CBCS SCHEME

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BMATE101

First Semester B.E./B.Tech. Degree Examination, June/July 2025
Mathematics-I for EEE Stream

Time: 3 hrs. Max. Marks: 100

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

		Module – 1	M	L	C
Q.1	**a.**	With usual notation prove that $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\theta}\right)^2$.	**6**	**L2**	**CO1**
	b.	Find the angle between the curves r = a(1 - cosθ) and r = 2a cosθ.	**7**	**L2**	**CO1**
	c.	Find the radius of curvature of the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at the point where it cuts the line y = x.	**7**	**L2**	**CO1**
		OR			
Q.2	**a.**	Derive an expression for the radius of curvature for a Cartesian curve.	**8**	**L2**	**CO1**
	b.	Find the pedal equation of the curve $r^n = a^n \cdot \sec n\theta$.	**7**	**L2**	**CO1**
	c.	Using modern mathematical tool write a programme code to plot sine and cosine curve.	**5**	**L3**	**CO5**
		Module – 2			
Q.3	**a.**	Expand $\sqrt{1+\sin 2x}$ by Maclaurin's series upto the term containing x^4.	**6**	**L2**	**CO1**
	b.	If u = $f\left(\frac{y-x}{xy}, \frac{z-x}{zx}\right)$ then find the value of $x^2\frac{\partial u}{\partial x} + y^2\frac{\partial u}{\partial y} + z^2\frac{\partial u}{\partial z}$.	**7**	**L2**	**CO1**
	c.	Find the maximum and minimum value of the function $x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$.	**7**	**L3**	**CO2**
		OR			
Q.4	**a.**	If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$ then find J = $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ at (1, -1,0)	**8**	**L3**	**CO2**
	b.	Evaluate $\lim_{x\to 0}\left(\frac{a^x + b^x + c^x}{3}\right)^{1/x}$.	**7**	**L2**	**CO2**
	c.	Using modern mathematical tool, write a programs/code. Show that $u_{xx} + u_{yy} = 0$, given u = e^x [x cosy – y siny]	**5**	**L3**	**CO5**

		Module – 3			
Q.5	**a.**	Solve $\frac{dy}{dx}+y\cdot\tan x=y^3\sec x$.	**6**	**L2**	**CO3**
	b.	Find the orthogonal trajectories of the family of curves $\frac{x^2}{a^2}+\frac{y^2}{b^2+\lambda}=1$ Where λ is the parameter?	**7**	**L3**	**CO3**
	c.	Solve $\frac{dy}{dx}-\frac{dx}{dy}=\frac{x}{y}-\frac{y}{x}$.	**7**	**L2**	**CO3**
		OR			
Q.6	**a.**	Solve $(xy+y^2+y)dx+(x^2+3xy+2x)\,dy=0$.	**6**	**L2**	**CO3**
	b.	An inductance of 2 henries and resistance of 20 ohms are connected in series with an emf E Volts. If the current is zero when $t=0$, find the current at the end of 0.01 secs if $E=100$ volts.	**7**	**L3**	**CO3**
	c.	Find the general and singular solution of the Clairaut's equation. $(y-px)(p-1)=p$.	**7**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Evaluate $\int_{-1}^{+1}\int_{0}^{z}\int_{x-z}^{x+z}(x+y+z)\,dy\,dx\,dz$.	**6**	**L2**	**CO4**
	b.	Prove that $\beta(m,n)=\frac{\lceil m\cdot\lceil n}{\lceil m+n}$.	**7**	**L2**	**CO4**
	c.	Change the order of integration and evaluate $\int_0^a\int_y^a\frac{x}{x^2+y^2}\,dx\,dy$.	**7**	**L2**	**CO4**
		OR			
Q.8	**a.**	Evaluate $\int_0^\infty\int_0^\infty e^{-(x^2+y^2)}\,dx\,dy$ by changing into polar coordinates.	**6**	**L2**	**CO4**
	b.	Using double integration find the area bounded between the circle $x^2+y^2=a^2$ and the line $x+y=a$.	**7**	**L2**	**CO4**
	c.	Prove that $\int_0^{\pi/2}\sqrt{\sin\theta}\;d\theta\times\int_0^{\pi/2}\frac{d\theta}{\sqrt{\sin\theta}}=\pi$.	**7**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Find the Rank of the matrix $A=\begin{pmatrix}4&0&2&1\\2&1&3&4\\2&3&4&7\\2&3&1&4\end{pmatrix}$.	**6**	**L2**	**CO4**
	b.	Solve by Gauss – Jordan method $2x+y+4z=12$, $8x-3y+2z=20$, $4x+11y-z=33$.	**7**	**L3**	**CO4**

	c.	Using Rayleigh's power method find the dominant eigen value and the corresponding eigen vector of $A = \begin{pmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{pmatrix}$ by taking $(1, 0, 0)^T$ as the initial eigen vector. Carry out 5 iterations.	**7**	**L3**	**CO4**
		OR			
Q.10	**a.**	Solve the following system of equations by Gauss – Seidal method $5x + 2y + z = 12$ $x + 4y + 2z = 15$ $x + 2y + 5z = 20$. Carry out 3 iterations with (1, 0, 3) as initial approximation.	**8**	**L3**	**CO4**
	b.	Solve the following system of equations by Gauss – elimination method. $x + y + z = 9$ $2x + y - z = 0$ $2x + 5y + 7z = 52$	**7**	**L3**	**CO4**
	c.	Using modern mathematical tool, write programme to test the consistency of the equation $x + 2y - z = 1$ $2x + y + 4z = 2$ $3x + 3y + 4z = 1$.	**5**	**L3**	**CO5**

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