2025

(NEP—2020)

(5th Semester)

MATHEMATICS (MAJOR3/MINOR)

(Astronomy)

Full Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

(SECTION : A—OBJECTIVE)

(*Marks* : 10)

Put a Tick ☑ mark against the correct answer in the box provided : 1×10=10

1. The sides of spherical triangle are

(a) less than 180° ☐ *(b)* greater than 180° ☐

(c) equal to 180° ☐ *(d)* None of the above ☐

2. Each angle of a spherical equilateral triangle is

(a) equal to 60° ☐ *(b)* greater than 60° ☐

(c) less than 60° ☐ *(d)* None of the above ☐

3. Obliquity of ecliptic is equal to

(a) 30° ☐ *(b)* 60° ☐

(c) 45° ☐ *(d)* 23°27 ☐

4. The zenith Z is the pole of

(a) ecliptic ☐ *(b)* horizon ☐

(c) celestial equator ☐ *(d)* None of the above ☐

5. Hour-angle of the zenith is

(a) 180° ☐ *(b)* 90° ☐

(c) 60° ☐ *(d)* 0° ☐

6. On summer solstice, longitude of the sun is

(a) 0° ☐ *(b)* 90° ☐

(c) 180° ☐ *(d)* 270° ☐

7. The difference between local mean time and hour-angle of the mean sun is

(a) 6 hours ☐ *(b)* 9 hours ☐

(c) 12 hours ☐ *(d)* 18 hours ☐

8. At a place of latitude 45° (north) azimuth A of star of declination 30° when rising is

(a) 30° ☐ *(b)* 45° ☐

(c) 60° ☐ *(d)* 90° ☐

9. If the observed zenith distance of a star is z, then the parallax of the star varies as

(a) $\sin z$ ☐ *(b)* $\cos z$ ☐

(c) $\sin 2z$ ☐ *(d)* $\tan z$ ☐

10. During solar eclipses the moon must be in

(a) conjuction ☐ *(b)* opposition ☐

(c) quadrature ☐ *(d)* None of the above ☐

(SECTION : B—SHORT ANSWERS)

(*Marks* : 15)

Answer *five* questions, taking at least *one* from each Unit : 3×5=15

UNIT—I

1. In a right angled spherical triangle ABC, A 90°, then show that

$\cos a$ $\cos b \cos c$

2. Show that in spherical equilateral triangle ABC, $\sec A \quad 1 \quad \sec a$.

UNIT—II

3. A star of declination 30° is observed to attain an altitude of 45° on the prime vertical. What is the latitude of the place of observation?

4. If a is the sun's altitude in the prime vertical at a place in latitude and L is its longitude, then prove that $\sin^{1}(\sin L \sin \quad \operatorname{cosec} a)$.

UNIT—III

5. If the declination of the sun be 12°30 N, find the lowest latitude at which twilight lasts all night.

6. Define equation of time.

UNIT—IV

7. Show that the resolved part of aberration of a star along any great circle arc B, where $B \quad 90°$ is $k \cos AB$. A being apex and k coefficient of aberration.

8. Show that the parallax in declination of a planet observed from a place in latitude vanishes, if $\tan \quad \tan^{1} \cos h$; and h being the planet's declination and hour-angle.

(SECTION : C—DESCRIPTIVE)

(*Marks* : 50)

Answer *five* questions, taking at least *one* from each Unit : 10×5=50

UNIT—I

1. *(a)* If A and A be angles of an equilateral triangle and its polar triangle respectively, then prove that $\cos A \quad \cos A \quad \cos A \cos A$. 5

(b) If D be the middle point of AB of a spherical triangle ABC, then show that

$$\cos a \quad \cos b \quad 2\cos\frac{c}{2}\cos CD$$

5

2. *(a)* In a spherical triangle ABC, show that

$$\sin b \sin c \quad \cos b \cos c \cos A \quad \sin B \sin C \quad \cos B \cos C \cos a$$ 5

(b) Show that in a spherical equilateral triangle ABC, $1 \quad 2\cos a \quad \cot^2 \frac{A}{2}$. 5

UNIT—II

3. Two stars ($_1$, $_1$) and ($_2$, $_2$) have same longitude. Prove that

$$\sin(\ _1 \quad \ _2) \quad \tan \quad (\cos \ _1 \tan \ _2 \quad \cos \ _2 \tan \ _1)$$ 10

4. *(a)* If z_1 and z_2 are zenith distances of a star on the meridian and on the prime vertical respectively, then prove that cot cosec z_1 sec z_2 cot z_1. 5

(b) At what latitude the sun sets at 4 PM (of apparent solar time) at the solar solstice? 5

UNIT—III

5. *(a)* If H be the hour-angle of the sun at rising, then show that

$$2\cos^2 \frac{H}{2} \quad \text{sec} \quad \text{sec} \quad \cos(\quad) \text{ and } \tan^2 \frac{H}{2} \quad \frac{\cos(\quad)}{\cos(\quad)}$$ 5

(b) In north latitude 45°, the greatest azimuth of a star is 45° (east or west). Prove that the star's declination is 60° N. 5

6. Derive Cassini's formula for atmospheric refraction. 10

UNIT—IV

7. Find the effect of aberration on right ascension and declination . 10

8. *(a)* Where must a star be situated so that effect of the annual parallax is greatest? When is it greatest? 5

(b) Show that $p \quad P \sin z$, where z = observed zenith distance, p = geocentric parallax and P = horizontal parallax. 5

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