Roll No. : .....

Total No. of Questions : **11**] [Total No. of Printed Pages : **3**

AFMA–274

M.A./M.Sc. (Final) Examination, 2023

MATHEMATICS

Paper – Opt.-IX

(Relativity and Cosmology)

*Time : **3** Hours*] [*Maximum Marks : **100***

Section–A **(Marks : 2 × 10 = 20)**

Note :– Answer all *ten* questions (Answer limit **50** words). Each question carries **2** marks.

Section–B **(Marks : 4 × 5 = 20)**

Note :– Answer all *five* questions. Each question has internal choice (Answer limit **200** words). Each question carries **4** marks.

Section–C **(Marks : 20 × 3 = 60)**

Note :– Answer any *three* questions out of five (Answer limit **500** words). Each question carries **20** marks.

Section–A

1. (i) Define Lorentz and Fitzgerald contraction.

   (ii) Define proper time.

   (iii) What do you mean by world point and world lines ?

(iv) Define null cone.

(v) Define Mach's principle.

(vi) Define Energy Momentum tensor.

(vii) Explain the statement that the mass of sun which is 1.99×10^{33} gms becomes in gravitational units 1.47 kilometers.

(viii) Write three laws of Kepler.

(ix) Write Cosmological principle.

(x) State Weyl's postulate.

Section–B

2. Write postulates of special theory of relativity and show that :

$$x^2 + y^2 + z^2 - c^2t^2$$

is Lorentz invariant.

Or

Write a short note on Time Dilation.

3. Write a short note on Minkowski's four dimensional continuum.

Or

Prove that :

$$p^2 - \frac{E^2}{C^2}$$

is Lorentz invariant.

4. Write a short note on principle of Equivalence.

Or

What do you understand by Isotropic co-ordinates ?

5. Discuss the phenomenon of red shift in general relativity.

Or

Derive the formula for energy momentum tensor for perfect fluid in the form :

$$T_j^i = (f + p)v_i v^j - g_j^i p$$

6. Write a short note on Hubble's law.

Or

Show that $E^2 - H^2$ is Lorentz invariant.

Section–C

7. Define aberration and derive the relativistic formula for aberration. Also determine classical value of aberration from the relativistic formula.

8. Prove that :

$$m = \frac{m_0}{\sqrt{1 - \frac{u^2}{c^2}}}$$

where u is the velocity of body when its mass is m and m_0 in the mass of the body at rest.

9. Show that the relativistic orbit of a planet round the sun is given by :

$$\frac{d^2u}{d\phi^2} + u = \frac{m}{h^2} + 3mu^2$$

10. Show that the deflection in the path of a light due to the relativistic field of a heavy mass in twice that predicted by the Newtonian theory.

11. Discuss the motion of a test particle in De-Sitter's universe.