c\theta$, where c is a constant. Find the force law. **6**

6. A) Prove the Jacobi identity [V, [V, W]] + [V, [W, U]] + [W, [U, V]] = 0. **8**

B) Show that, for $J = \int_{x_1}^{x_2} f(y, y_x, y_{xx}; x)\, dx$, the Euler's equation is

$$d^2 \Big/ dx^2 \left(\partial f \Big/ \partial y_{xx} \right) - \frac{d}{dx}\left(\frac{\partial f}{\partial y_x} \right) + \frac{\partial f}{\partial y} = 0 .$$ **6**

7. Write notes on **any two** : **14**

1) Cyclic coordinates and constants of motion.

2) Poissons brackets and their properties.

3) Generalized coordinates and degrees of freedom.

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SLR-IK – 9

Seat No.	

M.Sc. (Part – I) (Semester – II) Examination, 2014
APPLIED ELECTRONICS (Physics)
Statistical Mechanics (Paper – V)

Day and Date : Saturday, 15-11-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

Instructions *: 1) Q.* ***1*** *and Q.* ***2*** *are* ***compulsory****.*
2) Attempt ***any three*** *from Q.* ***3*** *to Q.* ***7****.*
3) ***All*** *questions carry* ***equal*** *marks.*
4) Figures to the ***right*** *indicate* ***full*** *marks.*

1. A) Choose the correct alternative : **8**

1) Heat is _____

a) A property of objects by virtue of their temperature

b) Energy content of the object

c) Energy transfer by virtue of temperature difference

d) Energy transfer by macroscopic work

2) According to second law of thermodynamics the energy of the universe is always _____

a) Conserved b) Increasing

c) Decreasing d) Fluctuating

3) For _____ ensemble $\partial \Omega / \partial T = 0$.

a) Non stationary b) Stationary

c) Vibrating d) All

4) For the stable state of the system G i.e. Gibbs's free energy should be _____

a) Large b) Small

c) Infinity d) Constant

P.T.O.

5) In Bose Einstein condensation all the particle accumulate in _____

a) Excited state b) Meta state

c) Ground state d) All existing states

6) A 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 chemical potential for photon gas is

a) Greater than zero b) Less than zero

c) Equal to zero d) Not defined

8) Phase space is _____ dimensional space.

a) 3N b) 6N c) 2N d) 0N

B) Fill in the blanks/state **True** or **False** : **6**

1) Second law of thermodynamics governs the spontaneity of reaction. State **true or false**.

2) The principle of equi-partition of energy states that the internal energy of gas is shared equally among the molecules. State **true or false**.

3) In _____ order phase transition heat is evolved or absorbed.

4) In microcanonical ensemble system exchange both energy and matter. State **true or false**.

5) The phonons are fermions. State **true or false**.

6) A quantitative explanation of Brownian motion was given by _____

2. Attempt **any three** : **14**

a) Distinguish between different types of ensemble.

b) Explain the contacts between statistic and thermodynamics.

c) Explain the 2^{nd} order phase transition phenomenon with an example.

d) An ideal gas undergoes an isothermal process starting with a pressure of 2×10^5 Pa and volume of 6 cm^3. Calculate the pressure and volume of the final state.

3. A) Derive Clasius-Clayperon equation for first order phase transition. **10**

   B) Discuss the concept of density matrix in quantum statistical mechanics. **4**

4. A) How will you explain various statistical distribution functions used in quantum statistical mechanics ? **10**

   B) Write note on phase space and quantum state. **4**

5. A) Explain the theory of cluster expansion for classical gas. **10**

   B) Discuss how Fokker-Plank equation leads to the state of equilibrium. **4**

6. A) Explain the characteristics of canonical ensemble and derive Gibb's distribution function for it. **10**

   B) Explain the P-T diagram of one component system. **4**

7. A) Develop Langevin theory of Brownian motion of particles. Derive Einstein's relation for diffusion coefficient in this case. **10**

   B) 1 kg of water at temperature 30°C is mixed with 2 kg of water at 90°C in a calorimeter of negligible heat capacity at constant pressure of 1 atm. Find the change in entropy of the system. **4**

SLR-IK – 10

Seat No.	

M.Sc. (Part – I) (Semester – II) Examination, 2014
APPLIED ELECTRONICS (Physics)
Quantum Mechanics (Paper – VI)

Day and Date : Tuesday, 18-11-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

***Instructions** : 1) Q. **(1)** and **(2)** are **compulsory**.*
*2) Answer **any three** questions from Q. **3** to Q. **7**.*
*3) **All** questions carry **equal** marks.*

1. A) Choose correct alternatives : **8**

1) An operator operating on an eigen function gives
   a) An eigenvalue and the same eigen function
   b) An eigenvalue and a different eigen function
   c) Another operator
   d) None of the above

2) If the length of the one dimensional box is longer, the wavelength at which the optical transition occurs is
   a) Shorter b) Longer
   c) Critical d) Unaltered

3) Conservation of probability is guaranteed by demanding that the operators are
   a) Hermitian
   b) Orthogonal
   c) Represented by square matrices
   d) Unitary

4) Hooks law gives the expression for force as
   a) $F = -dV/dx$ b) $F = m\,a$
   c) $F = -k\,x$ d) None of the above

5) Compared to the electron with a higher angular momentum, the electron having lower angular momentum is
   a) Away from the nucleus b) Nearer the nucleus
   c) Has a thicker orbital d) None of the above

6) The no. of electrons circulating about the positively charged nucleus in a hydrogen like atom is
   a) Equal to the number of protons in the nucleus
   b) Equal to mass number
   c) Negligible
   d) One
7) In atoms having many electrons, the electron repulsion term
   a) Can be ignored
   b) Can be included in the momentum operator
   c) Has to be included in the potential energy term of wave equation
   d) None of the above
8) The Born-Oppenheimer approximation is valid for
   a) The ground electronic state of the molecule
   b) The excited electronic state of the molecule
   c) Both the above
   d) None of the above

B) Fill in gaps : **3**

1) The wave associated with a particle is called _____ wave.
2) The molecular orbital theory can explain the _____ of O_2 and NO molecules.
3) The determinantal form of the wave function of a many electron system is known as _____ determinant.

