SLR-IVR – 8

Seat No.	

M.Sc. (Part – II) (Semester – III) Examination, 2014
PHYSICS (Applied Electronics)
Paper No. – XII : Atomic, Molecular and Nuclear Physics

Day and Date : Tuesday, 11-2-2014 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/select correct alternatives :

1) Hund's rule applies to
   i) LS – coupling scheme ii) jj-coupling scheme
   iii) Both coupling schemes iv) None of these

2) Two electron spectra always show
   i) singlets and doublets ii) doublets and triplets
   iii) singlets and triplets iv) all of these

3) Energy of diatomic rigid rotator molecules is
   i) $B\,J\,(J+1)$ ii) $B\,J\,(J+1)^2$
   iii) $B\,J^2\,(J+1)$ iv) $B\,J^2\,(J+1)^2$

4) A potential energy of anharmonic oscillator is given by _____

   i) $E = D_{eq}\left[1-\exp\{a\,(r_{eq}-r)^2\}\right]$

   ii) $E = D_{eq}\left[1-\exp\{a\,(r_{eq}-r)\}\right]$

   iii) $E = D_{eq}\left[1-\exp\{a^2\,(r_{eq}-r)\}\right]$

   iv) $E = D_{eq}\left[1-\exp\{a\,(r_{eq}-r)\}\right]^2$

P.T.O.

5) Which of the following does not obey inverse square law force ?
   i) electrostatic force
   ii) magnetic force between two poles
   iii) gravitational force
   iv) nuclear force

6) Exchange of π meson (a particle of non-zero rest mass) by nucleons satisfies the _____ nature of nuclear forces.
   i) short range ii) long range
   iii) both range iv) average range

7) A constant mass density and constant value of binding energy per nucleon, are the properties of _____
   i) shell model
   ii) liquid drop model
   iii) fermi gas model
   iv) extreme single particle model

8) When hydrogen atom loses an electron it becomes _____
   i) proton ii) position
   iii) a positively charged nucleus iv) neutron

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

i) The Rutherford scattering experiment may not be called a nuclear reaction, because the incident particle does not encounter the _____

ii) The nuclear process in which one or more particles may be liberated when the target nucleus absorbs γ-ray is called _____

iii) Splitting of spectral line into several components is called _____ effect.

iv) The effect of incidence of x-rays on matter is emission of _____ and _____ spectra.

v) It would be found that the total mass of the atom is less than the sum of the masses of the individual protons and neutrons. This difference in mass is known as the _____

vi) Hyperfine structure is due to interaction of _____ with nucleus.

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

   i) Differentiate between fine spectra and hyperfine spectra.

   ii) Show that the energy change for non-rigid rotator during transition $J \rightarrow J + 1$ is given by,

   $$\bar{\nu}_J = \varepsilon_{J+1} - \varepsilon_J = 2B(J+1) - 4D\,(J+1)^3\,cm^{-1}.$$

   iii) Write a note on disintegration of compound nucleus.

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

   i) Shell model ii) Types of nuclear reactions.

3. i) A deuteron of mass M and binding energy B ($B << Mc^2$) is disintegrated into a neutron and proton by a gamma ray of energy E_γ. Find, to lowest order in B/Mc^2, the minimum values of $(E_\gamma - B)$ for which the reaction can occur. **7**

   ii) Explain the following statements on the basis of physical principles :

   a) The motion of individual nucleons inside a nucleus may be regarded as independent from each other even though they interact very strongly. **7**

   b) All the even-even nuclei have 0^+ ground state.

4. A) What are the essential features of the liquid-drop model ? Indicate what properties of the nucleus are well predicted by this model, and how the model is applied ? **10**

   B) Write a note on superconductivity model. **4**

5. A) Explain various laws of conservation during nuclear reactions with suitable examples. **7**

   B) Discuss origin of spectral lines, selection rules in case of two electron spectra. **7**

6. A) What is vibrating rotator ? Show that in case of vibrating diatomic molecule as anharmonic oscillator spectra, P and R branches are found. **7**

   B) What is scattering ? Explain proton-proton and neutron-neutron scattering. Write similarities between both types of forces. **7**

7. A) Explain single particle model referred to spin-orbit potential. **8**

   B) Differentiate between rigid rotational spectra and non-rigid rotational spectra. **6**

SLR-VI – 1

Seat No.	

M.Sc. (Part – I) (Semester – I) Examination, 2014
PHYSICS (Applied Electronics)
Mathematical Techniques (Paper – I)

Day and Date : Monday, 21-4-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 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. A) Select the correct alternative : **8**

1) If the eigen values of a 3×3 matrix A are 2, 5, 6 then, the eigen values of A^2 are _____

a) 2, 5, 6 b) 4, 5, 6 c) 2, 25, 6 d) 4, 25, 36

2) $L^{-1}\left\{\frac{1}{(s-3)^2+16}\right\} =$ _____

a) $\frac{e^{3t}}{4}\sin 4t$ b) $\frac{e^{-3t}}{4}\sin 4t$ c) $e^{3t}\cos 4t$ d) $e^{-3t}\cos 4t$

3) The function f(z) = (x + ay) + i (bx + cy) is analytic if , _____

a) a = 1, b = 2, c = 3 b) a = – b, c = 1
c) a = b = c = 1 d) None of these

4) The conditions for expansion of a function in a Fourier series are known as _____

a) Harmonic b) Riemann conditions
c) Periodic d) Dirichlets conditions

P.T.O.

5) If f(z) is analytic and its partial derivatives are continuous throughout some simply connected region, then for every closed path C within this region $\oint_C f(z)\,dz =$ _____

a) $2\pi i$ b) 1 c) – 1 d) 0

6) The differential equation M(x, y) dx + N(x, y) dy = 0 is exact if _____

a) $\frac{\partial M}{\partial y} \neq \frac{\partial N}{\partial x}$ b) $\frac{\partial M}{\partial x} \neq \frac{\partial N}{\partial y}$ c) $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$ d) $\frac{\partial M}{\partial x} = \frac{\partial N}{\partial y}$

7) L { cos3t} = _____

a) $\frac{3}{S^2+9}$ b) $\frac{S}{S^2+9}$ c) $\frac{3}{S^2-9}$ d) $\frac{S}{S^2-9}$

8) Gaussian distribution function is given by

a) e^{ix^2} b) $Ne^{-\alpha x^2}$ c) $\cos \alpha x$ d) $\sin \alpha x$

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

1) If zero is one of the eigen value of matrix A, then A is singular.

2) $\frac{1}{(S+1)^2}$ is the Laplace transform of te^{-t}.

3) A function ϕ (x, y) having continuous partial derivatives of the first and second order is called harmonic function if $\nabla^2\phi \neq 0$.

4) If the complex Fourier transform of f(x) is F(s), then the complex Fourier transform of $f(x/2)$ is $\frac{1}{2}$ F(2s.)

5) The set of all solutions of an n^{th} order linear homogeneous differential equation forms an n-dimensional vector space.

6) A vector space is said to be n-dimensional if it contains precisely n linearly independent vectors.

2. Write short notes on :

   a) Properties of matrices **4**

   b) Cauchy integral formula **5**

   c) Types of homogeneous and non-homogeneous differential equations. **5**

3. a) Find Fourier series to represent $f(x) = |\sin x|$ for $-\pi \leq x \leq \pi$. **8**

   b) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 1 & 0 \\ 2 & -1 \end{bmatrix}$. **6**

4. a) Using Laplace transform solve **8**

   $(D^2 + D - 2)\, x = 2\,(1 + t - t^2)$, given that $x = 0$, $Dx = 3$, for $t = 0$.

   b) Show that $u = e^x \cos y$ is harmonic and find the corresponding conjugate function. **6**

5. a) The vertical motion of a particle of mass m on a spring with spring constant K is described by the following differential equation $my'' = -ky + mg$ with $y(0) = y_0$ and $y'(0) = 0$. Solve this equation for the position of the particle as a function of time. **8**

   b) Using Parsevals identity, prove that **6**

$$\int_0^{\infty} \frac{dt}{(p^2+t^2)\,(q^2+t^2)} = \frac{\pi}{2pq\,(p+q)}$$

6. a) Solve $x\,(x^2 + 2y^2)\,dx + y\,(2x^2 + y^2)\,dy = 0$. **6**

   b) Find the Fourier transform, F(k) of the Gaussian distribution function, $f(x) = Ne^{-\alpha x^2}$, where N and α are constants. **8**

7. a) Classify the singularities and calculate the residue for **8**

   $f(z) = \frac{1}{(z^2+a^2)^2}$ (where $a > 0$).

   b) Find the inverse Laplace transform of $\frac{2s^2 - 6s + 5}{s^3 - 6s^2 + 11s - 6}$ **6**

SLR-VI – 10

Seat No.	

