O.P.Code:23HS0831 | R23 | H.T.No.

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
B.Tech I Year II Semester Regular & Supplementary Examinations May/June-2026
DIFFERENTIAL EQUATIONS & VECTOR CALCULUS
(Common to All)

Time: 3 Hours **Max. Marks: 70**

PART-A
(Answer all the Questions **10 x 2 = 20** Marks)

1	a	Find the integrating factor of $\frac{dy}{dx}(x^2y^3 + xy) = 1$	CO1	L3	2M
	b	State Newton's Law of Cooling	CO1	L1	2M
	c	Find the Perticular Integral of $(D^2 + 3D + 2)y = e^{4x}$	CO2	L3	2M
	d	Define Simple Harmonic Motion	CO2	L1	2M
	e	Form the Partial Differential Equation by eliminating the arbitrary constants a and b from $z = ax + by + a^2 + b^2$	CO3	L6	2M
	f	Define Homogeneous Linear Partial differential equation with constant coefficients of n^{th} order.	CO3	L1	2M
	g	Define Solenoidal Vector	CO4	L1	2M
	h	Find $div\bar{r}$ where $\bar{r} = x\,\bar{\imath} + y\,\bar{\jmath} + z\,\bar{k}$	CO4	L3	2M
	i	Define work done by a force.	CO5	L1	2M
	j	State Gauss's divergence theorem	CO5	L1	2M

PART-B
(Answer all Five Units **5 x 10 = 50** Marks)

UNIT-I

2	a	Solve $x\frac{dy}{dx} + y = x^3y^6$.	CO1	L3	5M
	b	Solve $y(x^2y^2 + 2)dx + x(2 - 2x^2y^2)dy = 0$.	CO1	L3	5M
		OR			
3		The number N of bacteria in a culture grew at a rate proportional to N. The value of N was initially 100 and increased to 332 in one hour. What was the value of N after 1 ½ hour ?	CO1	L2	10M

UNIT-II

4	a	Solve $(D^2 - 3D + 2)y = cos3x$.	CO2	L3	5M
	b	Solve $(D^2 - 2D)y = e^x sinx$ by the method of variation of parameters.	CO2	L3	5M
		OR			
5		A condenser of capacity 'C' discharged through an inductance 'L' and resistance 'R' in series and the charge 'q' at time 't' satisfies the equation $L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{c} = 0$. Given that L=0.25 henries, R=250 ohms, C=2x10^{-6} farads, and that when t=0, charge 'q' is 0.002 coulombs and the current $\frac{dq}{dt} = 0$. Obtain the value of 'q' in terms of 't'.	CO2	L3	10M

UNIT-III

6	a	Form the Partial Differential Equation by eliminating the constants from $\log(az - 1) = x + ay + b$	CO3	L6	5M
	b	Solve $(z - y)p + (x - z)q = y - x$	CO3	L3	5M
		OR			
7		Solve $\frac{\partial^2 Z}{\partial x^2} + 4\frac{\partial^2 Z}{\partial x \partial y} - 5\frac{\partial^2 Z}{\partial y^2} = \sin(2x + 3y)$	CO3	L3	1

UNIT-IV

8	a	Find the directional derivative of $2xy + z^2$ at (1, -1, 3) in the direction of $\bar{\imath} + 2\,\bar{\jmath} + 3\,\bar{k}$	CO4	L3	
	b	Prove that $\vec{f} = (y + z)\bar{\imath} + (z + x)\bar{\jmath} + (x + y)\,\bar{k}$ is irrotational	CO4	L3	
		OR			
9	a	Prove that $\nabla r^n = nr^{n-2}\bar{r}$	CO4	L3	
	b	Prove that $\nabla.(\bar{f}X\bar{g}) = \bar{g}.(\nabla X\bar{f}) - \bar{f}.(\nabla X\bar{g})$	CO4	L3	

UNIT-V

10	a	If $\bar{F} = (2x^2 - 3z)\bar{\imath} - 2xy\bar{\jmath} - 4x\bar{k}$. Then evaluate $\int_v \nabla.\bar{F}\,dv$ where v is the closed region bounded by $x = 0, y = 0, z = 0$ and $2x + 2y + z = 4$.	CO5	L5	
	b	If $\bar{F} = (5xy - 6x^2)\bar{\imath} + (2y - 4x)\bar{\jmath}$. Then evaluate $\int_c \bar{F}.d\bar{r}$ along the curve $y = x^3$ in xy-plane from (1,1) to (2,8).	CO5	L5	
		OR			
11		Verify Stoke's theorem for the function $\bar{F} = x^2\bar{\imath} + xy\bar{\jmath}$ integrated round the square in the plane z=0 whose sides are along the lines $x = 0, y = 0, x = a, y = a$.	CO5	L6	1

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