PVP 23

Code: 23BS1201

I B.Tech - II Semester – Regular / Supplementary Examinations JUNE 2026

DIFFERENTIAL EQUATIONS & VECTOR CALCULUS

(Common for ALL BRANCHES)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	Solve the first order linear differential equation $\frac{dy}{dx} - 2y = e^x$.	L3	CO2
1.b)	Find the integrating factor for $(1 + xy)\, y\, dx + (1 - xy)\, x\, dy = 0$.	L2	CO1
1.c)	Find the general solution of $\frac{d^2x}{dt^2} + 6\frac{dx}{dt} + 9x = 0$.	L2	CO2
1.d)	Define Wronskian.	L1	CO1
1.e)	Form the partial differential equation by eliminating the arbitrary constants a, b from the equation $z = ax + by$.	L3	CO2
1.f)	Solve $4\frac{\partial^2 z}{\partial x^2} + 12\frac{\partial^2 z}{\partial x\, \partial y} + 9\frac{\partial^2 z}{\partial y^2} = 0$.	L3	CO2
1.g)	If $\bar{r} = x\,\bar{\imath} + y\,\bar{\jmath} + z\bar{k}$, show that $\nabla \times \bar{r} = \bar{0}$.	L3	CO3
1.h)	Compute div $\bar{F}$ for the vector $\bar{F} = x^2y\bar{\imath} + (3x - yz)\bar{\jmath} + z^3\bar{k}$.	L2	CO3

1.i)	State Gauss divergence theorem.	L2	CO1
1.j)	Calculate the line integral $\int_C (4xz + 2y)\, dx$, where C is the line segment from $(2, 1, 0)$ to (4, 0, 2).	L3	CO5

PART – B

			BL	CO	Max. Marks
UNIT-I					
2	a)	Solve $(1 + 2\mathrm{xy}\cos \mathrm{x}^2 - 2\mathrm{xy})\, \mathrm{dx} + (\sin \mathrm{x}^2 - \mathrm{x}^2)\, \mathrm{dy} = 0$.	L3	CO2	5 M
	b)	A cup of coffee is 180°F when freshly poured. After 2 minutes in a room at 70°F, the coffee cools to 165°F. Find the temperature at any time t and the time when the coffee reaches 120°F	L4	CO4	5 M
OR					
3	a)	If the rate of decay of a radioactive substance is proportional to the amount present and it reduces to half in 5 days, how much will remain after 15 days?	L4	CO4	5 M
	b)	Solve $\mathrm{x}\frac{\mathrm{dy}}{\mathrm{dx}} + \mathrm{y} = \mathrm{x}^3\mathrm{y}^6$	L3	CO2	5 M
UNIT-II					
4	a)	Solve the linear ordinary differential equation $\frac{d^2y}{dx^2} + 4\frac{\mathrm{dy}}{\mathrm{dx}} + 4y = e^{-2x}\sin 2x$	L4	CO2	5 M
	b)	Using method of variation of parameters, find the general solution of non-homogeneous differential equation $\frac{d^2y}{dx^2} + y = \sec x$	L4	CO4	5 M

OR					
5	For an L-C-R circuit with inductance $L = \frac{1}{5}$ henries, resistance $R = 1$ ohm, and capacitance $C = \frac{5}{6}$ farads, connected to a voltage source $E(t) = \sin t$. Using the governing equation $L\frac{d^2q}{dt^2} + R\frac{\mathrm{dq}}{\mathrm{dt}} + \frac{q}{C} = E(t)$, find the charge $q(t)$ and the current $\mathrm{i}(t)$ at any time t.		L3	CO2	10 M
UNIT-III					
6	a)	Solve $x(\mathrm{y}-\mathrm{z})\frac{\partial z}{\partial x} + \mathrm{y}(\mathrm{z}-\mathrm{x})\frac{\partial z}{\partial y} = \mathrm{z}(\mathrm{x}-\mathrm{y})$.	L3	CO2	5 M
	b)	Solve $\frac{\partial^2 z}{\partial x^2} - 3\frac{\partial^2 z}{\partial y^2} = x^2$.	L4	CO4	5 M
OR					
7	a)	Form the partial differential equation by eliminating the arbitrary constants a, b from $(\mathrm{x}-\mathrm{a})^2 + (\mathrm{y}-\mathrm{b})^2 + \mathrm{z}^2 = \mathrm{c}^2$.	L3	CO2	5 M
	b)	Solve $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x\,\partial y} - 6\frac{\partial^2 z}{\partial y^2} = e^{x+y}$	L4	CO4	5 M
UNIT-IV					
8	a)	Find the angle between the surfaces $\mathrm{x}^2 + \mathrm{y}^2 + \mathrm{z}^2 = 9$ and $\mathrm{z} = \mathrm{x}^2 + \mathrm{y}^2 - 3$ at the point $(2, -1, 2)$.	L3	CO1	5 M
	b)	Find the directional derivative of the function $\phi(x, y) = x^2y - 4y^3$ at $(2, 1)$ in the direction of the unit vector $\bar{u} = \frac{\sqrt{3}}{2}\,\bar{\imath} + \frac{1}{2}\bar{\jmath}$.	L3	CO2	5 M

OR					
9	a)	Is the magnetic field $\bar{F} = (2xy - 3)\,\bar{\imath} + (x^2 + \cos y)\,\bar{\jmath}$ irrotational or not? If it is, find a corresponding scalar potential function.	L4	CO3	5 M
	b)	Calculate curl $\bar{F}$ at the point (1, 2, 3) given $\bar{F} = 3x^2\bar{\imath} + 5xy^2\bar{\jmath} + 5xyz^3\bar{k}$.	L3	CO3	5 M
UNIT-V					
10	a)	Using Green's theorem, evaluate $\int_C (xy + y^2)\,dx + x^2\,dy$, where C is bounded by $y = x$ and $y = x^2$.	L4	CO5	5 M
	b)	Find the circulation of the field $\bar{F} = (x - y)\,\bar{\imath} + x\,\bar{\jmath}$ around the circle $r(t) = \cos t\,\bar{\imath} + \sin t\,\bar{\jmath}, 0 \le t \le 2\pi$.	L3	CO5	5 M
OR					
11	a)	Evaluate $\int \int_Q \int 6xy\,dz\,dy\,dx$, where Q is the tetrahedron bounded by the planes $0 \le x \le 2$, $0 \le y \le 4 - 2x$ and $0 \le z \le 4 - 2x - y$.	L4	CO5	5 M
	b)	Evaluate $\int (x^2 + y^2)\,dx - 2xy\,dy$, over the region bounded by the lines $x = \pm a$, $y = 0$, $y = b$ using Stoke's theorem.	L4	CO5	5 M