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

Day and Date : Wednesday, 23-4-2014 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) The type R thermocouple is formed using
   a) Pt/Pt – Rh b) Iron-Constantan
   c) Copper-Constantan d) Chromel-Alumel

2) Slew rate of IC 741 Op amp _____ microvolt/sec.
   a) 0.6 b) 0.3 c) 0.4 d) 0.5

3) _____ governs phenomena of thermocouple.
   a) Seeback coefficient
   b) Principle of induced emf (Where T is stress)
   c) D = dt
   d) Coulomb force

4) Isolation amplifier is used to isolate _____
   a) Control circuit and load circuit
   b) Load and load circuit
   c) Error voltage and control circuit
   d) Voltage and circuit

P.T.O.

5) _____ is unit of Torque.

a) Newton b) Newton-m^{-2}

c) Newton meter d) Erg

6) Hall probe is used for detection of _____

a) Electric field b) Magnetic field

c) AC current d) DC current

7) Platinum RTD can be used for measuring a temperature unto _____ °C.

a) 250 b) 500 c) 1000 d) 1500

8) Gain of instrumentation amplifier is defined as _____

a) 1 + 2R / RG b) 1 + R1 / R2

c) (1 + 2R1 / RG) (Rf / R1) d) None above

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

1) A photoconductive cell is a _____ transducer.

2) Tacho generator works as _____

3) The operating temperature range of Fe-CN thermocouple is _____

4) RS 232 is a serial communication interface bus.

5) Input is coupled through R = 1 network to DC Amplifier.

6) PH meter is basically a mV – meter.

2. Attempt following : **14**

1) Write a note on S-H circuit. **5**

2) Write a short note on IEEE 488 instrumentation bus. **5**

3) Explain precision half wave rectifier. **4**

3. a) Explain construction and working of circuit and interface for measurement of current DCM. **8**

   b) Calculate Q for A parallel R-C circuit with R = 10 MΩ , C = 100 pf and ω = 1 kHz. **6**

4. a) How differentiator is used to convert angular speed to acceleration consider example of dc tacho generator for measurement of speed / RPM ? **8**

   b) Draw and explain working of the F to V converter. **6**

5. a) Explain construction and working bridge circuit and interface for measurement C using lock in analyzer. **8**

   b) Explain basic principle and interface of Piezoelectric crystal. **6**

6. a) Explain basic principle and interface of PH meter. **8**

   b) What is a DC amplifier and discuss its frequency response ? **6**

7. a) Describe piezoelectric transducer as a voltage to strain converter. **8**

   b) Explain construction and working bridge circuit and interface for measurement of R. **6**

SLR-VI – 11

Seat No.	

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

Day and Date : Friday, 25-4-2014 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 : **6**

a) Select alternatives :

1) Figure of merit is always unity in _____

a) SSB-SC b) AM c) FM d) All the three

2) Each FM station is allowed with _____ deviation.

a) 70 KHz b) 77 KHz c) 73 KHz d) 75 KHz

3) The mixer uses a _____ circuit to combine the RF and oscillator signal.

a) Liner b) Non-linear c) Detector d) None of the above

4) In delta modulation, the output of modulator is applied to an integrator and compared in a _____ amplifier.

a) R – C b) b – c c) Difference d) None of these

5) Determine the percentage of modulation if Max. peak amplitude is 125 V and Min. peak amplitude is 35 V.

a) 56% b) 50% c) 65% d) 60%

6) The bandwidth required for A.M. is _____ the frequency of the modulating signal.

a) Three times b) Four times c) Half d) Two times

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

1) If the PLL input is zero the VCO will operate at it's _____ frequency. (Free running/locked)

2) The intermediate frequency of every radio receiver will be the _____ (Same/different)

3) State which characteristics of a PWM change with modulation. (Phase/duty cycle)

4) PPM is obtained from _____ (PAM/PWM)

c) State **True** or **False** : **4**

1) The diode modulator circuit does not provide amplifications.

2) FM receiver can function with a lower sensitivity.

3) Most TDM systems used today use PCM to transmit analog signal.

4) An AGC circuit corrects for frequency drift in the local oscillator circuit.

2. Answer in brief : **14**

1) Explain phase shift method to generate SSB. **5**

2) State Shannon's sampling theorem. **5**

3) Draw the basic block diagram of high level A.M. transmitter. **4**

3. a) Explain the pulse width modulation scheme with an appropriate circuit, mentioning the waveforms at different stages. **10**

b) Explain in brief quantization of signals. **4**

4. a) Explain the working of reactance modulator used in FM transmitter. **10**

   b) Explain ASK with suitable binary signals. **4**

5. a) Define amplitude modulation. Derive the relationship between the total transmitted power and carrier power in an AM system. **10**

   b) Compare AM and FM. **4**

6. a) Explain the working of PLL as a FM detector. **10**

   b) Using PLL block diagram, explain the various possible states of operation. **4**

7. a) Explain quantization for a PCM signals transmission. **10**

   b) Explain natural and flat-top sampling. **4**

SLR-VI – 12A

Seat No.	

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

Day and Date : Monday, 28-4-2014 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 alternatives.

1) In Zeeman effect, a spectral line, upon the application of magnetic field, splits into more than three components because of
   i) energy level split into 2J + 1 components
   ii) in magnetic field $\Delta M_J = 0, \pm 1$ no longer holds
   iii) variation of Lande factor 'g' from one level to another
   iv) none of the above

2) For the single electron system
   i) all the energy levels are singlet
   ii) all the energy levels are doublets
   iii) the ground state is singlet and all the other energy levels are doublets
   iv) the ground state is singlet and all the other energy levels are multistates

3) Energy of diatomic harmonic oscillator is

   i) $\varepsilon_v = \left(v + \frac{1}{2}\right)\bar{\nu}$ ii) $\varepsilon_v = \left(v + \frac{1}{2}\right)^2 \bar{\nu}$

   iii) $\varepsilon_v = \left(v + \frac{1}{2}\right)\bar{\nu}^2$ iv) $\varepsilon_v = \left(v^2 + \frac{1}{2}\right)\bar{\nu}$

4) Which one of the following molecules does not exhibit a rotational spectrum ?
   i) H_2 ii) CO
   iii) HCl iv) HBr

P.T.O.

5) According to shell model of the nucleus which is incorrect ?
   i) Magic numbers exist
   ii) Nucleons interact with their nearest neighbours only
   iii) Nucleons in a nucleus interact with general force field
   iv) Large electronic quadruple moment exists for certain nuclei

6) Consider the (1) nuclear, (2) electromagnetic, (3) weak and (4) gravitational forces. Correct sequence of these forces in order of increasing values of their magnitude is
   i) 4, 3, 1, 2 ii) 4, 3, 2, 1
   iii) 3, 4, 2, 1 iv) 3, 4, 1, 2

7) During a chemical reaction, atomic number _____
   i) Changes
   ii) Remains same
   iii) Changes and then is restored
   iv) Changes alternately

8) A photon has the properties except
   i) zero intrinsic angular momentum
   ii) its momentum is hv/c
   iii) its total energy is kinetic
   iv) it has zero rest mass

B) Solve and fill in gaps :
   i) The rotational energy levels are _____ spaced.
   ii) The short wavelength cut-off of the continuous X-ray spectrum from a nickel target is 0.0825 nm. The voltage required to be applied on an X-ray tube is _____
   iii) For CO molecule intermolecular distance r = 1.128 Å, then moment of inertia
   of CO is _____
   iv) The multiplicity of the energy level is given by (2S + 1). (T/F)
   v) Protons can be easily made monoenergetic. (T/F)
   vi) In case of Majorona force, there is an exchange of position co-ordinate. (T/F)

2. A) Attempt **any two** : **10**
   i) Differentiate between harmonic vibrational spectra and anharmonic vibrational spectra.
   ii) Show that the in vibration rotation spectra R branch is more closely spaced while P branch is widely spaced.
   iii) What is an individual particle model ?

