CBCS SCHEME

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BMATC101

First Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

Mathematics – I for Civil Engineering Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	With usual notations, prove that $\tan\phi = r\frac{d\theta}{dr}$.	6	L2	CO1
	b.	Find the angle between the curves $r = a(1 + \sin\theta)$ and $r = a(1 - \sin\theta)$.	7	L2	CO1
	c.	Show that the radius of curvature for the curve $r^n = a^n \cos n\theta$ varies inversely as r^{n-1}.	7	L3	CO1
		OR			
Q.2	a.	Show that the radius of curvature for the catenary of uniform strength $y = a \log[\sec(x/a)]$ is $a \sec(x/a)$.	7	L2	CO1
	b.	Find the pedal equation of the curve : $\frac{2a}{r} = (1+\cos\theta)$.	8	L2	CO1
	c.	Using modern mathematical tool, write a program/code to plot the sine and cosine curve.	5	L3	CO5
		Module – 2			
Q.3	a.	Expand $\log(\sec x)$ upto the terms containing x^6 using Maclaurin's series.	6	L2	CO1
	b.	If $u = f(x - y, y - z, z - x)$ then show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$.	7	L3	CO1
	c.	Examine the function $f(x, y) = xy(a - x - y)$ for extreme values.	7	L3	CO1
		OR			
Q.4	a.	If $u = e^{ax+by} \times f(ax - by)$, prove that $b\frac{\partial u}{\partial x} + a\frac{\partial u}{\partial y} = 2abu$.	7	L2	CO1
	b.	If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$, find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ at $(1, -1, 0)$.	8	L3	CO1
	c.	Using modern mathematical tool write a program/code to evaluate $\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$.	5	L3	CO5

		Module – 3			
Q.5	**a.**	Solve: $\frac{dy}{dx}+\frac{y}{x}=y^2x$	**6**	**L2**	**CO2**
	b.	Show that the family of parabolas $y^2 = 4a(x + a)$ is self orthogonal.	**7**	**L3**	**CO2**
	c.	Solve : $p^2 + 2py\cot x = y^2$.	**7**	**L2**	**CO2**
		OR			
Q.6	**a.**	Solve : $(2x + y + 1)\,dx + (x + 2y + 1)\,dy = 0$.	**6**	**L2**	**CO2**
	b.	A body originally at 80°C cools down to 60°C in 20 minutes, the temperature of the air being 40°C. What will be the temperature of the body after 40 minutes from the original?	**7**	**L3**	**CO2**
	c.	Solve the equation $(px - y)(py + x) = 2p$ by reducing into Clairaut's form, taking the substitution $X = x^2$, $Y = y^2$.	**7**	**L2**	**CO2**
		Module – 4			
Q.7	**a.**	Solve : $(4D^4 - 4D^3 - 23D^2 + 12D + 36)\,y = 0$.	**6**	**L2**	**CO3**
	b.	Solve : $(D - 2)^2\,y = 8(e^{2x} + \sin 2x)$.	**7**	**L2**	**CO3**
	c.	Solve by the method of variation of parameters $y'' + a^2y = \sec ax$.	**7**	**L3**	**CO3**
		OR			
Q.8	**a.**	Solve : $y'' + 3y' + 2y = 12\,x^2$.	**6**	**L2**	**CO3**
	b.	Solve : $\frac{d^2y}{dx^2} - 4y = \cosh(2x-1) + 3^x$.	**7**	**L2**	**CO3**
	c.	Solve : $(2x+1)^2y'' - 6(2x+1)y' + 16y = 8(2x+1)^2$.	**7**	**L3**	**CO3**
		Module – 5			
Q.9	**a.**	Find the rank of the matrix $A = \begin{bmatrix} 1 & 2 & 4 & 3 \\ 2 & 4 & 6 & 8 \\ 4 & 8 & 12 & 16 \\ 1 & 2 & 3 & 4 \end{bmatrix}$.	**6**	**L2**	**CO4**
	b.	Solve the system of equations by using Gauss-Jordan method: $2x + y + z = 10$, $3x + 2y + 3z = 18$, $x + 4y + 9z = 16$.	**7**	**L3**	**CO4**
	c.	Using Rayleigh's power method, find the dominant eigen value and corresponding eigen vector of $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ by taking $[1, 1, 1]^T$ as the initial eigen vector. Carryout 6 iterations.	**7**	**L3**	**CO4**

		OR			
Q.10	**a.**	Find the rank of the matrix $\begin{bmatrix} 11 & 12 & 13 & 14 \\ 12 & 13 & 14 & 15 \\ 13 & 14 & 15 & 16 \\ 14 & 15 & 16 & 17 \end{bmatrix}$.	**7**	**L3**	**CO4**
	b.	Solve the system of equations by using Gauss-Seidel method: $10x + 2y + z = 9$, $x + 10y - z = -22$, $-2x + 3y + 10z = 22$. Carryout 3 iterations.	**8**	**L3**	**CO4**
	c.	Using modern mathematical tool, write a program/code to test the consistency of the equations $x + 2y - z = 1$, $2x + y + 4z = 2$, $3x + 3y + 4z = 1$.	**5**	**L3**	**CO5**

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