M 3528

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B.A. Afsal-Ul-Ulama Degree (CCSS – Reg./Supple./Improv.)
Examination, May 2013
COMPLEMENTARY COURSE IN MATHEMATICS
4C 04 MAT : Numerical Analysis and Vector Calculus

Time : 3 Hours Max. Weightage : 30

1. Fill in the blanks :

a) The angle between 2i – j and j + k is ____________

b) If $\bar{a} = (2x^2y - x^3)\,\bar{i} + (x^2 \sin y)\,\bar{j} + (e^{xy} - x\cos y)\,\bar{k}$, then $\dfrac{\partial^2 a}{\partial x^2}$ = ____________

c) Modulus of 3i + 4k is ____________

d) Relation between a.b and b.a is a.b = b.a. (Wt.1)

Answer **any 6** from the following **(Weightage 1 each)** :

2. Find the real root of $x^3 + x^2 + 3x + 4 = 0$ correct to 4 decimal places, using Newton-Raphson method. Start with $x_0 = -1$.

3. Construct forward difference table for the following values :

x :	0	1	2	3	4	5
f(x) :	0	3	8	15	24	35

4. Apply Jordan's method to solve :

$$x + 2y + z = 8$$
$$2x + 3y + 4z = 20$$
$$4x + 3y + 2z = 16$$

P.T.O.

5. What do you mean by interpolation ? Give some use.

6. Given $\frac{dy}{dx} = \frac{y-x}{y+x} = f(x, y)$ with $y = 1$ when $x = 0$. Find approximately the value of y for $x = 0.1$ by Picard's method.

7. Given the 2 vectors $\overline{A} = 3\overline{i} + 2\overline{j} + 6\overline{k}$, $\overline{B} = 3\overline{i} + 4\overline{k}$. Evaluate d/dt (A + Bt).

8. Reparametrize the curve $R(t) = {t^2}/{2}\ \overline{i} + {t^3}/{3}\ \overline{k},\ 0 \le t \le 2$ in terms of arc length.

9. The position vector of a moving particle is $R = \cos t\left(\overline{i} - \overline{j}\right) + \sin t\left(\overline{i} + \overline{j}\right) + \frac{1}{2}\, t\overline{k}$. Determine acceleration of particle.

10. Find the directional derivative df/ds at (1, 3, – 2) in the direction of $-\overline{i} + 2\overline{j} + 2\overline{k}$ if $f(x, y, z) = x^2 + 2y^2 + 3z^2$. **(6×1=6)**

Answer **any 7** from the following **(Weightage 2 each)** :

11. Using Newton's formula for interpolation, estimate the population for the year 1905 :

Year	**Population**
1891	98, 752
1901	132, 285
1911	168, 076
1921	195, 690
1931	246, 050

12. Calculate the approximate value of $\int_0^{\pi/2} \sin x \, dx$ by Simpson's rule, using 11 ordinates.

13. Solve the following system of equations by Gauss-Seidel iteration method (iterate upto 2 iterations)

$27x + 6y - z = 85$

$6x + 15y + 2z = 72$

$x + y + 54z = 110$

14. Find the inverse of $A = \begin{pmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{pmatrix}$ by Gauss-Jordan method.

15. Use Taylor's series method to solve $dy/dx = x + y$; $y(1) = 0$ numerically upto $x = 1.2$ with $h = 0.1$.

16. a) Find div F, given that $F = e^{xy}\,\bar{i} + \sin xy\,\bar{j} + \cos^2 zx\,\bar{k}$

b) Give an example of a non-constant field with zero divergence.

17. a) If $F = z^2x\bar{i} + y^2z\bar{j} - z^2y\bar{k}$, find curl F.

b) Can you find a vector field whose curl is $x\bar{i}$.

18. a) Let $F(x, y, z) = x^2 y\, i + zj - (x + y - z)\,\bar{k}$. Find $\nabla \times \bar{F}$.

b) If F is a vector field, is $\nabla \cdot (\nabla \times F)$ a scalar field or vector field ? Justify.

19. Show that $\nabla \times (\bar{F} \times \bar{G}) = (\bar{G} \cdot \nabla)\bar{F} - (\bar{F} \cdot \nabla)\bar{G} + (\nabla \cdot \bar{G})F - (\nabla \cdot \bar{F})\bar{G}$.

if $\bar{F}$ and $\bar{G}$ are vector fields.

20. Evaluate $\int_C [3xydx + 3dy + yz\,dz]$, where C is the straight line joining the point (2, 1, 4) to the point (3, 3,4)

(7×2=14)

Answer **any three** from the following : **(Weightage 3 each):**

21. Use Runge-Kutta fourth order method to solve $y' = xy$ for $x = 1.4$. Initially $x = 1$, $y = 2$ (take $h = 0.2$).

22. Find the first and second derivatives of the function tabulated below at the point $x = 1.1$.

x :	1	1 .2	1.4	1.6	1.8	2.0
f(x) :	0	.1280	.5440	1.2960	2.4320	4.00

23. Show that $F = 2xy\,\bar{i} + (x^2 + 1)\,\bar{j} + 6z^2\,\bar{k}$ is conservative, and find a scalar potential ϕ.

24. Compute $\iint F \cdot dS$ where S is the surface of the cube bounded by the planes $x = \pm 1, y = \pm 1, z = \pm 1$, if $F = x^2\,\bar{i} + y^2\bar{j} + z^2\,\bar{k}$. Gauss Jordan

25. Let S be the portion of the paraboloid $z = 9 - x^2 - y^2$ that lies above the plane $z = 0$, and let $F = (y - z)\,\bar{i} - (x + z)\,\bar{j} + (x + y)\,\bar{k}$. Find $\iint_S (\nabla \times F) \cdot n\, dS$. **(3×3=9)**

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