UGC AUTONOMOUS

ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

QUESTION BANK

UNIT–I
FIRST ORDER ODE

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Define and write the working rule of exact differential equation.	L1	CO1	PO1
2		Solve $2xydy-(x^2-y^2+1)dx=0$.	L1	CO1	PO3
3		Solve $ydx-xdy=a(x^2+y^2)$dx	L3	CO1	PO1
4		Find the integrating factor of $x^2ydx-(x^3+y^3)dy=0$.	L3	CO1	PO2
5		Find the integrating factor of $(y-xy^2)dx-(x+x^2y)dy=0$.	L1	CO1	PO2
6		Find the integrating factor of $(x+2y^3)\frac{dy}{dx}=y$	L3	CO1	PO1
7		State Newton's law of cooling.	L3	CO1	PO1
8		Solve $P^2-5p+6=0$	L1	CO1	PO1
9		State the Law of Natural Growth and decay.	L2,L3	CO1	PO2
10		Define L-R circuit.	L3	CO1	PO2
Part – B (Long Answer Questions)					
11	a)	Solve $xlogx\frac{dy}{dx}+y=2logx$	L1	CO1	P01

	b)	Solve $(3x^2y^4 + 2xy)dx + (2x^3y^3 - x^2)dy$	L1,L3	CO1	P02
12		If the temperature of the air is 20°C and the temperature of the body drops from 100°C to 80°C in 10 mins. What will be its temperature after 20 mins? When the temperature will be 40°C?	L3,L4	CO1	PO3
13		Solve the differential equation $y(xy + 2x^2y^2)dx + x(xy - x^2y^2)dy = 0$.	L3,L4	CO1	PO3
14	a)	Solve $x\frac{dy}{dx} + y = x^2y^6$	L3,L4	CO1	PO3
	b)	Solve $(y - xy^2)\,dx - (x + x^2y)\,dy = 0$.		CO1	
15	a)	Solve $(x^3 + 3xy^2)\,dx + (y^3 + 3x^2y)\,dy = 0$.	L2,L4	CO1	PO1
	b)	If 30% of a radioactive substance disappears in 10 days, how long will it take for 90% of it to disappear?	L2,L4,L5	CO1	PO2
16		Solve $p^2 + 2py\cot x = y^2$ for p.	L3,L5	C01	PO1

UNIT–II

ORDINARY DIFFERENTIAL EQUATION OF HIGHER ORDER

S. No	Questions	BT	CO	PO
	Part – A (Short Answer Questions)			
1	Solve $(D^2 + 6D + 9)y = 0$	L1	CO2	PO1
2	Find the complementary solution of $(D^3 - 9D^2 + 23D - 15)y = 0$.	L1	CO2	PO1
3	Find $\frac{1}{D^3}cosx$	L3	CO2	PO2
4	Find the particular integral of $(D^2 - 5D + 6)y = e^{4x}$	L3	CO2	PO2
5	Solve $(4D^2 - 4D + 1)y = 100$	L3	CO2	PO2

6		Solve the differential equation $(D^2 - 3D + 4)y = 0$.	L3	CO2	PO2
7		Solve $(D^2 + 4)y = sin2x$	L1	CO2	PO1
8		Find the particular integral of $(D^2 + 1)y = x^2$.	L3	CO2	PO2
9		Find A(x) to the differential equation $(D^2 + 1)y = xcosx$	L3	CO2	PO2
10		Find B(x) to the differential equation $(D^2 - 2D)y = e^x sinx$	L3	CO2	PO2
Part – B (Long Answer Questions)					
11		Solve $(D-2)^2 y = 8(e^{2x} + \sin 2x + x^2)$.	L3,L5	CO2	PO3
12	a)	Find the solution of $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} - 6y = sin4xcosx$.	L3,L5	CO2	PO3
	b)	Solve $(D^3 + 2D^2 + D)y = x^3$	L3	CO2	PO2
13	a)	Solve $(D^2 - 4)y = 2cos^2 x$	L1	CO2	PO1
	b)	Solve $(D^3 - 1)y = (1 + e^x)^2$.	L3	CO2	PO2
14	a	Solve $\frac{d^2y}{dx^2}$ +y = x cosx by the method of variation of parameters.	L3,L4,L5	CO2	PO3
	b	Solve $(D^2 - 2D)y = e^x sinx$ by the method of variation of parameters.			
15	a)	Solve the differential equation $(D^2 + 1)y = x^2 e^{3x}$	L1	CO2	PO1
	b)	Solve $(D^2 + 2)y = e^x cosx$	L2	CO2	PO2
16	a)	Solve $(D^2 + 2D + 1)y = x\, cosx$.	L2	CO2	PO2
	b)	Solve $\frac{d^2y}{dx^2} + 2y = x^2 e^{3x} + e^x \cos 2x$.	L3	CO2	PO2