C) State **True** or **False** : **3**

1) For bound states, ψ must vanish at infinity.
2) A Hermitian operator conserves probability.
3) The exact solution of a many-electron is not obtained.

2. Attempt **any three** : **14**

a) What are commuting operators ? Show that the commutating operators have simultaneous eigen functions.

b) Discuss the phenomenon showing particle nature of light. What is wave-particle duality ?

c) State and explain the second postulate of quantum mechanics.

d) Write a note on many electron atoms.

3. a) Using the Heaviside step function, define Dirac delta function and discuss its properties. **10**

   b) Find the energy jump in electron volts for the emission of visible light of wavelength 7500 A°. **4**

4. a) What is an operator ? Discuss properties of operators in quantum mechanics. What are Hermitian and unitary operators ? **10**

   b) The hydrogen halides have the following fundamental vibration frequencies : HF(4141 cm^{-1}), HCl(2989 cm^{-1}), HBr(2650 cm^{-1}), HI(2309 cm^{-1}). Find their force constants in N/cm. (1 N = 10^5 dyne). **4**

5. a) Write down the wave equation for a harmonic oscillator. Give its normalized solutions in terms of Hermite polynomials. Comment on their symmetry property. **10**

   b) Calculate the zero-point energy of a mass of 1.67×10^{-24} gm connected to a fixed point by a spring with a force constant of 10^4 dyne/cm. **4**

6. a) Develop the self-consistent field method to find the energy eigenvalues of atomic orbitals **10**

   b) Show that a closed shell electron configuration is always represented by ^1S term. **4**

7. a) Apply the Born-Oppenheimer approximation and the LCAO molecular orbital theory to the Hydrogen molecule ion. **10**

   b) Obtain the term symbol for the ground state of the nitrogen atom assuming the Russell-Saunders coupling. **4**

SLR-IK – 11

Seat No.	

M.Sc. (Part – I) (Semester – II) Examination, 2014
PHYSICS (Applied Electronics) (Paper – VII)
Electromagnetic Theory

Day and Date : Thursday, 20-11-2014 Total Marks : 70

Time : 11.00 a.m. to 2.00 p.m.

Instructions *: 1) Attempt* ***five*** *questions.*

2) Q. ***(1)*** *and Q.* ***(2)*** *are* ***compulsory****.*

3) Attempt ***any three*** *questions from Q.* ***3*** *to Q.* ***7****.*

4) Figures to the ***right*** *indicate* ***full*** *mark.*

5) ***Use*** *of calculator is* ***allowed****.*

1. A) Select the correct alternatives : **6**

1) Differential from the Faraday's law is

a) Curl $E = -\frac{\partial B}{\partial t}$ b) Div $B = 0$

c) Curl $H = J + \frac{\partial D}{\partial t}$ d) Div $D = \rho$

2) The dominate mode in rectangular wave guide is

a) TE_{11} b) TM_{11} c) TE_{101} d) TE_{10}

3) The equation of continuity for non-stationary current is

a) Div $J = 0$ b) $\frac{\partial \rho}{\partial t} = 0$

c) Div $J + \frac{\partial \rho}{\partial t} = 0$ d) $\frac{\partial D}{\partial t} = 0$

P.T.O.

4) Work done per unit charge by the source is

a) EMF b) MMF

c) Poynting's vector d) Potential

5) Optics second law of reflection is

a) $\theta i = 0$ b) $\theta i = \theta r$ c) $\theta i < \theta r$ d) $\theta i > \theta r$

6) Skin depth (d) relates with wave vector (k) by the relation

a) $\frac{w}{k}$ b) $\frac{1}{k}$ c) $\frac{ck}{w}$ d) $\frac{K}{2\pi}$

B) **True** or **false** : **8**

1) According to Ampere's law, changing magnetic field produces electric current.

2) Scalar potential does satisfy Poisson's equation.

3) To obtain total internal reflection, wave must be incident from denser medium in to rarer medium.

4) The displacement current arises due to time varying electric field.

5) The electric potential due to linear quadrapole varies inversely with r^2.

6) Magnetic induction through a loop is proportional to the current through the loop.

7) In case of oblique incidence transmitted wave is always in phase with incident wave.

8) For a perfect conductor E = 0 even current is flowing through it.

2. Attempt the following : **14**

1) Amperes circuital law **5**

2) Energy in magnetic field **5**

3) Lorentz's gauge. **4**

3. a) Write about Poynting's theorem. **8**

   b) Explain conservation of momentum. **6**

4. a) Explain about energy and momentum in electromagnetic waves travelling through the vacuum. **9**

   b) Calculate the value of current passing through the conductor having conductivity $\sigma = 0.59 \times 10^{-8}$, length $l = 1.2$ cm, cross sectional area A = 1.5 cm^2 and applied potential difference V = 1.4 V. **5**

5. a) What is wave guide ? Explain about Transverse Magnetic (TM) mode. **8**

   b) Write about propagation constant of TE/TM wave. **6**

6. a) Write the equations of electric and magnetic fields in case of electromagnetic waves in conductor. **10**

   b) Write about the reflection of electromagnetic waves at a conducting surface. **4**

7. a) What is retarded potential ? Give the equation for Lienard – Wiechert potentials. **8**

   b) Give the Maxwell's equations in matter. **6**

SLR-IK – 12

Seat No.	

M.Sc. (Part – I) (Semester – II) Examination, 2014
PHYSICS (Applied Electronics)
Paper – VIII : Microprocessors and Microcontrollers

Day and Date : Saturday, 22-11-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

***Instructions** : 1) Q. **(1)** and **(2)** are **compulsory**.*
*2) Answer **any three** questions from Q. **3** to Q. **7**.*
*3) **All** questions carry **equal** marks.*

1. Objective questions : **(14)**

a) Choose correct alternatives : **8**

1) In Intel 8085 MPU, data bus is _____
   A) Bidirectional B) Unidirectional
   C) 32 bit bus D) None of these

2) The register that is used to sequence the execution of the instructions is called _____
   A) Program counter B) Stack pointer
   C) Accumulator D) None of these

3) What does the BIU of 8086 contain ?
   A) Queue B) Segment register
   C) Instruction pointer D) All of these

