ST JOSEPH ENGINEERING COLLEGE, MANGALURU

An Autonomous Institution

Second Semester BE(Autonomous) Examinations

USN: | | | | | | | | | | |

22MATS21

Duration: 3:00 Hrs **Model Question Paper-1** **Maximum Marks: 100**

Mathematics for CSE Stream

Note:

1. **Part-A** is mandatory.
2. Answer any five full questions from **Part-B** choosing at least one full question from each module.
3. For the necessary data, students are allowed to use data handbook.

PART-A					
Q.No.	**Questions**	**BL**	**CO**	**PO**	**Marks**
1	Evaluate $\int_0^1 \int_x^{\sqrt{x}} (x^2+y^2)\,dy\,dx$	**3**	**1**	**1**	**2**
2	Find the value of $\Gamma\left(\frac{7}{2}\right)$	**3**	**1**	**1**	**2**
3	Find the divergence of vector field $\vec{f} = 3x^2\hat{\imath} + 5xy^2\hat{\jmath} + xyz^3\hat{k}$	**3**	**2**	**2**	**2**
4	Write the base vectors for cylindrical polar coordinates.	**3**	**3**	**5**	**2**
5	State the rank nullity theorem for a m x n matrix.	**3**	**4**	**2**	**2**
6	Find the coordinate vector of [2 1] with respect to basis [1 1] and [0 1]	**3**	**4**	**5**	**2**
7	Construct a finite difference table for the function $f(x) = x^3 + x + 1$ where x takes the values $0, 1, 2, 3, 4, 5, 6$	**3**	**5**	**1**	**2**
8	Construct the table of values to evaluate $\int_0^6 3x^2\,dx$ by dividing the interval into 6 equal parts.	**3**	**5**	**5**	**2**
9	Find $y''(0)$ given $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1$.	**3**	**6**	**2**	**2**
10	Using Runge-Kutta method of fourth order find k_1 given $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$ taking $h = 0.1$.	**3**	**6**	**5**	**2**

Q.No.		**Question**	**BL**	**CO**	**PO**	**Marks**
MODULE - 1						
1	**a**	Evaluate $\int_{-c}^{c} \int_{-b}^{b} \int_{-a}^{a} (x^2+y^2+z^2)\,dz\,dy\,dx$	**3**	**1**	**1**	**5**
	b	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\,dy\,dx$ by changing into polar coordinates	**4**	**1**	**5**	**5**

	c	Show that $\int_0^{\infty} x\, e^{-x^8}\, dx$ x $\int_0^{\infty} x^2\, e^{-x^4}\, dx = \frac{\pi}{16\sqrt{2}}$	**4**	**1**	**5**	**6**
2	**a**	Evaluate $\iint xy(x+y)dy\, dx$ taken over the area between $y = x^2$ and $y = x$	**3**	**1**	**1**	**5**
	b	Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy\, dy\, dx$ by changing the order of integration.	**4**	**1**	**5**	**5**
	c	Show that $\int_0^{\frac{\pi}{2}} \frac{d\theta}{\sqrt{sin\theta}}$ x $\int_0^{\frac{\pi}{2}} \sqrt{sin\theta}\; d\theta = \pi$	**4**	**1**	**5**	**6**
MODULE - 2						
3	**a**	Find the directional derivative of $\varphi = x^2yz + 4xz^2$ at $(1,-2,-1)$ along $2i - j - 2k$	**3**	**2**	**2**	**5**
	b	Show that $\vec{F} = (y+z)\hat{\imath} + (z+x)\hat{\jmath} + (x+y)\hat{k}$ is irrotational. Also, find a scalar function $\emptyset$ such that $\vec{F} = \nabla\vec{\emptyset}$.	**3**	**2**	**5**	**5**
	c	Express the vector $f = z\hat{\imath} - 2x\hat{\jmath} + y\hat{k}$ in cylindrical polar coordinates.	**4**	**3**	**5**	**6**
4	**a**	Find the $curl(curl\, \vec{A})$, where $\vec{A} = x^2y\hat{\imath} - 2xz\hat{\jmath} + 2yz\hat{k}$ at the point (1,0,2).	**3**	**2**	**2**	**5**
	b	Show that $\vec{F} = (y^2 - z^2 + 3yz - 2x)\hat{\imath} + (3xz + 2xy)\hat{\jmath} + (3xy - 2xz + 2z)\hat{k}$ is both solenoidal and irrotational.	**3**	**2**	**5**	**5**
	c	Derive the expression for divergence in orthogonal curvilinear coordinates.	**4**	**3**	**5**	**6**
MODULE - 3						
5	**a**	Show that the polynomial $f(x) = x^2 + 2x + 2$ is in the linear span of the polynomials $4x^2 + x + 2, 3x^2 - x + 1$ and $5x^2 + 2x + 3$.	**4**	**4**	**2**	**5**
	b	Show that $T: V_2(R) \to V_3(R)$ defined by $T(x,y) = (-x + 2y, y, 3x + 3y)$ is a Linear Transformation and hence find the matrix of the Linear Transformation relative to the bases $X = \{(1,1), (-1,1)\}$ and $Y = \{(1,1,1), (1,-1,1), (0,0,1)\}$	**4**	**4**	**5**	**5**
	c	Verify rank-nullity theorem for the following matrix: $A = \begin{bmatrix} 1 & -3 & 4 & -1 \\ 9 & -2 & 6 & -6 \\ -1 & -10 & -3 & 9 \\ -6 & -6 & 3 & 3 \\ -9 & 4 & 9 & 0 \end{bmatrix}$	**3**	**4**	**5**	**6**
6	**a**	Check whether the w is in the span of $\{v_1, v_2, v_3\}$ where $w = [-9\ 7\ 4\ 8\,]$, $v_1 = [7\ -4\ -2\ 9\,]$, $v_2 = [-4\ 5\ -1\ 7\,]$, $v_3 = [-9\ 4\ 4\ -7\,]$	**4**	**4**	**2**	**5**

