Reg No.: _____ Name : _____

Jyothi Engineering College(Autonomous)

B. Tech Degree S2 (S) Examination, June 2026 (2025 Scheme)

25MAT202 - MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE - 2

Total Mark: 60 **Total Time: 2hrs 30 min**

CO MARK

PART A

(Answer All Questions. Each question carries 3 marks)

1. Find the critical points of $f(x,y) = x^2 + y^2 + \frac{2}{xy}$. CO1 (3)

2. Find $\frac{dw}{ds}$ at $s = \frac{1}{4}$ of $w = r^2 - r\tan\theta, r = \sqrt{s}, \theta = \pi s$. CO1 (3)

3. Evaluate $\int_0^{\ln 3}\int_0^{\ln 2} e^{x+2y}dydx$. CO2 (3)

4. Evaluate $\int_0^3\int_0^2\int_0^1 xyz\,dx\,dy\,dz$. CO2 (3)

5. Find the domain of $\bar{r}(t) = \sin 2t\hat{i} - 4t\hat{j}$ and the value of $\bar{r}'(t_0)$ at $t_0 = \pi$. CO3 (3)

6. Find the gradient of $f(x,y,z) = y\log(x+y+z)$ at $(-4,5,0)$. CO3 (3)

7. Find $\iint_S \vec{F}.\vec{n}\,dS$ where $\vec{F} = (2x+3z)\hat{i} - (xz+y)\hat{j} + (y^2+2z)\hat{k}$ and S is the surface of the sphere having centre at $(3,-1,2)$ and radius 3. CO4 (3)

8. Use Green's theorem to evaluate $\int_C xdy - ydx$ where C is the circle $x^2 + y^2 = 4$. CO4 (3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module - 1

9. a) Find the local linear approximation L of $f(x,y) = \ln(xy)$ at the point P(1,2). Compute the error in approximation f by L at the point Q(1.01,2.01). CO1 (5)

   b) Verify that $\frac{\partial^2 z}{\partial x \partial y} = \frac{\partial^2 z}{\partial y \partial x}$ for $f(x,y) = \sqrt{x^2+y^2}$. CO1 (4)

OR

10. a) Locate relative extrema of $f(x,y) = xy + \frac{8}{x} + \frac{8}{y}$. CO1 (5)

    b) If $U = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, prove that $x\frac{\partial U}{\partial x} + y\frac{\partial U}{\partial y} + z\frac{\partial U}{\partial z} = 0$ CO1 (4)

Module - 2

11. a) Find the volume of the solid in the first octant bounded by the coordinate planes and the plane $x + 2y + z = 6$. CO2 (5)

    b) Using double integral find the area enclosed by the lines $x = 0, y = 0$ and $\frac{x}{a} + \frac{y}{b} = 1$. CO2 (4)

OR

12. a) Using double integrals find the area between parabolas $y^2 = 4ax$ and $x^2 = 4ay$. CO2 (5)

b) Use triple integration in cylindrical coordinates to find the volume of the solid G bounded above by the cone $z = 6 - \sqrt{x^2 + y^2}$,below the XY-plane and laterally bounded by $x^2 + y^2 = 9$. CO2 (4)

Module - 3

13. a) Show that $\vec{F} = (y^2\cos x + z^3)\,\hat{i} + (2y\sin x - 4)\,\hat{j} + 3xz^2\hat{k}$ is irrotational and hence find the scalar potential. CO3 (5)

b) Find the maximum directional derivative of $f(x, y) = x^2e^y$ at $(-2, 0)$ and find a unit vector in the direction of maximum directional derivative. CO3 (4)

OR

14. a) Find the work done by the force field $\vec{F} = xy\hat{i} + yz\hat{j} + xz\hat{k}$ on a particle that moves along the curve $C : \vec{r}(t) = t\hat{i} + t^2\hat{j} + t^3\hat{k}, 0 \le t \le 1$. CO3 (5)

b) Evaluate $\int_C x^2ydx + xdy$ where C is the triangular path with vertices $(0, 0), (0, 1)$ and $(1, 2)$. CO3 (4)

Module - 4

15. a) Evaluate the surface integral $\iint_\sigma y^2z^2dS$ where σ is the part of the cone $z = \sqrt{x^2 + y^2}$ that lies between the plane $z = 1$ and $z = 2$. CO4 (5)

b) Use Stokes' theorem to evaluate $\int_C \vec{F}.dr$ where $\vec{F} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ taken round the rectangle bounded by $x = -a, x = a, y = 0, y = b$. CO4 (4)

OR

16. a) Use Green's theorem to evaluate the line integral $\int_C (xy + y^2)dx + x^2dy$ where C is bounded by $y = x$ and $y = x^2$ and positively oriented. CO4 (5)

b) Use Divergence theorem to find outward flux of the vector field $\vec{F} = 2x\hat{i} + 3y\hat{j} + z^2\hat{k}$ across the unit cube $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$. CO4 (4)

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