4) In Intel 8086, what is the size of the accumulator register ?
   A) 8 bit B) 16 bit C) 32 bit D) None of these

5) The stack in 8051 is _____
   A) Last-In-Last-Out B) First-In-First-Out
   C) Last-In-First-Out D) None of these

6) How many memory cells are there in a 128×4 memory chip ?
   A) 128 B) 512 C) 4 D) 1024

7) The 8051 has _____ parallel I/O ports.
   A) 2 B) 3 C) 4 D) 5

8) An instruction which contains the data in its use _____
   A) Register addressing
   B) Immediate addressing
   C) Register indirect addressing
   D) Relative addressing

b) Fill in gaps/**True** or **False** : **6**

1) The 8085 has _____ general-purpose registers.
2) Intel 8086 can access _____ number of I/O ports.
3) In 8051 PSW stands for _____
4) The Intel 8085 uses a single + 5 Vd.c for its operation. (True or False)
5) The program counter in 8051 is 16-bit wide. (True or False)
6) There are 14 flags in 8086 microprocessor.(True or False)

2. Attempt **any three** : **14**

a) Explain how 74LS244 and 74LS245 used a tri-state and bidirectional buffer. **5**

b) Explain the structure of address decoding. **5**

c) Enlist the features of 8051 mocrocontroller. **4**

d) Write a short note on clock generator 8284. **4**

3. a) With a neat diagram explain the architecture of 8085 microprocessor. **8**

b) Discuss the function of the following signals of 8085 : **6**

i) $\overline{RD}$ ii) $\overline{WR}$
iii) ALE and iv) S_0 and S_1.

4. a) What do you mean by term addressing modes ? Explain the different addressing modes supported by 8051 ? **10**

b) Explain the difference between MOVX and MOV instructions in 8051. **4**

5. a) Design a microprocessor system to interface an 8 K × 8 EPROM and 8 K × 8 RAM. **8**

b) Compare memory I/O with I/O mapped I/O. **6**

6. a) Draw and explain the minimum mode configuration of 8086 microprocessor. **10**

b) What is Effective Address (EA) and Physical Address ? Explain briefly. **4**

7. a) Explain with a neat diagram of memory segmentation in the 8086 microprocessor. **8**

b) Write a program to multiply two signed numbers and stored the result at 5000H. **6**

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SLR-IK – 13

Seat No.	

M.Sc. – II (Semester – III) Examination, 2014
PHYSICS (Applied Electronics)
Semiconductor Devices (Paper – IX)

Day and Date : Friday, 14-11-2014 Max. Marks : 70
Time : 3.00 p.m. to 6.00 p.m.

Instructions *: 1) Attempt **5** questions.*
*2) Q. **1** and Q. **2** are **compulsory**.*
*3) Attempt **any three** from Q. **3** to Q. **7**.*
*4) **Use** of calculators is **allowed**.*

1. Objective questions (Choose the correct alternative) : **14**

1) For a MIS diode system, the capacitance due to _____ is voltage independent.
   a) metal b) insulator
   c) semiconductor d) pn-junction

2) The dominating operating process for laser is _____
   a) stimulated emission b) spontaneous emission
   c) absorption d) transmission

3) The interface traps are normally reduced by _____ annealing.
   a) H_2 b) N_2
   c) O_2 d) Cl_2

4) Modern Si-MOSFET's are fabricated on _____ oriented silicon.
   a) $\langle 111 \rangle$ b) $\langle 110 \rangle$
   c) $\langle 100 \rangle$ d) $\langle 001 \rangle$

5) For ultra high speed CCD, GaAs is suitable than Si because of _____
   a) high electron mobility b) high electron concentration
   c) low electron mobility d) low electron concentration

6) Transferred electron devices operate at _____ frequencies.
   a) Hz b) KHz
   c) MHz d) GHz

7) Figure of merit of a tunnel diode is given as _____
   a) I_P b) I_V c) $\frac{I_P}{I_V}$ d) $\frac{I_V}{I_P}$

8) The effect of gate voltage is to reduce _____ in the SCR operation.
   a) V_{FB} b) V_{RB}
   c) Anode current d) Holding voltage

9) Transistor model of an SCR fails at _____
   a) $\alpha_1 = 1$ b) $\alpha_2 = 1$
   c) $\alpha_1 + \alpha_2 = 1$ d) $\alpha_1 + \alpha_2 = -1$

10) In the saturation region, collector-base junction is
   a) reverse biased b) forward biased
   c) does not require bias d) none of the above

11) To convert wavelength to photon energy, we use the relation
   a) $\lambda = \frac{1.24}{h\upsilon}$ b) $\lambda = \frac{12.4}{h\upsilon}$ c) $\frac{h\upsilon}{12.4}$ d) $\frac{h\upsilon}{1.24}$

12) For a semiconductor that exhibits NDR, any charge imbalance will grow with _____
   a) time constant b) voltage
   c) current d) time

13) The light modulation band width is given by _____
   a) $\Delta f = \frac{\Delta\omega}{2\pi}$ b) $\Delta f = \Delta\omega \cdot 2\pi$
   c) $\Delta f = \frac{2\pi}{\Delta\omega}$ d) None of these

14) In a CCD, MOS diode array must be biased into _____
   a) slight depletion b) depletion
   c) deep depletion d) bulk

2. Give a brief account of : **14**

   1) Measurement of interface trapped charges by conductance method. **5**

   2) SCR. **5**

   3) Pin photodiode. **4**

3. a) Discuss the ideal MIS curve referred to energy band diagram, charge, electric field and surface potential. **10**

   b) Write a note on diac. **4**

4. a) Discuss the charge storage mechanism referred to MOS diode operating as a CCD device. **10**

   b) What is the effect of density of ionized acceptors on the charge storage mechanism. **4**

5. a) Explain the bidirectional action of a triac and hence its different modes of operation. **10**

   b) Which of the mode is most sensitive ? Why ? **4**

6. a) Explain with the help of a suitable circuit arrangement how can active device be protected from the hazards of $\frac{dI}{dt}$ and $\frac{dV}{dt}$ effects ? **9**

   b) Write a note on CMOS device. **5**

7. a) Discuss the reverse recovery characteristic of a power diode. **8**

   b) Write a note on enhancement type power MOSFET. **6**

SLR-IK – 14

Seat No.	

