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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech S2 (S) / S1 (Challenge Course) Examination December 2025 / January 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 f_x(x,y) and f_y(x,y) for f(x,y) = $2x^3y^2$+2y+4x.Also find f_x(1,3) and f_y(1,3)	CO1	(3)
2	If f(x,y)=e^xsiny,show that $\frac{\partial^2 f}{\partial y\partial x}=\frac{\partial^2 f}{\partial x\partial y}$	CO1	(3)
3	Evaluate $\int_0^1\int_0^2(x+5)$ dydx	CO2	(3)
4	Evaluate $\iiint_G 12xy^2z^3$ dV over the rectangular box G defined by the inequalities $-1\le x\le 2,\ 0\le y\le 3,\ 0\le z\le 2$	CO2	(3)
5	Find the gradient of f(x,y,z)=x^2+ yz	CO3	(3)
6	Show that the vector field $\vec{F}$ =(2xy+z^3)$\hat{\imath}$ +$x^2\hat{\jmath}$ + 3x$z^2\hat{k}$ is irrotational	CO3	(3)
7	Use Green's theorem to find the area enclosed by the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}$=1	CO4	(3)
8	State divergence theorem	CO4	(3)

PART B

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

Module -1

			CO	Marks
9	a)	Use the local linear approximation of f(x,y) =$\sqrt{x^2+y^2}$ at the point (3,4) to estimate the value of f(3.05,4.05)	CO1	(5)
	b)	Suppose that w=e^{xyz} ,x=3u+v , y=3u-v ,z=u^2v .Find $\frac{\partial w}{\partial u}$ and $\frac{\partial w}{\partial v}$ using the chain rule	CO1	(4)

10	a)	Locate all relative extrema and saddle points of $f(x,y)=4xy-x^4-y^4$	CO1	(5)
	b)	Verify that the function $f(x,y,z)=x^2+y^2-2z^2$ satisfies the function three dimensional Laplace equation $\frac{\partial^2 f}{\partial x^2}+\frac{\partial^2 f}{\partial y^2}+\frac{\partial^2 f}{\partial z^2}=0$	CO1	(4)

Module -2

11	a)	By reversing the order of integration, evaluate $I=\int_0^2\int_{\frac{y}{2}}^1 e^{x^2}\,dx\,dy$	CO2	(5)
	b)	Using double integral find the area included between the parabolas $y^2=4ax$ and $x^2=4ay$	CO2	(4)
12	a)	Use polar co-ordinates to evaluate $I=\iint_R e^{-(x^2+y^2)}\,dA$ where R is the region enclosed by the circle $x^2+y^2=1$	CO2	(5)
	b)	Use triple integral to find the volume bounded by the co-ordinate planes and the planes. $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$	CO2	(4)

Module -3

13	a)	Find the divergence and curl of the vector field $\vec{F}(x,y,z)=x^2y\hat{\imath}+2y^3z\hat{\jmath}+3z\hat{k}$	CO3	(5)
	b)	Let $\vec{F}(x,y,z)=2xy^3\hat{\imath}+(1+3x^2y^2)\hat{\jmath}$ (i)Show that $\vec{F}$ is conservative vector field on the entire plane (ii) Find the potential function Φ	CO3	(4)
14	a)	Find the work done by the force field $\vec{F}=z\hat{\imath}+x\hat{\jmath}+y\hat{k}$ in moving a particle along the curve C given by $\overrightarrow{r(t)}=\sin t\,\hat{\imath}+\cos t\,\hat{\jmath}+\sin^2 t\,\hat{k}$ $0\leq t\leq\frac{\pi}{2}$	CO3	(5)
	b)	Find the directional derivative of $\Phi(x,y,z)=x^2yz+4xz^2$ at the point P(1,-2,-1) in the direction of a vector from P to Q(3,-3,-2)	CO3	(4)

Module -4

15	a)	Use the divergence theorem to find the outward Flux of the vector field $\vec{F}(x,y,z)=2x\,\hat{\imath}+3y\,\hat{\jmath}+z^2\hat{k}$ across the unit cube	CO4	(5)
	b)	Verify Green's theorem for $\oint_C y^2dx+x^2dy$,where C is the square with vertices (0,0),(1,0),(1,1) and (0,1) oriented counter clockwise	CO4	(4)
16	a)	Use Stoke's theorem to evaluate $\oint_C \vec{F}.d\vec{r}$ where	CO4	(5)

$\vec{F}(x, y, z) = z^2\, \hat{\imath} + 3x\, \hat{\jmath} - y^3\, \hat{k}$ and C is the circle $x^2 + y^2 = 1$ in the xy-plane with counter clockwise orientation looking down the positive z-axis

b) Evaluate the surface integral $\iint_{\sigma} xz \, ds$ where σ is the part of the plane x+y+z=1 in the first octant CO4 (4)

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