

B.Sc. - III (CBCS Pattern) Semester-VI
021C - (DSE-VIII) Mathematics Paper-IV : Special Relativity-II

P. Pages : 2

Time : Three Hours



GUG/S/25/13362

Max. Marks : 60

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

UNIT – I

1. a) Consider a mixed tensor T_{nrs}^m of order four then show that T_{nrs}^n is a tensor of order two. 6
- b) Show that gradient of a scalar is a covariant vector. 6

OR

- c) Show that any tensor of the second order (covariant/contravariant) may be expressed as the sum of a symmetric tensor and a skew-symmetric tensor. 6
- d) Show that if A_{rs} and B_m^M are tensors, $A_{rs}B_m^M$ is a tensor. 6

UNIT – II

2. a) Show that $g_{,r}^{mn} = -g^{ms}\Gamma_{sr}^n - g^{sn}\Gamma_{sr}^m$ 6
- b) Write down the line elements in various coordinate systems. 6

OR

- c) Show that the divergence of the Einstein tensor vanishes i.e., $G_{n;m}^m = 0$ or $G_{;m}^{nm} = 0$ 6
- d) Show that $R_{rsmn}X^mX^n = 0$ and $R_{rsmn}X^mX^n = 0$ 6

UNIT – III

3. a) There exists an inertial system S' in which the two events occur at one and the same time if the interval between two events is spacelike. 6
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- b) Deduce the transformations for an antisymmetric four tensor T^{rs} 6

OR

- c) Prove that $E = c\sqrt{p^2 + m_0^2c^2}$ and $\frac{dE}{dp} = u$ 6
- d) Show that the energy momentum tensor is not uniquely defined. 6

UNIT – IV

4. a) Explain the Maxell's equations of electromagnetic theory in vacuum and propagation of electric and magnetic field strength. 6

b) Show that the Hamiltonian for a charged particle moving in an electromagnetic field is 6

$$H = \left\{ m_0^2 c^4 + c^2 \left(p - \frac{e}{c} A \right)^2 \right\}^{1/2} + e\phi$$

OR

c) Suppose that on electromagnetic field is purely magnetic in an inertial frame S. Describe the field in inertial from S'. 6

d) Show that the tensor $\frac{\partial F_{ij}}{\partial x^k} + \frac{\partial F_{jk}}{\partial x^i} + \frac{\partial F_{ki}}{\partial x^j}$ is totally antisymmetric in I, j, k. 6

5. Solve **any six** questions.

a) Define the inner product of tensor. 2

b) Define the completely symmetric tensor. 2

c) Define Christoffel symbols. 2

d) Write the two kinds of Christoffel symbol. 2

e) Define the four force. 2

f) Define the proper time. 2

g) State the Transformations of the electromagnetic four potential vector. 2

h) Define the electromagnetic field tensor F_{ij} . 2