M.Sc. (Part – II) (Semester – III) Examination, 2014
PHYSICS (Applied Electronics)
Paper – X : Instrumentation

Day and Date : Monday, 17-11-2014 Total Marks : 70
Time : 3.00 p.m. to 6.00 p.m.

Instructions *: 1) Q.* ***1*** *and* ***2*** *are* ***compulsory****.*
2) Answer ***any three*** *questions from Q.* ***3*** *to* ***Q. 7****.*
3) ***All*** *questions carry* ***equal*** *marks.*

1. Objective questions : **14**

A) Choose correct alternatives : **8**

1) All inductance type transducers are based on _____
   a) Faradays laws b) Seeback effect
   c) Peltier effect d) Thomson effect
2) Piezo-electric transducers are _____
   a) Active transducers b) Inverse transducers
   c) Passive transducers d) None of the above
3) DVM measures _____ value.
   a) average b) r.m.s.
   c) peak-to-peak d) peak
4) Principle of Q-meter is _____
   a) Series resonance b) Parallel resonance
   c) Both a) and b) d) None of these
5) The thermo-electric effect was first observed by
   a) Seeback b) Thomas young
   c) Pirani d) Thermus
6) Which bridge is used to determine frequency ?
   a) Anderson bridge b) De Sauty's bridge
   c) Wein bridge d) Campell's bridge
7) The pH value of a solution is defined as
   a) –log (H^+ ion concentration) b) log (H^+ ion concentration)
   c) –log$^+$(H^+ ion concentration) d) –log (OH^- ion concentration)

P.T.O.

8) Which one of the following transducers require power supply for its operation ?

a) Thermocouple
b) Photovoltaic cell
c) Piezoelectric
d) Thermistor

B) Fill in gaps/state **true** or **false** : **6**

1) Thermistors have a high negative temperature coefficient of resistance.
2) In a pH meter, the glass electrode is the reference electrode.
3) In CRO mostly we use electro-magnetic deflection.
4) Strain is defined as _____ per unit length.
5) A neutral solution has a pH of _____
6) The resolution of a DVM with 4-digit display is _____

2. Attempt the following :

1) Explain the working of a Resistance Temperature Detector (RTD). **5**
2) Explain briefly working principle of a digital voltmeter. **5**
3) Write a note on Sample-Hold circuit. **4**

3. a) Explain the working principle of a D.C. amplifier. **8**
   b) Explain the working principle of a peak-detector. **6**

4. a) State the principle of operation of a dual slope digital voltmeter. **8**
   b) Write a short note on proximity detector. **6**

5. a) Explain basic principle and operation of logarithmic amplifier. **8**
   b) Draw and explain working of the precision half wave rectifier. **6**

6. a) With appropriate circuit diagram, outline the theory of Maxwell bridge for the measurement of an unknown inductance. **8**
   b) What is the basic principle of a Hall-effect transducer ? **6**

7. a) Briefly describe IEEE-488 interface standard. **8**
   b) Write a short note on Q-meter. **6**

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SLR-IK – 15

Seat No.	

M.Sc. (Part – II) (Semester – III) Examination, 2014
PHYSICS (Applied Electronics) (Paper – XI)
Communication Systems

Day and Date : Wednesday, 19-11-2014 Max. Marks : 70
Time : 3.00 p.m. to 6.00 p.m.

Instructions *: 1) Q.* ***1*** *and* ***2*** *are* ***compulsory****.*
2) Answer ***any three*** *questions from Q.* ***3*** *to Q.* ***7****.*
3) ***All*** *questions carry* ***equal*** *marks.*

1. Objective questions : **6**

a) Select alternatives :

1) What is FM modulation index (mf) for Fi = 30 Hz ?

a) 75 b) 500

c) 2500 d) 0.04

2) A unit ramp function is $\rho(t) = t$ when _____

a) $t < 0$ b) $t > 0$

c) $t \geq 0$ d) $t \leq 0$

3) Indicate which of the following pulse modulation system is analog ?

a) PCM b) Differential PCM

c) PWM d) Delta

4) In case of phase shift modulator, the message signal to each modulator is _____ in all respects except _____

a) not exact, exact b) exact, not exact

c) identical, magnitude d) identical, phase

P.T.O.

5) The AM signal can be detected using _____

a) Low pass filter b) High pass filter

c) Band pass filter d) All pass filter

6) Limiter is not essential in the following detector.

a) Foster-seely b) Balance slope

c) Ratio d) None

b) Fill in the blanks : **4**

1) In broadcast AM transmitter which type of modulation is used ?

(Low level / High level)

2) _____ shift keying is known as on off keying.

(Frequency / Amplitude)

3) In low level power modulation signal is amplified by _____ amplifier.

(Class B / Class C)

4) Indicate which at the following is not a binary code ?

(Morse / Baudat)

c) State **true** or **false** : **4**

1) Selectivity of a receiver is to separate on signal from others on closely adjacent frequency.

2) Theoretically an FM signal has infinite bandwidth.

3) The gain of a bipolar class A an amplifier can be varied by changing the collector current.

4) RC fitters are commonly used in SSB generation.

2. Answer in brief : **14**

1) Define sensitivity, selectivity and fidelity of a radio receiver. **4**

2) Explain cross talk in TDM. **5**

3) Explain synchronous detection of FSK signal. **5**

3. a) Draw the block diagram of High level AM transmitter and explain the function of each block in brief. **10**

   b) What is the role of limiter in FM receiver ? **4**

4. a) Draw the circuit diagram Foster-Seeley discriminator and explain its working. **10**

   b) Explain in brief frequency doublers. **4**

5. a) Explain in brief the principles used in time division multiplexing. **10**

   b) Explain delta modulation with its advantages and disadvantages. **4**

6. a) Specify the requirements of transmitter. Explain the different transmission modes with its suitable example.

   b) Compare : Half duplex and full duplex.

7. a) Describe PAM system using class D audio amplifier circuit with 20% duty cycle. **10**

   b) Explain sample hold circuit which will modify the PAM signal to flat – top PAM. **4**

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SLR-IK – 16

Seat No.	

