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CBCS SCHEME

BMATE101

First Semester B.E/B.Tech. Degree Examination, Dec.2023/Jan.2024
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. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
1	a.	With usual notations prove that $\tan\phi = r\dfrac{d\theta}{dr}$.	6	L2	CO1
	b.	Find the angle of intersection for the pair of curve $r = a(1 + \sin\theta)$, $r = b(1 - \sin\theta)$.	7	L2	CO1
	c.	Find the radius of curvature of the curve $x^3 + y^3 = 3xy$ at $\left(\dfrac{3}{2},\dfrac{3}{2}\right)$.	7	L2	CO1
		OR			
2	a.	Prove that the pair of curves $r = a\sec^2\left(\dfrac{\theta}{2}\right)$, $r = b\operatorname{cosec}^2\left(\dfrac{\theta}{2}\right)$ intersect orthogronally.	8	L2	CO1
	b.	Find the Pedal equation of the curve $r^n = a^n \cos n\theta$.	7	L2	CO1
	c.	Using modern mathematical tool write a program/code to plot sine and cosine curves.	5	L3	CO5
		Module – 2			
3	a.	Expand $\log(\sec x)$ up to the term containing x^6 using Maclaurin's series.	6	L2	CO1
	b.	If $u = \tan^{-1}\left(\dfrac{y}{x}\right)$ where $x = e^t - e^{-t}$ and $y = e^t + e^{-t}$. Find $\dfrac{du}{dt}$.	7	L2	CO1
	c.	If: $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$. Find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$ at $(1,-1,0)$.	7	L3	CO1

		OR			
4	a.	Evaluate : i) $\lim_{x\to 0}\left(\frac{a^x+b^x}{2}\right)^{1/x}$ ii) $\lim_{x\to 0}(\sin x)^{\tan x}$.	7	L2	C(
	b.	If $u=f(y-z, z-x, x-y)$ prove that $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}=0$.	8	L2	CO
	c.	Using modern mathematical tool write a program/ code to evaluate : $\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$.	5	L3	C(
		Module – 3			
5	a.	Solve : $\frac{dy}{dx}+2\frac{y}{x}=\frac{y^2\log x}{x}$.	6	L2	C(
	b.	Find the orthogonal trajectories of the family of Asteroid $x^{2/3}+y^{2/3}=a^{2/3}$.	7	L3	C(
	c.	Solve : $p^3+2xp^2-y^2p^2-2xy^2p=0$.	7	L2	C(
		OR			
6	a.	Solve : $y(x+y+1)dx+x(x+3y+2)dy=0$.	6	L2	C(
	b.	Show that a DE for the current i in an electric circuit containing an inductance L and resistance R in series and acted by an electromotive force $E\sin\omega t$ satisfies the equation : $L\frac{di}{dt}+Ri=E\sin\omega t$. Find the value of the current at any time t, if initially there is no current in the circuit.	7	L3	C(
	c.	Modify the equation into Clairaut's form. Hence find the general and singular solution of $xp^2-py+kp+a=0$.	7	L2	C(
		Module – 4			
7	a.	Evaluate : $\int_{-1}^{1}\int_{0}^{z}\int_{x-z}^{x+z}(x+y+z)\,dy\,dx\,dz$.	6	L2	C(
	b.	Evaluate by changing the order of integration : $\int_0^1\int_0^{\sqrt{1-x^2}} y^2\,dx\,dy$.	7	L2	C(
	c.	Prove that $\beta(m,n)=\frac{\Gamma(m)\cdot\Gamma(n)}{\Gamma(m+n)}$.	7	L2	C(

