4	M	H	2	3	C	B	0	2	0

M23BMATS201

Maharaja Education Trust (R), Mysuru

MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE

An Autonomous Institute, affiliated Visvesvaraya Technological University, Belagavi
Belawadi, Srirangapatna Taluk, Mandya – 571 477
Approved by AICTE, New Delhi |Recognized by Govt. of Karnataka|

Second SemesterB.E Degree Examination, July/August-2024
Mathematics -II for CSE- Stream

Duration: **3 hrs** Max. Marks: **100**

Note: 1. Answer five full questions choosing one complete question from each module.
2. M: Marks, L: Bloom`s Level, C: Course outcome

Sl. No.	Questions	M	C	L
	Module 1			
1 a)	Obtain the relationship between Beta and Gamma functions in the form $\beta(m,n) = \frac{\Gamma m * \Gamma n}{\Gamma m+n}$	8	1	L2
b)	By double integration, find the area bounded between the parabola $y^2 = 4x$ and the straight line $y = x$.	8	1	L1
c)	Solve the integral $\int_0^1 \int_0^2 \int_0^3 x^2y^2z^2 \ dx\, dy\, dz$.	4	2	L3
	OR			
2 a)	Find the solution of $\int_0^{\frac{\pi}{2}} \frac{d\theta}{\sqrt{sin\theta}} \ * \int_0^{\frac{\pi}{2}} \sqrt{sin\theta}\ d\theta$ in terms of Gamma function.	8	1	L2
b)	Changing into polar coordinates and solve $\int_0^a \int_0^{\sqrt{a^2-y^2}} y\sqrt{x^2+y^2}\, dx\, dy$.	8	2	L3
c)	Write the codes to find the volume of the tetrahedron bounded by the planes $x = 0. y = 0 , z = 0\ \& \frac{x}{2} + \frac{y}{3} + \frac{z}{4} = 1$ using mathematical tools.	4	4	L3
	Module 2			
3 a)	Prove that the spherical coordinate system is orthogonal.	8	2	L2
b)	Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at $(2,-1,2)$ along $2i - 3j + 6k$.	8	1	L1
c)	Find the value of constant 'a' such that $\vec{F} = (axy - z^3)i + (a-2)x^2j + (1-a)xz^2k$ is irrotational.	4	1	L1
	OR			
4 a)	Prove that the cylindrical coordinate system is orthogonal.	8	2	L2
b)	If $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$ find $div\,\vec{F}$ and $curl\vec{F}$.	8	1	L1
c)	Using the Mathematical tools, write the codes to find the divergence of $\vec{F} = x^2y\, i + yz^2j + x^2z\, k\ at\ (1,1,1)$.	4	4	L3
	Module 3			
5 a)	Define subspace. Prove that the subset $W = \{(x,y,z)/x = y = z\}$ in $V_3(R)$is a subspace of R^3.	8	2	L2
b)	Define inner product space. Consider the vectors $u = (1,2,4)$ $v = (2,-3,5)$ and $w = (4,2,-3) in R^3$. Find $i) < u,v >, < u,w >, < v,w >, < u+v, w >$.	8	2	L1
c)	Find the basis and dimensions of the subspace spanned by the vectors, $\{(2,4,2),(1,-1,0),(1,2,1),(0,3,1)\}$ in $V(R^3)$.	4	2	L1
	OR			
6 a)	Define linearly independent and linearly dependent set. Show that the vectors	8	2	L2

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	$\{(1,-2,2),(3,0,4),(-2,2,-4)\}$ is linearly independent.			
b)	Find the matrix representation of linear transformation $T: R^3 \to R^3$ defined by $T(x,y,z) = (2y+z, x-4y, 3x)$ corresponding to the basis $B = \{(1,1,1),(1,1,0),(1,0,0)\}$.	8	2	L1
c)	State and verify the Rank-Nullity theorem for the linear transformation defined by $T(x,y,z) = (x+2y-z, y+z, x+y-2z)$.	4	2	L2
	Module 4			
7a)	Use Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule to estimate an integral $\int_0^1 \frac{dx}{1+x^2}$ by taking 4 equal strips and hence deduce an approximate value of π.	8	3	L3
b)	Use Lagrange's interpolation formula to find $f(4)$ given x: 0, 2, 3, 6 $f(x)$: -4, 2, 14, 158	8	1	L1
c)	Find a real root of the equation $x\log_{10}x - 1.2 = 0$ between (2,3) correct to three decimal places by Regula-falsi method. Correct to two iterations only.	4	3	L3
	OR			
8 a)	Use Simpson's $\left(\frac{3}{8}\right)^{th}$ rule to estimate an integral $\int_0^1 \frac{dx}{1+x}$ by taking 7 ordinates.	8	3	L3
b)	Use Newton's general interpolation formula find $f(8)$&$f(15)$ from the following table. x: 4, 5, 7, 10, 11, 13 $f(x)$: 48, 100, 294, 900, 1210, 2028	8	3	L3
c)	Use Newton-Raphson method to find the real root of the equation $x\sin x + \cos x = 0$ near $x = \pi$. Correct to two iterations .	4	1	L1
	Module 5			
9 a)	Compute $y(1.4)$, given $\frac{dy}{dx} = 1 + \frac{y}{x}$ with $y(1) = 2$ &$h = 0.2$ by Modified Euler's method.	8	3	L3
b)	Compute $y(0.4)$ by Milne's predictor and corrector formulae for $\frac{dy}{dx} = 2e^x - y$. Given that $y(0) = 2, y(0.1) = 2.010, y(0.2) = 2.040, y(0.3) = 2.090$. Apply corrector formula twice.	8	1	L3
c)	Use Runge-Kutta method of 4th order find an approximate value of y at $x = 0.5$ correct to 4 decimal places. Given that $\frac{dy}{dx} = x + y;\ y(0.4) = 1$ and $h = 0.1$	4	1	L3
	OR			
10a)	Employ Taylor's series method, find the value of y at $x = 0.1$ given $\frac{dy}{dx} = x^2 - y^2; y(0) = 1$ upto 4th derivative.	8	3	L3
b)	Use Runge-Kutta method of 4th order find an approximate value of y at $x = 0.1$ correct to 4 decimal places. Given that $\frac{dy}{dx} = 3e^x + 2y\ ;\ y(0) = 0\ and\ h = 0.1$.	8	1	L3
c)	Write the Mathematical tool codes to solve the differential equation $\frac{dy}{dx} = x - y^2$ with $y(0) = 1$ using the Modified Euler's method at x = 0.1,0.2	4	4	L3

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