UPES
End Semester Examination, May 2025

Course: COSMOLOGY
Semester: VIII
Program: B.SC_PHYS (RES.)   **Time** : 03 hrs.
Course Code: PHYS 4046P   **Max. Marks: 100**

Instructions: All questions in Section A are mandatory, while Sections B and C have internal choices in question #9 and question #10, respectively.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Match the **closest** in the following: i. Galilean transformation a. non-inertial too ii. Special theory of relativity b. Light velocity constant iii. Lorentzian transformation c. high velocities iv. General theory of relativity d. time absolute	4	CO1
Q 2	Describe briefly what co-variant and contra-variant vectors are.	4	CO2
Q 3	What is a Euclidean space?	4	CO1
Q 4	Explain what Geodesics are.	4	CO1
Q 5	While 'proper length' and 'proper time' are well heard of, what is 'proper velocity'?	4	CO1

SECTION B
(4Qx10M= 40 Marks)

Q 6	What are 4-vectors and what is their significance in the context of relativity? [Hint: Besides other, ease of handling frames of references.]	10	CO2
Q 7	A train has a rest length of 100 m. Traveling at a very high velocity, it goes through a tunnel of length 80 m. Observers located at both ends of the tunnel note that at one instant the train appears to exactly fit within the tunnel. What is the velocity of the train? Is this real?	7+3	CO4
Q 8	What is Lorentz metric? Analyze its significance in Special Relativity. [Hint: Consider 3 points A, B and C in Minkowski spacetime (X vs ct) and determine spacetime intervals for each pair of these points.]	10	CO3
Q 9	How does the Equivalence Principle relate to the curvature of spacetime in General Relativity? **OR** Analyze the 'seeding' (initial) mechanisms and appraise in detail the formation of galaxies.	10	CO3

	SECTION-C **(2Qx20M=40 Marks)**		
Q 10	Like for 'beings' and 'things', our universe too has a history. Discuss and analyze the different epochs and reconstruct the development of our universe in the Big Bang model. **OR**	**20**	**CO4**
	The Big Bang model is the most celebrated model of our universe. However, it too has weaknesses. Analyze the strengths and shortcomings of this model in detail.	**10+10**	
Q 11	The scale of distances travelled on earth and in cosmos are more than orders of magnitude different. Appraise the concept of 'distance ladder' used to measure distances in cosmos. Also consider in this, those 'ladder steps' which are typically called classical.	**20**	**CO2**