

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc. EXAMINATION**  
**Monday, 10<sup>th</sup> October**  
**2011**  
**10.30 a.m to 1.30 p.m**  
**PHYSICS: P-301**  
**[MATHEMATICAL PHYSICS]**

**Total Marks: 80**

**N.B: All the symbols have their usual meaning.**

- Que:1 (a) Obtain an expression of curl in terms of curvilinear coordinates. (07)  
 (b) Explain cylindrical coordinates as a special curvilinear coordinate system & Obtain expressions for  $\vec{\nabla}\phi$ ,  $\vec{\nabla}^2\phi$ ,  $\vec{\nabla}\cdot\vec{F}$  &  $\vec{\nabla}\times\vec{F}$  in the terms of cylindrical coordinates. (06)

**OR**

- Que.1 (a) Define orthogonal curvilinear coordinates & Deduce the condition for orthogonality. Derive an expression of gradient in terms of orthogonal curvilinear coordinates. (09)  
 (b) If  $x = uv\cos w$ ,  $y = uv\sin w$ ,  $z = \frac{1}{2}(u^2 - v^2)$  then find  $h_1, h_2, h_3$  and show that  $ds^2 = (u^2 + v^2)du^2 + (u^2 + v^2)dv^2 + u^2v^2dw^2 + 2uvdudv$ . (04)

- Que.2 (a) Obtain the solution of Legendre's differential equation in the form of series of descending power of  $x$ . (07)  
 (b) Find the Associated Legendre polynomial by using Laplace's equation in spherical coordinates. (06)

**OR**

- Que.2 (a) Obtain series solution of Hermite's differential equation. (07)  
 (b) Discuss the orthogonal properties of Bessel's polynomials. (06)
- Que.3 (a) Discuss complex representation of a Fourier's series & find a cosine & sine series for  $f(t)$  when  $0 \leq t \leq \pi$ . (08)  
 (b) Find a series solution of sines & cosines of multiple of  $x$  which represents  $f(x) = x^2 + x$  in the interval  $-\pi < x < \pi$ . Deduce that  $\frac{\pi^2}{6} = \sum_{n=1}^{\infty} \frac{1}{n^2} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \dots$ . (06)

**OR**

- Que.3 (a) Give the physical interpretation of Fourier's series with reference to transverse vibration of a string. (08)  
 (b) Give the physical interpretation of Fourier's series with reference to effective values and average of product. (06)

- Q.4 (a) What are constraints? Discuss Holonomic and Non-Holonomic constraints with illustration. [07]  
(b) Derive the Lagrange's equation of motion for a conservative system from D'Alembert principle. [07]

OR

- Q.4 (a) What is cyclic coordinates? Show that total energy is conserved. [07]  
(b) Derive the equation of motion of a spherical pendulum using Lagrangian formulation. [07]

- Q.5 (a) State the Hamilton's principle and derive the Lagrange's equation of motion. [07]  
(b) Derive the equation of motion for a cylinder rolling on inclined plane. [06]

OR

- Q.5 (a) Discuss the calculus of variation and derive the Euler's equation. [07]  
(b) Discuss the Brachistochrone problem using variational principle. [06]

- Q.6 (a) Derive the Hamilton's equations of motion. [07]  
(b) Derive the Hamilton's equation of motion for simple pendulum with moving support. [06]

OR

- Q.6 (a) What is phase space? Give the comments on the Hamiltonian formulation. [07]  
(b) Derive the Hamilton's equation of motion for a particle in a electromagnetic field. [06]

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**SARDAR PATEL UNIVERSITY**  
**T. Y. B.Sc. EXAMINATION**  
**2011**  
**Wednesday, 12<sup>th</sup> October**  
**10.30 a.m. to 1.30 p.m.**  
**P-303 : PHYSICS**  
**(Condensed Matter Physics)**

**Total Marks : 80**

**Note :** Figures in the right indicate full marks.

- Que-1** (a) With the help of schematic diagram, discuss a technique to record X-ray photograph from a rotating crystal. What are the limitations of the technique? (07)
- (b) What is lattice vacancy? Distinguish between Schottky defect and Frankel defect. (07)

OR

- Que-1** (a) Explain Debye-Schener method for poly-crystalline materials. (07)
- (b) Discuss diffusion in detail. (07)
- Que-2** (a) Write a detailed note on: Hall Effect (07)
- (b) Derive the following expression for free electron gas in three dimensions. (06)

$$D(E) = \frac{dN}{dE} = \frac{3N}{2E}$$

OR

- Que-2** (a) Explain heat capacity of the electron gas. (07)
- (b) Derive the equation of electrical conductivity and resistivity with the help of Ohm's law. (06)
- Que-3** (a) What is Meissner effect in superconductor? Explain superconducting magnetization curves. (07)
- (b) What is superconductivity? Differentiate between type I and type II superconductors. (06)

