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**Question Paper Code: 91002**

B.E./B.Tech. DEGREE EXAMINATION, NOV 2022

First Semester

Civil Engineering

19UMA102- ENGINEERING MATHEMATICS I

(Common to ALL branches)

(Regulation 2019)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. If  $A = \begin{pmatrix} a & 1 \\ 3 & b \end{pmatrix}$  has Eigen values 2 and -2, then a and b are \_\_\_\_ CO6- U  
(a) 1, -1                      (b) -1, -1                      (c) 1, 1                              (d) -1, 1
2. If 0,3,4 are the Eigen values of a matrix A then  $|A| =$  \_\_\_\_ CO6- U  
(a) 0                              (b) 1                              (c) 2                              (d) 3
3.  $\lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} =$  \_\_\_\_ CO6- R  
(a)  $\theta$                               (b) 2                              (c) 1                              (d) 0
4. The Radioactive decay law states that \_\_\_\_\_ CO6- R  
(a)  $\frac{dN}{dt} = \lambda N$                       (b)  $\frac{dN}{dt} = -\lambda N$                       (c)  $\frac{dN}{dt} = N$                               (d)  $\frac{dN}{dt} = -\lambda / N$
5. If u, v, w are functionally dependent functions of independent variables x, y, z then  $\frac{\partial(u, v, w)}{\partial(x, y, z)} =$  \_\_\_\_ CO6- U  
(a)  $\frac{\partial(x, y, z)}{\partial(u, v, w)}$                       (b) 0                              (c) 1                              (d) -1
6. The stationary points of  $x^2 - xy + y^2 - 2x + y$  is \_\_\_\_\_ CO3- App  
(a) (-1, 0)                      (b) 0, -1)                      (c) (1, 0)                              (d) (0, 1)

7. The value of  $\Gamma\left(\frac{1}{2}\right) =$  \_\_\_\_\_ CO6- U  
 (a)  $\pi$  (b)  $\frac{\pi}{2}$  (c)  $\frac{\sqrt{\pi}}{2}$  (d)  $\sqrt{\pi}$
8.  $\int_0^{\frac{\pi}{2}} \sin^6 x \, dx$  is \_\_\_\_\_ CO4- App  
 (a)  $\frac{\pi}{85}$  (b)  $\frac{3}{256}$  (c)  $\frac{\pi}{32}$  (d)  $\frac{5\pi}{32}$
9.  $\int_0^1 \int_0^2 \int_0^3 dx dy dz$  is equal to CO5- App  
 (a) 2 (b) 3 (c) 4 (d) 6
10. The area of an ellipse is CO6- R  
 (a)  $\pi r^2$  (b)  $\pi r$  (c)  $\pi ab$  (d)  $\pi$

PART – B (5 x 2= 10 Marks)

11. Find the constants a and b such that the matrix  $A = \begin{pmatrix} a & 4 \\ 1 & b \end{pmatrix}$  has 3 and -2 as its Eigen values CO6- U
12. Find  $n^{\text{th}}$  derivative of  $\sin x \cos 3x$  CO6- U
13. If  $u = \frac{x}{y} + \frac{y}{z} + \frac{z}{x}$  find  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z}$  CO3- App
14. Find the value of  $\int_0^1 x^8 (1-x)^5 dx$  CO4- App
15. Evaluate  $\iint xy \, dx \, dy$  over the positive quadrant of the circle  $x^2 + y^2 = a^2$  CO5- App

PART – C (5 x 16= 80 Marks)

16. (a) Using Characteristic equation to the Eigen values and Eigen vectors of  $\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$  CO1- App (16)

Or

- (b) Reduce the Q.F  $x_1^2 + 5x_2^2 + x_3^2 + 2x_1x_2 + 2x_2x_3 + 6x_3x_1$  to a canonical form by an orthogonal Transformation and hence find rank, signature, index and nature. CO1- App (16)
17. (a) (i) Expand  $e^{\sin x}$  by Maclaurin's series up to the term containing  $x^4$  CO2- App (8)
- (ii) A pot of boiling water  $100^\circ\text{C}$  is removed from the fire and allowed to cool at  $30^\circ\text{C}$  room temperature. Two minutes later, the temperature of the water in the pot is  $90^\circ\text{C}$ . What will be the temperature of the water after 5 minutes? CO2- App (8)
- Or
- (b) (i) Find  $n^{\text{th}}$  derivatives of  $\frac{1}{(x^2 - a^2)}$  CO2- App (8)
- (ii) The initial mass of an Iodine isotope was 200g. Determine the Iodine mass after 30 days if the half-life of the isotope is 8 days? CO2- Ana (8)
18. (a) (i) Find the maximum volume of the rectangular parallelepiped that can be inscribed in the ellipsoid  $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ . CO3- App (8)
- (ii) Compute the Jacobian of  $y_1, y_2, y_3$  with respect to  $x_1, x_2, x_3$  if  $y_1 = \frac{x_2x_3}{x_1}, y_2 = \frac{x_3x_1}{x_2}, y_3 = \frac{x_1x_2}{x_3}$  CO3- App (8)
- Or
- (b) (i) Find the extreme values of  $x^3 + y^3 - 3x - 12y + 20$  CO3- App (8)
- (ii) Expand as Taylor's series  $e^x \log(1+y)$  about  $(0,0)$  up to third degree term. CO3- App (8)
19. (a) (i) Compute  $\int_0^{\frac{\pi}{2}} \frac{(\sin x)^{\frac{3}{2}}}{(\cos x)^{\frac{3}{2}} + (\sin x)^{\frac{3}{2}}} dx$  CO4- App (8)
- (ii) Prove that  $\beta\left(m, \frac{1}{2}\right) = 2^{2m-1} \beta(m, m)$  CO4- App (8)
- Or
- (b) Derive the relationship between Beta and Gamma functions CO4- App (16)

20. (a) (i) Using the Triple integration, compute the volume of the Sphere  $x^2 + y^2 + z^2 = a^2$  CO5- App (8)

(ii) Using the double integration, compute the area of the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  CO5- App (8)

Or

(b) (i) Using the Triple integration, compute the volume of the Ellipsoid  $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$  CO5- App (8)

(ii) Change the order of integration and hence evaluate CO5- App (8)

$$\int_0^{4a} \int_{\frac{x^2}{4a}}^{2\sqrt{ax}} xy \, dy \, dx$$