

Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – December 2022

Programme Name: DNS

Semester: 1

Subject Code: UD11T5101

Subject Name: Applied Mathematics

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Date: 24.12.2022

Max Marks: 70

Duration: 02 Hours

Pass Marks: 35

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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

Choose the correct answer. [01 Mark Each]

- 1. The shortest distance between two points on the surface of the sphere is
  - a. an arc of a small circle.
  - b. an arc of a great circle
  - c. an arc of a small circle or great circle.
  - d. an arc of a small circle and great circle.
- 2. Measure of the side of a spherical triangle is the
  - a. measure of angle subtended by it at the centre of the sphere.
  - b. measure of angle subtended by it at the surface of the sphere.
  - c. measure of angle subtended by it at its poles.
  - d. measure of angle subtended by it at the opposite vertex of the spherical triangle.
- 3. The sum of the three angles of a spherical triangle is
  - a. equal to  $180^\circ$ .
  - b. equal to  $360^\circ$ .
  - c. between  $180^\circ$  and  $540^\circ$ .
  - d. between  $0^\circ$  and  $360^\circ$ .
- 4. The scalar product of the vectors  $5\hat{i} + \hat{j} - 3\hat{k}$  and  $3\hat{i} - 4\hat{j} + 7\hat{k}$  is
  - a. 15
  - b. -15
  - c. 10
  - d. -10

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5. For the parabola  $y^2 = 16x$  the length of the latus rectum is
- 4
  - 16
  - 8
  - 32
6. Two identical cubes each of total surface area of 6 square cm are joined end to end, then the total surface area of the cuboid so formed is
- $12 \text{ cm}^2$
  - $18 \text{ cm}^2$
  - $10 \text{ cm}^2$
  - $8 \text{ cm}^2$
7. Using Simpson's 1/3rd rule by dividing the interval  $[0,4]$  in 4 equal parts, the value of  $\int_0^4 x^3 dx$  is
- 64
  - 27
  - 8
  - 1
8. From a distance 150 feet from the foot of a vertical flagstaff the angle of elevation is found to be  $30^\circ$ , the height of the flagstaff is
- 259.81 feet
  - 86.60 feet
  - 75 feet
  - 300 feet
9. A pump takes 55 minutes to deliver 4400 litres of water. Under similar conditions, how long would it take to deliver 6000 litres of water.
- 50 minutes
  - 100 minutes
  - 75 minutes
  - 65 minutes
10. Given  $(1,6)$ ,  $(3,28)$  and  $(10,231)$ , it is found that the function  $y = 2x^2 + 3x + 1$  passes through the three data points. Your estimate of  $y$  at  $x=2$  is
- 6
  - 15
  - 17
  - 28

### Section B

Solve all the five Questions [02 Marks Each].

11. In a spherical triangle AVM, if sides  $v=92^\circ$ ,  $m=51^\circ55'$  and angle  $V=91^\circ$ . Using Sine rule calculate the acute angle M.

12. Find the values of  $a$  for which the vectors  $3\hat{i} + 2\hat{j} + 9\hat{k}$ ,  $\hat{i} + a\hat{j} + 3\hat{k}$  are perpendicular.

13. For  $\pi = 3.14$ , find the curve surface area of the cone with height 4 cm and radius of the base 3 cm.

14. Prove that  $\frac{1 + \tan A}{1 - \tan A} = \frac{\cot A + 1}{\cot A - 1}$

15.  $y$  varies directly as  $x$ . When  $x=32$ ,  $y=6$ . Find  $y$  when  $x = 48$ .

### Section C

Solve any five out of seven questions. (10 Marks Each)

16. a) In a spherical triangle ABC, if sides  $a=59^\circ18'$ ,  $b=48^\circ32'$  and  $c=77^\circ22'$ . Calculate angle A.

b) In a spherical  $\Delta$  PQR, angles P & Q are  $83^\circ12'$  and  $102^\circ30'$  respectively, side  $r=50^\circ$ . Calculate angle R.

17. a) In spherical triangle PXY, angle  $X=92^\circ5'$ ,  $Y=90^\circ$  and side  $p= 53^\circ20'$ , calculate side  $y$ .

b) Given  $f(0)=2$ ,  $f(1)=3$ ,  $f(2)=12$  and  $f(5)=147$ . Using Lagrange's interpolation estimate  $f(3)$ .

18. a) Find the torque of the force  $4\hat{i} + 2\hat{j} + \hat{k}$  acting at the point  $(5,2,4)$  about the point  $(3, -1,3)$ .

b) Find the constant  $\lambda$  so that the vectors  $2\hat{i} - \hat{j} + \hat{k}$ ,  $\hat{i} + 2\hat{j} - 3\hat{k}$  and  $3\hat{i} + \lambda\hat{j} + 5\hat{k}$  are coplanar.

19. a) Selvi's house has an overhead tank in the shape of a cylinder. This is filled by pumping water from a sump (an underground tank) which is in the shape of a cuboid. The sump has dimensions  $1.57 \text{ m} \times 1.44 \text{ m} \times 95 \text{ cm}$ . The overhead tank has its radius 60 cm and height 95 cm. Find the height of the water left in the sump after the overhead tank has been completely filled with water from the sump which had been full. (Use  $\pi = 3.14$ )

b) The ordinates measured athwartships across a ship at the load water line are (in m) 2.5, 9, 15.5, 20, 21.5, 20.5, 18.5, 12.5, 10.2 and 7.3 respectively and the length is 180m. Find the water plane area by using Simpson's  $3/8^{\text{th}}$  rule.

20. a) Find the equation of circle concentric with the circle  $x^2 + y^2 + 4x + 6y + 11 = 0$  and passing through the point (5,4).

b) Find the equation of the hyperbola whose center is (0, 0), conjugate axis along the x-axis and of length 6 and eccentricity is 2.

21. a) A man is watching from the top of the tower a boat speeding away from the tower. The boat makes the angle of depression of  $60^\circ$  with the man's eye when at a distance of 75 meters from the tower. After 10 seconds the angle of depression becomes  $45^\circ$ . What is the approximate speed of the boat, assuming that it is running in still water?

b) Show that  $\cos^4 A - \sin^4 A + 1 = 2 \cos^2 A$

22. a) Suppose x varies jointly with y and the square root of z. When  $x = -18$ ,  $y = 2$  then  $z = 9$ . Find the value of y when  $x = 10$  and  $z = 4$ .

b) The volume of the sphere varies directly as the cube of its radius. The volume of the sphere is  $36\pi$  cc when the radius is 3 cm. Find the volume of the sphere when the radius is 5 cm.