M.Sc. (Part – II) (Semester – III) Examination, 2014
PHYSICS (Applied Electronics)
Atomic, Molecular and Nuclear Physics

Day and Date : Friday, 21-11-2014 Total Marks : 70
Time : 3.00 p.m. to 6.00 p.m.

***Instructions** : 1) Q. **(1)** and Q. **(2)** are **compulsory**.*
*2) Answer **any three** questions from Q. **(3)** to Q. **(7)**.*
*3) **All** questions carry **equal** marks.*

1. Objective questions : **14**

A) Choose/select correct alternative :

1) The values of the total angular momentum of single electrons are _____

i) $\frac{5}{2}, \frac{7}{2}$ ii) $\frac{3}{2}, \frac{5}{2}$ iii) $\frac{1}{2}, \frac{3}{2}$ iv) $0, \frac{1}{2}$

2) Multiplicity of state $^2d_{3/2}$ is given by _____

i) 1 ii) 2 iii) 3 iv) 4

3) Pure vibrational spectrum of diatomic molecule are when _____

i) it has a center of symmetry
ii) it has a permanent dipole moment
iii) it exhibit change in polarizability due to electronic transition
iv) it has no magnetic moments

4) Which one of the following molecules exhibit a vibrational absorption ?

i) H_2 ii) N_2 iii) O_2 iv) HCl

5) The spin and parity of $_4Be^9$ nucleus, as predicted by the shell model, are respectively

i) $\frac{3}{2}$ and odd ii) $\frac{1}{2}$ and odd iii) $\frac{3}{2}$ and even iv) $\frac{1}{2}$ and even

P.T.O.

6) The hyperfine structure of $Na(3^2p_{3/2})$ with nuclear moment $I = 3/2$ has,
   i) 1 state ii) 2 states iii) 3 states iv) 4 states

7) During a chemical reaction, proton number
   i) changes ii) remains same
   iii) changes and then is restored iv) changes alternately

8) The K, L and M shells of an atom are full. Its atomic number is _____
   i) 18 ii) 20 iii) 10 iv) 12

B) Solve and fill in gaps : **6**

i) Pune rotational spectra is observed in _____ region.

ii) The X-ray tube is operated on a potential difference of 20 kV. The maximum frequency of the radiation emitted is _____ Hz.

iii) The fundamental vibration frequency of HCl molecule is 2989 cm^{-1}. The force constant of HCl bond is _____ N/m.

iv) Rotational energy is inversely proportional to _____

v) The capacity of a sub-shell is given by _____

vi) The force between the two nucleons is charge dependent **(T/F)**.

2. A) Attempt **any two** : **10**

i) Differentiate between diatomic rotational spectra and polyatomic rotational spectra.

ii) What is rigid rotator ? Give the classification of rigid rotator molecules with examples.

iii) State and explain Paulis exclusion principle.

B) Write note on **any one** : **4**

i) Magic numbers

ii) Nuclear reactions.

3. i) Assuming deuteron inter-nucleon potential to be of rectangular well type, show that radius of deuteron is $\frac{2r_0}{\pi}\sqrt{\frac{V_0 - E_B}{E_B}}$. **7**

ii) Discuss normal and anomalous Zeeman effects in case of atomic spectra ? Show Zeeman spectra for $^3D_3$ level. **7**

4. A) Explain diatomic vibrating molecule as a harmonic oscillator. **8**

   B) What are the essential features of the liquid drop models ? Indicate what properties of the nucleus are well predicated by these models in brief. **6**

5. A) Write a note on pp-scattering at low energy. **7**

   B) What are nuclear forces ? Give their types with suitable examples. **7**

6. A) The position of the lines in fundamental band ($\nu = 0 \rightarrow \nu = 1$) of CO molecule is given by, $\bar{\nu} = 2143.3 + 3.813\ m - 0.0175\ m^2$ in cm^{-1}, $m = \pm 1, \pm 2, \pm 3, ...$ Calculate :

   a) Wave numbers of the first two lines in P and R branches,

   b) The values of B_0 and B_1

   c) The value of B_e if $\alpha_e = 0.018$,

   d) The equilibrium internuclear distance.
   (Given : reduced mass of CO molecule = 1.1385×10^{-26} kg). **8**

   B) Explain effective mass range theory. Discuss the spin dependence and charge independence of nuclear forces. **6**

7. A) What are different stages of nuclear reaction ? **6**

   B) Give a statistical account of nuclear reactions. **8**

SLR-IK – 17

Seat No.	

M.Sc. (Part – II) (Sem. – IV) Examination, 2014
PHYSICS (Appl. Elect.) (New)
Paper – XIII : Computational Methods and Programming

Day and Date : Saturday, 15-11-2014 Total Marks : 70

Time : 3.00 p.m. to 6.00 p.m.

Instructions *: 1) Attempt* ***five*** *questions.*

2) Q. ***1*** *and Q.* ***2*** *are* ***compulsory****.*

3) Attempt ***any three*** *questions from Q.* ***3*** *to Q.* ***7****.*

4) ***Use*** *of nonprogrammable calculator is* ***allowed****.*

1. A) Choose the correct alternative : **8**

i) A _____ analysis may be regarded as a process to develop and evaluate the methods for computing required mathematical numerical results from the given numerical data.

a) graphical b) statistical

c) numerical d) none of these

ii) A fitting of curve of type xy = b + ax, then normal equations are

a) $\sum\left(\frac{b}{x}+a\right)=na+b\sum\left(\frac{1}{x}\right),\ \sum\left(\left(\frac{1}{x}\right)\left(\frac{b}{x}+a\right)\right)=a\sum\left(\frac{1}{x}\right)+b\left(\sum\left(\frac{1}{x}\right)\right)^2$

b) $\sum\left(\frac{b}{x}-a\right)=na+b\sum\left(\frac{1}{x}\right),\ \sum\left(\left(\frac{1}{x}\right)\left(\frac{b}{x}-a\right)\right)=a\sum\left(\frac{1}{x}\right)+b\left(\sum\left(\frac{1}{x}\right)\right)^2$

c) $\sum\left(\frac{b}{x}+a\right)=na-b\sum\left(\frac{1}{x}\right),\ \sum\left(\left(\frac{1}{x}\right)\left(\frac{b}{x}+a\right)\right)=a\sum\left(\frac{1}{x}\right)-b\left(\sum\left(\frac{1}{x}\right)\right)^2$

d) none of these

P.T.O.

