

## DEPARTMENT OF SCIENCES, II SEMESTER M.Sc END SEMESTER EXAMINATIONS - 2019 PHY 5204: GENERAL RELATIVITY AND COSMOLOGY (REVISED CREDIT SYSTEM)

Time: 3 Hours MAX. MAR		KS: 50	
Answo 1 A 1 B 1 C	er all the questions Show that four-velocity and four-acceleration are orthogonal Show that geodesic is an auto-parallel curve Obtain the equations for geodesic on a spherical surface with constant radius	3 M 3 M 4 M	
2 A	Obtain the equations for particle and photon orbits in Schwarzschild space-time	5 M	
2 B	Explain the precession of the planetary orbits with necessary equations	3 M	
2 C	Explain gravitational red-shift with necessary equations	2 M	
3 A 3 B	Obtain the values of $\Gamma_{ij}^{k}$ in Schwarzschild space-time Using the values of $\Gamma_{ij}^{k}$ obtained in the question 3A, find all the non-	5 M 5 M	
4 A 4 B 4 C	Obtain Tolman-Oppenheimer-Volkoff equation State first and second law of black hole physics Describe the features of Kruskal-Szekeres diagram	4 M 2 M 4 M	
5 A 5 B 5 C	Obtain Killing equation for space-time symmetry Describe big bang nucleosynthesis and the role of neutron-proton ratio and baryon-photon ratio Describe the features of Friedmann models for flat, open and closed universe with necessary equations	3 M 3 M 4 M	
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## **Useful Information**

$$\Gamma_{ij}^{k} = \frac{1}{2} g^{kl} \left[ \frac{\partial g_{il}}{\partial x^{j}} + \frac{\partial g_{jl}}{\partial x^{i}} - \frac{\partial g_{ij}}{\partial x^{l}} \right]$$

$$\mathbf{R}_{ijl}^{k} = \left[\frac{\partial \Gamma_{il}^{k}}{\partial x^{j}} - \frac{\partial \Gamma_{ij}^{k}}{\partial x^{l}} + \Gamma_{mj}^{k} \Gamma_{il}^{m} - \Gamma_{ml}^{k} \Gamma_{ij}^{m}\right]$$