		OR			
8	a.	Evaluate : $\int_0^a \int_0^{\sqrt{a^2-y^2}} y\sqrt{x^2+y^2}\,dx\,dy$ by changing into polar form.	6	L2	CO3
	b.	Find the area bounded between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ using double integration.	7	L3	CO3
	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	CO3
		Module – 5			
9	a.	Find the Rank of the Matrix : $\begin{bmatrix} 1 & 0 & 2 & -2 \\ 2 & -1 & 0 & -1 \\ 1 & 0 & 2 & -1 \\ 4 & -1 & 3 & -1 \end{bmatrix}$.	6	L2	CO4
	b.	Solve the system of equations by Gauss – Elimination method. $2x + y + z = 10$ $3x + 2y + 3z = 18$ $x + 4y + 9z = 16$.	7	L3	CO4
	c.	Using Gauss – Seidel iterative method to solve : $5x + 2y + z = 12$ $x + 4y + 2z = 15$ $x + 2y + 5z = 20$ Carryout 4 iterations, taking the initial approximation to the solution as (1, 0, 3).	7	L3	CO4
		OR			
10	a.	Find the Rank of the matrix : $\begin{bmatrix} 4 & 0 & 2 & 1 \\ 2 & 1 & 3 & 4 \\ 2 & 3 & 4 & 7 \\ 2 & 3 & 1 & 4 \end{bmatrix}$.	7	L2	CO4
	b.	Solve by Gauss – Jordan method : $2x + y + 3z = 1$ $4x + 4y + 7z = 1$ $2x + 5y + 9z = 3$.	7	L3	CO4
	c.	Using modern mathematical tool write a program/code to test the consistency of the equations : $x + 2y - z = 1$ $2x + y + 4z = 2$ $3x + 3y + 4z = 1$.	6	L3	CO5

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CBCS SCHEME

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BMATS101

First Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024
Mathematics – I for CSE 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.

			M	L	C
		Module – 1			
Q.1	a.	With usual notation prove that $\tan\phi = r\cdot\frac{d\theta}{dr}$.	6	L2	CO1
	b.	Find the angle between the curves $r = 6\cos\theta$ and $r = 2(1+\cos\theta)$.	7	L2	CO1
	c.	Find the radius of curvature for the Folium of De-Cartes $x^3 + y^3 = 3axy$ at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ on it.	7	L2	CO1
		OR			
Q.2	a.	Show that the curves $r = a(1+\sin\theta)$ and $r = a(1-\sin\theta)$ cut each other orthogonally.	8	L2	CO1
	b.	Find the pedal equation of $r^n = a(1+\cos n\theta)$.	7	L2	CO1
	c.	Using modern mathematical tool, write a program/code to plot the curve sine and cosine curve.	5	L3	CO5
		Module – 2			
Q.3	a.	Using Maclaurin's series, expand $\sqrt{1+\sin 2x}$ in powers of x upto the terms x^4.	7	L2	CO1
	b.	If $U = e^{ax+by} f(ax - by)$, prove that $b\frac{\partial U}{\partial x} + a\frac{\partial U}{\partial y} = 2abU$.	6	L2	CO1
	c.	Find the extreme values of the function $\sin x + \sin y + \sin(x+y)$.	7	L3	CO1
		OR			
Q.4	a.	Evaluate the $\lim\limits_{x\to 0}\left[\frac{a^x + b^x + c^x + d^x}{4}\right]^{1/x}$.	8	L2	CO1
	b.	If $U = f(2x - 3y, 3y - 4z, 4z - 2x)$, prove that $\frac{1}{2}\frac{\partial U}{\partial x} + \frac{1}{3}\frac{\partial U}{\partial y} + \frac{1}{4}\frac{\partial U}{\partial z} = 0$.	7	L2	CO1
	c.	Using modern mathematical tool, write a program/code to evaluate $\underset{x\to\infty}{Lt}\left(1+\frac{1}{x}\right)^x$.	5	L3	CO5
		Module – 3			
Q.5	a.	Solve $\frac{dy}{dx} + \frac{y}{x} = x^2y^6$.	6	L2	CO2
	b.	Find the orthogonal trajectories of the family $r = a(1 + \sin\theta)$.	7	L3	CO2
	c.	Find the solution of the equation $x^2(y - Px) = P^2y$ by reducing into Clairaut's form using the substitution $X = x^2$, $Y = y^2$.	7	L2	CO2
		OR			

