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Reg No.:_______________ Name:_______________________

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree S2 (R,S) Examinations April 2026 (2024 Scheme)

## Course Code: GYMAT201

## Course Name: MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE – 2

Max. Marks: 60 Duration: 2 hours 30 minutes

**PART A**

*(Answer all questions. Each question carries 3 marks)*

| | | CO | Marks |
|---|---|---|---|
| 1 | Find the slope of the surface $f(x,y) = \sqrt{3x+2y}$ in the $x$-direction at the point (2, 5). | CO1 | (3) |
| 2 | Find the first order partial derivatives of $f(x,y) = 2x^3y^2 + 2y + 4x$ at (1, 3). | CO 1 | (3) |
| 3 | Evaluate the $\iint_R 4xy^3\, dA$ where R=$\{(x,y): -1 \le x \le 1, -3 \le y \le 3\}$ | CO 2 | (3) |
| 4 | Evaluate $\int_{-2}^{3}\int_{0}^{2}\int_{0}^{1} xy^2z^4\,dzdydx$. | CO 2 | (3) |
| 5 | Find the gradient of $f(x, y, z) = y \ln(x+y+z)$ at (-4,5,0). | CO 3 | (3) |
| 6 | Determine whether the vector field $\vec{F}(x,y) = 6y^2\hat{\imath} + 12xy\hat{\jmath}$ is conservative. | CO 3 | (3) |
| 7 | Use Green's theorem to evaluate $\int_C 2xy\,dx + (x^2+x)\,dy$ where C is the boundary of a triangle with vertices (0,0) , (1,0) and (1,1) oriented counterclockwise. | CO 4 | (3) |
| 8 | Use divergence theorem to find the outward flux of a vector field $\vec{F} = y\hat{\jmath}$ across the sphere $x^2+y^2+z^2=4$. | CO 4 | (3) |

**PART B**

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

**Module -1**

| | | | | |
|---|---|---|---|---|
| 9 | a) | Locate the relative extrema and saddle points of $f(x,y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$ | CO 1 | (5) |

b) If w= $x^2+y^2$ , $x=\rho \sin\varphi \cos\theta$ , $y=\rho \sin\varphi \sin\theta$ use chain rule to find $\frac{\partial w}{\partial \rho}$ and $\frac{\partial w}{\partial \theta}$. CO 1 (4)

10 a) Find the local linear approximation $L(x,y)$ to $f(x,y)=xyz$ at $(1,2,3)$. Also find the error in approximating the value of $f$ by $L$ at $(1.001, 2.002, 3.003)$ CO 1 (5)

b) Find the maximum value of the directional derivative of $f(x, y) = x^2 e^y$ at (-2,0) and find the unit vector in the direction along which the maximum value occurs. CO 1 (4)

**Module -2**

11 a) Use a double integral to find the volume of the tetrahedron bounded by the coordinate planes and the plane z=4-4x-2y . CO 2 (5)

b) Use polar coordinates to evaluate the double integral $\iint_R e^{-(x^2+y^2)} dA$ where R is the region enclosed by the circle $x^2+y^2=4$ . CO 2 (4)

12 a) Use a triple integral to find the volume of the solid within the cylinder $x^2+y^2=9$ and between the planes $z=1$ and $x+z=5$ . CO 2 (5)

b) Evaluate the integral $\int_0^4 \int_{\sqrt{y}}^2 e^{x^3}\, dx\, dy$ by reversing the order of integration. CO 2 (4)

**Module -3**

13 a) Find the work done by the force field $\vec{F} = 3xy\hat{\imath} - y^2\hat{\jmath}$ when it moves a particle along the curve $y=2x^2$ in the xy- plane from (0,0) to (1,2). CO 3 (5)

b) Find div $\vec{F}$ and curl $\vec{F}$ where $\vec{F}(x,y,z) = e^{xy}\,\hat{\imath} - 2\cos y\,\hat{\jmath} + \sin^2 z\,\hat{k}$ . CO 3 (4)

14 a) Show that $\int_C 2xy^3 dx + 3y^2x^2 dy$ is independent of the path and hence evaluate the line integral along any path joining (2, -2) to (-2,0). CO 3 (5)

b) Find $\nabla . (\vec{F} \times \vec{G})$ where $\vec{F}(x,y,z) = 2x\,\hat{\imath} + \hat{\jmath} + 5y\,\hat{k}$ and $\vec{G}(x,y,z) = x\hat{\imath} + y\hat{\jmath} - z\hat{k}$ . CO 3 (4)

**Module -4**

15 a) Using Stoke's theorem, evaluate $\oint_C \vec{F}.d\vec{r}$ where $\vec{F} = 2z\hat{\imath} + 3x\hat{\jmath} + 5x\hat{k}$ and $C$ is the positively oriented circle $x^2+y^2=4$, that forms the boundary of the surface $\sigma$ which is the portion of the paraboloid $z=4-x^2-y^2$ for $z \geq 0$ with upward orientation. CO 4 (5)

b) Use Green's theorem to find the area enclosed by the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$. CO 4 (4)

16 a) Use Stoke's theorem to evaluate $\oint_C \vec{F}\cdot d\vec{r}$ where $\vec{F}(x,y,z)=z^2\hat{\imath}+3x\,\hat{\jmath}-y^3\,\hat{k}$ and C is the circle $x^2+y^2=1$ in the *XY*-plane with counterclockwise orientation looking down the positive z-axis. CO 4 (5)

b) Evaluate the surface integral $\iint_\sigma y^2z^2\,dS$ where $\sigma$ is the part of the cone $z=\sqrt{x^2+y^2}$ that lies between the planes $z=1$ and $z=2$. CO 4 (4)

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