

B.Sc. (with Credits)-Regular-Semester 2012 Sem VI
B.Sc.4531 - Mathematics- II Paper- II
(Special Relativity - II) (Optional)

P. Pages : 2

Time : Three Hours



GUG/W/16/5648

Max. Marks : 60

- Notes : 1. Solve all the **five** questions.
2. Each question carries equal marks.

UNIT - I

1. a) Show that : 6
i) $a_{mn}x^m x^n = 0$ for skew symmetric tensor a_{mn} .
ii) If A^{rs} is a skew symmetric tensor & B_{rs} is symmetric then $A^{rs}B_{rs} = 0$.
b) Show that, if A_{rs} and B_m^{pq} are tensor, then $A_{rs} B_m^{pq}$ is a tensor. 6

OR

- c) Let A_{rst}^{pq} be a tensor. Choosing $p=t, q=s$ show that A_{rst}^{pq} is also a tensor. What is its rank? 6
d) Prove that $A_{rs} B^r C^s$ is an invariant, if B^r and C^r are contravariant vector and A_{rs} is a covariant tensor of order two. 6

UNIT - II

2. a) Prove that $\int_{mn}^m (\ln\sqrt{g})_{,n}$ OR $(\ln\sqrt{-g})_{,n}$ for $g < 0$. 6
b) Prove that, geodesics are auto-parallel curves. 6

OR

- c) Show that : 6
i) The covariant derivatives g_{mn}, g^{mn} & δ_n^m vanish.
d) Prove that, the divergence of the Einstein tensor vanishes i.e. $G_{n;m}^m = 0$ or $G^{nm}_{;m} = 0$ 6

UNIT - III

3. a) Prove that $E = c\sqrt{p^2 + m_0^2 c^2}$ and $\frac{dE}{dP} = u$ 6
b) Obtain the transformation for the four momentum vector. 6

OR

- c) Show that $p^2 - E^2/c^2$ is invariant whose numerical value is $-m_0^2 c^2$. 6
- d) Show that for a single particle moving in a conservative force field independent of velocity, the function $L = -m_0 c^2 \sqrt{1 - u^2/c^2} - V$ is the suitable Lagrangian to get the relativistic equation of motion where V is the P.E. which depends on x_i . 6

UNIT - IV

4. a) Obtain the wave equation for the propagation of electric & magnetic field strengths. 6
- b) Obtain the Lagrangian L for a charged particle in electromagnetic field. 6

OR

- c) Show that the second set of Maxwell's equation $\frac{\partial f^{ik}}{\partial x^k} = 0$ 6
- d) Show that an electromagnetic field is purely magnetic in an inertial frames. Describe the field in inertial frame S^1 . 6

5. Solve **any six**.

- a) Define a Riemannian metric. 2
- b) Define contraction in a tensor. 2
- c) Define Ricci tensor & Einstein tensor. 2
- d) Define Christoffel's symbols of first and second kind. 2
- e) Find velocity of particle so that its mass appears to increase by 50% of its rest mass. 2
- f) Define four force & prove that four velocity of a particle is a unit timelike vector. 2
- g) Show that T^{ij} is symmetric. 2
- h) Prove that energy momentum tensor of electromagnetic field is tracefree. 2
