LOYOLA COLLEGE (AUTONOMOUS), CHENNAI–600 034.
M.Sc. DEGREE EXAMINATION – MATHEMATICS
FOURTH SEMESTER – APRIL 2003
MT 4801/ M 1026 MECHANIES – II

16.04.2003
1.00 – 4.00 Max: 100 Marks

Answer ALL the questions

01. a) Explain the term 'ABERRATION'. Also derive the relativistic formula

for aberration in the form $\tan\alpha' = \dfrac{\sin\alpha}{\beta\left(\cos\alpha - \dfrac{v}{c}\right)}$ *where* $\beta = \dfrac{1}{\sqrt{1-\dfrac{v^2}{c^2}}}$ (8)

(OR)

b) Show that the operator $\equiv \dfrac{\partial^2}{\partial x^2} + \dfrac{\partial^2}{\partial y^2} + \dfrac{\partial^2}{\partial z^2} - \dfrac{1}{c^2}\dfrac{\partial^2}{\partial t^2}$ is an invariant for Lorentz transformation. (8)

02. a) State 'ETHER' Hypothesis. Explain the Michelson– Morley experiment and give the conclusion. (17)

(OR)

b) Show that Lorentz transformations forma group . (17)

03. a) Obtain the transformation formula for mass in the form $m' = m\dfrac{\left(1-\dfrac{v^2 u_x}{C^2}\right)}{\sqrt{1-\dfrac{v^2}{C^2}}}$ (8)

(OR)

b) If a body of mass m disintegrates while at rest in to two parts of rest masses m_1 and m_2, show that the energies E_1 and E_2 of the parts are given by $E_1 = \dfrac{C^2}{2m}\left(m^2 + m_1^2 - m_2^2\right)$ *and* $E_2 = \dfrac{C^2}{2m}\left(m^2 - m_1^2 + m_2^2\right)$ (17)

04. a) Derive the equation $E = m C^2$, Deduce that $p^2 - \dfrac{E^2}{C^2}$ is an invariant under Lorentz transformation. (17)

(OR)

b) Obtain the transformation formula for force components in the

$$form \quad F'x = Fx - \frac{\frac{v}{C^2}}{\left(1 - \frac{vu_x}{C^2}\right)}\left(u_y F_y + u_z F_z\right)$$

$$F'y = \frac{F_y\sqrt{1-\frac{v^2}{C^2}}}{\left(1-\frac{vu_x}{C^2}\right)} \quad and \; F'z = \frac{F_z\sqrt{1-\frac{V^2}{C^2}}}{\left(1-\frac{vu_x}{C^2}\right)} \qquad (17)$$

05. a) Explain 'contravariant vectors', covariant vectors, 'contravariant tensors' and 'covariant tensors'. (8)

(OR)

b) If a vector has components, on cartesion coordinates then the components in polar coordinates are and if the components be then the polar coordinates components are (8)

06. a) Define fundamental tensors and show that $g_{\mu\gamma}$ is a Covariant tensor of rank two. Also transform $ds^2 = dx^2 + dy^2 + dz^2$ in polar and cylindrical coordinates. (17)

(OR)

b) Define Christoffel's 3–index symbols of the first and second kind. Also calculate christoffel's symbols corresponding to the metric $ds^2 = dr^2 + r^2d\theta^2 + r^2\sin^2\theta\, d\phi^2$. (17)

07. a) Define ‘Energy Tensor’. Show that the equationfor $\mu = 4$ gives the equation of continuity in Hydrodynamics. (8)

(OR)

b) Obtain isotropic polar coordinates and Cartesian coordinates. Also Deduce that the velocity of light at distance r_1 from the origin is

(8)

08. a) Obtain the schwarzchild line element in the neighbourhood of an attracting particle

in the from (17)

(OR)

b) Derive the differential equation to the planetary orbits in the

form . (17)

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