Reg.No. | | | | | | | | | |

DEPARTMENT OF SCIENCES, IV SEMESTER M.Sc. (Physics)
END SEMESTER EXAMINATIONS, APRIL 2023
General Relativity & Cosmology [PHY 6202]
(CHOICE BASED CREDIT SYSTEM – 2020)

Time: 3 Hours   Date: 26-04-2023   MAX. MARKS: 50

Note   (i) Answer ALL questions

   (ii) Draw diagrams, and write equations wherever necessary. Show all steps and substitutions.

   (iii) Any missing data can be suitably assumed

		Marks	CO	BL
1A	Show that dot product of four velocity with itself is Lorentz invariant	2	1	2
1B	Find the Killing vectors for the surface of a unit sphere	4	1	3
1C	Obtain the transformation equation for Christoffel's symbols of second kind	4	1	2
2A	Obtain Bianchi identity	5	1	2
2B	State and prove quotient law of tensors	3	1	2
2C	Describe Hubble's law with necessary equations	2	3	2
3A	An object in motion on a plane has the velocity vector field given by $v^i = (x^2, y^2)$ in Cartesian co-ordinates. Find the **covariant derivative** of the vector field in polar co-ordinates (Given: $\Gamma^1_{22} = -r, \quad \Gamma^2_{12} = \Gamma^2_{21} = 1/r$)	5	1	3
3B	Obtain an expresion for deviation in the path of light due to gravitational field	3	2	2
3C	Decribe cosmological principle and Weyl postulate	2	3	2
4A	Obtain all non-vanishing Chirstoffel symbols of second kind for Schwarzschild metric outside a spherically symmetric, static gravitational field. Show all steps and substitutions.	4	2	3
4B	Using the Christoffel symbols obtained in previous question, obtain R_{00}, R_{11} and R_{22}	3	2	3
4C	Using the components R_{00}, R_{11} and R_{22} obtained in the previous question, find Schwarzschild solution for Einstein's field equation outside a spherically symmetric, static gravitational field	3	2	3
5A	Describe (i) static limit and ergosphere of Kerr blackhole (ii) Kruskal-Szekeres coordinates	4	3	2
5B	Describe Newtonian cosmology with necessary equations	3	3	2
5C	Describe Einstein's model of the universe with necessary equations	3	3	2

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