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EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY
An Autonomous Institution Affiliated to Visvesvaraya Technological University (VTU) Belagavi

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25MTV21

Second Semester B.E. Degree Examination, June/July 2026
DIFFERENTIAL CALCULUS AND NUMERICAL METHODS

TIME:3 hrs. Max.Marks:100

Note: 1. Answer **any FIVE** full questions, choosing **ONE** question from **each MODULE.**
2. Formula Hand Books Permitted.
3. M: Marks, L: Bloom's level, C: Course outcomes.
4. Assume missing data suitably.

		Module-1	M	L	C
Q.1	a	Evaluate $\int_0^1 \int_x^{x^2} (x+y)\, dy\, dx$.	06	L2	CO1
	b	Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy\, dy\, dx$ by changing the order of integration.	07	L3	CO1
	c	Determine the area of the cardioid $r = a(1+\cos\theta)$ at $\theta = 0$ and $\theta = \pi$ by the initial line using double integration.	07	L3	CO1
		OR			
Q.2	a	Evaluate $\int_0^a \int_0^b e^{x+y}\, dy\, dx$.	06	L2	CO1
	b	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx\, dy$ by changing to polar coordinates.	07	L3	CO1
	c	Prove that $\beta(m,n) = \frac{\Gamma(m).\Gamma(n)}{\Gamma(m+n)}$.	07	L3	CO1
		Module–2			
Q.3	a	Form the Partial differential equation by eliminating arbitrary constant from $z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$.	06	L2	CO2
	b	Solve $\frac{\partial^2 z}{\partial x \partial y} = sinx\, siny$, given that $\frac{\partial z}{\partial y} = -2siny$ when $x = 0$ and $z = 0$ when $y = (2n+1)\pi/2$.	07	L3	CO2
	c	Derive the one-dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.	07	L3	CO2
		OR			
Q.4	a	Form the Partial differential equation by eliminating arbitrary function from $\varphi(xy + z^2,\ x + y - z) = 0$.	06	L2	CO2
	b	Solve $\frac{\partial^2 z}{\partial y^2} = z$ given that when $y = 0, z = e^x$ and $\frac{\partial z}{\partial y} = e^{-x}$.	07	L3	CO2
	c	Derive the one-dimensional heat equation in the form $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$.	07	L3	CO2

Module–3

Q.5	**a**	If $\vec{F} = (x+y+1)\hat{i} + \hat{j} - (x+y)\hat{k}$ show that $\vec{F}.Curl\,\vec{F} = 0$.	**06**	**L2**	**CO3**
	b	Find the constants a and b so that $\vec{F} = (axy + z^3)\hat{i} + (3x^2 - z)\hat{j} + (bxz^2 - y)\hat{k}$ is irrotational and hence find ϕ, such that $\vec{F} = \nabla\phi$.	**07**	**L3**	**CO3**
	c	Evaluate $\oint_C (xy + y^2)dx + x^2 dy$ byusing Green's theorem,where C is the closed curve of the region bounded by $y = x$ and $y = x^2$.	**07**	**L3**	**CO3**
		OR			
Q.6	**a**	Determine the directional derivative of $\varphi = xy^2 + yz^2$ at the point $P(2,-1,1)$ in the direction of the vector $\hat{i} - \hat{j} - \hat{k}$.	**06**	**L2**	**CO3**
	b	Show that $\vec{F} = \frac{x\hat{i} + y\hat{j}}{x^2 + y^2}$ is both solenoidal and irrotational.	**07**	**L3**	**CO3**
	c	Determine the total work done by the force represented by $\vec{F} = 3xyi - 2zxk$ in moving a particle round the circle $x^2 + y^2 = 4$.	**07**	**L3**	**CO3**
		Module–4			
Q.7	**a**	Determine a real root of the equation $3x = \cos x + 1$ lies between (0, 1) by using Regula-False methodcorrect to three decimal places (x is in radian measures).	**06**	**L2**	**CO4**
	b	Use Lagrange's interpolation formula to fit a polynomial for the data x: 0, 1, 3, 4 y: -12, 0, 6, 12	**07**	**L3**	**CO4**
	c	Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by Simpson's 3/8th rule by taking 7 ordinates.	**07**	**L3**	**CO4**
		OR			
Q.8	**a**	Determine the real root of the equation $x^3 + 5x - 11 = 0$ lies between (1, 2) using Newton–Raphson method(Carryout three iterations).	**06**	**L2**	**CO4**
	b	Using Newton's forward Interpolation find y at $x = 5$ from the data x: 4, 6, 8, 10 y: 1, 3, 8, 16	**07**	**L3**	**CO4**
	c	Evaluate $\int_0^6 \frac{dx}{4x+5}$ by using Simpson's 1/3rd rule by dividing interval into 6 equal parts.	**07**	**L3**	**CO4**
		Module–5			
Q.9	**a**	Using Taylor series determine the value of $y(0.1)$ given that $\frac{dy}{dx} = x^2 + y$ with $y(0) = 1$up to 3rd degree terms.	**06**	**L2**	**CO5**
	b	Using the Runge-Kutta method of fourth order, determine y (0.2) for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$ with y (0) = 1 taking h = 0.2.	**07**	**L3**	**CO5**

	c	If $\frac{dy}{dx} = 2e^x - y, y(0) = 2, y(0.1) = 2.010, y(0.2) = 2.040,$ $y(0.3) = 2.090$ determiney(0.4) correct to four decimal places by using Milne's predictor and corrector formulae.	07	L3	CO5
		OR			
Q.10	a	Use Modified Eulers Method $\frac{dy}{dx} = 3x + \frac{y}{2}$,with $y(0) = 1$. h $= 0.1$and compute $y(0.1)$ by taking $h = 0.2$.Carryout two approximations.	06	L2	CO5
	b	Use Runge-Kutta method of fourth order to determiney at $x = 0.1$ given that $\frac{dy}{dx} = 3\,e^x + 2y,\ y(0) = 0\ and\ h = 0.1.$	07	L3	CO5
	c	Using Adams-Bashforth predictor and corrector formulae determine y(0.4) given $\frac{dy}{dx} = 2e^x - y,\ y(0) = 2, y(0.1) = 2.010, y(0.2) = 2.040, y(0.3) = 2.090$	07	L3	CO5

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