   B) Write note on **any one** : **4**
   i) Single particle model
   ii) Conservation laws in 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) Define nuclear cross section. Derive an expression for number of surviving particles, if number of particles are incident on slab of certain area. **7**

4. A) Obtain Breit Wigner dispersion formula for single resonance level. **10**

   B) What are the essential features of the nuclear model ? Indicate what properties of the nucleus are well predicated by these models in brief. **4**

5. A) What are nuclear shock waves ? **6**

   B) Discuss Zeeman effect in case of atomic spectra. What is importance of this effect ? **8**

6. A) Explain effective mass range theory. Discuss the spin dependence and charge independence of nuclear forces. **8**

   B) Explain rotation spectra of polyatomic molecules with suitable example. **6**

7. A) Explain the compound nucleus reactions and different stages of nuclear reactions. **10**

   B) Derive an expression for interaction energy of one electron with nucleus. **4**

SLR-VI – 12B

Seat No.	

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

Day and Date : Monday, 28-4-2014 Total Marks : 70
Time : 3.00 p.m. to 6.00 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.*

1. A) Choose correct alternative : **6**

1) The energy of interaction between a magnetic moment μ and applied magnetic field H is given by _____
   a) μ .H b) $\mu \times H$ c) μ / H d) $(\mu H)^2$

2) Alpha decay is _____
   a) Emission of He nucleus b) Emission of gamma ray
   c) Emission of an electron d) emission of proton

3) What does the mass defect stands for
   a) The nucleus weighs less than the sum of the individual protons and neutrons it is composed off
   b) The mass of Uranium is smaller than of iron
   c) It is the missing term in semi empirical mass formula
   d) It is defect in the structure of atom

4) Parity non conservation was established in beta decay when it was observed that from polarized CO^{60} nuclei _____
   a) electrons were emitted equally in all directions
   b) more electrons were emitted in direction opposite to that of magnetic field
   c) more electrons were emitted perpendicular to the direction of magnetic field
   d) electrons were not emitted in any direction

P.T.O.

5) The ratio of the nuclear radius of $_{52}Te^{125}$ to that of $_{13}Al^{27}$ is

a) 4 b) 125/17 c) 1/4 d) 5/3

6) When E exceeds 10^7 V/m the spacing between the line becomes proportional to E^2 and this is called _____

a) Second order Stark Effect b) Normal Zeeman Effect

c) Anomalous Zeeman Effect d) First order Stark Effect

B) State **true** or **false /** Fill in the blanks /Single sentence answer : **8**

1) The Zeeman effect is the breaking of degeneracy in atomic energy levels due to the interaction between the magnetic moment of an atom and an external magnetic field. State true or false.

2) Complete the nuclear reaction

$_1H^1 + _{13}Al^{27} =$ _____ $= _{14}Si^{28} +$ _____

3) _____ is most massive particle.

4) When an electron and positron annihilates one new _____ is generated ?

5) State three important properties of neutrino.

6) Write a reaction of type Photo disintegration.

7) Rotational spectra are obtained in the microwave region. State true or false.

8) Q term has greatest effect on the life time of alpha radioactive nucleus. State true or false.

2. Write short notes on : **14**

1) Discuss few reasons for the failure of proton electron hypothesis.

2) Discuss the merits and demerits of liquid drop model.

3) Explain the charge independence and charge symmetry of nuclear forces.

3. A) Discuss various coupling schemes of two electron vector atom model. Derive an expression for interaction energy in L-S coupling. **10**

   B) What are quantum numbers for the complete atoms ? Give their physical significance. **4**

4. A) What are magic numbers ? How does the shell model explain the existence of magic numbers and other nuclear properties. **10**

   B) What is fine structure ? Explain fine structure in alkali elements. **4**

5. A) Discuss the phenomenon of nucleon-nucleon scattering. Explain the neutron-proton scattering at low energy. **10**

   B) Explain the phenomenon of internal conversion with an example. **4**

6. A) What is beta decay ? Explain the necessity of the neutrino hypothesis in beta decay. **10**

   B) Explain Hund's rule with few examples. **4**

7. A) Explain the magnetic moments and Schmidt lines. Discuss collective model of Bohr and Mottelson. **10**

   B) Explain the spin dependence of nuclear force. **4**

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SLR-VI – 13

Seat No.	

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

Day and Date : Tuesday, 22-4-2014 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) $y_1 = y_0 + \frac{h}{24}(9f_1 - 19f_0 - f_{-1} + f_{-2})$ is _____

a) Milne's predictor formula
b) Adam's predictor formula
c) Milne's corrector formula
d) Adam's corrector formula

ii) In solving simultaneous equation by Gauss elimination method, the coefficient matrix is reduced to _____

a) Lower triangular form b) Upper triangular form
c) Diagonal form d) None of the above

iii) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f(x, y)$ is known as _____

a) Laplace equation b) Poisson's equation
c) Heat equation d) None of the above

iv) The solution of any ordinary differential equation in 'n' unknowns can be written as _____

a) $y(t) = y(t_0) - \int_{t_0}^{t} f[y(t'), t']dt'$ b) $y(t) = y(t_0) + \int_{t_0}^{t} f[y(t'), t']dt'$

c) $y(t_0) = y(t) - \int_{t_0}^{t} f[y(t'), t']dt'$ d) $y(t_0) = y(t) + \int_{t_0}^{t} f[y(t'), t']dt'$

P.T.O.

v) Square matrix is called orthogonal if _____

a) $A = A^2$ b) $A^1 = A^{-1}$

c) $AA^{-1} = I$ d) None of the above

vi) $\frac{dy}{dt} \pm i\omega y = 0$ is the oscillation equation with solution _____

a) $y = y_0 \exp(-i\omega t)$ b) $y = y_0 \exp(+i\omega t)$

c) $y = y_0 \exp(\mp i\omega t)$ d) $y = y_0 \exp(\mp \omega t)$

vii) Amplification factor for hyperbolic equation is _____

a) $g = 1 + i\alpha$ with $\alpha = \frac{C\delta t}{\delta x} \sin(K\delta x)$

b) $g = 1 - i\alpha$ with $\alpha = \frac{C\delta t}{\delta x} \sin(K\delta x)$

c) $g = 1 + i\alpha$ with $\alpha = \frac{C\delta t}{2\delta x} \sin(K\delta x)$

d) $g = 1 + i\alpha$ with $\alpha = \frac{C\delta t}{2\delta x} \cos(K\delta x)$

viii) If K = 60, the maximum value generated by the random function random (K) will be _____

a) 60 b) 61

c) 59 d) 600

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

i) Positive definite matrices used in _____ calculations.

ii) Jacobi iteration method can be used to solve a system of _____ equations.

iii) $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ is known as _____ equation.

iv) A simple algorithm method is always unstable for the advective equation.

v) Random numbers are generated in descending order.

vi) Using Euler's method $\frac{dy}{dx} = \frac{(y - 2x)}{y}$, with y(0) = 1 gives y(0.1) = 1.1818.

2. Attempt following : **14**

   i) For the equation $\frac{dy}{dt} + \alpha y = 0$ develop an algorithm based on Runga-Kutta method.

   ii) Determine X_1 to X_6 of a pseudo random numbers series. Given – $X_1 = 2$, $a = 13$, $b = 7$.

   iii) Solve the nonlinear equations $x = 2(y + 1)$, $y^2 = 3xy - 7$, correct to the three decimals.

