

T.Y.B.SC. SEM – V (CBCS - 2016 Course) : SUMMER - 2019
SUBJECT : PHYSICS – MATHEMATICAL METHODS IN PHYSICS

Day : Wednesday
 Date : 10/04/2019

Time 11.00 A.M. To 02.00 P.M.
 Max. marks : 60

S-2019-0855

N.B.

- 1) All questions are **COMPULSORY**.
- 2) Figures to the **RIGHT** indicate **FULL** marks.
- 3) Draw neat diagram **WHEREVER** necessary.

Q 1. Attempt any **Two** of the following. **(12)**

- (a) Obtain unit vectors in cylindrical co-ordinates in terms of Cartesian co-ordinate
- (b) Solve by series solution method around $x=0$ of the differential equation

$$2x^2y'' - xy' + (x - 5)y = 0$$
- (c) Represent $\vec{A} = y\hat{i} - z\hat{j} + x\hat{k}$ in spherical polar co-ordinate .Hence calculate A_r, A_θ, A_ϕ .

Q 2. Attempt any **Two** of the following. **(12)**

- (a) Separate the variable in three dimensional Helmholtz equation in Cartesian co-ordinate

$$\nabla^2 \varphi + k\varphi = 0$$
- (b) Show that $x = \infty$ is an essential singular of the differential equation

$$x^2y'' + xy' + (x^2 - n^2)y = 0$$
- (c) Prove that $P'_{n+1}(x) - P'_{n-1}(x) = 2xP'_n(x) + P_n(x)$

Q 3. Attempt any **Two** of the following. **(12)**

- (a) Explain Michelson Morley experiment
- (b) In spherical polar co-ordinate system $x = r\sin\theta\sin\phi, y = r\sin\theta\cos\phi, z = r\cos\theta$ verify the mutual orthogonality of $\frac{\partial \vec{r}}{\partial r}, \frac{\partial \vec{r}}{\partial \theta}, \frac{\partial \vec{r}}{\partial \phi}$
- (c) Explain length contraction on the basis of Lorentz transformation

Q 4. Attempt any **Three** of the following. **(12)**

- (a) Find the work required to increase speed of electron from 1.5×10^8 to 2.7×10^8 m/s .
- (b) Prove that spherical polar co-ordinate system is orthogonal.
- (c) Using the generating function of Hermite polynomial $g(x, t) = e^{2xt-t^2} = \sum_{n=0}^{\infty} H_n(x) \frac{t^n}{n!}$ Find the values of $H_0(x), H_1(x), H_2(x)$.
- (d) Show that square of length element in spherical polar co-ordinate is $dl^2 = dr^2 + (r \sin \theta d\phi)^2$.

Q 5. Attempt any **Four** of the following. **(12)**

- (a) The rest mass of electron is 9.1×10^{-31} kg. What will be its mass if it were moving with $(4/5)^{\text{th}}$ times the speed of light.
- (b) A certain particle has lifetime of 10^{-7} sec when measured at rest. How far does it go before decaying, if its speed is $0.99C$ when it is created.
- (c) Prove that i) $P_n(1) = 1$ ii) $P_n(-1) = (-1)^n$
- (d) Draw neat labeled diagram of volume element in spherical polar co-ordinates
- (e) Write the transformation equation in cylindrical co-ordinates in terms of Cartesian co-ordinates.
- (f) Define degree and order of differential equation.

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