iii) The square root of 'a' can be considered a root of the equation, $x^2 - a = 0$, solvable by Newton's method, formula for this is

a) $x_{n+1} = \frac{1}{2}\left(x_n - \frac{a}{x_n}\right)$ b) $x_{n+1} = \frac{1}{2}\left(x_n + \frac{a}{x_n}\right)$

c) $x_{n+1} = \frac{1}{2}\left(x_n + \frac{x_n}{a}\right)$ d) none of these

iv) The _____ error is caused by replacing the tabulated function by means of an interpolating polynomial.

a) truncation b) rounding off

c) truncation and rounding off d) none of these

v) Errors involved in numerical calculation are _____ errors.

a) iterative b) approximation

c) rounding off d) all of these

vi) Regula-Falsi is _____ convergent while Newton's method is conditionally convergent.

a) rarely b) never c) surely d) conditionally

vii) $\Delta^n [x]^n =$ _____

a) $(n-1)!$ b) $(n+1)!$ c) $n!$ d) none of these

viii) The order of convergence of the _____ method is 1.618.

a) Bisection b) Regula Falsi

c) Iteration d) Newton-Raphson

B) Fill in the blanks/state **true** or **false** : **6**

i) A great advantage of Euler's method lies in the fact that if dy/dx changes rapidly over an interval, at the beginning it give a better approximation.

ii) The n^{th} divided differences of a polynomial of n^{th} degree are constant.

iii) Δ obeys distributive, commutative and index laws.

iv) $\Delta = E - 1$ or $E = 1 + \Delta$ where, E is _____

v) The process of finding the value of y corresponding to any value of $x = x_i$ between x_0 and x_n is called _____

vi) Putting n = 3 in general quadrature formula and taking the curve through limits as a polynomial of degree one so that differences of an order higher than one vanish, we get _____ formula.

2. Attempt following : **14**

i) Show that rate of convergence for Newton Raphson method is quadratic.

ii) Find a real root of the equation $x\log_{10}x = 1.2$ by Regula-Falsi method correct to four decimal places.

iii) What are the advantages of Monto-Carlo method in computational methods ?

3. A) Using Runge Kutta method, obtain a solution of the equation **10**

$$\frac{dy}{dx} = xy + \left|\sqrt{x}\right| = f(x, y)$$

with initial condition y = 1 at x = 0 for the range $0 \leq x \leq 0.3$ in steps of 0.1.

B) What is Pivoting ? When it done ? Explain. **4**

4. A) Write a algorithm for predictor-corrector method for solution of differential equation. **8**

B) Using Jocobi's iterative method solve following simultaneous equations : **6**
$-2x + 3y + z = 9$, $3x + 4y - 5z = 0$, $x - 2y + z = -4$.

5. A) For two random variables, x and y with the same mean, the two regression equations are **8**

$y = ax + b$ and $x = \alpha y + \beta$ show that $\frac{b}{\beta} = \frac{1-\alpha}{1-\beta}$.

B) Use the trapezoidal rule for 6 ordinates, and for 11 ordinates, to estimate the integral $\int_0^1 e^x \, dx$, correct to four decimal places and comment on the result. **6**

6. A) Construct the forward difference table, given that and point out the values of $\Delta^2 y_{10}$, $\Delta^4 y_5$. **6**

x	5	10	15	20	25	30
y	9962	9848	9659	9397	9063	8660

B) Show that : **8**

i) $\delta = \frac{1}{2}\left(E^{1/2} + E^{-1/2}\right)$

ii) $\mu = \frac{1}{2}\left(E^{1/2} + E^{-1/2}\right)$

iii) $E = e^{hD}$

iv) $\Delta = E - 1$.

7. A) Fit an equation of the form $y = ae^{bx}$ to the following data by the method of least squares. **6**

x	1	2	3	4
y	1.65	2.7	4.5	7.35

B) Using the Lagrange method of interpolation, find the unique polynomial P(x) of degree 2 such that :

P(1) = 1, P(3) = 27, P(4) = 64. **8**

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SLR-IK – 18

Seat No.	

M.Sc. (Part – II) (Semester – IV) Examination, 2014
PHYSICS (Applied Electronics) (Paper – XIII) (Old)
Computational Methods and Programming

Day and Date : Saturday, 15-11-2014 Total Marks : 70
Time : 3.00 p.m. to 6.00 p.m.

Instructions *: 1) Attempt in* ***all five*** *questions.*
2) Q. ***1*** *and Q.* ***2*** *are* ***compulsory****.*
3) Attempt ***any three*** *questions from Q.* ***3*** *to Q.* ***7****.*

1. A) Choose the correct alternative : **8**

i) If the stability factor is $g = 1 - j\omega\delta t$, the stability condition is _____

a) $1 - \delta t^2\omega^2 \le 1$ b) $1 + \delta t^2\omega^2 \le 1$

c) $1 - \delta t^2\omega^2 \ge 1$ d) $1 + \delta t^2\omega^2 \ge 1$

ii) The equation $\frac{dy}{dt} + 10y = 0$ represents an equation of _____

a) Exponential decay b) Exponential growth
c) Oscillations d) None above

iii) Damped harmonic oscillator obeys differential equation of the form _____

a) $a\frac{d^2y}{dx^2} - b\frac{dy}{dx} + cy = 0$ b) $a\frac{d^2y}{dx^2} - b\frac{dy}{dx} - cy = 0$

c) $a\frac{d^2y}{dx^2} + b\frac{dy}{dx} + cy = 0$ d) None of these

iv) Schmidt explicit formula is valid for _____

a) Any value of α b) $0 < \alpha \le 1$

c) $0 < \alpha \le 1/2$ d) None of the above

P.T.O.

v) It matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 2 & 5 \\ 0 & 0 & 3 \end{bmatrix}$ then the eigen values of A^{-1} are _____,

_____, _____

a) 1, $^1/_2$, 1/3 b) 1, 2, 3

c) 2, $^1/_2$, 3 d) 1, 3, 1/2

vi) In solving simultaneous equation by Gauss Jordon method the coefficient matrix is reduced to _____ form.

