 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