B.Sc.-III CBCS Pattern Semester-VI

021C - Mathematics Paper-IV (DSE-VIII) : Special Relativity-II

P. Pages : 2 **GUG/W/23/13362**

Time : Three Hours * 6 7 5 8 * Max. Marks : 60

Notes : 1. Solve all the questions.
2. Each question carry equal marks.

UNIT – I

1. a) Show that any covariant tensor of the second order may be expressed as the sum of symmetric & skew symmetric tensor. **6**

b) Show that if A^m, Bnrs are tensors then A^m Bmrs is also a tensor. **6**

OR

c) Show that $\frac{dg}{g} = g^{mn} dg_{mn} = -g_{mn} dg^{mn}$ **6**

d) Show that an element of volume $g^{\frac{1}{2}} dx^1 dx^2 - - - - dx^N$ is invariant. **6**

UNIT – II

2. a) Show that $g_r^{mn} = -g^{ms} \left\lceil \overline{sr}^n - g^{sn} \right\lceil \overline{sr}^m$. **6**

b) Compute the nonvanishing Christoffel symbols of second kind for **6**
$ds^2 = dr^2 + r^2 d\theta^2 + r^2 \sin^2 \theta d\phi^2$

OR

c) Prove that $\frac{\delta A}{\delta u} = \frac{dA}{du}$ for a scalar A. **6**

d) Show that under a linear transformation of a coordinate system **6**
$x^m = a_n^m \; x'^n + b^m, a_n^m, b^m$ are constants, the Christoffel symbols are tensors.

UNIT – III

3. a) Obtain the transformation equations for mass. **6**

b) Obtain the transverse & longitudinal mass. **6**

OR

c) A particle is given a kinetic energy equal to n times its rest energy m_oC^2 what are its speed & momentum? **6**

d) Find the expression for four velocity in component form. **6**

UNIT – IV

4. a) Obtain wave equation for propagation of magnetic field strength. **6**

b) Obtain expression for transformation of charge density. **6**

OR

c) Show that the energy momentum tensor of electromagnetic field is trace free. **6**

d) Prove that: $\bar{E}' \cdot \bar{H}' = \bar{E} \cdot \bar{H}$ & $E'^2 - H'^2 = E^2 - H^2$. **6**

5. Solve **any six**:

a) Define the inner product of tensors. **2**

b) Define the contraction of tensor. **2**

c) define Christoffel symbols. **2**

d) Show that $\delta^m_{n;r} = 0$ **2**

e) Show that $P^2 - E^2/C^2 = -m_o^2C^2$ **2**

f) Define the four force. **2**

g) State the Lorentz gauge condition. **2**

h) Define the electromagnetic field tensor Fij. **2**

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