Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN | | | | | | | | | | | **Course Code** 2 2 M A T C 2 1

Second Semester B.E. Degree Summer Semester Examinations, September/October 2025

MATHEMATICS-II FOR CIVIL ENGINEERING STREAM

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

Note: ***1. Answer any* FIVE *full questions, choosing* ONE *full question from each module.***
2. Use of Mathematics Formula Handbook is permitted.
3. Missing data, if any, may be suitably assumed.

Q. No		Question	Marks	(RBTL:CO:PI)
		Module-1		
1.	**a.**	Find the unit vector normal to the surface at the indicated point $x^2y+2xz=4$ at $(2,-2,3)$.	**06**	**(1 :1 : 1.2.1)**
	b.	If $\vec{F}=(x+y+1)i+j-(x+y)k$, show that $\vec{F}.\text{curl}\,\vec{F}=0$.	**07**	**(2 :1 : 1.2.1)**
	c.	Show that $\vec{F}=\dfrac{xi+yj}{x^2+y^2}$ is both solenoidal and irrotational.	**07**	**(2 :1 : 1.2.1)**
		(OR)		
2.	**a.**	Evaluate $\int_c \vec{F}.d\vec{r}$ where $\vec{F}=xyi+\left(x^2+y^2\right)j$ along (i) the path of the straight line from $(0,0)$ to $(1,0)$ and then to $(1,1)$. (ii) the straight line joining the origin and $(1,2)$.	**06**	**(1 :1 : 1.2.1)**
	b.	Evaluate $\int\left(3x^2-8y^2\right)dx+(4y-6xy)dy$, by Green's theorem in a plane, where C is the boundary of the region enclosed by $y=\sqrt{x}$ and $y=x^2$.	**07**	**(2 :1 : 1.2.1)**
	c.	Evaluate the vector $\vec{F}=\left(x^2+y^2\right)i-2xyj$ by Stoke's theorem taken round the rectangle bounded by $x=0,\ x=a,\ y=0,\ y=b$.	**07**	**(2 :1 : 1.2.1)**
		Module-2		
3.	**a.**	Solve $\dfrac{d^3y}{dx^3}-2\dfrac{d^2y}{dx^2}+4\dfrac{dy}{dx}-8y=0$	**06**	**(1 :2 : 1.2.1)**
	b.	Solve $\left(D^2+5D+6\right)y=e^x$	**07**	**(2 :2 : 1.2.1)**
	c.	Solve $y''-4y'+13y=\sin 2x$	**07**	**(2 :2 : 1.2.1)**
		(OR)		
4.	**a.**	Use the method of variations of parameters to solve $\dfrac{d^2y}{dx^2}+y=\tan x$.	**06**	**(1 :2 : 1.2.1)**
	b.	Solve $(2x+1)^2y''-6(2x+1)y'+16y=8(2x+1)^2$.	**07**	**(2 :2 : 1.2.1)**
	c.	Solve $x\dfrac{d^2y}{dx^2}-\dfrac{2y}{x}=x+\dfrac{1}{x^2}$.	**07**	**(2 :2 : 1.2.1)**

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

Module-3

			Marks	(RBTL : CO : PI)
5.	a.	Form the Partial differential equation by eliminating the arbitrary constants from $(x-a)^2+(y-b)^2+z^2=c^2$.	06	(1 :3 : 1.2.1)
	b.	Form the PDE eliminating the arbitrary function from $f\left(x+y+z, x^2+y^2+z^2\right)=0$.	07	(2 :3 : 1.2.1)
	c.	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	(2 :3 : 1.2.1)

(OR)

6.	a.	Solve $\frac{\partial^2 z}{\partial x \partial y}=\sin x \sin y$, given that $\frac{\partial z}{\partial x}=-2\sin y$ when $x=0$ and $z=0$ when y is odd multiple of $\frac{\pi}{2}$.	06	(1 :3 : 1.2.1)
	b.	Solve $(y-z)p+(z-x)q=(x-y)$.	07	(2 :3 : 1.2.1)
	c.	Derive one-dimensional heat equation in the standard form.	07	(2 :3 : 1.2.1)

Module-4

7. a. Use Newton-Raphson method to find the real root of the equation $x\sin x+\cos x=0$ near $x=\pi$. Carry out three iterations. **06** **(1 :4 : 1.2.1)**

b. Use Newton's forward interpolation formula to find $f(38)$ **07** **(2 :4 : 1.2.1)**

x	40	50	60	70	80	90
$f(x)$	184	204	226	250	276	304

c. From the following table, find the number of students who have obtained (i) less than 45 marks (ii) between 40 and 45 marks by using interpolation formula **07** **(2 :4 : 1.2.1)**

Marks	30-40	40-50	50-60	60-70	70-80
No. of Students	31	42	51	35	31

(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	(1 :4 : 1.2.1)
	b.	By using Simpson's 1/3rd rule evaluate $\int_2^8 \frac{dx}{\log_{10} x}$ by considering seven ordinates	07	(2 :4 : 1.2.1)
	c.	Evaluate $\int_0^6 \frac{dx}{1+x^2}$ taking 6 equal intervals using Trapezoidal rule.	07	(2 :4 : 1.2.1)

Module-5

9.	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	(1 :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	(2 :5 : 1.2.1)

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

	c.	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**	**(2 :5 : 1.2.1)**

(OR)

10.	**a.**	Use Taylor's series method to find y at x=0.1 considering terms up to 3rd degree given that $\frac{dy}{dx}=x^2+y^2$ and y (0) =1.	**06**	**(1 :5 : 1.2.1)**
	b.	Using modified Euler's method to find y(0.1) correct to four decimal places solving the equation $\frac{dy}{dx}=x-y^2$, y(0)=1 taking h=0.1	**07**	**(2 :5 : 1.2.1)**
	c.	Given $\frac{dy}{dx}=3x+\frac{y}{2}$, y(0)=1, compute y(0.2) by taking h=0.2 using Range-Kutta method of fourth order.	**07**	**(2 :5 : 1.2.1)**

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