VP & RPTP Science College-Vallabh Vidyanagar

BSc Examination [Semester: V] 2018

Subject: Physics Course: US05CPHY02

Physics

Monday, Date 01-10-2018 **Time: 10.00 am to 12.00 pm** **Total Marks: 50**

INSTRUCTIONS:

1 Attempt all questions.
2 The symbols have their usual meaning.
3 Figures to the right indicate full marks.

Q-1 Multiple Choice Questions: [Attempt all] **08**

(i) The condition for orthogonality for curvilinear co-ordinates is

(a) $\frac{\partial r}{\partial u}\cdot\frac{\partial u}{\partial v}=0$ (b) $\frac{\partial u}{\partial r}\cdot\frac{\partial v}{\partial r}=0$

(c) $\frac{\partial r}{\partial u}\cdot\frac{\partial r}{\partial u}=0$ (d) $\frac{\partial r}{\partial u}\cdot\frac{\partial r}{\partial v}=0$

(ii) The matrix of order $n\times m$ is obtained from any matrix A of order $m\times n$, by interchanging its rows and columns is called _____.

(a) Inverse of a Matrix (b) Cofactor of a Matrix

(c) Traspose of a Matrix (d) Adjoint of a Matrix

(iii) $(1-x^2)\frac{d^2y}{dx^2}-2x\frac{dy}{dx}+n(n+1)y=0$ is called

(a) Hermite differential equation (b) Legendre's differential equation

(c) Bessel's differential equation (d) None of these

(iv) The generating function for Bessel's function of the order n is

(a) $e^{\frac{x}{2}(t-1)}$ (b) e^{x}

(c) $e^{\frac{x}{2}(t-\frac{1}{t})}$ (d) $e^{x(t-\frac{1}{t})}$

(v) The diffusion equation or Fourier equation of heat flow is

(a) $\frac{\partial u}{\partial t}=h\nabla^2 u$ (b) $\frac{\partial u}{\partial t}=h^2\nabla^2 u$

(c) $\frac{\partial^2 u}{\partial t^2}=h^2\nabla^2 u$ (d) $\frac{\partial u}{\partial t}=h^2\nabla u$

(vi) Shift operator E = _____.

(a) $\nabla+1$ (b) $\Delta-1$

(c) $\Delta+1$ (d) $\delta+1$

(vii) $y=ax^2+bx+c$ is the equation of

(a) Parabola (b) Ellipse

(c) Straight Line (d) None of these

(viii) The backward difference operator ∇ defined as

(a) $\nabla y_i=y_i-y_{i+1}$ (b) $\nabla y_i=y_{i-1}-y_i$

(c) $\nabla y_i=y_i-y_{i-1}$ (d) $\nabla y_i=y_{i+1}-y_i$

Q-2 **Answer the following questions in short. (Attempt any Five)** **10**

(1) Write Laplacian in terms of orthogonal curvilinear co-ordinates.

(2) Define Unit matrix and Null Matrix.

(3) For Bessel's function $J_n(x)$, prove that $xJ_n'(x) = nJ_n(x) - xJ_{n+1}(x)$.

(4) Write Hermite differential equation.

(5) Write sine series for $f(x)$, when $0 \leq x \leq \pi$.

(6) Write telegraphy equation.

(7) Convert $y = ae^{bx}$ in to equivalent equation of a straight line.

(8) Define (i) interpolation and (ii) extrapolation.

Q-3 **(a)** Derive expression of gradient in terms of orthogonal curvilinear system. **6**

(b) If $u = x + 4, v = y - 5, w = z + 3$, show that u, v *and* w are orthogonal. **2**

OR

Q-3 **(a)** Prove that the product of sets of two triads of mutually orthogonal vectors are reciprocal to each other. **6**

(b) Write expression for $\nabla\emptyset$ in terms of curvilinear co-ordinate system. **2**

Q-4 Derive the series solution of Legendre differential equation in the form of descending power of x. **8**

OR

Q-4 Derive the series solution of Bessel's differential equation in the form of ascending power of x. **8**

Q-5 Define Fourier series and Derive the expression of Fourier series for a periodic function $f(x)$ in the interval $(-\pi, \pi)$. **8**

OR

Q-5 Obtain Fourier series for $f(x) = x \cdot \sin x$ in the interval $-\pi < x < \pi$. show that $\frac{\pi}{4} = \frac{1}{2} + \frac{1}{1\cdot3} - \frac{1}{3\cdot5} + \frac{1}{5\cdot7} - \cdots$ **8**

Q-6 Derive Newton's backward difference interpolation formula and evaluate $f(48)$ from the following table of values. **8**

x	10	20	30	40	50
$y = f(x)$	46	66	81	93	101

OR

Q-6 Using Simpson's 1/3 rule find the approximate value of $I = \int_0^{\pi} cosx\, dx$ by dividing the range of integration into ten equal parts. What is the analytical value of $I = \int_0^{\pi} cosx\, dx$ **8**