3. a) What do you mean by iterative method for solving the matrix equation ? $AX = B$ Explain the Jacobi Method. **8**

   b) Solve the following equation using Jacobi Method. **6**

$$\begin{pmatrix} 20 & 1 & -2 \\ 3 & 20 & -1 \\ 2 & -3 & 20 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 17 \\ -18 \\ 25 \end{pmatrix}$$

4. a) How Poisson's Equation could be represented in the form of Tridiagonal matrix ? **10**

   b) In case of pseudo random numbers if $b = 5$, after how many numbers the sequence of random number repeats. Why ? **4**

5. a) Express general form of first order ODE and solution y(t). What do you mean by boundary conditions ? Thus explain Leep-Frog Method to numerically solve the ODE. **10**

   b) What are differential equations ? Discuss with example different types of differential equations and define order of a differential equation. **4**

6. a) Show that the Runge-Kutta method is stable for decay and oscillation equation but unstable for growth equation. Write down the algorithm for Runge-Kutta method. **10**

   b) Find the inverse of the matrix $\begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{bmatrix}$. **4**

7. a) What is diffusion equation ? How this equation satisfies the condition of being parabolic ? Express an algorithm to solve the Diffusion equation. **10**

   b) Determine first four values for the equation ; $\frac{dy}{dt} + 10y = 0$; Given $y_0 = 1$. **4**

SLR-VI – 14

Seat No.	

M.Sc. – II (Semester – IV) Examination, 2014
PHYSICS (Appl. Elect.)
Paper – XIV : Microelectronics

Day and Date : Thursday, 24-4-2014 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** – Q. **7**.*
*3) **All** questions carry **equal** marks.*
*4) **Use** of calculator is **allowed**.*

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

1) The length of a typical zone in the zone process is _____

a) 1 cm b) 1.5 cm
c) 2 cm d) 3 cm

2) For an instantaneous source diffusion, the doping profile is _____

a) Logarithmic b) Linear
c) Gaussian d) erf.C.

3) Novolac is a _____ photo resists.

a) Negative b) Positive
c) Both a) and b) d) None of the above

4) An aspect ratio is _____

a) L/W b) W/L
c) R/L d) L/R

5) The purple plague is _____

a) $AuAl_2$ b) Au.Al
c) $AuAl_3$ d) Al_2O_3

P.T.O.

6) An important advantage of an ion implantation is that the process is a _____ temperature process.
   a) Low b) High
   c) Intermediate d) None

7) Which isolation is better for fabrication of IC's ?
   a) pn-junction b) Dielectric
   c) Both a) and b) d) None

8) Very stable high resistances are fabricated by a _____
   a) Diffusion b) Trimming
   c) Laser trimming d) Etching

9) Emitters are normally fabricated by _____ diffusion.
   a) Constant source b) Instantaneous source
   c) Dielectric d) None

10) In the projected range, the distribution of impurity atoms follows almost _____ behaviour.
   a) Gaussian b) erf.C.
   c) Linear d) Exponential

11) A dielectric isolation _____ the parasitic capacitance.
   a) Increases b) Decreases
   c) Does not affect d) None of the above

12) Silicon is _____ packed structure.
   a) Loosely b) Closely
   c) Random d) Disordered

13) Zone levelling is a technique of _____ Si-bar.
   a) Refining b) Diffusion
   c) Exchange d) Doping

14) The base width of a normal npn-transistor is of the order of _____ μm.
   a) 6 to 8 μm b) 0.06 to 0.08 μm
   c) 0.6 to 0.8 μm d) 1 to 2 μm

2. Attempt the following : **14**

   1) Substitutional diffusion. **5**

   2) Ficks 2^{nd} law of diffusion. **5**

   3) Stich bonding. **4**

3. a) Define the term epitaxy. How vapour phase epitaxy is used for the fabrication of an n-type epilayer ? **10**

   b) What is an etch-back effect ? **4**

4. a) Discuss in brief an ion implantation process for implantation of ions in the epilayer. **10**

   b) What is projected range ? **4**

5. a) What are pn-junction and dielectric isolations ? **10**

   b) Write a note on oxide formation. **4**

6. a) Explain why Al is preferred in metallisation ? **5**

   b) What is a negative photo resist ? **5**

   c) T0-5 package. **4**

7. a) How are the monolithic planar diodes fabricated ? Give a suitable diode configuration for high voltage/speed application. **10**

   b) Write a note on planar transistors. **4**

SLR-VI – 15

Seat No.	

M.Sc. (Part – II) (Semester – IV) Examination, 2014
PHYSICS (Applied Electronics)
Paper No. – XV : Microwave Engineering

Day and Date : Saturday, 26-4-2014 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) Select correct alternatives : **6**

1) The time varying form of equation of continuity is described by

a) $\Delta.J = d\rho / dt$ b) $\Delta.J = -d\rho / dt$ c) $\Delta.J = \rho$ d) $\Delta.J = -\rho$

2) The dominant mode in a circular waveguide is

a) TE10 b) TE00 c) TE11 d) TM11

3) The intrinsic impedance of free space is _____ Ω .

a) $120 / \pi$ b) 75 c) 377 d) 100

4) The dielectric bead supports used in coaxial line are useful at frequencies

a) below 3 GHz b) above 3 GHz
c) above 5 GHz d) above 10 GHz

5) E × H is usually interpreted as

a) power radiated by an antenna
b) energy transmission through space
c) surface propagation
d) power flow per unit area

P.T.O.

6) The wave impedance of TE wave is given by

a) $Z = E_x/H_y$ b) $Z = E_y/H_x$ c) $Z = -E_x/H_y$ d) $Z = \sqrt{jw/\sigma}$

7) In microwaves, reflection can occur if _____ is provided.

a) matched load b) short circuit

c) open circuit d) unmatched load

8) The principal mode of propagation in a coaxial line is _____ mode.

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

b) State **true** or **false**/justify/**one** line answer : **8**

1) The orientation of the electric field is also known as _____ (Plane polarization / Linear polarization).

2) A $(\lambda/2)$ long transmission line can be used for impedance matching.

3) Applegate diagram gives the _____ of the electrons (path / density).

4) In drift space of two cavity Klystron _____ modulation occurs (Velocity / Current).

5) A standard mismatch consists of known impedance whose value differs from Z_0 of the connecting line.

6) Twin lead wire is not useful at microwave frequency.

2. Answer in brief : **14**

1) Draw the diagram of electromagnetic spectrum, mentioning (from long waves to cosmic rays) with its wavelength and frequency. **5**

2) Compare waveguide with transmission line. **5**

3) The wavelength of a 600 MHz wave propagating through a nonmagnetic dielectric is 20 cm. What is the dielectric constant of the material ? **4**

3. a) Obtain instantaneous field components for the TE10 modes for a rectangular waveguide using transverse field components of TE modes for + Z directed wave. **10**

b) Sketch the directions of E-field, H-field and propagation in a perfect insulator. **4**

4. a) Obtain the boundary conditions at the surface and define surface impedance. **10**

   b) The terminating load of a transmission line with characteristic impedance $Z_0 = 50\,\Omega$ working at 300 MHz is $50 + j50\,\Omega$. Calculate the VSWR and reflection coefficient. **4**

5. a) Explain with cross sectional view, symmetrical strip transmission line and obtain expression for Z_0 and attenuation constant. **10**

   b) With the help of dimensions explain SMA connector. **4**

6. a) Explain the construction and operation of reflex klystron. **10**

   b) Explain briefly how Gunn domains are formed. **4**

7. a) Explain rotatory phase shifter (with vector phasor representation) to obtain output to be phase delayed additionally by 2θ. **10**

   b) Describe working of a variable phase shifter that utilizes change in dielectric constant of insulating region in the waveguide. **4**

SLR-VI – 16

Seat No.	

