

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

Sep/Oct'25 SE

Programme Name: B Sc {Nautical Science}

Semester: I

Subject Code: UG21T5102

Subject Name: Mathematics

Date: 06.10.2025

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) Use of scientific calculator is permitted.

Section A

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

1. A right spherical triangle has an angle $C=90^\circ$, $a=50^\circ$ and $c=80^\circ$. find the angle B
 - a) 45.33°
 - b) 78.66°
 - c) 77.87°
 - d) 75.89°
2. When the plane passes through the centre of the sphere, the circle is defined as
 - a) small circle
 - b) great circle
 - c) hemisphere
 - d) diameter
3. The first, second and third derivatives of a cubic polynomial $f(x)$ at $x=1$ are 1^3 , 2^3 and 3^3 respectively. Then the value of $f(0)+f(1)-2f(-1)$ is ?
 - a) 76
 - b) 86
 - c) 126
 - d) 41.5
- 4) The degree of the homogeneous function $w = \frac{x+2y+3z}{x^8+y^8+z^8}$ is,
 - a) 7
 - b) -7
 - c) 8
 - d) -8

5) If $u = x^3 + y^3$ then $\frac{\partial^2 u}{\partial x \partial y}$ is equal to,

- (a) -3 (b) 3
(c) 0 (d) $3x+3y$

6. A vector field which has a vanishing divergence is called a

- a) solenoidal field b) rotational field
c) hemispheroidal field d) irrotational field

7. what is the value of $\Gamma(1/2)$?

- a) $\sqrt{\pi}$ b) $\sqrt{\pi}/\sqrt{2}$ c) $\sqrt{\pi}/2$ d) $\pi/2$

8) If $\beta(n, 3) = \frac{1}{3}$ and n is a positive integer, then n =

- (a) 1 (b) 2
(c) 3 (d) 4

9. Find the eigen vector for value of $\lambda = -2$ for the given matrix $A = \begin{bmatrix} 3 & 5 \\ 3 & 1 \end{bmatrix}$

- a) $\begin{bmatrix} 0 \\ -1 \end{bmatrix}$ b) $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$ c) $\begin{bmatrix} -1 \\ -1 \end{bmatrix}$ d) $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$

10. If A is a 3×5 matrix then the rank of A^T is at most

- a) 4 b) 2 c) 5 d) 3

Section B

Five Questions of 02 Marks each

11. In a spherical triangle ABC, angle C = 90° angle B = 30° side AB = 70° find side AC

12. State the supplementary theorem of polar triangle.

13. Show that the area between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ is $\frac{16}{3}a^2$

14. If W is the set of 2×2 matrices of the form $\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$, show that W is a subspace of space V of all 2×2 matrices.

15. Prove that $\nabla r^n = nr^{n-2} \vec{r}$ $\vec{r} = xi+yj+zk$

Section C

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

16. (i) In spherical triangle PZX, side $z=70^{\circ}45'$ side $x=62^{\circ}10'$ and side $p=46^{\circ}19'$
find angles P,Z,X (5Marks)

(ii) In spherical triangle ABC, angles $A=81^{\circ}24.3'$, $B=61^{\circ}31.7'$, $C=102^{\circ}58'$
calculate sides a,b,c (5Marks)

17.(i) In spherical triangle ABC if $a=49^{\circ}8'$, $b=58^{\circ}23'$ and $c=71^{\circ}20'$ find A and B
using four part formula (5Marks)

(ii) In spherical triangle NBC, $N=40^{\circ}44'$, $n=36^{\circ}13'$ and $C=90^{\circ}$ find b and B using
Napier's rule (5Marks)

18a) Prove that $\beta(m, n) = \int_0^{\infty} \frac{x^{m-1}}{(1+x)^{m+n}} dx$. Hence evaluate $\int_0^{\infty} \frac{x^{10}-x^{18}}{(1+x)^{30}} dx$.
(5Marks)

18b) Evaluate $\int_0^1 \int_{y^2}^1 \int_0^{1-x} (x) dz dx dy$
(5Marks)

19.(i) If $\vec{r}=xi+yj+zk$ show that (a) $\nabla \cdot \vec{r}=3$ (b) $\nabla \times \vec{r} = 0$ (5Marks)

(ii) Show that $\text{div}(\text{grad } r^n) = \nabla^2 r^n = n(n+1)r^{n-2}$ (5Marks)

20. (i) Express $\int_0^{\frac{\pi}{2}} \sqrt{\tan \theta} d \theta$ in terms of gamma function (5Marks)

(ii) Prove that $\beta(m, \frac{1}{2}) = 2^{2m-1} \beta(m, m)$ (5Marks)

21a) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 1 & 4 \\ 3 & 2 \end{bmatrix}$.
(6Marks)

21b) Evaluate $\int_0^{\infty} x^{1/4} e^{-\sqrt{x}} dx$ (4Marks)

22. Evaluate the following integral by changing the order of integration :

$$\int_0^1 \int_0^{\sqrt{1-x^2}} y^2 dx dy .$$

(10 Marks)

