BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN											Course Code	2	2	M	A	T	M	2	1

Second Semester B.E. Degree Examinations, September/October 2023
Mathematics for MECHANICAL Stream- II

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

Note: *1. Answer any* **FIVE** *full questions, choosing* **ONE** *full question from each module.*
2. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO: PI)
		MODULE – 1		
1.	a.	Find the directional derivative of the function $\emptyset = 4xz^3 - 3x^2y^2z$ at $(2, -1, 2)$ along $2i - 3j + 6k$	06	1:1:1.2.1
	b.	Show that $\vec{F}.curl\,\vec{F} = 0$, if $\vec{F} = (x + y + 1)i + j - (x + y)k$,	07	3:1:1.2.1
	c.	Find constants a and b such that $\vec{F} = (axy + z^3)i + (3x^2 - z)j + (bxz^2 - y)k$ is irrotational. Also find a scalar function $\emptyset$ such that $\vec{F} = \nabla\emptyset$	07	1:1:1.2.1
		OR		
2.	a.	Find the total work done by the force represented by $\vec{F} = 3xyi - yj + 2zxk$ in moving a particle round the circle $x^2 + y^2 = 4$	06	1:1:1.2.1
	b.	Verify Green's theorem in a plane for $\int(3x^2 - 8y^2)dx + (4y - 6xy)dy$, where C is the boundary of the region enclosed by $y = \sqrt{x}$ and $y = x^2$	07	3:1:1.2.1
	c.	Verify Stoke's theorem for $\vec{F} = (2x - y)i - yz^2j - y^2zk$ where S is the upper half surface of the sphere $x^2 + y^2 + z^2 = 1$, C is its boundary .	07	3:1:1.2.1
		MODULE – 2		
3.	a.	Solve: $\frac{d^3y}{dx^3} + 2\frac{d^2y}{dx^2} - \frac{dy}{dx} - 2y = 0$	06	3:2:1.2.1
	b.	Solve: $(D^2 - 3D + 2)y = sin3x$	07	3:2:1.2.1
	c.	Solve: $\frac{d^2y}{dx^2} + \frac{dy}{dx} = x^2 + 2x + 4$	07	3:2:1.2.1
		OR		
4.	a.	Solve: $\frac{d^2y}{dx^2} + y = tanx$ by the method of variation of parameters.	06	3:2:1.2.1
	b.	Solve: $(x + 1)^2\frac{d^2y}{dx^2} + (x + 1)\frac{dy}{dx} + y = 2\sin[\log(x + 1)]$	07	3:2:1.2.1
	c.	Solve: $x^2\frac{d^2y}{dx^2} + 4x\frac{dy}{dx} + 2y = e^x$	07	3:2:1.2.1

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**

MODULE – 3

5.	a.	**Form the PDE by eliminating the arbitrary constants of** $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$	06	3:3:1.2.1
	b.	**Form the PDE by eliminating the arbitrary functions of** $\phi(x+y+z,\ x^2+y^2-z^2)=0$	07	3:3:1.2.1
	c.	**Find the PDE of the family of all spheres whose centres lie on the plane $z=0$ and have a constant radius 'r'**	07	1:3:1.2.1

OR

6.	a.	Solve: $\frac{\partial^2 u}{\partial x \partial t}=e^{-t}cosx$ given that $u=0\ when\ \frac{\partial u}{\partial t}=0\ at\ x=0$	06	3:3:1.2.1
	b.	Solve: $\frac{\partial^2 z}{\partial x^2}=a^2 z$ given that when $x=0, z=0\ and\ \frac{\partial z}{\partial x}=a\,Siny$	07	3:3:1.2.1
	c.	**Derive one dimensional wave equation of the form** $\frac{\partial^2 u}{\partial t^2}=c^2\frac{\partial^2 u}{\partial x^2}$	07	3:3:1.2.1

MODULE – 4

7.	a.	**Compute a real root of $x\ \log_{10} x-1.2=0$ by the method of false position. Carry out three iterations.**	06	3:4:1.2.1
	b.	**Find the interpolating polynomial for $f(x)$ using Newton's forward interpolation formula, given $f(0)=0, f(2)=4, f(4)=56$, $f(6)=204, f(8)=496, f(10)=980$ and hence find $f(3)$**	07	1:4:1.2.1
	c.	**Using Newton's divided difference formula to find $f(8)$, $f(15)$ from the following data.**	07	1:4:1.2.1

x	4	5	7	10	11	13
$f(x)$	48	100	294	900	1210	2028

OR

8.	a.	**Using Lagrange's interpolation formula compute u_4 , given $u_0=707, u_2=819,\ \ u_3=866, u_6=966.$**	06	3:4:1.2.1
	b.	**Use Simpson's 1/3 rd rule to find $\int_0^{0.6} e^{-x^2}\ dx$ by taking 6 sub-intervals.**	07	1:4:1.2.1
	c.	**Evaluate $\int_0^6 \frac{dx}{1+x^2}$ taking 6 equal intervals using Trapezoidal rule.**	07	3:4:1.2.1

MODULE – 5

9.	a.	**Use Taylor's series method to find y(4.1) given that $\frac{dy}{dx}=\frac{1}{x^2+y}$ and y (4) =4**	06	3:5:1.2.1
	b.	**Given $\frac{dy}{dx}=1+\frac{y}{x}$, y=2 at x=1, find y at x=1.2 taking h=0.2 by applying modified Euler's method.**	07	1:5:1.2.1
	c.	**Use 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**	07	3:5:1.2.1

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**

OR

10.	**a.**	**Employ Taylor's series method to find y at x=0.1 given that** $\frac{dy}{dx} - 2y = 3e^x$, **y(0)=0**	**06**	3:5:1.2.1
	b.	**Apply Milne's predictor-corrector formula to find** $y(0.4)$ **using the values y(0)=1, y(0.1)=1.1113, y(0.2)=1.2507, y(0.3)=1.426, given that** $\frac{dy}{dx} = x^2 + y^2$ **. Write the answer approximating correct to four decimal places.**	**07**	3:5:1.2.1
	c.	**Using Scilab develop a program to solve ODE using modified Euler's method for** $f = y - 2x^2 + 1$ **with the conditions** $x_0 = 0, y_0 = 5, x_m = 1, h = 0.1$	**07**	3:5:1.2.7

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