Q.6	a.	Solve $(8xy-9y^2)dx+2(x^2-3xy)dy=0$.	6	L2	CO2
	b.	A voltage Ee^{-at} is applied at $t=0$ to a circuit of inductance L and resistant R. Find the current at any time t given that the current is initially zero when $t=0$.	7	L3	CO2
	c.	Solve $x(y')^2-(2x+3y)y'+6y=0$.	7	L2	CO2
		Module – 4			
Q.7	a.	i) Find the last digit in 7^{289}. ii) Find the remainder when $135\times74\times48$ is divided by 7.	7	L2	CO3
	b.	Solve the linear congruence $6x\equiv15(\mathrm{mod}\,21)$.	6	L2	CO3
	c.	Using Wilson's theorem, show that $4(29)!+5!$ is divisible by 31.	7	L2	CO3
		OR			
Q.8	a.	Solve the set of simultaneous congruences $x\equiv5(\mathrm{mod}\,3)$, $x\equiv2(\mathrm{mod}\,5)$, $x\equiv1(\mathrm{mod}\,11)$.	7	L2	CO3
	b.	Solve $7x+3y\equiv10(\mathrm{mod}\,16)$, $2x+5y\equiv9(\mathrm{mod}\,16)$.	6	L2	CO3
	c.	Show that $2^{340}-1$ is divisible by 31, using Fermat's little theorem.	7	L2	CO3
		Module – 5			
Q.9	a.	Find the rank of the matrix $\begin{bmatrix}1&2&4&3\\2&4&6&8\\4&8&12&16\\1&2&3&4\end{bmatrix}$	6	L2	CO4
	b.	Solve the system of equation by using Gauss-Jordan method. $x+y+z=8$, $-x-y+2z=-4$, $3x+5y-7z=-14$	7	L3	CO4
	c.	Using Rayleigh's power method, find the largest eigen value and the corresponding eigen vector of the matrix $A=\begin{bmatrix}2&-1&0\\-1&2&-1\\0&-1&2\end{bmatrix}$ by taking initial vector as $[1\ \ 1\ \ 1]^T$. Perform 6 iterations.	7	L3	CO4
		OR			
Q.10	a.	Solve the system of equation by using Gauss elimination method. $x+2y+z=3$, $2x+3y+3z=10$, $3x-y+2z=13$	8	L3	CO4
	b.	Solve the following system of equations by Gauss-Seidal method $20x+y-2y=17$, $3x+20y-z=-18$, $2x-3y+20z=25$	7	L3	CO4
	c.	Using modern mathematical tool, write a programme/code 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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MAKE-UP EXAM

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BMATE101

First Semester B.E./B.Tech. Degree Examination, Nov./Dec.2023
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. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

