



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION - MATHEMATICS

FOURTH SEMESTER – APRIL 2013

MT 4813 - RELATIVISTIC MECHANICS

Date : 03/05/2013
Time : 1:00 - 4:00

Dept. No.

Max. : 100 Marks

Answer ALL the questions

- 01.a.** i. What is Relativity?
ii. Explain the meaning of absolute quantities with examples.
iii. Is relativistic energy is absolute constant?
iv. Who and when Relativistic Transformation was set up?
v. On what principles the Lorentz transformations are based?

OR

Define Aberration and determine the relativistic value of Aberration -5 marks

- b.** Discuss about Michelson-Morley experiment.

OR

Derive the Lorentz transformations -15 marks

- 02 .a.** i. State the transformation formula for Mass
ii. What is the nature of $P^2 - \frac{E^2}{c^2}$ under Lorentz transformation
iii. What is the rest mass of a light photon?
iv. What types of energies are included in $E = mc^2$?
v. Every point in MINSKOWSKI is called -----

OR

Discuss about the concept of Minkowski space -5 marks

- b.** Derive the relativistic equation for mass and momentum.

OR

Derive the relativistic equations of motion and energy. -15marks

- 3. a** If $g_{ij} = 0$ for $i \neq j$, then

i). $\{ij, k\} = \dots$ ii). $\{jj, i\} = \dots$ iii). $\{ij, j\} = \dots$ iv). $\{ii, i\} = \dots$ v). $g_{ij} g^{ij} = \dots$

OR

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If $A_{\gamma\mu}$ is an anti - symmetric tensor, prove that $(B_{\gamma}^{\mu} B_{\tau}^{\sigma} + B_{\tau}^{\mu} B_{\gamma}^{\sigma}) A_{\mu\sigma} = 0$

-5 marks

b. Transform $ds^2 = dx^2 + dy^2 + dz^2$ in to $ds^2 = dr^2 + r^2 d\theta^2 + dz^2$ and express it in terms Christoffel symbol

OR

Obtain the transformation laws for Christoffel symbols and show that these symbols are not tensors. Show that the covariant derivatives of g_{ij} , g^{ij} and δ_j^i vanish identically.

-15 marks

04. a. i. The example for flat space is

ii. An enclosure at an infinite distance where there is no effect of gravity is pulled by a rope with uniform acceleration equal to that of gravity. What we observe ?

iii. The condition for the space time to be flat is ----

iv. What is gravitational mass

v. What is permanent gravitational fields.

OR

Derive the necessary and sufficient condition for flat space.

-5 marks

b. Obtain the equation of the geodesic for the metric $ds^2 = -e^{-2kt}(dx^2 + dy^2 + dz^2) + dt^2$.

OR

Derive the equation determining the Geodesic.

-15 marks

05. a. i. The third law of Kepler is ---

ii. What is Perihelion

iii. What is Isotropic polar co-ordinate

iv. The tensor of the matter is ---

v. Each planet describes an -----

OR

Derive Isotropic polar co- ordinate

-5 marks

b. Derive the advance of Perihelion .

OR

Derive the differential equation to the planetary orbits in the form

$$\frac{d^2u}{d\phi^2} + u = \frac{m}{h^2} + 3mu^2, \quad \text{where} \quad r^2 \frac{d\phi}{ds} = h.$$

-15 marks