OR

- Que-3** (a) Derive London equation in detail. Define penetration depth. (07)
- (b) What is weak link? Discuss AC Josephson effect. (06)

- Q-4.
- What are elastic constants? Define them 5
  - Discuss the theory of slip planes. 5
  - A 1000 m length of welded steel railway track is heated to  $85^{\circ}\text{C}$  before being firmly secured to the track bed. Calculate the stress in the track at a temperature  $15^{\circ}\text{C}$ . On cooling from  $85^{\circ}\text{C}$  to  $15^{\circ}\text{C}$  a tensile strain of  $14 \times 10^{-6}$  is developed in the rail.  
(Young modulus of steel is  $208 \times 10^9$  and  $\alpha = 14 \times 10^{-6} / ^{\circ}\text{C}$ ) 4
- Q-4. OR
- Discuss deformation by twinning and dislocations. 7
  - What are poly crystalline metals? 7
- Q-5.
- What are the challenges of nano science and technology 5
  - What is molecular recognition? 4
  - Discuss about scanning probe instrument 4
- Q-5. OR
- What is nanoscale lithography, dip pen lithography and self-assembly? 6
  - Discuss about nanoscale bio-structures. 5
  - What are smart materials? 2
- Q-6.
- What is ultrasound? Discuss the production of ultrasound. 4
  - Write a note on the following 9
    - Mode Scan.
    - Echo-ophthalmoscope.
    - Doppler Technique.
- Q-6. OR
- Define (1) Glucoma (2) Myopia (3) Astigmatism 3
  - Write a note on the following 10
    - Tunica Fibrosa.
    - Tunica Vasculosa.

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc. EXAMINATION**  
**Thursday, 13<sup>th</sup> October**  
**2011**

**10.30 am to 1.30 pm**

**PHYSICS : P-304**

**[ELECTRODYNAMICS, PLASMA AND STATISTICAL MECHANICS]**

**Total Marks: 80**

**Note:** Symbols have their usual meanings

- Q.1 (a) State Bio-Savart law. Using Bio-Savart law obtain the [07]  
 formula for the divergence of " $\vec{B}$ " and show that the  
 integral of " $\vec{B}$ " around the circular path of the radius "s" is  
 product of  $\mu_0$  and I.  
 (b) Explain the effect of a magnetic field on the electron [04]  
 revolving about nucleus in atom.  
 (c) Define the following terms:- [03]  
 (i) Surface current density  
 (ii) The curl of " $\vec{B}$ ".

**OR**

- Q.1 (a) State Ampere's law and derive an equation of the magnetic [07]  
 field at a distance 'r' from a long straight wire, carrying a  
 steady current I.  
 (b) Write a note on Magnetostatics and Electrostatics. [04]  
 (c) What is magnetic force? Write the equation of the magnetic [03]  
 force on a charge Q, moving with velocity v in a magnetic  
 field  $\vec{B}$ .

- Q.2 (a) State and explain Maxwell's equations for electromagnetic [05]  
 theory.  
 (b) Write short note on "Emf" and "Motional Emf". [05]  
 (c) Discuss the following laws [03]  
 (i) The Joule heating law  
 (ii) The Lenz's law of induction

**OR**

- Q.2 (a) Explain the mutual inductance of the two loops and derive [05]  
 the Neumann formula for mutual inductance.  
 (b) Show that the energy stored in the magnetic field is [05]  

$$\frac{1}{2\mu_0} \int B^2 dT \text{ all space}$$
  
 (c) State and explain Ohm's law in terms of the current density [03]  
 and the electric field.

- Q.3 (a) Discuss the diffusion and mobility in plasma and obtain [05]  
 Einstein relation.  
 (b) Discuss elastic collision and inelastic collisions in plasma. [05]  
 (c) Obtain Ohm's law in plasma. [03]

OR

- Q.3 (a) Write Maxwell's equations and explain charge conservation [05]  
in plasma.  
(b) Discuss motion of charge particle in constant electric and [05]  
magnetic field for plasma.  
(c) Define and discuss macroscopic and microscopic distribution [03]  
in plasma.

- Q.4 (a) Explain Maxwell equation in a homogeneous plasma. [07]  
(b) Write short note on:- [06]  
(i) Plasma as a gas mixture.  
(ii) Oscillation and waves in plasma.