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

Day and Date: Tuesday, 29-4-2014 Total Marks : 70

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

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

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

1) In 8255 PPI, only port _____ can operate in BSR mode.
a) C b) B c) A d) X

2) _____ interrupt of 8085 has highest priority.
a) TRAP b) RST 7.5 c) RST6.5 d) INTR

3) IC 8279 provides _____ display modes.
a) 2 b) 3 c) 4 d) 5

4) IC 8255 is a programmable, parallel _____ device.
a) Memory b) I/O c) Display d) Interrupt

5) The interfacing chip used for data transmission between 8085 microprocessor and 8 ADC is
a) 8255 b) 8253 c) 8279 d) 8259

6) _____ is a programmable interval timer.
a) IC 8259 b) IC 8255 c) IC 8279 d) IC 8253

7) IC _____ is a buffer device.
a) 74LS245 b) 74LS138 c) 74LS373 d) 74LS340

8) IC 74LS138 is a
a) Buffer b) Decoder c) Latch d) Counter

P.T.O.

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

1) IC 8279 is _____ and _____ controller chip.

2) In 8279 PKDI _____ RAM used to store the display codes for 16 digits.

3) In 8255 PPI, if bit $D_7 = 0$, then it is known as _____ mode.

4) Resolution of flash type ADC is up to 2^{16}.

5) SID and SOD pins of 8085 can be used for serial communication.

6) In multilevel interrupts, microprocessor has more than one interrupt pin.

2. Attempt following : **14**

1) What is disadvantage of software approach used for interfacing keyboard and display ?

2) Explain the operation of flash A/D converter.

3) Draw and explain the interrupt structure of 8085 microprocessor.

3. A) Draw and explain the binary weighted resistor technique of DACs. **8**

B) Draw and explain interface circuit for DAC 1408. **6**

4. A) Draw and explain functional block diagram of IC 8279. **8**

B) Interface 8 × 4 key matrix keyboards to the 8085 microprocessor using 8255. Write an 8085 assembly language program to initialize 8255 and to read the key code. **6**

5. A) Draw and explain interfacing diagram of 8255 I/O and memory mapped I/O mode. **8**

B) Draw and explain the control word format of 8255. **6**

6. A) Draw and explain the internal block diagram of IC 8253. **8**

B) Draw and explain control word format of 8253. **6**

7. A) Draw and explain functional block diagram of IC 8259. **8**

B) Explain the following modes of 8259 priority interrupt controller :

1) FNM 2) SFNM

3) Rotating Priority 4) Polling mode. **6**

_____

SLR-VI – 17N

Seat No.	

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

Day and Date : Tuesday, 22-4-2014 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**.*
*4) **Use** of non-programmable calculator is **allowed**.*

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

i) Adam-Bashforth method is used to _____
   a) find out root of the algebraic equation
   b) solve ordinary differential equation
   c) evaluate integration
   d) none of the above

ii) The positive root of the equation $x^3 - x - 11 = 0$ lies between _____
   a) 0 and 1 b) 2 and 3 c) 1 and 2 d) 3 and 4

iii) To initialize the random number generator, which library function is used ?
   a) srandu (u) b) fabs (x) c) *f* mod (x, y) d) ceil (x)

iv) The normal equations of regressions for $y = a_0 + a_1 x$ are _____
   a) $na_0 + (\Sigma x_i)a_1 = \Sigma y_i$ and $(\Sigma x_i)a_0 + (\Sigma x_i^2)a_1 = \Sigma x_i y_i$
   b) $na_1 + (\Sigma x_i)a_0 = \Sigma y_i$ and $(\Sigma x_i)a_0 + (\Sigma x_i^2)a_1 = \Sigma x_i y_i$
   c) $na_0 + (\Sigma x_i)a_1 = \Sigma y_i$ and $(\Sigma x_i)a_1 + (\Sigma x_i^2)a_0 = \Sigma x_i y_i$
   d) none of these

v) The order of convergence for Newton-Raphson method is
   a) 1 b) 2 c) 1.66 d) 2.66

vi) The Regula-Falsi method is surely convergent while Newton's method is _____ convergent.
   a) unconditionally b) never
   c) surely d) conditionally

vii) Romberg's method is based on successive application of _____ rule.

a) Trapezoidal b) Simpson's 1/3

c) Simpson's 3/8 d) Weddles

viii) In the Euler's method n^{th} approximation formula for solving $y' = f(x, y)$ is given by a _____

a) $y_{n+1} = y_n + h\, f(x_{n-1}, y_{n-1})$ b) $y_{n+1} = y_n + h\, f(x_n, y_n)$

c) $y_{n+1} = y_n$ d) $y_{n+1} = y_{n-1} + f(x_n, y_n)$

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

i) The Euler's method gives a poor approximation, when dy/dx changes rapidly over the given interval and therefore the Predictor-Corrector method is used.

ii) Newton's forward difference formula is used to find out value of y at x which is present in the lower part of the table.

iii) The elimination including scaled pivoting, is commonly called Gauss elimination.

iv) The sum of the squares of the errors must be minimum. This is the _____ _____ principle.

v) Putting n = 1 in a general quadrature formula and taking the curve through the limits as a polynomial of degree one so that differences of an order higher than one vanish and one obtains _____ _____

vi) _____ _____ elimination is a variation of Gauss elimination method in which the elements above the major diagonal are eliminated as well as the elements below the major diagonal.

2. Attempt the following : **14**

i) Find a real root of the equation $3x + \sin x - e^x = 0$ by the method of false position correct to four decimal places. **5**

ii) Discuss the stability of Euler's method for solving the differential equations. **5**

iii) Derive the normal equations for fitting the curve $2^x = ax^2 + bx + c$. **4**

3. A) Using Euler's modified method, obtain a solution of the equation

$\frac{dy}{dx} = x + \left|\sqrt{y}\right| = f(x, y)$ with initial condition y = 1 at x = 0 for the range $0 \le x \le 0.6$ in steps of 0.2. **10**

B) Why Monto-Carlo method is advantageous over other methods used for finding the integration ? Explain. **4**

4. A) The values of e^{-x} at x = 1.72 to x = 1.76 are given in the following table :

x	1.72	1.73	1.74	1.75	1.76
$\mathbf{e^{-x}}$	0.17907	0.17728	0.17552	0.17377	0.17204

Find the value of $e^{-1.7425}$ using Newton's forward difference formula. **10**

B) Using Jacobi's iterative method, solve the following simultaneous equations : **4**

$-2x + 3y + z = 9, \quad 3x + 4y - 5z = 0, \quad x - 2y + z = -4$

5. A) Explain the method of least square principle for fitting a power function : $y = ax^c$. **6**

B) Using Newton-Raphson method, find the real root of the equation : $3x = \cos x + 1$, correct to five decimal places. **8**

6. A) Large prime numbers a and b are required to generate a set of pseudo random numbers. Explain it. **6**

B) Using Gauss-Seidal iterative method, solve the following simultaneous equations : **8**

$a + b + c = 2, \quad 5a + 3b + c = 3, \quad 2a + 3b + z = -1$

7. A) Solve the following differential equation : **6**

$$\frac{dy}{dx} = y + x$$

given that y(0) = 1 using Runge-Kutta method for y(0.2) in two steps.

B) Derive Lagrange's interpolation formula for the following data : **8**

x	– 1	0	2	3
y	– 8	3	1	12

Also find Y at x = 1.

———————

SLR-VI – 2

Seat No.	

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

Day and Date : Wednesday, 23-4-2014 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 alternative : **8**

1) Number of atoms present in unit area of (0 1 0) plane of simple cubic crystal are

a) $1/2r^2$ b) $1/6r$ c) $1/4r^2$ d) $1/8r$

2) Diffraction of crystal is possible only when

a) $n\lambda > 2d$ b) $n\lambda < 2d$

c) $n\lambda \leq 2d$ d) $n\lambda \geq 2d$

3) Width of energy gap of superconductor at 0 K is

a) 0 b) $3.5\ K_B Tc$

c) $K_B Tc$ d) 3.5

4) Specific heat of superconductor shows abrupt change at the temperature

a) 0 b) $<T_C$ c) $>T_C$ d) = Tc

5) 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) $\frac{\lambda_0}{(1-t^4)}$

P.T.O.

