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Second Semester B.E./B.Tech. Degree Examination, June/July 2026
Differential Calculus and Numerical Methods : CV Stream

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
 2. M : Marks, L: Bloom's level, C: Course outcomes.
 3. VTU Formula Hand Book is permitted.*

Module – 1			M	L	C
Q.1	a.	Find $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$ by changing to polar coordinates	6	L2	CO1
	b.	Find $\int_{-1}^1 \int_0^z \int_{x-z}^{x+z} (x+y+z) dx dy dz$	7	L2	CO1
	c.	Show that $\beta(m, n) = \frac{\Gamma(m) \Gamma(n)}{\Gamma(m+n)}$	7	L2	CO1
OR					
Q.2	a.	Change the order of integration and hence find $\int_0^1 \int_0^{\sqrt{1-x^2}} y^2 dy dx$	6	L2	CO1
	b.	Find the area between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ using double integral.	7	L2	CO1
	c.	Show that $\int_0^{\pi/2} \frac{d\theta}{\sqrt{\sin\theta}} \cdot \int_0^{\pi/2} \sqrt{\sin\theta} d\theta = \pi$	7	L2	CO1
Module – 2					
Q.3	a.	Form a partial differential equation of the family of sphere $(x-a)^2 + (y-b)^2 + z^2 = r^2$ by eliminating arbitrary constants.	6	L2	CO1
	b.	Solve $\frac{\partial^2 z}{\partial x^2} + z = 0$, given that, $z = e^y$ and $\frac{\partial z}{\partial x} = 1$ when $x = 0$	7	L2	CO1
	c.	Derive of one-dimensional heat equation.	7	L2	CO1
OR					
Q.4	a.	Form a partial differential equation by eliminating the arbitrary functions f and g from the relation $z = f(x+ay) + g(x-ay)$.	6	L2	CO1
	b.	Solve $\frac{\partial^2 z}{\partial x \partial y} = \sin x \sin y$ for which $\frac{\partial z}{\partial y} = -2 \sin y$, when $x = 0$ and $z = 0$ when $y = (2n+1)\frac{\pi}{2}$.	7	L2	CO1
	c.	Find the solution of $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 2(x+y)u$ by the method of separation of variables.	7	L2	CO1

Module – 3

Q.5	a.	Find the directional derivative of $\phi = x^2yz + 4xz^2$ along $2\mathbf{i} - \mathbf{j} - 2\mathbf{k}$ at $(1, -2, -1)$	6	L2	CO1
	b.	Show that the vector field $\vec{F} = (x^2 - yz)\mathbf{i} + (y^2 - zx)\mathbf{j} + (z^2 - xy)\mathbf{k}$ is irrotational and find its scalar potential.	7	L2	CO1
	c.	If $\vec{F} = xy\mathbf{i} + yz\mathbf{j} + zx\mathbf{k}$, find $\int_C \vec{F} \cdot d\vec{r}$ where C is a curve represented by $x = t, y = t^2, z = t^3, -1 \leq t \leq 1$	7	L2	CO1

OR

Q.6	a.	If $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$ find $\nabla \cdot \vec{F}$ and $\nabla \times \vec{F}$	6	L2	CO1
	b.	Find the constants a, b, c so that vector function $\vec{F} = (x + 2y + az)\mathbf{i} + (bx - 3y - z)\mathbf{j} + (4x + cy + 2z)\mathbf{k}$ is irrotational. Hence find scalar potential ϕ such that $\vec{F} = \nabla\phi$	7	L2	CO1
	c.	Using Green's theorem find $\int_C (xy - x^2) dx + x^2 y dy$ where C is the closed curve formed by $y = 0, x = 1$ and $y = x$.	7	L2	CO1

Module – 4

Q.7	a.	Using Newton Raphson method find the real root of the equation $x^3 - 2x - 5 = 0$ correct to three decimal places.	6	L2	CO2												
	b.	From the following table find the number of students who scored less than 45 marks using Newton's forward interpolation formula <table border="1" data-bbox="331 1303 1257 1424"> <tr> <td>Marks</td><td>30 – 40</td><td>40 – 50</td><td>50 – 60</td><td>60 – 70</td><td>70 – 80</td></tr> <tr> <td>No. of Students</td><td>31</td><td>42</td><td>51</td><td>35</td><td>31</td></tr> </table>	Marks	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80	No. of Students	31	42	51	35	31	7	L2	CO2
Marks	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80												
No. of Students	31	42	51	35	31												
	c.	Find $\int_0^6 \frac{1}{1+x^2} dx$ using Simpson's $\left(\frac{1}{3}\right)^{rd}$ and Simpson's $\left(\frac{3}{8}\right)^{th}$	7	L2	CO2												

OR

Q.8	a.	Using Regula-Falsi method find the real root of the equation $x \log_{10} x = 1.2$ correct to 4 decimal places.	6	L2	CO2														
	b.	Find the interpolating polynomial $y = f(x)$ for the data given below using Newton's divided difference formula. <table border="1"><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>f(x)</td><td>3</td><td>2</td><td>7</td><td>24</td><td>59</td><td>118</td></tr></table>	x	0	1	2	3	4	5	f(x)	3	2	7	24	59	118	7	L2	CO2
x	0	1	2	3	4	5													
f(x)	3	2	7	24	59	118													

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Q.8	c.	Using Lagrange's interpolation formula, find the interpolating polynomial that approximates the function described by the following data and hence find $f(3)$.	7	L2	CO2										
		<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>5</td></tr><tr><td>f(x)</td><td>2</td><td>3</td><td>12</td><td>147</td></tr></table>	x	0	1	2	5	f(x)	2	3	12	147			
x	0	1	2	5											
f(x)	2	3	12	147											
Module – 5															
Q.9	a.	Employ Taylor series method to find an approximate solution to find y at $x = 0.1$ given $\frac{dy}{dx} = x - y^2, y(0) = 1$ by considering upto fourth degree term.	6	L2	CO2										
	b.	Using Runge -Kutta method of fourth order, compute $y(0.2)$ given that $\frac{dy}{dx} = 3x + \frac{y}{2}, y(0) = 1$ by taking $h = 0.2$.	7	L2	CO2										
	c.	If $\frac{dy}{dx} = 2e^x - y$ and $y(0) = 2, y(0.1) = 2.010, y(0.2) = 2.040, y(0.3) = 2.090$ find $y(0.4)$ corrected to 4 decimal places by using Milnes Predictor corrector formula.	7	L2	CO2										
OR															
Q.10	a.	Using Euler's modified method, find y at $x = 0.1$ given $\frac{dy}{dx} = \frac{y-x}{y+x}, y(0) = 1$ by taking $h = 0.1$	6	L2	CO2										
	b.	Using Runge - Kutta method of fourth order, compute $y(1.1)$ given that $\frac{dy}{dx} = xy^{\frac{1}{3}}, y(1) = 1$ by taking $h = 0.1$	7	L2	CO2										
	c.	Using Adams-Bashforth method, determine $y(0.4)$ given $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1, y(0.1) = 1.1113, y(0.2) = 1.2507, y(0.3) = 1.426$.	7	L2	CO2										
