FD-615

M.A./M.Sc. 3rd Semester
Examination, Dec.-Jan., 2021-22

MATHEMATICS

Optional (B)

Paper - III

General Relativity and Cosmology

Time : Three Hours] [*Maximum Marks* : 80

Note : Answer any **two** parts from each question. All questions carry equal marks.

Unit-I

1. (*a*) Define intrinsic derivatives and obtain differential equation for the Geodesic.

(*b*) State and prove the Quotient law of tensors.

(*c*) Prove that :

(*i*) $dg_{\alpha\beta} = -g_{\mu\alpha}\, g_{\nu\beta}\, dg^{\mu\nu}$

(*ii*) $A^{\alpha\beta}\, dg_{\alpha\beta} = -A_{\alpha\beta}\, dg^{\alpha\beta}$

(*iii*) $\frac{dg}{g} = -g_{\mu\nu}\, dg^{\mu\nu}$

Unit-II

2. (*a*) Discuss symmetric properties of covariant curvature tensor and show that there are twenty independent components in 4-dimensional space time.

(*b*) Derive Bianchi identity and contract it to find Einstein's tenor.

(*c*) State and prove the necessary and sufficient condition for flat space time.

Unit-III

3. (*a*) Find Newtonian equations of motion in case of weak static field.

(*b*) Obtain Einstein's law of gravitation of the material world which deduce some of its consequences.

(*c*) Derive field equation (in empty space) from Lagrangian density.

Unit-IV

4. (*a*) Derive Schwarzschild exterior solution for an entirely empty world.

(*b*) Show that the relativistic orbit of a plant round the sun is given by

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

(*c*) Prove that the deflection of light passing near the surface of the sun according to general relativity is twice the predicted by Newtonian theory.

Unit-V

5. (*a*) Obtain field equations in Electromagnetic field.

(*b*) Discuss in detail about Einstein-Maxwell equation.

(*c*) Derive Reissner-Nordstrom solution for gravitational field of point charged mass.

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