6) At Curie temperature, the spontaneous magnetization for ferromagnetic material is

a) 0 b) infinite

c) –1 d) +1

7) Elemental solid dielectric have only

a) electronic polarization

b) ionic polarization

c) orientational polarization

d) all polarizations

8) Relative permittivity (ε_r) of the air is

a) 2 b) 0.5 c) 1 d) 0

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

1) The addition of tri valent impurity creates n-type semiconductor.

2) At Curie temperature spontaneous magnetization is maximum.

3) Ewald sphere is drown with a radius $\frac{1}{\lambda}$.

4) FCC structure contains the contribution of six atoms.

5) Extrinsic semiconductor is the natural semiconductor.

6) Rectifier rectifies internal resistance.

2. Attempt following : **14**

1) Define the terms :

1) Unit cell

2) Coordination number

3) Packing fraction. **5**

2) Absence of fivefold symmetry. **5**

3) Cooper pair. **4**

3. a) What is superconductor ? Discuss London theory in detail. **10**

   b) Meissner's effect. **4**

4. a) What is dielectric polarization ? Give the expression for electronic polarizability. **10**

   b) Calculate the electronic polarizability of an isolated Se atom. The atomic radius of Se atom is 0.12 nm. **4**

5. a) What is Miller indices ? Give the expression for inter planner spacing. **10**

   b) Write the relation for Fermi level in n-type semiconductor. **4**

6. a) Give the theory regarding the calculation of energy gap in intrinsic semiconductor. **10**

   b) Calculate critical current (I_c) flowing through long superconducting wire of diameter 10^{-3} m in the absence of applied field. Given Hc = 7.9×10^3 A/m. **4**

7. a) What is ferromagnetic material ? Explain Weiss molecular theory of ferromagnetisms. **10**

   b) Show that superconductor is diamagnetic below critical temperature. **4**

SLR-VI – 3

Seat No.	

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

Day and Date : Friday, 25-4-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

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

1. a) Select correct alternative : **14**

1) Slew rate of an ideal opamp is **8**

a) Infinite b) Very high

c) Low d) Very low

2) In the differential circuit, which of the following terminals are connected together ?

a) Bases b) Collector

c) One base to another collector d) Emitters

3) The minimum number of FLIP-FLOPS required for a synchronous decade counter is _____

a) 1 b) 2

c) 4 d) 10

4) In order to startup, a feedback oscillator requires

a) Negative feedback less than one

b) Positive feedback greater than one

c) Unity feedback equal to one

d) No feedback

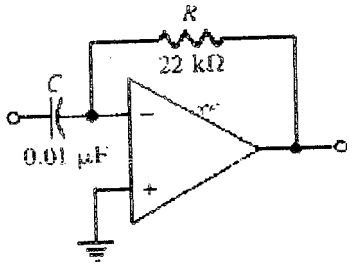
P.T.O.

5) The Boolean expression : $B \cdot (A + B) + A \cdot (\overline{B} + A)$ can be realized using minimum number of

a) One AND gate b) Two AND gates

c) One OR gate d) Two OR gates

6) Refer to the given circuit. This circuit is known as



a) a non inverting amplifier b) a differentiator

c) an integrator d) a summing amplifier

7) Why 8085 processor is called an 8 bit processor

a) Because 8085 processor has 8 bit ALU

b) Because 8085 processor has 8 bit data bus

c) Because speed of 8085 processor depend on data bus width

d) Both a) and b)

8) What does microprocessor speed depends on

a) Clock b) Data bus width

c) Address bus width d) Size of register

b) Fill in the blanks/States **True** or **False** : **6**

i) An SR flip-flop does not accept the input entry both input at one.

ii) The AND operation can be produced with three NAND gates.

iii) A modulus-12 counter must have 4 flip-flops.

iv) When an op-amp is operated in a single ended mode one input is grounded.

v) ROM is a volatile memory.

vi) The device used to convert a binary number to a 7 – segment display format is Decoder.

2. Explain **any three** of the following : **14**

   1) Phase shift oscillator.

   2) Voltage follower.

   3) Switching voltage regulator

   4) Shift registers.

3. a) Explain the operation of Weign Bridge Oscillator with suitable circuit diagram. **8**

   b) What is multiplexer and de-multiplexer. Explain with illustrative examples. **6**

4. a) Explain the circuit for a three op-amp instrumentation amplifier and obtain the expressions for output voltage for a given input voltages and resistance value. **8**

   b) Explain the transistor as a switch. **6**

5. a) Explain about JK Flip-Flop with proper diagram. **8**

   b) Describe square and triangle wave generators. **6**

6. a) Explain the circuit and timing diagram of synchronous counters. What advantages do synchronous counters have over asynchronous counters ? **8**

   b) Explain LC tunable oscillator. **6**

7. a) Draw the functional block diagram of 8085 microprocessor and explain it. **8**

   b) Assume that the accumulator contents data bytes 88 hand instruction MOV C, A 4FH is fetched. List the steps decoding and executing the instructions. **6**

SLR-VI – 4

Seat No.	

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

Day and Date : Monday, 28-4-2014 Total Marks : 70
Time : 11.00 a.m. to 2.00 p.m.

Instructions**: 1) Q. No. **(1)** and **(2)** are **compulsory.
*2) Answer **any three** questions from Q. No. **(3)** to Q. No. **(7).***
*3) **All** questions carry **equal** marks.*

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

1) Generalized or canonical momenta is given by

a) $p_j = \frac{\partial L}{\partial p_j}$ b) $p_j = \frac{\partial L}{\partial \dot{q}_j}$

c) $p_j = \frac{\partial L}{\partial q_j}$ d) $q_j = \frac{\partial L}{\partial \dot{p}_j}$

2) Lagrangian, L for linear harmonic oscillator is given by

a) $L = \frac{1}{2} m\dot{x}^2 - \frac{x^2}{2}$ b) $L = \frac{1}{2} m\dot{x}^2 + \frac{x^2}{2}$

c) $L = \frac{1}{2} m\dot{x}^2 - k\frac{x^2}{2}$ d) $L = \frac{1}{2} m\dot{x}^2 + k\frac{x^2}{2}$

3) According to Rutherford, the dimensions of nucleus are of the order of

a) 10^{-8} cm b) 10^{-10} cm

c) 10^{-13} cm d) 10^{-15} cm

P.T.O.

4) For orbits, the conic depends on the value of eccentricity given by

a) $\sqrt{1+\frac{mk^2}{2EI^2}}$ b) $\sqrt{1-\frac{2EI^2}{mk^2}}$

c) $\sqrt{1+\frac{2EI^2}{mk^2}}$ d) $\sqrt{1-\frac{mk^2}{2EI^2}}$

5) According to Kepler's third law of planetary motion, the period of rotation is proportional to the _____ power of the major axis.

a) 3 b) 3/2 c) 2 d) 2/3

6) Reduced mass of two equal masses is

a) $m^2/2$ b) 2m c) m/2 d) 2/m

7) For repulsive inverse square forces, the shape of orbit will be

a) Elliptic b) Parabolic

c) Hyperbolic d) All of the above

8) Equations of the orbits of a particle under the action of central forces are given by $\frac{1}{r}$ = a cosh b $(\theta-\theta_o)$, the force is proportional to

a) r^3 b) $1/(r^3)$ c) r^{3a} d) $1/(r^{3a})$

B) Fill in the blanks : **3**

1) The function $\sum_j p_j P_j$ generates _____ transformation.

2) In _____ variation, time as well as position coordinates vary.

3) If the Lagrangian remains invariant under rotation about an axis, then the _____ of the system about this axis will remain constant in time.

C) State **true** or **false** : **3**

1) $[u, p_j] = \sum_j \frac{\partial u}{\partial q_j}$.

2) Hamilton's equations are 2nd order differential equations.