	b	Determine the Linear Transformation $T: V_3(R) \to V_2(R)$ such that $T(e_1) = (-1,0), T(e_2) = (1,1), T(e_3) = (0,-1)$ where e_1, e_2, e_3 are the standard basis of $V_3(R)$.	**4**	**4**	**5**	**5**
	c	Find the range, null space, rank, nullity for the Linear Transformation $T: V_3(R) \to V_3(R)$ defined by $T(x,y,z) = (x+2y+z, z-x, y+z)$. Also verify rank nullity theorem.	**3**	**4**	**5**	**6**
		MODULE - 4				
7	**a**	Find cube root of 37 correct to three decimal places using Newton Raphson method.	**3**	**5**	**1**	**5**
	b	Find the cubic polynomial which passes through the points $(2,4),\ (4,56),\ (9,711),\ (10,980)$ using Newton's divided difference formula.	**3**	**5**	**5**	**5**
	c	Evaluate $\int_0^1 \frac{dx}{1+x}$ applying Simpson's 3/8th rule taking 7 ordinates.	**4**	**5**	**5**	**6**
8	**a**	Compute the real root of $x^2 - 1.2 = 0$ correct to four decimal places using Regula-Falsi method.	**3**	**5**	**1**	**5**
	b	Given $sin\, sin\, 45^{\circ} = 0.7071,\ sin\, 50^{\circ} = 0.7660,\ sin\ 55^{\circ} = 0.8192,\ sin\, 60^{\circ} = 0.8660$ find $sin\, 57^{\circ}$ using Newton's backward interpolation formula.	**3**	**5**	**5**	**5**
	c	Evaluate $\int_4^{5.2} log\, x \quad dx$ by taking 6 equal parts using Trapezoidal rule.	**4**	**5**	**5**	**6**
		MODULE - 5				
9	**a**	Employ Taylor's series method upto third degree to find y at $x = 0.1$ given $\frac{dy}{dx} - 2y = 3e^x$ whose solution passes through the origin.	**4**	**6**	**2**	**5**
	b	Using modified Euler's method find y at $x = 0.2$ given $\frac{dy}{dx} = 3x + \frac{y}{2}$ with $y(0) = 1$ taking $h = 0.1$.	**4**	**6**	**5**	**5**
	c	Given that $\frac{dy}{dx} = x - y^2$ and the data $y(0) = 0,\ y(0.2) = 0.02,\ y(0.4) = 0.0795, y(0.6) = 0.1762$. Compute y at $x = 0.8$ by applying Milne's method.	**4**	**6**	**5**	**6**
10	**a**	Use Taylor's series method to obtain a power series in $(x-4)$ upto third degree for the equation $5x\frac{dy}{dx} + y^2 - 2 = 0$ given $y = 1$ at $x = 4$.	**4**	**6**	**2**	**5**
	b	Using Runge-Kutta method of fourth order, find $y(0.2)$ for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ taking $h = 0.2$.	**4**	**6**	**5**	**5**

	c	Apply Milne's method to compute $y(1.4)$ correct to four decimal places given $\frac{dy}{dx} = x^2 + \frac{y}{2}$ and the following data: $y(1) = 2,\ y(1.1) = 2.2156,\ y(1.2) = 2.4649,\ y(1.3) = 2.7514.$	**4**	**6**	**5**	**6**