Indian Maritime University

(A Central University, Govt of India)

Mar/Apr'26 SE
Programme Name: B Sc (NS)

Semester: I

Subject Code: UG21T5102

Subject Name: Mathematics

Date: 11.03.2026	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) Scientific Calculator is permitted.

Section A

Objective type questions/Fill in the blanks(01 Marks Each)

1.Matrix has a value.This statement

a)is always true b)depends upon the matrices c)is false

2.The sum of the squares of the eigen values of $\begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$ is .....

a)10 b)100 c)38

3.If $u=x^y$ then $\frac{\partial u}{\partial y}$ is .....

a)0 b)yx^{y-1} c)$x^y \log x$

4.The sum of the three angles must lie between 180° and 540°.True or False

5.A great circle is .....

6.The first derivative of $e^{-x}x^3$ is.....

7.If an error of 1% is made in measuring its length and breadth the percentage error in the area of a rectangle is .....

a) 0.2% b)0.02% c)2% d)1%

8.The value of $\beta(2,1) + \beta(1,2) is$ .....

a)1 b)2 c)0

9.To change cartesian coordinates (x,y,z) to spherical polar coordinate (r,θ,φ); $dxdydz$ is replaced by .....

10.If the directional derivative of f = ax+by+cz at (1,1,1) has maximum magnitude 4 in direction parallel to x axis then the values of a,b,c are .....

a)(-2,2,2) b)(2,-2,2) c) (2,2,-2)

Section B
Short Answer Type Questions(02 Marks Each)

11.If u=$sin^{-1}(\frac{x+2y+3z}{x^8+y^8+z^8})$ find the value of $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}+z\frac{\partial u}{\partial z}$

12.In spherical triangle PQR,p=62°10.1′ ,q=111°35.2′ ,r=63°33′ Calculate P.

13.If u$\vec{F}=\nabla v$, wher u,v are scalar fields and $\vec{F}$ is a vector field, show that $\vec{F}.curl\,\vec{F}=0$

14.Change the order of integration and hence prove $\int_0^\infty\int_x^\infty \frac{1}{y}e^{-y}dxdy=1$

15.Determine whether the set {t^2+2t-3,t^2+5t,2t^2-4} of vectors is linearly independent.

Section C
Answer five out of seven questions(10 Marks Each)

16. a) Define quadrantal spherical triangles and mention any two properties of the same (5)

b) In spherical triangle PQR, PQ=52°11′ ,Q=69°47′ and QR=90° Calculate P,R and PR (5)

17. a) Define spherical triangle and its properties (5)

b)In spherical triangle WXY ,W=88°24.5′ ,x=98°10′,y=100°09′ find w and X. (5)

18. a) State Leibnitz' theorem (3)

b)If y=$(\sin^{-1}x)^2$ show that $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}-x^2y_n=0$.hence find $(y_n)_0$ (7)

19.a) If =$tan^{-1}\frac{x^3+y^3}{x-y}$ prove that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=\sin 2u$ (4)

b) Find the extreme points of the function $z=x^3+y^3-3axy$ (6)

20.a) Evaluate in terms of gamma function, the integral $\int_0^\infty e^{-x^4}dx$ (5)

b) Find by double integration the areas enclosed by the curve

$a^2y^2=x^3(2a-x)$ (5)

21.a) Find the directional derivative $f=(x x^2+y^2+z^2)^{-1/2}$ at the point P(3,1,2) in the direction of the vector yxi+zxj+xyk (5)

b)If $\bar{r}$ =xi+yj+zk and r=$\bar{r}$ show that div$(\frac{\bar{r}}{r^3})$=0 (5)

22.If $A=\begin{bmatrix} 3 & -1 & -1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ find eigen values and eigen vectors of

a)A^2-2A+I b)A^2 c)$4A^{-1}$ (10)