a) null b) diagonal

c) square d) hermitian

vii) If K = 75, the maximum value generated by the random function random (K) will be _____

a) 75 b) 76

c) 74 d) 750

viii) Which of the following equation is parabolic ?

a) $f_{xy} - f_x = 0$ b) $f_{xx} + 2f_{xy} + f_{yy} = 0$

c) $f_{xx} + 2f_{xy} + 4f_{yy} = 0$ d) None of the above

B) Fill in blanks/State **True** or **False** : **6**

i) For Gaussian elimination step, the time taken to solve N equations in N unknowns is proportional to _____

ii) Methods which generate random number depend on a _____ sequence.

iii) A matrix with $A_i, i \neq 0$ and $A_i, i \pm 1 \neq 0$ is known as _____

iv) The eigen value of a skew symmetric matrix are real.

v) Truncation error in simple algorithm method is second order in time but third order in space.

vi) To use Adam's Bashforth predictor-corrector method at least four values of y, prior to the desired value are required.

2. Attempt following : **14**

i) How Monte-Carlo method could be used to determine an average value of a statistic f(x) ?

ii) Write short note on the Leap-Frog method.

iii) Determine first four values for the equation.

$\frac{dy}{dt} + 10y = 0$; Given $y_0 = 1$.

3. a) Express general form of first order ODE and solution y(t). What do you mean by boundary conditions. Thus explain Runga-Kutta to numerically solve the ODE. **10**

   b) Discuss properties of pseudo random number series ; $X_{n+1} = \frac{X_n x a}{b}$. **4**

4. a) Discuss Euler's method to obtain solution of ordinary differential equation and write its algorithm. **10**

   b) Write an algorithm to find inverse of a matrix. **4**

5. a) What do you mean by itterative method for solving the matrix equation

   Ax = b ?

   Explain the Gauss-Seidal Method. **10**

   b) How the Jacobi method is implemented by Gauss-Seidel method ? **4**

6. a) Obtain solution of Laplace equation $\nabla^2 u = 0$ using finite difference approximation. **10**

   b) Explain Eulerian and Langragian method. **4**

7. a) Determine X_1 to X_6 of a pseudo random numbers series.

   Given : $X_1 = 1$, a = 13, b = 5. **6**

   b) Using Gauss-Elimination method solve following set of simultaneous equations;

   $3x_1 - 0.1x_2 - 0.2x_3 = 7.85$

   $0.1x_1 + 7x_2 - 0.3x_3 = -19.3$

   $0.3x_1 - 0.2x_2 + 10x_3 = 71.4$ **8**

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SLR-IK – 19

Seat No.	

M.Sc. – II (Semester – IV) Examination, 2014
PHYSICS (Applied Electronics) (Paper – XIV)
Micro Electronics

Day and Date : Tuesday, 18-11-2014 Total Marks : 70

Time : 3.00 p.m. to 6.00 p.m.

***Instructions** : 1) Attempt **any five** questions.*
*2) Q. **1** and Q. **2** are **compulsory**.*
*3) Attempt **any three** questions from Q. **3** – Q. **7**.*
*4) Figures to the **right** indicate **full** marks.*
*5) **Use** of non-programmable calculator is **allowed**.*

1. Choose the correct alternative : **14**

i) The disadvantage of pn-junction isolation is _____

a) smaller isolation time b) effective diffusion

c) parasitic diffusion d) parasitic capacitance

ii) Buried layer fabrication is an essential condition for the fabrication of _____

a) diode b) capacitor

c) transistor d) resistor

iii) _____ photoresist is specially developed for LSI and VLSI applications.

a) Iso fine Kodak – 820

b) Kodak micropositive – 820

c) Hunt Way HPR – 256

d) Novolac

iv) Ion implantation energy is of the order of _____

a) very large b) very small

c) several KeV to MeV d) few KeV to MeV

P.T.O.

v) The most modern high frequency transistors are fabricated by _____ only.

a) Diffusion b) Epitaxy

c) Combination of a) and b) d) Subsequent processes

vi) Etch attacks are preferentially faster on a _____ oriented silicon.

a) (110) b) (100) c) (111) d) (101)

vii) The laws of diffusion are derived especially for _____ diffusion.

a) Substitutional b) Interstitial

c) Combinational d) Interchange

viii) In the zone process, the length of a typical zone is _____ cm.

a) 15 cm b) 0.15 cm

c) 0.015 cm d) 1.5 cm

ix) Base diffusion in transistors is usually carried out by _____ source diffusion.

a) constant b) instantaneous

c) both a) and b) d) subsequent diffusion

x) Czochalarski technique works on the principle of _____

a) controlled freezing b) controlled heating

c) controlled polymerization d) controlled oxidation

xi) Boron has a diffusion coefficient of _____ cm^2/sec.

a) 10^{-12} b) 10^5 c) 10^8 d) 10^{-8}

xii) Snow – Plow is due to diffusion of _____ into silicon.

a) Boron b) Phosphorus

c) Arsenic d) Indium

xiii) Silicon oxide layer acts as a _____ electrode in MOS devices.

a) drain b) source

c) shield d) gate

xiv) Planar diodes are generally _____ adopted for the operation.

a) simple diodes b) thyristors

c) transistors d) capacitors

2. Write a short note on **any three** : **14**
   a) Ion implantation
   b) Fabrication of diffused resistors
   c) Ficks 2nd law of diffusion
   d) Show that (111) plane in silicon is closest of all.

3. a) Discuss the various steps in the fabrication of a standard IC. **10**
   b) Compare CMOS with that of the bipolar technology. **4**

4. a) Write a note on fabrication of an n ϕ n-transistor (monolithic) referred to impurity profile. **8**
   b) Explain how does the integrated transistor differ from the discrete. **6**

5. a) Discuss the various growth conditions and parameters for the fabrication of an epitaxial layer. **10**
   b) What is a thin film resistor ? **4**

6. a) Give a brief account of substitutional diffusion. **8**
   b) Write a note on oxide formation. **6**

7. Attempt the following : **14**
   a) What is redistribution during growth ? **5**
   b) Evaluation of an epilayer. **5**
   c) Mention the characteristics of a good photoresist. **4**

SLR-IK – 20

Seat No.	