UNIT–III

LAPLACE TRANSFORM

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Find L{(sint+cost)^2}.	L1	CO3	PO1
2		Find L{(sin2t.cos3t)}	L2	CO3	PO2
3		Find L$\{\sqrt{t}e^{-3t}\}$	L1	CO3	PO1
4		Define Laplace transform of a function f(t).	L1	CO3	PO1
5		State First shifting theorem of Laplace transform	L3	CO3	PO2
6		Find L$\{\frac{1-e^t}{t}\}$	L3	CO3	PO2
7		Find $L^{-1}\{\frac{S^2-3s+4}{s^3}\}$	L1	CO3	PO1
8		Find $L^{-1}\{\frac{1}{(s+1)^2}\}$	L3	CO3	PO2
9		If $L\{f(t) = \frac{9S^2-12S+15}{(s-1)^3}\}$, find L{f(3t)} using change of scale property.	L3	CO3	PO2
10		Find $L^{-1}\{\frac{1}{S(S+2)}\}$	L3	CO3	PO2
Part – B (Long Answer Questions)					
11	a)	Evaluate L$\{\int_0^t te^{-t}sin2t\ dt\}$.	L4,L5	CO3	PO3
	b)	Evaluate $L\{\frac{cos\sqrt{t}}{\sqrt{t}}\}$	L3	CO3	PO2
12	a)	Find $L\{te^{-t}sin2tcos2t\}$	L3	CO3	PO2
	b)	Using Laplace transform, evaluate $\int_0^\infty \frac{cosat-cosbt}{t}dt$	L3	CO3	PO2
13	a)	Find $L\{t^2cos3t\}$	L4,L5	CO3	PO3
	b)	Find $L^{-1}\{\frac{S^2}{(S^2+4)(S^2+25)}\}$	L3	CO3	PO2
14	a)	Using the Convolution theorem, find $L^{-1}\{\frac{S}{(S^2+a^2)^2}\}$	L3	CO3	PO2
	b)	Find the inverse Laplace transform of $\{\frac{S+3}{(S^2+6S+13)^2}\}$	L3	CO3	PO2
15		Solve the differential equation $\frac{d^2x}{dt^2}$ +9x = sint using laplace transform given that x(0)=1,x^1(0)=0	L2,L3	CO3	PO2

16		Using Laplace transform, evaluate $(D^2+5D+6)x=5e^t$ given that x(0)=2,x^1(0)=1	L2,L3	CO3	PO2

UNIT–IV
VECTOR DIFFERENTIATION

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Find $\nabla(x^2+y^2z)$.	L1	CO4	PO1
2		Define gradient of a scalar point function	L1	CO4	PO1
3		Define divergence of a vector point function.	L4	CO4	PO1
4		Find the unit normal vector to the given surface $x^2y+2xz=4$ at the point (2,-2,3)	L1	CO4	PO1
5		If $\bar{f}=xy^2\boldsymbol{i}+2x^2yz\boldsymbol{j}-3yz^2\boldsymbol{k}$ find div $\bar{f}$ at (1,-1,1).	L3	CO4	PO1
6		If $\bar{f}=(x+1+y)\boldsymbol{i}+\boldsymbol{j}-(x+y)\boldsymbol{k}$ then show that $\bar{f}\cdot curl\bar{f}=0$.	L3	CO4	PO1
7		Prove that $\bar{F}=yzi+zxj+yxk$ is irrotational.	L1	CO4	PO1
8		Define curl of a vector point function	L2,L3	CO4	PO1
9		If $\bar{r}=xi+yj+zk$ the find div $\bar{r}$.	L2	CO4	PO1
10		If $\bar{f}=y(ax^2+z)\boldsymbol{i}+x(y^2-\boldsymbol{z^2})\boldsymbol{j}+\boldsymbol{2xy}(z-xy)\boldsymbol{k}$ **is** solenoidal then find a	L1	CO4	PO1
Part – B (Long Answer Questions)					
11	a)	Find the directional derivative of $\varphi=4xy^2+2x^2yz$ at $A(1,2,3)$ in the direction of AB,$B(5,0,4)$.	L3,L4	CO4	PO2
	b)	Find the directional derivative of $\varphi=x^2yz+4xz^2$ at $(1,-2,-1)$ in the direction of normal to the surface $f=x\log z-y^2$ at $(-1,2,1)$.	L2,L4,L5	CO4	PO3

12	a)	Find a and b such that the surfaces $5x^2 - 2yz - 9x = 0$ and $ax^2y + bz^3 = 4$ cuts orthogonally at $(1,-1,2)$.	L1,L4,L5	CO4	PO3
	b)	Find the angle between the surfaces $xy^2z = 3x + z^2$ and $3x^2 - y^2 + 2z = 1$ at $(1,-2,1)$.	L3,L4	CO4	PO2
13	a)	Prove that $div(gradr^n) = n(n+1)r^{n-2}$.	L2,L3	CO4	PO3
	b)	Prove that $div\left(\frac{\vec{r}}{r}\right) = \frac{2}{r}$.	L3,L4	CO4	PO3
14	a)	If $\vec{F} = 2xyz^2\vec{i} + (x^2z^2 + z\cos yz)\vec{j} + (2x^2yz + y\cos yz)\vec{k}$ is conservative (Irrotational), then find its scalar potential function.	L3,L4	CO4	PO3
	b)	Show that $\vec{F} = (x^2 - yz)\vec{i} + (y^2 - zx)\vec{j} + (z^2 - xy)\vec{k}$ is irrotational and find its scalar potential function.	L3,L4	CO4	PO3
15	a)	Prove that $div(\vec{a} \times \vec{b}) = \vec{b}.Curl\vec{a} - \vec{a}.Curl\vec{b}$.	L1,L4	CO4	PO1
	b)	Prove that $Curl(\vec{a} \times \vec{b}) = \vec{a}div\vec{b} - \vec{b}div\vec{a} + (\vec{b}.\nabla)\vec{a} - (\vec{a}.\nabla)\vec{b}$.	L1,L4	CO4	PO1
16	a)	Find the directional derivative of the function $xy^2 + yz^2 + zx^2$ along the tangent tot the curve $x = t, y = t^2, z = t^3$ at the point (1,1,1).	L1,L3	CO4	PO2
	b)	Prove that if $\bar{r}$ *is the* position vector of any point in space, then $r^n\bar{r}$ is irrotational.	L3,L4	CO4	PO3

