Day	:	Wednesday	**Time :** 03.00 P.M. To 06.00 P.M
Date	:	10/10/2018	**Max. marks : 60**

W-2018-0737

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) Find the series solution of the differential equation $x y'' + (1 - x)y' + \lambda y = 0$
  (b) In spherical polar co ordinate system $x = r\sin\theta\sin\varnothing$, $y = r\sin\theta\cos\varnothing$, $z = r\cos\theta$
  Verify the mutual orthogonality of $\dfrac{\partial \vec{r}}{\partial r}$, $\dfrac{\partial \vec{r}}{\partial \theta}$, $\dfrac{\partial \vec{r}}{\partial \varnothing}$
  (c) Explain whether the point at $x = \infty$ is an ordinary point or singular point of differential equation $y'' - 2 x y' + 2 \lambda y = 0$

Q 2. Attempt any **Two** of the following. (12)
  (a) Prove that $P'_{n+1}(x) = (n - 1)P_n(x) + x P'_n(x)$
  (b) Explain length contraction on the basis of Lorentz transformation
  (c) Given that A(x=2, y=3, z= -1) and B(r=4, θ=25^0, φ=120^0) Find (i) spherical polar co-ordinate of A and (ii) Co-ordinate of B in Cartesian co-ordinate system

Q 3. Attempt any **Two** of the following. (12)
  (a) Obtain expression for velocity in spherical polar co-ordinate system
  (b) Find the unit vector in spherical polar co-ordinate in terms of Cartesian co-ordinate .
  (c) Explain Michelson Morley experiment

Q 4. Attempt any **Three** of the following. (12)
  (a) Prove that $J_n(x) = (-1)^n J_n(-x)$
  (b) Find work required to be done to increase speed of electron from 1.5×10^8 m/s to 2.7×10^8 m/s
  (c) Obtain volume element in cylindrical co-ordinate .
  (d) Considering generating function $g(x,t) = (1 - 2xt + t^2)^{-1/2} = \sum_{n=0}^{\infty} P_n(x)t^n$
  Obtain $P_0(x)$, $P_1(x)$, $P_2(x)$.

Q 5. Attempt any **Four** of the following. (12)
  (a) What is increase in relativistic mass of particle of rest mass 1 gm when it is moving with velocity 0.8C ? Hence find its kinetic energy.
  (b) Draw neat labeled diagram of volume element in spherical polar co-ordinate.
  (c) At what speed will be mass of proton become double of its rest mass.
  (d) Write equations for gradient, divergence and Laplacian in cylindrical co-ordinate.
  (e) Prove that Pn (1) = 1.
  (f) Define degree and order of differential equation.

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