3) The distance of closest approach is small when both the impact parameter 's' and angular momentum 'L' are Zero.

2. Attempt the following : **14**

a) Convert the following Lagrangian

$L = \frac{1}{2} m l^2 (\dot{\theta}^2 + \sin^2 \theta \dot{\phi}^2) + mgl \cos \theta$ of spherical pendulum into Hamiltonian.

Obtain corresponding Hamilton's canonical equations of motion and show that in the limiting condition the equations take the form of simple pendulum.

b) State and prove Jacobi identity.

c) For what values of α and β do the equation $Q = \sqrt{2}\, p^{\alpha} \sin \beta q$,

$P = \sqrt{2}\, p^{\alpha} \sin \beta q$ represent canonical transformation ?

3. a) Develop equations of motion of the body moving in a central force field. Further obtain solution of the problem in terms of (r(t), θ (t)), While doing so prove law of conservation of energy and angular momentum. **10**

b) A satellite of mass m = 2000 kg is going around earth in an elliptic orbit. At the farthest point from earth (apogee=da) the altitude is 4100 km, while at the nearest point (perigee = dp) the altitude is 1100 km. Calculate the energy E and angular momentum L of the satellite and its speed va and vp at da and dp, respectively. **4**

4. a) Discuss the problem of scattering of charged particles by a Coulomb field and obtain Rutherford formula for scattering of charged particles. **10**

b) Show that the transformation , **4**

P = q cot p, Q = log (sin p/q) are canonical. Show that the generating function is $F = e^{-Q} \left(1 - q^2 e^{2Q}\right)^{1/2} + q \sin^{-1}\left(q e^{Q}\right)$.

5. a) Discuss advantages of Hamiltonian formulation over Lagrangian one. Develop an equation of motion of the simple pendulum having mass 'm' and length 'l' via both formulations. Also find its period. **10**

   b) Determine the canonical transformation defined by the generating function $F = -\left(e^{Q} - 1\right)^{2} \tan p$. **4**

6. a) If the canonical transformation is defined by generating function

   $F = (1/2)\, m\, \omega^{2}\, q^{2} \cot Q$. What happens to the Hamiltonian when transformed from q, p coordinates to Q, P coordinates. Find solution of this problem by using transformed set of co-ordinates. **10**

   b) Considering the generating function $F_2 = \sum_{j} q_j P_j$, show that it generates identity transformation. **4**

7. a) Explain constraints and generalized coordinates. What is D'Alembert's principle ? Obtain Lagrange's equations of motion from D' Alembert's principle. **10**

   b) Derive the expression for Canonical equations in terms of Poisson Brackets. **4**

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SLR-VI – 5

Seat No.	

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

Day and Date : Tuesday, 22-4-2014 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) How many calories of heat are required to raise the temperature of 3 kg of aluminum from 20°C to 55°C ? Given specific heat capacity of aluminum C = 910J $kg^{-1}K^{-1}$ and 4.2J = 1 calorie.

a) 13000 b) 22750 c) 35750 d) 95550

2) Which of the statements below is wrong about an ideal gas ?

a) The total number of molecules is large

b) The molecules are in random motion

c) The molecules do not exert any appreciable force on one another or on the walls

d) The volume of the molecule is negligibly small compared with the volume occupied by the gas

3) When ice melts ?

a) a phase change occurs from a solid phase to liquid phase

b) an endothermic process occurs which requires energy

c) the water changes from a crystalline solid to a liquid

d) all of the above

4) The first order phase transitions are accompanied by a discontinuous change in _____

   a) Gibb's molar free energy function
   b) Internal energy
   c) Crystal symmetry
   d) None of the above

5) The ration of Universal gas constant and Avogadro's number is called

   a) Boltzmann's constant b) Equilibrium constant
   c) Velocity constant d) Maxwell coefficient

6) The phase space is _____ dimensional space.

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

7) The chemical potential for photon gas is

   a) Greater than Zero b) Less than Zero
   c) Equal to Zero d) Not defined

8) 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) $(\partial S_1 / \partial V_1) = (\partial S_2 / \partial V_1)$

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

1) In solids the molecules have no motion and no energy. (True/False)
2) Closed isolated system is an example of _____ ensemble.
3) The classical results are valid only at high temperature. (True/False)
4) It is possible to calculate the transport properties of gases from the law of corresponding states. (True/False)
5) When the order parameter changes _____ oat the transition, the transition is first order.
6) The transition from liquid He I to He II is called _____ transition.

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

   a) Show that the energy of universe is constant and the entropy of the universe tends to a maximum.

   b) Explain the concept of Phase space.

   c) Find the second viral coefficient of anharmonic oscillator with potential energy $V(x) = (1/2)\ (\alpha x^2 + \gamma x^4)$.

   d) Distinguish between 1^{st} order and 2^{nd} order phase transition.

3. A) Derive Plank's formula for black body radiation using Bose-Einstein statistics. **10**

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

4. A) Derive partitions function for canonical ensemble. **10**

   B) Explain the concept of Gibb's paradox. How it can be removed ? **4**

5. A) Show that during the first order phase transition, the Gibb's function is continuous, but the first derivative of the Gibb's function changes discontinuously. **10**

   B) Distinguish between classical and quantum statistical mechanics. **4**

6. A) Express the equation of state of a hard sphere gas in the viral form including Terms upto the third viral coefficient. **10**

   B) Derive Ehrenfest's equation for second order phase transition. **4**

7. A) Establish Fokkr-Planck equation and solve it. Discuss how this equation leads to the state of equilibrium. **10**

   B) Discuss the fluctuations in grand canonical ensemble. **4**

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Seat No.	

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

Day and Date : Thursday, 24-4-2014 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) Hermitian matrices have
   a) real eigenvalues b) complex eigenvalues
   c) no eigenvalues d) zero eigenvalues

2) If $\delta(x)$ is a Dirac delta function, the $\delta(a, x)$ is equivalent to
   a) $|a| \cdot \delta(x)$ b) $1/|a| \cdot \delta(x)$
   c) 0 d) a

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 hydrogenlike 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 the gaps :
1) The wave associated with a particle is called _____ wave. **3**
2) The Heisenberg's Uncertainty relation involving energy E is _____
3) The determinantal form of the wavefunction 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) Considering the de Broglie wave associated with a moving particle, derive Schrodinger equation. Generalize it to three dimensions. How would interpret the wave function Ψ ? **10**

   b) When X-rays of wavelength 1.5 $\mathring{A}$ are allowed to hit an atom they eject an inner electron which moves after collision with the velocity of 2.14×10^9 cm/s. Find the binding energy of that electron in the atom ? **4**

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

5. a) How would you write and process the Schrodinger equation for a Hydrogenlike atom ? What are spherical harmonics ? Obtain the expression for energy levels. **10**

   b) How would you explain color of a physical system ? Why some transitions between energy levels are forbidden ? **4**

6. a) What do you understand by space quantization of Electronic orbits ? Why is it called so ? Why m is called magnetic quantum number ? **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**

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Seat No.	

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

Day and Date : Saturday, 26-4-2014 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** marks.*
*5) **Use** of calculator is **allowed**.*

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

1) Maxwell's equation from Ampere's law circuital law is

a) div B = 0 b) curl $E = -\frac{\partial B}{\partial t}$

c) curl $H = J + \frac{\partial D}{\partial t}$ d) div D = ρ

2) Total outward flux of magnetic induction 'B' through any close surface 'S' is equal to

a) one b) infinite c) ϕ d) zero

3) EMF around a close path is equal to the time derivative of which quantity associated with the surface bounded by the path

a) magnetic field b) electric field

c) magnetic induction d) electric field intensity

4) The law of conservation of energy for transmission and reflection of the e.m. waves is

a) $T \times R = 1$ b) $T - R = 1$ c) $\frac{T}{R} = 1$ d) $T + R = 1$

5) Incident, reflected and transmitted wave vectors are in a plane _____ to the surface.

a) normal b) tangential c) oblique d) parallel

6) $P = VI = I^2R$ is the _____ heating law.

a) Ohm's b) Faraday's law c) Inductive d) Joule's law

B) **True/ false** : **8**

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

2) Scalar potential does satisfy Poison's equation

3) Electromagnetic waves are transverse in nature.

