PHYSICS HONOURS QUESTION PAPERS (MODEL)
PART (1)
PAPER – 1st   FULL MARKS – 100

Answer question No-1 and any four questions each from Unit-1 and Unit-2 (2×10)

1(a) Test whether the following series is convergent or not

$$\sum_{\eta} \frac{(1+\eta)^p}{\eta^v}$$

b. Solve $(D^2 - 4D + 4)y = x^3 e^{2x}$

c. Prove the recurrence formula

$$(2n+1) P_n(x) = P'_{n+1}(x) - P'_{n-1}(x)$$

d. Draw the ckt diagram of OR and AND gates using discrete components.

e. Verify the Boolean identity

$$\overline{(A+B)} \,(\overline{B}+\overline{C})\,(\overline{C}+\overline{A}) = \overline{A} \cdot \overline{B}$$

f. Find the adjoint of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 5 & 0 & 1 \\ 2 & 6 & 7 \end{bmatrix}$

g. Prove the following vector identity

$$\overline{\nabla} \times (\overline{\nabla}\phi) = 0$$

h. State the superposition theorem of Network analysis.

i. What is Hall effect?

j. Why do Si or Ge diodes not emit light but GaAs diodes do?

k. Prove the Kepler's 2nd law of planetary motion.

2. (a) Using Gauss's theorem show that

$$\oiint_S (\nabla r^2) \cdot \overline{ds} = 6V$$

Where s is the changed Surface, exclusing Volume V.   3

(b) Verify Stoke's theorem for the vector   1

$$A = (2x-y)\,\hat{i} - yz^2\,\hat{j} - y^2z\,\hat{k}$$

over the upper half surface of the sphere $x^2 + y^2 + z^2 = 1$

(c) Prove that $H_n(-x) = (-1)^n H_n(x) \quad n \geq 0$ 2

(d) Show that $H_0(x) = 1$ 1

3. (a) Show that $\displaystyle\int_{-1}^{+1} x\,P_n(x)\,P_{n-1}(x)\,dx = \frac{2n}{4n^2-1}$ 3

(b) Find a Fourier Series to represent function   4

$$f(x) = (\pi - x) \text{ for } 0 < x < 2\pi$$

(c) Find the eigen values and normalized eigen vectors of the following matrix   3

$$\begin{bmatrix} 3 & 1 & 1 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$$

4. (a) Solve the differential equation $x \log x \frac{dy}{dx} + y - \log x = 0$ (3)

(b) find the directional derivative of the $f(x,y,z) = xy^2 + yz^2 + zx^2$ at the point $(2, -1, -1)$ in the direction of vector $(\hat{i} + 2\hat{j} + 2\hat{k})$ (3)

(c) If m things are distributed among a men and b women, show that the chance that the number of things received by men is odd $\dfrac{(b+a)^m - (b-a)^m}{(b+a)^m}$ (4)

5. (a) starting from the expression for the velocity of a particle in spherical polar co-ordinates, show that the acceleration $\bar{a} = a_r \hat{r} + a_\theta \hat{\theta} + a_\phi \hat{\phi}$ (3)

(b) Show that for a non-dissipative system

$$\int_1^2 \bar{F} \cdot d\bar{r} = T_2 - T_1$$ (3)

(c) A particle is thrown vertically upward with a velocity v_0 at a place of latitude λ. Show that it will land at a distance

$$\frac{4 \omega v_0^3}{3 g^2} \cos \lambda$$ (4)

6. (a) State parallel axis theorem and prove it (1+2)

(b) Find the moment of inertia of a solid sphere of radius r with centre at the origin O. (4)

(c) Find the moment of inertia of a solid cylinder about an axis which passes through its centre of mass and perpendicular to its axis (3)

7. (a) A particle executes one dimentional motion along XOX' under (i) a restoring force proportional to its displacement from the equilibrium position 'O' and (ii) a damping force proportional to its velocity. Set up the equation of motion of the particle. (3)

(b) Solve it for underdamed motion (4)

(c) Show that for the above motion logarithm of the ratio of successive amplitudes on either side of E position is constant (4)

Unit - 2

8. (a) How is the depletion region formed in p-n junction? 3

(b) Distinguish between avalanche breakdown and zener breakdown. 3

(c) What are the differences between BJT and JFET? 'A JFET can be used as a voltage variable resistor? Explain (2+2)

9. (a) What is a filter? Explain physically the action of C filter and L filter. (1+3)

(b) What are the factors that effect the bias stability of a transistor? (3)

(c) What do you mean by load line and Q point of a transistor amplifier. What is the significance of load line. (2+1)

10. (a) An n-channel E-Mos has device constant $K = 500 \mu A/v^2$ and $V_T = 2V$. Find Saturation drain current for $V_{GS} = 4V$. (3)

(b) Why NAND and NOR gates are called Universal building block? Show that using only NOR gates an Anding operation can be formed. (1+2)

(c) Convert $(14.289)_{10}$ to binary number. (2)

(d) Convert $(C5E2)_6$ to binary number (2)

11. (a) Find the equivalent focal length of two lenses seperated by a distance. (3)

(b) Two convex lenses of focal lengths 12 cm and 4 cm are kept seperated by a distance 8 cm in air. Find the position of cardinal points (4)

(c) Obtain the relation $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ for a thin lens by matrix method. (3)

12. (a) Show that the system matrix of an optical system may be written as $\begin{bmatrix} \frac{1}{m} & -a \\ 0 & m \end{bmatrix}$, where m is the linear magnification of the system. (3)

(b) What are the advantages and disadvantages of (i) Huygens eye-piece (ii) Ramsden's eye-piece. (2+2)

(c) The focal lengths of a glass lens for red and violet lights are 100 cm and 96.8 cm respectively. Find the dispersive power of glass (3)

13. (a) Consider the equation $\frac{d^2 y}{dx^2} + W^2 y = 0$. Since zero is an ordinary point x of this differential equation, obtain a power series sol^n around zero. - (4)

(b) Expand $\frac{1}{x-3}$ in a Taylor series about the point $x=1$. What is the radius of convergence of this series? (3+1)

(c) Prove that all eigen values of a Hermitian matrix are real (2)