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Question Paper Code: U1M02

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

First Semester

Civil Engineering

21UMA102- ENGINEERING MATHEMATICS I

(Common to ALL branches)

(Regulation 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- The product of the Eigen values of $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is _____. CO1- R
(a) $abcd$ (b) $ad - bc$ (c) a (d) 0
- The equation $|A - \lambda I| = 0$ is called the _____ of the matrix A . CO1- R
(a) Characteristic equation (b) Characteristic polynomial
(c) Eigen value (d) None of the above
- $\lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} =$ _____. CO6- R
(a) θ (b) 2 (c) θ (d) 2
- $\frac{d}{dx} \left(\frac{u}{v} \right) =$ CO2- R
(a) $\frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$ (b) $\frac{v \frac{du}{dx} + u \frac{dv}{dx}}{v^2}$ (c) $\frac{v \frac{du}{dx} / u \frac{dv}{dx}}{v^2}$ (d) $\frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v}$
- The degree of the homogeneous function $u = \frac{x^2 + y^2}{\sqrt{x+y}}$ is _____. CO3- R
(a) 2 (b) 1 (c) $3/2$ (d) 0

6. A point at which $f(x, y)$ has neither maximum nor minimum is called CO3- R
 (a) Saddle point (b) Stationary point (c) Maximum point (d) Minimum point
7. $\int (ax + b)^n dx$ CO4- R
 (a) $\frac{(ax+b)^{n+1}}{a(n+1)}$ (b) $\frac{(ax+b)^{n-1}}{a(n-1)}$ (c) $(ax + b)^n$ (d) $\frac{(ax+b)^n}{an}$
8. $\int \sin^2 x dx =$ CO4- R
 (a) $\frac{x}{2} - \frac{\sin 2x}{4}$ (b) $\cos^2 x$ (c) $x - \frac{\cos 2x}{2}$ (d) $\frac{x}{2} - \frac{\cos 2x}{4}$
9. If $x = r \cos\theta$, $y = r \sin\theta$ then $dx dy =$ _____ CO6- U
 (a) $r dr d\theta$ (b) $dr d\theta$ (c) $r^2 dr d\theta$ (d) $\frac{1}{r} dr d\theta$
10. The area of an ellipse is CO6- R
 (a) πr^2 (b) πr (c) πab (d) π

PART – B (5 x 2= 10 Marks)

11. State Cayley Hamilton Theorem? CO1- R
12. Evaluate CO2- R

$$\lim_{x \rightarrow 1} \frac{x^3 - 1}{x - 1}$$
13. State Euler's theorem. CO3- R
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) Reduce the Quadratic form CO1- App (16)
 $2x_1^2 + 2x_2^2 + 2x_3^2 - 2x_1x_2 - 2x_2x_3 + 2x_3x_1$ to the canonical form through an orthogonal transformation and also find its rank, index, signature and nature.
- Or
- (b) Show that the matrix CO1- App (16)

$$\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$$
 satisfies its own characteristic equation and hence find A^{-1}

17. (a) (i) Find the nth derivative of $\frac{1}{x^2+a^2}$ CO2- App (8)
(ii) Expand $e^{\cos x}$ by Maclaurin's series CO2- App (8)
Or
- (b) Show that $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = n a^{n-1}$ for all relational values of n. CO2- App (16)
18. (a) The temperature $u(x, y, z)$ at any point in space is $u = 400xyz^2$. Find the highest temperature on surface of the sphere $x^2 + y^2 + z^2 = 1$. CO3- Ana (16)
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) Find the relation between Beta and Gamma function. CO4- App (16)
Or
- (b) Evaluate $\int_0^{\frac{\pi}{2}} \cos^m x \sin^n x dx$ CO4- App (16)
20. (a) Find the volume of the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ using integration. CO5- App (16)
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)

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

