

2021
(JUNE)

MATHEMATICS
HONOURS

MAT-312

(Optional-Spherical Trigonometry and Astronomy)

Theory

Full Marks: 50

*The figures in the margin indicates full marks for the questions
Answer all the questions.*

1. Choose and rewrite the correct answer for each of the following:

1x5=5

- a) In a spherical triangle ABC , the sum $A+B+C$ is
- i) greater than 0 and less than π
 - ii) greater than π and less than 2π
 - iii) greater than 2π and less than 3π
 - iv) equal to π
- b) The spherical excess (E) of a spherical triangle ABC is
- i) $A + B + C + \pi$
 - ii) $A + B + C + \frac{\pi}{2}$
 - iii) $A + B + C - \pi$
 - iv) $A + B + C - \frac{\pi}{2}$
- c) The sun is at the first point of Libra on the
- i) Vernal equinox
 - ii) Autumnal solstice
 - iii) Winter solstice
 - iv) Summer solstice
- d) The right ascension of the sun on the 23rd September is
- i) 0°
 - ii) $23^\circ 27'$
 - iii) 90°
 - iv) 180°
- e) The area of a spherical quadrilateral $ABCD$ is
- i) $(A + B + C + D - \pi)r$
 - ii) $\left(A + B + C + D - \frac{\pi}{2}\right)r^2$
 - iii) $(A + B + C + D - 2\pi)r^2$
 - iv) $(A + B + C + D - 2\pi)r^2$

2. Write very short answer for each of the following:**1x6=6**

- Write the sine formula in a spherical triangle.
- Name the two kinds of parallax
- Distinguish between annual aberration and diurnal aberration.
- What is the spherical excess of a spherical triangle ABC ?
- What is Earth's way?
- What is precession?

3. Write short answer for any three of the following:**3x3=9**

- In any equilateral spherical triangle ABC , show that

$$\sec A = 1 + \sec \alpha$$
- State Kepler's three laws of planetary motion.
- In a spherical triangle ABC in which angle C is a right angle, prove that

$$\sin(c + a) \sin(c - a) = \sin^2 b \cos^2 a = \cos^2 A \sin^2 c,$$
- Show that the sum of the three sides of a spherical triangle is less than the circumference of a great circle.
- Deduce Kepler's third law from Newton's law of gravitation.

4. Answer any two questions:**6x2=12**

- In any spherical triangle ABC , Show that

$$\frac{\sin(a + b)}{\sin c} = \frac{\cos A + \cos B}{1 - \cos C}$$
- State and prove a cotangent formula in a spherical triangle.
- In a spherical triangle ABC , prove that

$$\cos a = \cos b \cos c + \sin b \sin c \cos A$$

5. Answer any one question:**6x1=6**

- If two stars (α, δ) and (α_1, δ_1) rise at the same moment at a place in latitude ϕ , show that

$$\cot^2 \phi \sin^2(\alpha_1 - \alpha) = \tan^2 \delta + \tan^2 \delta_1 - 2 \tan \delta \tan \delta_1 \cos(\alpha_1 - \alpha).$$
- Two stars (α_1, δ_1) and (α_2, δ_2) have the same longitude; prove that

$$\sin(\alpha_1 - \alpha_2) = \tan \epsilon (\cos \alpha_1 \tan \delta_2 - \cos \alpha_2 \tan \delta_1).$$

6. Answer any one question.**6x1=6**

- Find the coefficient of refraction by Bradley's method.
- What do precession and nutation have in common? Explain the physical cause of nutation.

7. Answer any one question.**6x1=6**

- Show that the apparent path of a star on account of aberration is an ellipse.
- Discuss the right ascension and declination due to geocentric parallax where earth is taken as spheroid.