M.Sc. – II (Semester – IV) Examination, 2014
PHYSICS (Appl. Electronics)
Paper – XV : Microwave Engineering

Day and Date : Thursday, 20-11-2014 Total Marks : 70
Time : 3.00 p.m. to 6.00 p.m.

Instructions *: 1) Q.* ***1*** *and Q.* ***2*** *are* ***compulsory****.*
2) Answer ***any three*** *questions from Q.* ***3*** *to Q.* ***7****.*
3) ***All*** *questions carry* ***equal*** *marks.*
4) Figures to the ***right*** *indicate* ***full*** *marks.*
5) ***Use*** *of non programmable calculator is* ***allowed****.*

1. Objective Questions : **14**

a) Select correct alternatives : **6**

1) Both electric and magnetic fields are purely transverse to the direction of propagation is called as

a) TE waves b) TM waves
c) TEM waves d) HE waves

2) If E_z is not equal to 0, H_z is equal to 0, then it is referred as

a) TE waves b) TM waves
c) HE waves d) None of these

3) The insertion loss is contributed by

a) Mismatching loss at the input
b) Match between input and output
c) Matched at load resistance
d) Matched at input resistance

4) Principal mode of propagation in a coaxial line is _____ mode.

a) TEM b) TE
c) TM d) Quasi TEM

P.T.O.

5) The frequency is greater than 100MHz cannot be used in conventional microwave tubes because
   a) Increases the bandwidth
   b) Load resistance effect
   c) Loading effect at input side
   d) Transit time effect

6) The passive elements used to limit the amount of microwave power transferred from one point to another on a transmission line is called as
   a) Isolator b) Phase shifter
   c) Attenuator d) None of these

b) State **True** or **False**/**Justify**/**One line** answer : **8**

i) As frequency increases, directivity increases and bandwidth decreases. Hence the beam width of radiation θ is proportional to λ/D.
True/False

ii) Neither electric nor magnetic fields are transverse to the direction of propagation is referred as TE waves.
True/False

iii) Single cavity Reflex Klystron can be used as local oscillator in microwave receivers.
True/False

iv) Magnetrons are providing of microwave oscillations of very high peak power.
True/False

v) The frequency range is used for microstrip-line is 50GHz-100GHz.
True/False

vi) TEM wave are cannot exist in rectangular waveguide.
True/False

vii) The short circuit termination produces an adjustable reactive load at the desired point on a microwave line.
True/False

viii) The passive elements are used to control the amount of microwave power transferred from one point to another on a transmission line is called microwave isolators.
True/False

2. Write short notes :

   i) Field pattern of TE wave. **5**

   ii) Prove that the components if E-field parallel to the interface are continuous across the boundary. **5**

   iii) Attenuators and phase shifters. **4**

3. a) Derive the wave equation with the help of Maxwell's equations. **8**

   b) Discuss wave polarization. **6**

4. a) With the help of neat sketch, explain the operation of TWT. **10**

   b) Explain the operation of Reflex Klystron with the help of apple gate diagram ? **4**

5. a) Derive the equation for low-loss in a co-axial line. **10**

   b) What are the planar transmission line and explain with necessary diagram. **4**

6. a) Discuss coaxial and stripline attenuation. **10**

   b) Explain standard co-axial connectors. **4**

7. a) What are the different types of microwave devices used in Faraday rotation ? **10**

   b) Discuss briefly the wave guide phase shifters. **4**

SLR-IK – 21

Seat No.	

M.Sc. (Part – II) (Sem. – IV) Examination, 2014
PHYSICS (Applied Electronics)
Paper – XVI : Microprocessor and Interfacing

Day and Date : Saturday, 22-11-2014 Total Marks : 70
Time : 3.00 p.m. to 6.00 p.m.

***Instructions** : 1) Q. **(1)** and **(2)** are **compulsory**.*
*2) Answer **any three** questions from Q. **3** to Q. **7**.*
*3) **All** questions carry **equal** marks.*

1. Objective Questions : **14**

A) Choose correct alternative : **8**

1) The 4-bit D/A converter has _____ possible combinations.
   a) 8 b) 2
   c) 4 d) 16

2) When the 8085 system reset, all the interrupts are disabled except _____
   a) TRAP b) RST 7.5
   c) INTR d) RST 6.5

3) _____ is used commonly to implement and extend the capacity of the 8085 interrupt.
   a) 8279 b) 8259
   c) 8253 d) 8255

4) The _____ includes status read back command that can latch the count and the status of the counter.
   a) 8279 b) 8259
   c) 8254 d) 8255

5) 74LS373 is a _____
   a) Latch b) Buffer
   c) Counter d) Decoder

6) Priority Encoder is used in _____ type ADC.
   a) Integrator b) Flash
   c) Ramp d) Dual Slope
7) The Higher Address bus of 8085 is _____
   a) Unidirectional b) Non-directional
   c) Bidirectional d) All of these
8) The _____ capacitor is used in 8085 system to drive the clock inputs.
   a) 20 pF b) 25 pF
   c) 15 pF d) 16 pF

B) State **True** or **False** : **6**

1) In mode 0 of 8255 outputs are latched only.
2) The 8279 is 20 pin devices.
3) IC 74LS138 is 3 : 8 decoder.
4) DI (Disable Interrupt) is a 1-Byte instruction.
5) In 8085, the call instruction require 28-T states.
6) Dual slope ADC is the fastest type ADC.

2. Attempt the following : **14**
   a) Write a short note on 74LS373 latch.
   b) What is an interrupt ? Why it is used ?
   c) With a neat diagram explain working of Weighted Resistor D/A Converter.

3. a) Give a brief overview of 8085 interrupt system. **8**
   b) Explain interfacing of 8259A with 8085. **6**

4. a) With a neat diagram explain features of IC 8255A. **8**
   b) Write a program to read Port A of 8255A and write the result to Port B. **6**

5. a) With a neat block diagram explain the working of IC 8253. **8**
   b) Explain the operating modes of IC8253. **6**

6. a) Explain interfacing of Keyboard with 8085 via IC 8279. **10**
   b) Explain 8279 Commands. **4**

7. a) Explain the system design using IC 1408 and 8085 to generate triangular wave. **8**
   b) With a neat diagram explain Successive Approximation ADC. **6**

_____