Ex/M.Sc/M/B1.17/36/2017

MASTER OF SCIENCE EXAMINATION, 2017

(2nd Year, 1st Semester)

MATHEMATICS

Unit - 3.4 (B1.17)

(General Theory of Relativity and Cosmology - I)

Full Marks : 50 Time : Two Hours

The figures in the margin indicate full marks.

Answer any *five* questions. 10×5=50

1. Derive the Einsteins Equation from variational principle. 10

2. Find the weak field approximation of Einstein Equations. 10

3. (a) What is the killing equations and killing vectors ?

   (b) Find the killing vectors for the metric

$$ds^2 = d\theta^2 + \sin^2\theta d\phi^2 .$$ 3+7

4. Show that in general spacetime, causal future, $J^+(p)$ is neither open nor closed set. Define full domain of dependence with example. 6+4

[*Turn over*]

5. Define stable causality. Show that a space time (M, g_{ab}) is stably causal if there exists a differentiable function f on M s.t $\nabla^a f$ is a past directed time like vector field. 10

6. Explain Penrose diagram of Minkowski spacetime. 10

7. Define with example of cauchy surface. Give an example of a space time which is not globally hyperbolic. Show that future cauchy horizon, $H^+(S)$ is achronal and closed.

3+2+5

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