PVP 23

Code: 23BS1201

I B.Tech - II Semester – Supplementary Examinations
DECEMBER 2025

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.

PART – A

1.a)	Find the integrating factor that makes the equation $(3xy^2 - y^3)dx - (2x^2y - xy^2)dy = 0$ exact.
1.b)	Solve $xdy + (y + x)dx = 0$.
1.c)	Find the particular integral of $(D^2 + 6D + 9)y = 2e^{-3x}$.
1.d)	Find the complementary function of $(D^2 + 4D + 5)y = -2\cosh x$.
1.e)	Form the partial differential equation by eliminating the arbitrary functions from $z = f(x + at) + g(x - at)$.
1.f)	Solve $\frac{\partial^2 z}{\partial x^2} - 4\frac{\partial^2 z}{\partial x \partial y} + 4\frac{\partial^2 z}{\partial y^2} = 0$.
1.g)	Find the greatest value of the directional derivative of the function $f = x^2yz^3$ at (2, 1, -1).
1.h)	Find the constants a, b, and c if the vector $\overline{f} = (2x + 3y + az)i + (bx + 2y + 3z)j + (2x + cy + 3z)k$ is Irrotational.
1.i)	Write the statement of Gauss Divergence's theorem.
1.j)	Given $F(t) = (5t^2 - 3t)i + 6t^3 j - 7t\,k$, then evaluate $\int_{t=2}^{4} F(t)\,dt$.

PART – B

			Max. Marks
		UNIT-I	
2	a)	Solve the differential equation $\frac{dy}{dx}+\frac{2x}{1+x^2}y=\frac{1}{(1+x^2)^2}$ given that y = 0 when x = 0.	5 M
	b)	A body originally at 80^0C cools down 60^0C in 20 minutes, the temperature of the air being 40^0C. What will be the temperature of the body after 40 minutes from the original?	5 M
		OR	
3	a)	Solve $x^2y\,dx-(x^3+y^3)\,dy=0$.	5 M
	b)	A bacterial culture growing exponentially, increases from 200 to 500 grams in the period of 6 am to 9 am. How many will be present at noon.	5 M
		UNIT-II	
4	a)	Solve $(D^2-4)y=2\cos^2 x$.	5 M
	b)	Solve $(D^2-7D+6)y=e^{2x}(1+x)$.	5 M
		OR	
5		Using method of variation of parameters solve $(D^2+2D+1)y=xe^{2x}$.	10 M
		UNIT-III	
6	a)	Form the partial differential equation by eliminating the arbitrary function from $z=(x+y)\phi(x^2-y^2)$.	5 M
	b)	Solve $(mz-ny)p+(nx-lz)q=ly-mx$.	5 M

		OR	
7	a)	Solve the PDE $(D^2 - DD')z = \cos x \cos 2y$.	5 M
	b)	Solve the PDE $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial x \partial y} - 6\frac{\partial^2 z}{\partial y^2} = y \sin x$.	5 M
		UNIT-IV	
8	a)	Find the directional derivative of a scalar function $\phi = x^2 - 2y^2 + 4z^2$ at (1, 1, -1) in the direction $2i + j - k$.	5 M
	b)	Find the angle between the normal's to the surface $\phi = x^2 + y^2 - z$ at the points (1, 2, 3) and (2, 3, 4).	5 M
		OR	
9	a)	Check whether the vector field $\bar{f} = (2xy + z^3)i + x^2 j + 3xz^2 k$, is irrotational or not? If so, find its scalar potential function**.**	5 M
	b)	If $\bar{r} = x\bar{i} + y\bar{j} + z\bar{k}$ then show that $\nabla(r^n) = nr^{n-2}\bar{r}$, where $r = \lvert\bar{r}\rvert$.	5 M
		UNIT-V	
10	a)	Find the work moving the particle in the force field $F = 3x^2 i + j + z k$ along the straight line from (0, 0, 0) to (2, 1, 3).	5 M
	b)	Apply the Green's theorem to evaluate $\int_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where 'C' is the region bounded by $y = x^2$ and $y = \sqrt{x}$.	5 M
		OR	
11		Verify Stoke's theorem for a vector field defined by $\bar{f} = -y^3 i + x^3 j,$ in the region $x^2 + y^2 \le 1,\ z = 0.$	10 M