OR

- Q.4 (a) Explain plasma frequency and obtain formula for plasma [07]  
frequency using alternative methods of derivative.  
(b) Write short note on:- [06]  
(i) Force on plasma in magnetic plasma.  
(ii) Collision in fully ionized magnetoplasma.

- Q.5 (a) Obtain the expression for Maxwell's velocity distribution. [07]  
(b) Prove that :- [06]

(i)  $\langle u \rangle = \sqrt{\frac{8kT}{\pi m}}$

(ii)  $\sqrt{\langle u^2 \rangle} = \sqrt{\frac{3kT}{m}}$

(iii)  $\langle E \rangle = \frac{3}{2} NkT$

OR

- Q.5 (a) Analyze completely the classical formulation of Liouville's [07]  
theorem.  
(b) Explain principles of conservation of density and extension [06]  
in phase.

- Q.6 (a) Explain grand canonical ensemble and obtain the grand [07]  
canonical distribution in terms of the fugacity of the system.  
(b) Explain physical interpretation of  $\alpha$ . [07]

OR

- Q.6 (a) Derive the Quantum distribution function for MB statistics [07]  
and BE statistics.  
(b) Discuss with required equations [04]  
(i) Entropy for adiabatic processes.  
(ii) Entropy in terms of probability.  
(c) A system with just two energy is in thermal equilibrium with [03]  
a heat reservoir at temp 600 °K. The energy gap between  
the levels is 0.1 eV. Find (i) the probability that the system  
is in higher energy level and (ii) the temperature at which  
this probability will equal 0.25.

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## SARDAR PATEL UNIVERSITY

## T.Y. B.Sc. EXAMINATION

2011

Friday, 14<sup>th</sup> October

10.30 am to 1.30 pm

P - 305: PHYSICS

(Analog - Digital Circuits &amp; Communication System)

Total Marks: 80

Note: All the symbols have their usual meanings.

Que-1 (A) Describe the procedure to obtain h-parameters of a transistor using equivalent circuit. Also mention the graphical method to determine them. (07)

(B) Give a hybrid equivalent transistor amplifier circuit and derive the following equations: (05)

$$(i) A_i = -\frac{h_f}{1 + h_o R_L} \quad (ii) R_i = h_i + h_r A_i R_L$$

(C) Define  $\alpha$ -cut off and  $\beta$ -cut off frequencies. (02)

OR

Que-1 (A) With the help of equivalent circuit diagram discuss the effect of an emitter bypass capacitor on the low frequency voltage gain of a CE transistor amplifier. (07)

(B) For single tuned inductively coupled transistor amplifier obtain the following condition for maximum power transfer, (05)

$$R_0 = \left(\frac{L_1}{M}\right)^2 R_i$$

(C) For a transistor 2N2218,  $h_{fe} = 50$ ,  $I_c = 1.5$  mA and  $T = 27$  °C. Calculate transistor transconductance  $g_m$ . (02)

Que-2 (A) Define conversion efficiency of an amplifier. Show that maximum conversion efficiency of class A transformer coupled resistive load amplifier is only 50%. (06)

(B) Explain the principle of class A push pull amplifier with suitable circuit diagram and show that its output is free from even harmonics. (05)

(C) What is the use of transistor phase inverter circuit in push pull amplifier? What are its limitations? (02)

OR

Que-2 (A) Give the composite characteristic curve of class B push pull amplifier and prove that maximum efficiency is 78.5% in this circuit. (06)

(B) Write a note on complementary symmetry. (05)

(C) What is cross over distortion in class B push pull amplifier? How it is minimized. (02)

Que-3 (A) What is differential amplifier? Discuss the dc analysis of dual input balanced output configuration with suitable circuit diagram. (06)

(B) Define input and output offset voltages. Explain the universal balancing technique for balancing offset voltages. (05)

(C) Define following operational amplifier (opamp) parameters: (02)  
(i) input offset current (ii) slew rate

OR

Que-3 (A) State the characteristics of an ideal opamp. Obtain the expression for voltage gain of an ideal opamp in inverting mode. What is virtual ground? (06)

(B) Discuss the application of an opamp as a logarithmic amplifier (05)

(C) Define following operational amplifier (opamp) parameters: (02)  
(i) input bias current (ii) CMRR

- Q4** Write short notes on:
- (a) AND Gate 4
  - (b) RS NAND latch 4
  - (c) JK flip-flop 4
  - (d) T flip-flop. 2

