

**Indian Maritime University**  
**(A Central University, Govt of India)**

**End Semester Examinations – December 2025**

**Programme Name: B Sc (NS)**

**Semester: I**

**Subject Code: UG21T6102**

**Subject Name: MATHEMATICS**

Date: 09.12.2025

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.
- (iii) Non-programmable calculators are permissible for use.

**Section A**

**Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.**

1. Which of the following is a characteristic of a great circle on a sphere?  
A) It is smaller than all other circles on the sphere.  
B) It has its center at the center of the sphere.  
C) It is always parallel to the equator.  
D) It is a type of small circle.
2. What characterizes a quadrantal spherical triangle?  
A) It has four sides.  
B) It has a side measuring 90 degrees.  
C) It is smaller than other spherical triangles.  
D) It has a angle measuring 90 degrees.
3. The area of sector which subtends and angle of  $60^\circ$  at center of circle whose radius is 18 cm is  
A)  $148 \text{ cm}^2$   
B)  $214 \text{ cm}^2$   
C)  $169.71 \text{ cm}^2$   
D)  $175.05 \text{ cm}^2$
4. An ellipse is defined as the locus of all points in a plane for which a specific condition is met. What is this condition?  
A) The difference between the distances from any point on the curve to two fixed points is constant.

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- B) The distance from any point on the curve to a fixed point and a fixed line are equal.
- C) The product of the distances from any point on the curve to two fixed points is constant.
- D) The sum of the distances from any point on the curve to two fixed points (the foci) is constant.
5. Median and Mode for data: 4, 4, 6, 8, 10 are
- A) 4 and 8 respectively
- B) 6 each
- C) 4 and 6 respectively
- D) 6 and 4 respectively
6. If  $P(A) = 0.6$  and  $P(B) = 0.5$ , and A and B are independent events, then  $P(A \cap B)$  is
- A) 0.11
- B) 0
- C) 0.3
- D) 1
7. For Interpolation with unequal intervals, which of the following methods is used?
- A) Newton's forward interpolation
- B) Newton's backward interpolation
- C) Lagrange's interpolation formula
- D) Simpson's formula
8. Adding two vectors, the resultant vector will be smallest in magnitude when the vectors are?
- A) Parallel to each other
- B) Perpendicular to each other
- C) At a 45-degree angle to each other
- D) In opposite direction to each other
9. A key principle of trigonometry states that the values of trigonometric ratios for a specific angle
- A) depend only on the length of the perpendicular side.
- B) increase as the lengths of the triangle's sides increase.
- C) remain the same, regardless of the triangle's side lengths.
- D) are only valid for triangles with a hypotenuse of length 1.
10. To find the height 'h' of a tree, an observer measures the distance from the base as 'x' and the angle of elevation to the top as  $\theta$ . Which formula should be used?
- A)  $h = x \cdot \cos \theta$
- B)  $h = x \cdot \tan \theta$
- C)  $h = x \cdot \sin \theta$
- D)  $h = x / \tan \theta$
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### Section B

#### Five Questions of 02 Marks each

11. Express  $35^{\circ}15'30''$  into Radians.
12. In a spherical triangle AVM, if sides  $v=92^{\circ}$ ,  $m=51^{\circ}55'$  and angle  $V=91^{\circ}$ . Using Sine rule calculate the acute angle M.
13. If a cylinder have radius=2 cm and height= 7 cm. Find the curved surface area and total surface area.
14. A bag contains 4 white and 5 black balls. If a man draws 3 balls at random, without replacement, what is the probability that all three are black ?
15. Explain Newton's Backward difference interpolation formula.

### Section C

#### Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. a) In a spherical triangle PQR, side  $p = 16^{\circ}$ , side  $q = 37^{\circ}$ , and angle  $R = 42^{\circ}$ . Find Q?  
b) In spherical triangle PZX, Right angled at Z, side  $p = 110^{\circ} 20'$  and side  $z = 84^{\circ} 12'$ . Find the value of P, X. **[5+5 Marks]**
17. a) An archway is in the shape of semi-ellipse, the road level being the major axis. If the breadth of the road is 28m and the height of the arch is 5m at a distance 2m from the side, find the greatest height of the arch.  
b) Find the equation of the circle which touches both the coordinate axes and passes through the point (1, 2). **[5+5 Marks]**
18. a) The angle of elevation of the top of a tower from a point A at the foot of the tower is  $30^{\circ}$ . And after advancing 150mtrs towards the foot of the tower, the angle of elevation becomes  $60^{\circ}$ . Find the height of the tower?  
b) If you are onboard a ship approaching a coastline. A lighthouse is located at the shore and is 50 meters tall. You are standing on the ship's deck, which is 10 meters above sea level. You spot the top of the lighthouse at an angle of elevation of  $2.5^{\circ}$ . Use trigonometric identities to calculate the horizontal distance from the ship to the lighthouse. If the angle of elevation increases to  $5^{\circ}$ , recalculate the distance. Discuss what this indicates about the ship's movement. **[5+5 Marks]**
19. a) During a 7-day voyage, the daily fuel oil consumption (in tonnes/day) of a container vessel was recorded as follows: `28, 32, 30, 29, 35, 31, 30`. As the ship's officer in charge of fuel management: Calculate the mean, variance, and

standard deviation of daily fuel consumption. Interpret what the variance and SD indicate about the stability of engine performance and voyage planning.

b) Compute the mode of the given data set:

C.I.	1000-3000	3000-5000	5000-7000	7000-9000	9000-11000	11000-13000	13000-15000	15000-17000	17000-19000	19000-21000
Freq.	50	110	162	100	83	45	25	15	8	2

[5+5 Marks]

20. a) For the following table of values, estimate  $f(7.5)$

x	1	2	3	4	5	6	7	8
y = f(x)	1	8	27	64	125	216	343	512

b) Using the data below, evaluate  $\int_0^{60} y \, dx$  using Simpson's 1/3<sup>rd</sup> rule.

x	0	10	20	30	40	50	60
y = f(x)	30	31.63	33.44	35.47	37.75	40.33	43.25

[5+5 Marks]

21. a) Prove that  $\sqrt{\frac{1-\sin\theta}{1+\sin\theta}} = \sec\theta - \tan\theta$

b) In spherical triangle PQR,  $PQ = 52^\circ 11'$ ,  $Q = 69^\circ 47'$  and  $QR = 90^\circ$ . Calculate P, R.

[5+5 Marks]

22. a) A toy is in the form of a cone mounted on a hemisphere of diameter 7cm. The total height of toy is 15.5 cm. Find the total surface area and volume of the toy.

b) During a port state control inspection 60% of vessels are cargo ships, 25% are tankers, and 15% are passenger ships. Probability that a ship has safety defective is Cargo ship = 0.1, Tanker = 0.2, Passenger ship = 0.05. Find a randomly selected ship is found with safety defective. What is the probability that it is a tanker?

[5+5 Marks]