			M	L	C
		Module – 1			
Q.1	a.	With usual notations, prove that $\rho = \dfrac{(1+y_1^2)^{\frac{3}{2}}}{y_2}$.	06	L2	CO1
	b.	Find the angle between the radius vector and the tangent of polar curve : $r = a(1-\cos\theta)$.	07	L2	CO1
	c.	Find the radius of curvature of the curve $r = a\sin n\theta$ at the pole.	07	L3	CO1
		OR			
Q.2	a.	Show that the pair of curves intersect each other orthogonally. $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$	08	L2	CO1
	b.	Find the pedal equation of the curve : $r^n = a^n \cos n\theta$.	07	L2	CO1
	c.	Using modern mathematical tool, write a programs/code to plot the sine and cosine curve.	05	L2	CO5
		Module – 2			
Q.3	a.	Using Maclaurin's series, prove that $\sqrt{1+\sin 2x} = 1 + x - \dfrac{x^2}{2} - \dfrac{x^3}{6} + \dfrac{x^4}{24} + \ldots\ldots$	06	L2	CO1
	b.	Find $\dfrac{dy}{dt}$, when $u = x^3y^2 + x^2y^3$, with $x = at^2$, $y = 2at$. Use partial derivatives.	07	L2	CO1
	c.	If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$. Find the value of $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$ at the point $(1, -1, 0)$.	07	L3	CO1
		OR			
Q.4	a.	Evaluate. (i) $\lim\limits_{x\to 0} \dfrac{\sin 2x - 2\sin x}{x^3}$. (ii) $\lim\limits_{x\to 0}(a^x + x)^{\frac{1}{x}}$	08	L2	CO1
	b.	If $u = f(y-z, z-x, x-y)$, prove that $\dfrac{\partial u}{\partial x} + \dfrac{\partial u}{\partial y} + \dfrac{\partial u}{\partial z} = 0$.	07	L2	CO1
	c.	Using modern mathematical tool, write a programs/code. Show that $u_{xx} + u_{yy} = 0$, given $u = e^x(x\cos y - y\sin y)$.	05	L2	CO5
		Module – 3			
Q.5	a.	Solve : $\dfrac{dy}{dx} + \dfrac{y}{x} = y^2x$.	06	L2	CO2
	b.	Find the orthogonal trajectories of the family of asteroids $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$.	07	L3	CO2
	c.	Solve $xyp^2 - (x^2 + y^2)p + xy = 0$.	07	L2	CO2

		OR			
Q.6	**a.**	Solve : $(x^2-4xy-2y^2)dx+(y^2-4xy-2x^2)dy=0$.	06	L2	CO2
	b.	The current i in an electrical circuit containing an inductance L and a resistance R in series and acted upon an emf $E\sin\omega t$ satisfies the differential equation $L\frac{di}{dt}+R_i=E\sin\omega t$. Find the value of the current at any time t, if initially there is no current in the circuit.	07	L3	CO2
	c.	Find the general and singular solution of $p=\log(px-y)$.	07	L2	CO2
		Module – 4			
Q.7	**a.**	Evaluate : $\int_{x=0}^{x=1}\int_{y=0}^{y=x} x(x^2+y)dydx$..	06	L2	CO3
	b.	Change the order of integration and evaluate $\int_0^1\int_0^{\sqrt{1-x^2}} y^2dxdy$.	07	L2	CO3
	c.	Prove that $\left\lceil\frac{1}{2}\right. = \sqrt{\pi}$.	07	L2	CO3
		OR			
Q.8	**a.**	Evaluate $\int_0^\infty\int_0^\infty e^{-(x^2+y^2)}dxdy$ by changing into polar co-ordinates.	06	L2	CO3
	b.	Find the relation between Beta and Gamma function $\beta(m,n)=\frac{\Gamma m\Gamma n}{\Gamma(m+n)}$.	07	L2	CO3
	c.	Find the area bounded by the parabola $y^2=4ax$ and $x^2=4ay$ by using double integration.	07	L3	CO3
		Module – 5			
Q.9	**a.**	Find the rank of the matrix $A=\begin{bmatrix}1&2&3&2\\2&3&5&1\\1&3&4&5\end{bmatrix}$.	06	L2	CO4
	b.	Solve by Gauss elimination method, $2x+y+4z=12$; $4x+11y-z=33$; $8x-3y+2z=20$.	07	L3	CO4
	c.	Find the dominant eigen value and the corresponding eigen vector of the matrix $A=\begin{bmatrix}6&-2&2\\-2&3&-1\\2&-1&3\end{bmatrix}$ taking the initial eigen vector as [1, 1, 1].	07	L3	CO4
		OR			
Q.10	**a.**	Find the rank of the matrix $A=\begin{bmatrix}4&0&2&1\\2&1&3&4\\2&3&4&7\\2&3&1&4\end{bmatrix}$.	08	L2	CO4
	b.	Investigate for what values of λ and μ the simultaneous equations $x+y+z=6$; $x+2y+3z=10$; $x+2y+\lambda z=\mu$ have (i) no solution (ii) a unique solution (iii) an infinite number of solution.	07	L3	CO4
	c.	Using modern mathematical tool to write a programs/code to test the consistency of the equations $x+2y-z=1$; $2x+y+4z=2$; $3x+3y+4z=1$	05	L3	CO5

