 LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**M.Sc.** DEGREE EXAMINATION - **MATHEMATICS**

FOURTH SEMESTER – **APRIL 2012**

# MT 4813 - RELATIVISTIC MECHANICS

Date : 23-04-2012 Dept. No. Max. : 100 Marks

Time : 1:00 - 4:00

**Answer ALL the questions and each question carries 20 marks.**

1. **a**. i.what is Relativity?

ii..Explain the meaning of absolute quantities with examples.

iii..Is relativistic energy is absolute constant?

iv. Explain why Michelson-Morley experiment should be repeated during nights and days and

during all seasons of the year?

v. What do you understand by Relativistic effects?

**OR**

**b.** i. What is the rest frame of a moving body?

ii .If two events are simultaneous in a reference frame S, will they also be simultaneous in another

reference frame S’ moving with constant velocity relative to S ?

iii. If velocity of light in a frame S is v = c, what will be the velocity of light in the frame S’.

iv. What is the rest mass of a light photon?

v. What types of energies are included in E= mc2 ?

-6 marks

**c**. Derive the Lorentz Transformations

**OR**

**d**. i. Define Aberration and determine the relativistic value of Aberration and deduce its

classical value.

ii. Discuss about Doppler’s effect. –14marks

**02 .a**. Derive the transformation formula for force.

**OR**

**b.** Derive the relativistic equations of motion and energy. -6 marks

**c**. Discuss the concept of Minkowski space and Space-like and Time-like intervals.

**OR**

**d.** i.Prove that  is invariant under Lorentz transformation.

ii.If a moving particle has velocities u and u’ in the frame S and S’ respectively. Prove that

 -14marks

**3.a.** **OR**

**b.** If Bij = A i,j - A j,i, prove that B ij,k +B jk,i + B ki,j = 0.

–6 marks

**c.** Transform ds2 = dx2 + dy2 + dz2  into ds2 = dr2 + r2 dθ2 +dz2 and express it in terms

Christoffel symbol.

**OR**

**d.** i. State the Rigorous Quotient Law with an Illustration.

ii. A quantity A (p,q) is such that A(p,q)Bqs= Cps where Bqs is an arbitrary tensor and Cps is a

tensor. Show that A(p,q) is a tensor. What is its type?

-14marks

4.**a**. Derive Einstein’s law of gravitation in empty space.

**OR**

**b**. Discuss about the principle of equivalence

–6marks

**c.** Derive the equation of Geodesic in the form



**OR**

**d**. Obtain the equation of the Geodesic for the metric ds2 = -e-2kt (dx2 + dy2 + dz2 ) + dt2.

–14marks

5.**a**. Prove that the Isotrophic polar coordinates in the form 

**OR**

**b**. Discuss about Material energy tensor.

–6marks

**c**. Derive the deflection of light in passing through gravitational field in the neighborhood of the

sun.

**OR**

**d**. Derive the differential equation to the planetary orbits in the form 

where .

–14marks