UNIT–V

VECTOR INTEGRATION

S.No	Questions	BT	CO	PO
	Part – A (Short Answer Questions)			

1		Evaluate $\int_c \bar{F} \cdot d\bar{r}$ where $\bar{F} = x^2 i + y^2 j$ and C is the curve $y=x^2$ in the xy plane from (0,0) to (1,1).	L1	CO5	PO1
2		Find the work done in moving a particle in the force field $\bar{F} = 3x^2 i + j + zk$ along the straight line from (0,0,0) to (2,1,3).	L1	CO5	PO1
3		Evaluate by using Green's theorem in plane for$\oint(3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the region bounded by $y = \sqrt{x}\ and\ y = x^2$	L2,L4	CO5	PO2
4		If $\emptyset = x^2yz^3$, evaluate $\oint \emptyset d\bar{r}\ along$ the curve x=t, y=2t, z=3t from t=0 to t=1	L2,L3	CO5	PO1
5		Evaluate by Stoke's theorem $\oint(x + y)dx + (2x - z)dy + (y + z)dz$ where C is the boundary of the triangle with vertices (0,0,0),(1,0,0),(1,1.0).	L2,L3	CO5	PO1
6		State Green's theorem.	L2,L3	CO5	PO1
7		State Gauss divergence theorem.	L1	CO5	PO1
8		State Stoke's theorem.	L1	CO5	PO1
9		Evaluate $\iiint_V \nabla \cdot \bar{F} dv$ where $\bar{F} = x^3 i + y^3 j + z^3 k$ taken over the cube bounded by x=0, x=a; y=0,y=a; z=0,z=a.	L1	CO5	PO1
10		Evaluate $\iiint_V \nabla \cdot \bar{F} dv$ where $\bar{F} = x^2 i + y^2 j + z^2 k$ taken over the cube bounded by x=0, x=a; y=0,y=b; z=0,z=c.	L1	CO5	PO1
Part – B (Long Answer Questions)					
11	a)	Find the work done in moving a particle in force field $\vec{F} = (3x^2)\vec{\imath} + (2xz - y)\vec{\jmath} + z\vec{k}$ along the line from $(0,0,0)\ to\ (2,1,3)$.	L4,L5	CO5	PO3
	b)	Show that the area bounded by a simple closed curve C is given by $\frac{1}{2}\oint x\,dy - y\,dx$ and hence find the area of the circle $x^2 + y^2 = a^2$.	L4,L5	CO5	PO4
12			L4,L5	CO5	PO3

		Verify Greens theorem for $\int_c (xy + y^2)dx + (x^2)dy$ where C is the region bounded by $y = x$ and $y = x^2$.	L3	CO5	PO2
13		Verify Gauss divergence theorem for $\vec{F} = (x^2)\vec{\imath} + (y^2)\vec{\jmath} + (z^2)\vec{k}$ over the parallelepiped $x = 0, x = a, y = 0, y = b, z = 0, z = c$.	L3,L4	CO5	PO3
			L3	CO5	PO3
14		Verify Stokes theorem for $\vec{F} = (2x - y)\vec{\imath} - yz^2\vec{\jmath} - y^2z\vec{k}$ over the upper half surface of the sphere $x^2 + y^2 + z^2 = 1$ bounded by the projection of the xy-plane.	L2,L3	CO5	PO2
			L2,L3	CO5	PO2
15		Verify Gauss divergence theorem for $\vec{F} = (x^3 - yz)\vec{\imath} - 2x^2y\vec{\jmath} + z\vec{k}$ over the cube bounded by the planes $x = y = z = a$ and coordinate planes.	L4,L5	CO5	PO3
16		Verify Stokes theorem for $\vec{F} = (x^2 - y^2)\vec{\imath} - 2xy\vec{\jmath}$ over the box bounded by the planes $x = 0, x = a, y = 0, y = b$.	L4,L5	CO5	PO3

* **Blooms Taxonomy Level (BT)** (L1 – Remembering; L2 – Understanding; L3 – Applying; L4 – Analyzing; L5 – Evaluating; L6 – Creating)

Course Outcomes (CO)Program Outcomes (PO)

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