

T.Y.B.SC. SEM – V (2014 COURSE) : WINTER- 2017
SUBJECT : PHYSICS: MATHEMATICAL METHODS FOR PHYSICS

Day : Monday
 Date : 23/10/2017

W-2017-0640

Time : 12.00 NOON TO 02.00 PM
 Max. Marks : 40.

N.B.:

- 1) All questions are **COMPULSORY**.
- 2) Figures to the **RIGHT** indicate full marks.
- 3) Use of electronic calculator/ log table is allowed

Q.1 Answer any **TWO** of the following: **(10)**

- a) Explain length contraction and time dialation.
- b) Obtain Einstein's mass energy relation.
- c) Show that $p'_{n+1}(x) + p'_{n-1}(x) = 2xp'_n(x) + p_n(x)$.

Q.2 Answer any **TWO** of the following: **(10)**

- a) for spherical polar co-ordinate system.

$$x = r \sin\theta \cos\phi$$

$$y = r \sin\theta \sin\phi$$

$$z = r \cos\theta$$

Verify the mutual orthogonally of $\frac{\partial \vec{r}}{\partial r}, \frac{\partial \vec{r}}{\partial \theta}, \frac{\partial \vec{r}}{\partial \phi}$.

- b) Obtain the expressions for curl and Laplacian in cylindrical co-ordinate system.
- c) Prove that $H_{n+1}(x) = 2x H_n(x) - 2n H_{n-1}(x)$.

Q.3 Answer any **TWO** of the following: **(10)**

- a) Using the method of separation of variables, convert the following one-dimensional heat equation into two ordinary differential equations.

$$\frac{\partial \psi}{\partial t} = \alpha^2 \Delta^2 \psi \quad \text{where } \phi = \phi(x, y, z, t), \alpha^2 = \text{constant.}$$

- b) Show that the point $x = 0$ is a regular singular point of the Bessel differential equation.
- c) Show that $P_n(0) = 0$, when 'n' is odd and

$$P_n(0) = (-1)^{n/2} \cdot \frac{1.3.4.7.....(n-1)}{2^{n/2} (n/2)!} \quad \text{when 'n' is even}$$

Q.4 Answer any **FIVE** of the following: **(10)**

- a) Find the order and degree of an equation,

$$\sqrt[3]{\frac{d^2 y}{dx^2} + \frac{dy}{dx} + xy^2} = 0.$$

- b) State Fuch's theorem.
- c) Prove that $J_0'(x) = -J_1(x)$.
- d) Write the generating function of
 - i) Legendre polynomials
 - ii) Hermite polynomials
- e) At what speed is a particle moving if the mass is equal to three times its real value.
- f) Explain the negative result of Michelson-Morley experiment.
- g) Define (i) co-ordinate surface (ii) co-ordinate liner.

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