M.Sc. Math (F)

Sub. : Relativity & Cosmology

Time Allowed : 3 Hour Max. Marks : 100

Attempt any five questions in all

UNIT- I

Q.1 (a) Write short notes on the following:-

(i.) Lorentz contraction factor

(ii.) Velocity of light as fundamental velocity

(b) What is Relativistic aberration & deduce it to Newtonian theory.

OR

Q.2 (a) Derive transformation formula for velocities.

(b) Derive Transformation formula for particle acceleration.

UNIT- II

Q.3 (a) Derive lagrangian & Hamiltonian explosion of Relativistic.

(b) What is Relativity & Causality.

OR

Q.4 (a) If a body of mass disintegrates while at rest into two parts of test masses m_1 & m_2

show that energies E_1 & E_2 are given by -

$$E_1 = C^2 \frac{m^2+{m_1}^2-{m_1}^2}{2m}$$

$$E_2 = C^2 \frac{m^2-{m_1}^2+{m_2}^2}{2m}$$

(b) At what speed should a clock be moved that it may appear to lose 1 minute in each hour.

(c) The rest mass of an electron is 9×10^{-28} gms. Find its mass if it were moving with velocity $\frac{4}{5}$ times the speed of light.

Q.5 Derive Schwarzschild exterior metric its isotropic form.

OR

Q.6 (a) Prove that $GM = C^2$m where G is gravitational constant, M the mass of attractive particle & in the constant ousting in Schwarzschild exterior solution.

(b) Derive differential Relativistic equation for orbit of planet.

UNIT- IV

Q.7 Name the three crucial tests in general relativity & derive test.

OR

Q.8 What is second crucial test in general relativity. Derive explosion for it.

UNIT- V

Q.9 (a) Show that following are .....invariant

(i) $\vec{E}^2 - \vec{H}^2$

(ii) $\vec{E}' \vec{H}$

(b) Prove expression for perfect fluid.

OR

Q.10 What are static cosmological models. Write geometrical & physical properties of Einstein universe.

Biyani's Group of Girls' Colleges

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UNIT- I

1. (a) Derive special Lorentz transformation equations.

   (b) What are the consequences of Lorentz transformation ? Derive expressions of each consequence.

OR

2. (a) If u & v are two velocities in the same direction & V their resultant velocity given by $\tan h^{-1}\frac{V}{c} = \tan h^{-1}\frac{u}{c} + \tan h^{-1}\frac{V}{c}$ then deduce the law of composition of velocities from this equation.

   (b) Show that $x^2 + y^2 + z^2 - c^2t^2$ is Lorentz invariant.

   (c) If u & u' are the velocities of a particle in two inertial systems s & s' respectively where S' les velocity v relative to S in X-direction. Show that :-

$$u^2 = \frac{u'^2 + v^2 + 2u'v\cos\theta - \left(\frac{u'v}{c}\sin\theta'\right)^2}{\left(1 + \frac{u'v}{c^2}\cos\theta'\right)^2}$$

Where θ' is the angle which u' makes with $x - a$xis.

UNIT- II

3. (a) Theorem variation of mass with velocity prove that $m = \frac{mo}{\sqrt{1-\frac{u^2}{c^2}}}$

Where 'u' is the velocity of the particle when its mass is m & mo is mass of the particle when it is at test.

   (b) Derive transformation formula for mass.

OR

4. (a) Theorem : equivalence of mass & energy.
Show that $E = mc^2$
Where E is the energy of particle.

(b) Derive transformation formula for momentum & energy.

UNIT- III

5. (a) Write short note on following :-
(i) Principle of Equivalence
(ii) General connivance
(iii) Mach's Principle
(iv) Geodesic postulate

OR

6. (a) Derive equation of motion for Newtonian approximation.
(b) Reduce the Enstein's field equation to poisson's equation.

UNIT- IV

7. (a) What is fourth test in general relativity derive expression for it.
(b) If ρ be the co-ordinate density of matter then prove that energy momentum tensol T^{ii} is given as

$$T^{ij} = \rho \frac{dx^i dx^j}{dt^{dt}}$$

OR

8. (a) Derive Schwarzschild internal solution in general relativity.
(b) What do you mean by analogous of kepler's law .

9. (a) Derive lorentz invariance of maxwell's equation & their tensor form

OR

(b) Write short notes on the following :-
(i) Hubble's law
(ii) Weyl's Postulate

(iii) Cosmology
(v) Lorentz Maxwell equation