4) $B_0 = \frac{k}{w}(Z \times E_0)$.

5) When light passes from air (n_1 =1) in to glass (n_2 = 1.5) then R < T.

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) Induced electric field **5**

2) Motional emf **5**

3) Electromotive force. **4**

3. a) Give the wave equations in 1-dimension. **7**

b) Give the terminology of sin wave in 1-dimension. **7**

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

   b) If light ray passes from the medium of refractive index 1.7 to the medium of refractive index 1.4. Calculate the coefficient of reflection and transmission. **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) Derive Cauchy's formula calculate refractive index of transparent materials. **8**

   b) Write about the magnetic dipole radiation. **6**

7. a) Prove R + T = 1 for normal incidence of electromagnetic waves travelling in linear media. **8**

   b) Explain the boundary conditions related to the magnetic field vectors D, B, E and H. **6**

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SLR-VI – 8

Seat No.	

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

Day and Date : Tuesday, 29-4-2014 Total Marks : 70

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

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

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

i) The 8086 Microprocessor with its address lines is capable of addressing
a) 2^8 b) 2^{16} c) 2^{20} d) 2^{32}

ii) In an 8051 Microcontroller the I/O lines are
a) 16-bit parallel port b) 8-bit parallel port
c) 20-bit parallel port d) 32-bit parallel port

iii) In 8085 Microprocessor the Program counter (PC) and Stack pointer (SP) registers are
a) 32-bit b) 16-bit c) 8-bit d) 20-bit

iv) In Memory mapped I/O, the device is assigned a 16-bit address because
a) The data is transferred using sixteen address lines
b) The address bus has sixteen lines
c) The memory data transfer instructions require a 16-bit address
d) The data bus has 16 lines

v) The control signals of 8085 microprocessor are used to interface I/O devices
a) RD, WR and IO/M b) RD, WR and ALE
c) RD,IO/M and ALE d) IN,OUT and ALE

P.T.O.

vi) Arithmetic/Logic unit (ALU) is a part of
   a) Memory b) CPU
   c) Peripheral devices d) Control signals

vii) Address Latch Enable (ALE) Pin is used in Microprocessor
   a) To latch the lower order address bit
   b) To latch the data bit
   c) To latch higher order address bit
   d) To transfer data

viii) Assuming Microprocessor clock frequency 2 MHZ and seven T-states for instruction MVI. The execution time to run the MVI instruction is
   a) 2 microsecond b) 3.5 microsecond
   c) 7 microsecond d) 14 microsecond

B) Fill in the blanks : **6**

i) Instruction IN and Out are classified in the group of _____

ii) Opcode is defined as _____

iii) The time required to complete the operation of accessing either memory or I/O is defined as _____

iv) The content of HL and DE register are interchanged using _____ instruction.

v) In an 8086 Microprocessor pin MN/MX = VCC is used for _____ operation.

vi) In an 8051 Microcontroller the function of Watch Dog Timer is _____

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

a) Explain with a suitable example how a physical address is generated.

b) Explain the role of ALE and IO/M signals of the 8085 microprocessor with timing diagram.

c) Write a note on clock generator 8284.

d) Explain special function registers of 8051 Microcontroller.

3. A) Interface 8K$\times$8 RAM with 8085 bus at the address 2000H to 3FFFH using four 6116 chips. **10**

   B) Write a short note on ROM of 8051. **4**

4. A) Draw and explain the block diagram of 8086 Microprocessor. **10**

   B) What are EU and BIU Buses used in microprocessor ? **4**

5. A) How the 8086 is interfaced in the minimum mode with buffer and transceivers ? **10**

   B) Interrupt of 8051. **4**

6. A) Draw and explain the block diagram of 8051 Microcontroller. **10**

   B) Write a control instruction used in 8086 microprocessor. **4**

7. A) What are different addressing modes of 8051 microcontroller ? **10**

   B) What would be the contents of AX and DX register after execution of ? **4**

   MOV DX, 0000H

   MOV AX. 2335H

   MOV CX, 3535H

   MUL CX

SLR-VI – 9

Seat No.	

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

Day and Date : Monday, 21-4-2014 Max. Marks : 70
Time : 3.00 p.m. to 6.00 p.m.

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

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

1) The forced β of a BJT is given by _____

a) $\frac{I_{c(sat)}}{I_b}$ b) $\frac{I_{e(sat)}}{I_b}$ c) $\frac{I_b}{I_{b(sat)}}$ d) $\frac{I_b}{I_{c(sat)}}$

2) Power MOSFET's are _____ controlled devices.

a) Power b) Voltage
c) Current d) Both a) and b)

3) In order to achieve flat band condition, surface potential (ψ_s) must be _____

a) Zero b) Negative
c) Positive d) Excessively positive

4) The maximum sensitivity of the eye is at _____ μm.

a) 0.500 b) 0.555
c) 0.520 d) 0.700

5) The dominating operating process for LED is _____

a) Spontaneous emission b) Stimulated emission
c) Absorption d) Reflection

P.T.O.

6) In a CCD, charge transfer efficiencies larger than 99.99% can be obtained in the presence of _____
   a) Self induced drift
   b) Density of interface states
   c) Fringing field
   d) Thermal diffusion

7) Enhancement type MOSFET's respond only to _____ V_{GS}.
   a) Negative
   b) Positive
   c) Both a) and b)
   d) No voltage needed

8) CMOS technology implies _____ technology.
   a) n-channel depletion
   b) p-channel depletion
   c) only channel enhancement
   d) both a) and b)

9) In MIS diode, the ON-set of strong inversion occurs at _____
   a) $\psi_S = 0$
   b) $\psi_S = \psi_B$
   c) $\psi_S = 2\psi_B$
   d) $\psi_S = \frac{1}{\psi_B}$

10) In a buried channel CCD, storage and transfer of the charge packet takes place _____
   a) Through the bulk of the semiconductor
   b) Along the surface of the semiconductor
   c) Both a) and b)
   d) None of the above

11) If the bottom of the conduction band is located at _____, it is called Γ-Point.
   a) $K = \pi$
   b) $K = 0$
   c) $K = -\pi$
   d) $K = 2\pi$

12) In SiO_2-Si MOS diode, the layer SiO_x is stoichiometric when _____
   a) x = 0
   b) x = 1
   c) x = 2
   d) x = 3

13) Tunnel diode exhibits _____ controlled NDR.
   a) Current
   b) Voltage
   c) Power
   d) None of the above

14) Resonant tunneling diode has a cut-off frequency in the _____ range.
   a) KHz
   b) MHz
   c) GHz
   d) THz

2. Write a note on : **14**

   1) The modern MOSFET's are fabricated on $\langle 100 \rangle$ oriented Si – – Comment. **5**

   2) Visible LED's. **5**

   3) Triac. **4**

3. a) With constructional details, explain the complex I-V characteristic of an SCR. **10**

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

4. a) Sketch and explain a basic 3-phase CCD and discuss how a charge packet is transferred along the surface of a continuous substrate. **9**

   b) Discuss the I-V characteristic of a tunnel diode. **5**

5. a) Discuss with an energy band diagram and equivalent circuit, the pn-junction solar cell referred to open circuit voltage (V_{OC}), short circuit current (I_{SC}), maximum power output (Pm) and conversion efficiency (η). **10**

   b) Write a note on organic LED's. **4**

6. a) Discuss and compare transferred electron effect in GaAs and InP. **10**

   b) Find the characteristic impedance of a nearly loss less transmission line (R very small) that has a unit length inductance of 10 nH and a unit length capacitance of 4 pF. **4**

7. a) Discuss the potential-well model for the charge storage system. **10**

   b) What are $\frac{dV}{dt}$ and $\frac{dI}{dt}$ effects ? **4**
