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Reg. No:

B.E./B.Tech. DEGREE EXAMINATION, DEC 2021

First Semester

Civil Engineering

15UMA102 – ENGINEERING MATHEMATICS-I

(Common to All Branches)

(Regulation 2015)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. If resistance $R = 1000$ ohms and current $I = 0.2\ A$ then voltage (V) is   CO1- R

    (a) 2000V   (b) 20V   (c) 2V   (d) 200V

2. $1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$ is the standard Macalurin series expansion of   CO1- R

    (a) $sinx$ (b) $\log x$ (c) e^x (d) $(1-x)^{-1}$

3. If $u = \log(\frac{x^3+y^3}{x+y})$ then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is   CO2- R

    (a) 0   (b) 5   (c) 2   (d) None of these

4. If $u = \frac{y^2}{x}$, $v = \frac{x^2}{y}$ then $\frac{\partial(u,v)}{\partial(x,y)}$ is   CO2- R

    (a) -3   (b) 3   (c) 0   (d) 1

5. If $f(2a - x) = -f(x)$ then $\int_0^{2a} f(x)dx =$ CO3- R

   (a) $2\int_0^a f(x)dx$ (b)0   (c) $\int_0^a f(2a - x)dx$ (d) None of these

6. Evaluation of $\int x^{-5}\, dx$ is   CO3- R

   (a) $\frac{x^4}{4} + C$ (b) $-\frac{1}{4\,x^4} + C$ (c) $\frac{x}{2} + C$ (d) None of these

7. The value of $\int_0^b \int_0^a \frac{dxdy}{xy}$ is   CO4- R

   (a) $\log ab$ (b) $\log \frac{a}{b}$ (c) log a log b   (d) $\log a^b$

8. The value of $\int_0^{\frac{\pi}{2}} \int_0^{sin\theta} rdrd\theta$ is   CO4- R

   (a) $\frac{\pi}{2}$ (b) $\frac{\pi}{8}$ (c) π (d) $\frac{\pi}{3}$

9. If one of the eigen value of the matrix A is zero then matrix A is   CO5 R

   (a) singular   (b) nonsingular

   (c) square   (d) None of these

10. Sum of the eigen values of the matrix $\begin{pmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{pmatrix}$ is   CO5 R

    (a) 3   (b) 5   (c) 6   (d) 0

<center>PART – B (5 x 2= 10Marks)</center>

11. Define Ohms law.   CO1- App

12. Find $\frac{dy}{dx}$ given $y sinx = x cosy$.   CO2- App

13. Evaluate $\int x^2\sqrt{x^3 + 1}\, dx$.   CO3- App

14. Sketch roughly the region of integration for $\int_0^1 \int_0^x f(x, y)dx\, dy$.   CO4- App

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15. Prove that if λ is the eigen value of A then $\frac{1}{\lambda}$ is the eigen value do A^{-1}.   CO5- App

<div align="center">PART – C (5 x 16= 80Marks)</div>

16. (a) (i) If $f(x) = xe^x$ then find $f'(x)$ CO1 -App   (4)

    (ii) Evaluate $\lim_{x \to 1} arc \sin\left(\frac{1-\sqrt{x}}{1-x}\right)$ CO1 -App   (4)

    (iii) Find the nth differential coefficient of $(ax + b)^m$ CO1 -App   (8)

<div align="center">Or</div>

   (b) (i).Find y_n if $y = x^{n-1} log x$ CO1 -App   (8)

    (ii)If $y = e^{ax} \sin(bx)$ then prove that   CO1 -App   (8)
         $y_2 - 2ay_1 + (a^2 + b^2)y = 0$

17. (a) (i) Find the Jacobian of   CO2 -App   (8)
         $u = xyz, v = xy + yz + zx, w = x + y + z$
    (ii) Expand $e^x log(1 + y)$ as Taylors series upto second degree   CO2 -App   (8)
        terms.

<div align="center">Or</div>

   (b) (i) Examine $f(x, y) = x^3 + y^3 - 12x - 3y + 20$ for its extreme   CO2 -App   (8)
       values.
    (ii) The temperature T at any point (x, y, z) in a space is   CO2 -App   (8)
        $T = 400xyz^2$. Find the
        highest temperature on the surface of the unit sphere
        $x^2 + y^2 + z^2 = 1$.

18. (a) (i) Find the reduction formula for $\int \sin^n x \, dx$, $n \geq 2$ is an integer.   CO3 -Ana   (8)

    (ii) Define gamma and beta function and derive the relationship   CO3 -U   (8)
        between them

<div align="center">Or</div>

   (b) (i)Evaluate $\int \frac{x^2}{(x-1)^3 (x-2)} \, dx$ CO3 -E   (8)

    (ii) Evaluate $\iint [xy[1 - x - y]^{\frac{1}{2}} \, dx \, dy$, over the lines enclosed by   CO3 -E   (8)
        the lines

        $x = 0, y = 0 \; and \; x + y = 1$in the positive quadrant.

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19. (a) (i) Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx\, dy$ using polar coordinates.   CO4 -E   (8)

(ii) Change the order of integration in $I = \int_0^1 \int_{x^2}^{2-x} xy\, dy\, dx$ and   CO4 -E   (8)

hence evaluate it.

Or

(b) (i) Find the area of the region outside the inner circle $r = 2\cos\theta$ CO4 -App   (8)
and inside the outer circle $r = 4\cos\theta$ by double integration.

(ii) Find the volume of the tetrahedron bounded by the plane   CO4 -App   (8)
$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ and the ordinate axis.

20. (a) (i) Find the eigen values and eigen vectors of $A = \begin{pmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$ CO5 -App   (8)

(ii) Verify Cayley Hamilton Theorem and hence find A^{-1} for   CO5 -App   (8)
$A = \begin{pmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{pmatrix}$

Or

(b) Reduce the quadratic form $2x_1^2 + 6x_2^2 + 2x_3^2 + 8x_1x_3$ into   CO5-Ana   (16)
canonical form using orthogonal transformation and hence find its
rank, index, signature and nature.

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