OR

- Q4** Write short notes on:
- (a) OR Gate 4
  - (b) RS NOR latch 4
  - (c) Closed RS flip flop 4
  - (d) D flip-flop. 2

- Q5**
- (a) Define Communication and discuss any six types of electronic communications. 8
  - (b) Define and explain the modulation index of an AM signals. 4
  - (c) An FM signal has a deviation ratio of 3 [Nos of significant sidebands are 6]. The maximum modulating signal is 5 kHz. Calculate bandwidth of the signal. 1

OR

- Q5**
- (a) Explain the following terms: 8  
(i) ASK (ii) OOK (iii) DSB and (iii) SSB
  - (b) List the major segments of the electromagnetic spectrum and give the frequency ranges of each with its applications. 5

- Q6**
- (a) Discuss in detail :: types of fiber-optic cable. 6
  - (b) Explain the operation/working of Photo diode as an optical receiver. 4
  - (c) State the type of coordinates used in locating a communication satellite in orbit. 3

OR

- Q6**
- (a) Discuss various applications of artificial satellite. 6
  - (b) Define the term multiplexing. Discuss usefulness of multiplexing in communication systems. 4
  - (c) Explain how light is propagated through a fiber cable. 3

[31]

No. of printed pages : 2

**SARDAR PATEL UNIVERSITY**  
**T.Y.B.Sc. EXAMINATION**  
**2011**  
**Saturday, 15<sup>th</sup> October**  
**10.30 am to 1.30 pm**  
**P306 : PHYSICS**  
**(Instrumentation & Energy Science)**

**Total Marks: 80**

- Note:**(1) Numbers to the right indicate full marks.  
(2) Notations have their usual meanings.  
(3) Draw labeled diagram where required.

Q.1

- (a) Explain principle and working of a piezo-electric transducer. Discuss its dynamic characteristics. [07]  
(b) Explain linear variable differential (LVDT) transducers. [05]  
(c) What is transducer? State the important factors that decide the choice of a transducer. [02]

**OR**

Q.1

- (a) Explain principle of inductive type transducers and discuss various self generating type inductive transducers. [07]  
(b) What are resistance strain gauges? Discuss briefly the two types of strain gauges. [05]  
(c) Define gauge factor and mention its unit. [02]

Q.2

- (a) What are opto-electrical transducers? Explain their principle and working. [06]  
(b) What is microphone? Explain with labelled diagram, the working of Capacitor type Microphone. [05]  
(c) Name the microphone that is based on the principle of generation of emf when moving conductor is placed in magnetic field. [02]

**OR**

Q.2

- (a) Explain low pressure measurements using (i) thermal conductivity gauge or pirani gauge and (ii) ionization gauge. [06]  
(b) Explain principle and working of (i) ionization and (ii) mechno-electronic transducers. [05]  
(c) What is a manometer? Mention the desirable characteristics of a manometer fluid? [02]

Q.3

- (a) Explain temperature measurements using non-electrical methods. [06]  
(b) What is thermistors? Write a brief note on temperature measurements using thermistors. [05]

(c) What is thermocouple? Explain Peltier effect. [02]

OR

Q.3

(a) Explain working principle of biosensors and discuss blood glucose monitor. [06]

(b) What are optical fiber sensors? Discuss photometric sensors. [05]

(c) State advantages of optical sensors. [02]

Q.4

(a) Name different types of solar thermal collector. Discuss (i) characteristic features of a collector and (ii) important aspects of solar thermal collector. [07]

(b) Using neat diagram, explain the origine of geothermal energy. [06]

OR

Q.4

(a) Explain V-I characteristics of a solar cell. Give an account of power of a solar cell-panel and module. [07]

(b) Give figure showing large solar hot water system. Explain three factors affecting efficiency of the collector. [06]

Q.5

(a) Explain the meaning of tide and tidal energy. Derive following equation for the tidal energy. Conversion  $W = gDAR^2$  Joule [08]

(b) Explain different types of wind turbine used to convert wind power into electrical power. [05]

OR

Q.5

(a) Derive equation for the power efficiency of the wind turbine. [08]

(b) Giving neat labeled diagram explain three blade HAWT. [05]

Q.6

(a) What is oceanography? State seven aspects of ocean energy technologies. [08]

(b) Taking an example of  $H_2$ ,  $O_2$  fuel cell explain the electro-chemistry of the cell. [04]

(c) State four advantages of fuel cell power plants. [02]

OR

Q.6

(a) Explain the limitations and merits of ocean energy conversion technologies. [08]

(b) What is a fuel cell? State its ten applications. [05]

(c) Give Block diagram explaining ocean energy biomass route. [01]