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MAKE-UP EXAM

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BMATS101

First Semester B.E./B.Tech. Degree Examination, Nov./Dec. 2023

Mathematics – I for CSE 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 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 of intersection between the curves $r = ae^{\theta}$ and $re^{\theta} = b$.	7	L2	CO1
	c.	Find the radius of curvature of the curve $x = a\log(\sec t + \tan t)$, $y = a\sec t$ at any point 't'.	7	L2	CO1
		OR			
Q.2	a.	Show that the curves $r = a(1 + \sin\theta)$ and $r = a(1 - \sin\theta)$ cuts each other orthogonally.	6	L2	CO1
	b.	Find the Pedal equation of the curve $r(1 - \cos\theta) = 2a$.	7	L2	CO1
	c.	Using modern mathematical tool, write a programe / code to plot the sine and cosine curves.	7	L3	CO5
		Module – 2			
Q.3	a.	Expand $\sqrt{1+\sin 2x}$ upto the term containing x^4 using Maclaurin's series.	6	L2	CO2
	b.	If $u = f(2x - 3y, 3y - 4z, 4z - 2x)$, then prove that $\frac{1}{2}u_x+\frac{1}{3}u_y+\frac{1}{4}u_z=0$.	7	L2	CO2
	c.	Find the extreme values of the function $f(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$.	7	L2	CO2
		OR			
Q.4	a.	Evaluate $\lim\limits_{x\to 0}\left(\frac{\tan x}{x}\right)^{1/x}$.	8	L2	CO1
	b.	If $u=\log\left(\frac{x^2+y^2}{x+y}\right)$, show that $xu_x + yu_y = 1$.	7	L2	CO2
	c.	Using modern mathematical tool, write a programe / code to evaluate $\lim\limits_{x\to\infty}\left(1+\frac{1}{x}\right)^x$.	5	L3	CO5

Module – 3

Q.5	a.	Solve $\frac{dy}{dx} + y \tan x = y^3 \sec x$.	6	L2	CO2
	b.	Find the orthogonal trajectories of $r = a(1 - \cos\theta)$, where a is parameter.	7	L3	CO2
	c.	Find a solution for the non – linear differential equation $xy\,p^2 - (x^2 + y^2)p + xy = 0$.	7	L2	CO2
		OR			
Q.6	a.	Solve $(y\cos x + \sin y + y)dx + (\sin x + x\cos y + x)\,dy = 0$.	6	L2	CO2
	b.	Find the general solution of the equation $(px - y)(py + x) = 2p$ by reducing into Clairauts form by taking the substitution $X = x^2$, $Y = y^2$.	7	L3	CO2
	c.	If the temperature of the air is 30°C and the substance cools from 100°C to 70°C in 5 minutes. Find 't' when the temperature will be 40°C.	7	L2	CO2

Module – 4

Q.7	a.	Find the unit digit in the remainder 7^{289}.	6	L1	CO3
	b.	Solve the system of linear congruence $x \equiv 2 \pmod 3$, $x \equiv 3 \pmod 5$, $x \equiv 2 \pmod 7$ by using CRT.	7	L2	CO3
	c.	Find the remainder when 146! is divided by 149.	7	L2	CO3
		OR			
Q.8	a.	Find the remainder when $135 \times 74 \times 48$ is divided by 7.	6	L2	CO3
	b.	Using RSA algorithm decrypt 09810461 using $d = 937$, $p = 43$, $q = 59$.	7	L2	CO3
	c.	Using Fermat's little theorem, find the remainder when 11^{104} is divided by 7.	7	L2	CO3

