

M.Sc.-II (Mathematics) (New CBCS Pattern) Semester - IV
PSCMTH19B - Optional Paper : Cosmology

P. Pages : 2

Time : Three Hours



GUG/S/23/13771

Max. Marks : 100

- Notes : 1. Solve all **five** questions.
2. All questions carry equal marks.

UNIT – I

1. a) Explain **10**
i) Einstein Universe
ii) De sitter universe
b) Explain Doppler shift in Einstein universe **10**

OR

- c) Explain Doppler shift in de sitter universe. **10**
d) Explain Weyl hypothesis. **10**

UNIT – II

2. a) Discuss the properties of the R-W model. **10**
b) Show that the spatial extent of **10**

$$ds^2 = -e^{g(t)} \left[\frac{dr^2}{1 - \frac{r^2}{a^2}} + r^2 d\theta^2 + r^2 \sin^2 \theta d\phi^2 \right] + dt^2$$

At any given time is the whole three dimensional spherical surface

$(x^1)^2 + (x^2)^2 + (x^3)^2 + (x^4)^2 = a^2$ embedded in the four dimensional Euclidean space

(x^1, x^2, x^3, x^4)

OR

- c) To show that the quantity $\frac{1}{a^2}$ in **10**

$$ds^2 = -e^{g(t)} \left[\frac{dr^2}{1 - \frac{r^2}{a^2}} + r^2 d\theta^2 + r^2 \sin^2 \theta d\phi^2 \right] + dt^2$$

Is the Riemannian curvature of the spatial extent at any given time t.

- d) Show that the RW model gives rise to the doppler shift in frequency of light emitted by distance object. **10**

UNIT – III

3. a) Discuss the fundamental equations of dynamical cosmology. **10**
- b) Explain age of the universe & show that the inverse of Hubble's constant gives the age of the universe. **10**

OR

- c) Discuss Friedmann closed model $k = 1$. **10**
- d) Show that for the closed isotropic model $ds^2 = a^2 (1 - \cos \tau)^2 \left[-d\alpha^2 - \sin^2 \alpha (d\theta^2 + \sin^2 \theta d\phi^2) + d\tau^2 \right]$, the matter density of distribution varies as inverse square of time and the cube of the radius of universe as square of time for $\tau \ll 1$. **10**

UNIT – IV

4. a) Explain parallax & parallax distance. **10**
- b) Explain Apparent luminosity & luminosity distance. **10**

OR

- c) Explain Angular diameter & angular diameter distance. **10**
- d) Explain proper motion & proper motion distance. **10**
5. a) Explain special relativity universe. **5**
- b) Write a short note on Hubble's law. **5**
- c) Write a short note on the matter dominated era of the universe. **5**
- d) Explain the light paths. **5**
