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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S2 (R) Exam May 2025 (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	If $f(x,y) = 4x^3y^2 + 5x - 2y$, then find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ at (1,2).	CO1	(3)
2	Show that $\frac{\partial^2 f}{\partial y \partial x} = \frac{\partial^2 f}{\partial x \partial y}$ if $f(x,y) = e^x \cos y$.	CO1	(3)
3	Evaluate $\int_{-1}^{2}\int_{0}^{3}\int_{0}^{2} xy^2z^3\,dzdydx$.	CO2	(3)
4	Evaluate using polar co-ordinates $\iint_R (x^2+y^2)dA$, where R is the region enclosed by the circle $x^2 + y^2 = 4$.	CO2	(3)
5	Determine whether the vector field $\vec{F} = (y^2-3)\hat{\imath} + (2xy+5)\hat{\jmath}$ is conservative.	CO3	(3)
6	Calculate the work done by the force field $\vec{F} = \hat{\imath} - y\hat{\jmath} + xz\hat{k}$ in moving a particle from $(0,0,0)$ to $(1,-1,1)$ along the curve $x = t, y = -t^2, z = t$ for $0 \le t \le 1$.	CO3	(3)
7	State Divergence theorem.	CO4	(3)
8	Apply Green's theorem, to evaluate $\int_C \sin y\, dx + x(1+\cos y)\, dy$ where C is the circular path $x^2+y^2 = 4$ in the counterclockwise direction.	CO4	(3)

PART B

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

Module -1

9	a)	Using chain rule, evaluate $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$ if $z = x^2 + y^2$ where $x = u + v$ and $y = u - v$.	CO1	(4)
	b)	Find the local linear approximation $L(x, y)$ to $f(x, y) = xyz$ at $(1, 2, 3)$. Also find the error in the approximation at $(1.001, 2.002, 3.003)$.	CO1	(5)
10	a)	If $u = f(2x - 3y, 3y - 4z, 4z - 2x)$, then prove that $\frac{1}{2}\frac{\partial u}{\partial x} + \frac{1}{3}\frac{\partial u}{\partial y} + \frac{1}{4}\frac{\partial u}{\partial z} = 0$.	CO1	(4)
	b)	Locate all relative extrema and saddle points of $f(x, y) = 3x^2 - 2xy + y^2 - 8y$.	CO1	(5)

Module -2

11	a)	Using double integrals, find the area enclosed between the parabolas $y^2 = x$ and $x^2 = y$.	CO2	(4)
	b)	Find the volume of the solid in the first octant bounded by the coordinate planes and the plane $2x + y + z = 4$.	CO2	(5)
12	a)	Evaluate $\iint_R y\,dA$ where R is the region in the first quadrant enclosed between the circle $x^2 + y^2 = 25$ and the line $x + y = 5$.	CO2	(4)
	b)	Evaluate by changing the order of integration: $\int_0^4 \int_{\sqrt{x}}^2 \sin(y^3)\,dy\,dx$.	CO2	(5)

Module -3

13	a)	Evaluate $\int_C [(1 + xy)dx + x^2 dy]$ where $C: \vec{r}(t) = t^2\hat{\imath} + 2t\hat{\jmath}; 0 \le t \le 1$.	CO3	(4)
	b)	Find the values of a, b, c so that $\vec{F} = (axy + bz^3)\hat{\imath} + (3x^2 - cz)\hat{\jmath} + (3xz^2 - y)\hat{k}$ is irrotational. For these values of a, b, c find the scalar potential of $\vec{F}$.	CO3	(5)

14	a)	Find $div\ curl\ \vec{F}$, where $\vec{F} = x^2z\hat{\imath} - 2y^3z^2\hat{\jmath} + xy^2z\hat{k}$.	CO3	(4)
	b)	Show that the integral $I = \int_C (y\sin x\ dx - \cos x\ dy)$ is independent of the path. Hence evaluate the integral I along any path from $(0, 1)$ to $(\pi, -1)$.	CO3	(5)

Module -4

15	a)	Use divergence theorem to find the outward flux of the vector field $\vec{F} = x^2\hat{\imath} + z\hat{\jmath} + yz\hat{k}$ across the unit cube.	CO4	(4)
	b)	Use Stoke's theorem to evaluate $\oint_C \vec{F}.d\vec{r}$ where $\vec{F} = (2x - y)\hat{\imath} - yz^2\hat{\jmath} - y^2z\hat{k}$ and C is the boundary of the surface σ which is the upper half of the sphere $x^2 + y^2 + z^2 = 1$ oriented upwards.	CO4	(5)
16	a)	Find the flux of the vector field $\vec{F} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$ across σ, which is the portion of the surface $z = 1 - x^2 - y^2$ that lies above the XY – plane and is oriented upwards.	CO4	(4)
	b)	Using Green's theorem, evaluate $\int_C (y - e^x)dx + \cos x\, dy$, where C is the boundary of a plane triangle with vertices (0,0), $\left(\frac{\pi}{2}, 0\right)$ and $\left(\frac{\pi}{2}, 1\right)$ oriented counterclockwise.	CO4	(5)

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