8. (a) What is big bang nucleo-synthesis ? How this helps in verifying the big bang hypothesis? 1+5=6

   (b) Show that in an expanding Universe, the light signal gets red shifted. 8

UNIT - V

9. (a) What are the major constitutions of the present Universe ? Mark their relative abundance in a pi chart. 2+2=4

   (b) Discuss the process of nucleo-synthesis in the Universe. 6

   (c) Classify the different types Supernova and describe how they help in estimating extra-galactic distances. 4

10. Write short notes on : 5+5+4=14

    (1) Dark Energy

    (2) Neutrino Mass

    (3) Gravitational Waves

★★★

PG (CBCS) EVEN SEMESTER EXAMINATION, 2023

PHYSICS

4th Semester

Course No. : PHYCC - 404 A

(Astrophysics - II)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(Answer five questions, taking one from each unit)

UNIT - I

1. Define electromagnetic field tensors. Derive their transformation properties to find the expressions for four potential, electric field and magnetic field, when a charge 'q' moves with uniform velocity. Hence find the expressions for four potential, electric field and magnetic field, when the charge is moving with some arbitrary non-uniform velocity. 2+4+8=14

2. (a) Find the expression for power radiated by an oscillating dipole as a function of azimuthal angle. 7

(b) An electromagnetic wave having wavelength (λ) is scattered by a dipole having natural frequency (λ_o). Show that the scattered intensity varies as $1/\lambda^4$, when $\lambda >> \lambda o$. Does this scattering explain the existence of blue sky? If YES, explain how ? 6+1=7

UNIT - II

3. (a) How can one distinguish planets form the stars on the night sky? Further, how can one distinguish a nebula from the planets and stars on the sky ? What are the physical characteristics of a nebulae ? Describe its different types and justify why a spiral nebulae is a special one. 1+1+2+3=7

(b) Describe the different types of external galaxies in terms of the morphological classifications schemes. 3

(c) Also describe how galaxies can be classified by their energy output and describe its significance. 4

4. Explain the detail features of the rotation curve as observed for our galaxy. Explain how it is different from the rotation curves as observed for a rigid body and a Keplerian body.

Hence make an estimate of missing mass in our galaxy.

Explain with diagram in details the different parts of our galaxy. 5+5+4=14

UNIT - III

5. (a) Define Ricci Tensor, Riemann tensor and Scalar curvature. Discuss how they are related. 6

(b) State and establish Bianchi Identity. 8

6. (a) State the expression for Schwarzschild line element and explain the significance of Schwarzschild radius and event horizon. 2

(b) Derive the expression for Schwarzschild line element from the symmetry consideration. 12

UNIT - IV

7. (a) Starting from the Friedmann equation $\dot{R}^2 = \frac{c}{R} - Kc^2$ show that the universe had zero spatial extent at the beginning assuming a dusty universe (p=0). 9

(b) Define particle horizon. What is horizon problem in cosmology and how can the idea of an initial accelerated phase sort out the problem. 1+2+2=5