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UMA620526AC-1

Reg No.: _____ Name: _____

Jyothi Engineering College(Autonomous)

B. Tech Degree S2 (R) Examination, May 2026(2025 Scheme)

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

EC, EE, CE, MEPI

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

CO MARK

PART A

(Answer All Questions. Each question carries 3 marks)

1. Let $f(x,y) = \tan^{-1}(x+y) + \sqrt{x^2+y^2}$. Find the slope of the surface f in the x-direction and y-direction at the point (0,1). CO1 (3)

2. Find $\frac{dz}{dt}$ of $z = x^2y, x = t^2, y = t^3$. CO1 (3)

3. Evaluate $\int_0^2 \int_0^1 y\cos x \, dy \, dx$. CO2 (3)

4. Verify Fubini's theorem for the integral $\int_1^2 \int_0^3 (x - 3y^2)dxdy$. CO2 (3)

5. Check whether the vector field $\vec{F}(x,y) = (y+x)\hat{i} + (y-x)\hat{j}$ is conservative or not. CO3 (3)

6. Find the gradient of $f(x,y,z) = xy^2z^2$ at $(-4,5,1)$. CO3 (3)

7. Determine the source and sink of the vector field $\vec{F}(x,y,z) = x^2\hat{i} + y^2\hat{j} + z^2\hat{k}$. CO4 (3)

8. Use Green's theorem to evaluate $\int_C (x-2y)dx + xdy$ around the circle $x^2 + y^2 = a^2$. CO4 (3)

PART B

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

Module - 1

9. a) Locate all relative extrema of $f(x,y) = 3x^2 - 2xy + y^2 - 8y$. CO1 (5)

   b) If $z = x^2 - y\tan x, x = \frac{u}{v}, y = uv$. find $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$. CO1 (4)

OR

10. a) Use the local linear approximation of $f(x,y) = e^{x+y}$ at the point(0,0) to estimate the value of f(0.1,-0.1).Compare this approximation with the actual value and calculate the error. CO1 (5)

    b) Find all second order partial derivatives of $f(x,y) = x^2y^3 + x^4y$. CO1 (4)

Module - 2

11. a) Evaluate $\iint_R xydA$ where R is the region bounded by $y = \sqrt{x}$, $y = 6 - x$ and $y = 0$. CO2 (5)

    b) Use polar coordinates to evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}dydx$. CO2 (4)

OR

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

    b) Change the order of integration in $\int_0^1 \int_{y^2}^{\sqrt{2-y^2}} f(x,y)dxdy$ CO2 (4)

Module - 3

13. a) Find the unit vector in the direction in which f increases most rapidly at P and find the rate of change of f at $P(2,4)$ in that direction, where $f(x,y) = 3x - \ln y$. CO3 (5)

b) Find $\text{curl}\vec{F}$ and $\text{div}\vec{F}$ where $\vec{F}(x,y,z) = e^{xy}\hat{i} - 2\cos y\hat{j} + \sin^2 z\hat{k}$. CO3 (4)

OR

14. a) Find the directional derivative of $f(x,y,z) = x^3z - yx^2 + z^2$ in the direction of $3\bar{i} - \bar{j} + 2\bar{k}$ at $(2,-1,1)$. Also find the unit vector in the direction along which maximum value of directional derivative occurs. 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) Using divergence theorem evaluate $\iint_S \vec{F}.\vec{n}dS$ where $\vec{F}(x,y,z) = x^3\hat{i} + y^3\hat{j} + z^3\hat{k}$, S is the surface of the cylindrical solid bounded by $x^2 + y^2 = 4, z = 0, z = 4$. CO4 (5)

b) Evaluate $\int_C \vec{F}.dr$ where $\vec{F}(x,y,z) = xy\,\hat{i} + yz\,\hat{j} + zx\,\hat{k}$, C is the triangle in the plane $x + y + z = 1$ with vertices $(1,0,0),(0,1,0),(0,0,1)$ with a counter clockwise orientation looking from the first octant towards the origin. CO4 (4)

OR

16. a) Using Stokes' theorem evaluate $\int_C \vec{F}.dr$ where $\vec{F}(x,y,z) = 2z\,\hat{i} + 3x\,\hat{j} + 5y\,\hat{k}$ taking σ to be the portion of the paraboloid $z = 4 - x^2 - y^2$ for which $z \geq 0$ with upward orientation and C to be the positively oriented circle $x^2 + y^2 = 4$ that forms the boundary of σ in the xy-plane. CO4 (5)

b) Use Green's theorem to evaluate $\int_C \tan^{-1}ydx - \frac{y^2x}{1+y^2}dy$ where C is the square with vertices $(0,0),(0,1),(1,1)$ and $(1,0)$. CO4 (4)

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