Module – 5

Q.9	a.	Find the rank of the matrix $\begin{bmatrix} 91 & 92 & 93 & 94 & 95 \\ 92 & 93 & 94 & 95 & 96 \\ 93 & 94 & 95 & 96 & 97 \\ 94 & 95 & 96 & 97 & 98 \\ 95 & 96 & 97 & 98 & 99 \end{bmatrix}$.	6	L2	CO4
	b.	Solve the system of equation by using Gauss – Jordan method. $x + y + z = 9$, $x - 3y + 4z = 13$, $3x + 4y + 5z = 40$.	7	L2	CO4
	c.	Using Power method, find the largest eigen value and corresponding eigen vector of the matrix $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ by considering Initial vector as $[1, 1, 1]^T$.	7	L2	CO4

		OR			
Q.10	a.	Solve the following system of equations by Gauss – Seidel method. $x + y + 54z = 110$. $27x + 6y - z = 85$, $6x + 15y + 2z = 72$. Carry out four iterations.	8	L1	CO4
	b.	Investigate the values of λ & μ, such that the system of equations $x + y + z = 6$ $x + 2y + 6z = 10$ $x + 2y + \lambda z = \mu$ may have i) Unique solution ii) No solution and iii) Infinitely many solution.	7	L2	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

CBCS SCHEME

USN

BMATS101

First Semester B.E./B.Tech. Degree Examination, June/July 2023
Mathematics-I for CSE 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 $\tan\phi = r\dfrac{d\theta}{dr}$	06	L2	CO1
	b.	Find the angle between the curves $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$	07	L2	CO1
	c.	Find the radius of curvature for $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at $\left[\frac{a}{4}, \frac{a}{4}\right]$	07	L3	CO1
		OR			
Q.2	a.	With usual notations prove that $\rho = \dfrac{(1+y_1^2)^{3/2}}{y_2}$	07	L2	CO1
	b.	Obtain pedal equation for the curve $r^n = a^n \cos n\theta$	08	L2	CO1
	c.	Using modern mathematical tool write a program/code to plot the curve $r = 2\lvert\cos 2\theta\rvert$	05	L3	CO5
		Module – 2			
Q.3	a.	Expand Leg(cos x) by Maclaurin's series upto term containing x^6	06	L2	CO2
	b.	If $u = f\left(\dfrac{x}{y}, \dfrac{y}{z}, \dfrac{z}{x}\right)$, show that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} + z\dfrac{\partial u}{\partial z} = 0$	07	L2	CO2
	c.	Find the extreme values of the function $x^3 + y^3 - 3x - 12y + 20$	07	L3	CO2
		OR			
Q.4	a.	Evaluate $\lim\limits_{x \to 0}\left(\dfrac{a^x + b^x + c^x + d^x}{4}\right)^{1/x}$	07	L2	CO3
	b.	If $u = \dfrac{yz}{x}$, $v = \dfrac{zx}{y}$, $w = \dfrac{xy}{z}$, show that $\dfrac{\partial(u,v,w)}{\partial(x,y,z)} = 4$	08	L2	CO3
	c.	Using modern mathematical tool write a program/code to show that $u_{xx} + u_{yy} = 0$ give $u = e^x (x \cos y - y \sin y)$	05	L2	CO5
		Module – 3			
Q.5	a.	Solve : $x\dfrac{dy}{dx} + y = x^3 y^6$	06	L2	CO3
	b.	Find the orthogonal trajectories of the family of the curves $r^n \sin n\theta = a^n$ where 'a' is parameter.	07	L3	CO3
	c.	Solve : $xyp^2 - (x^2 + y^2)p + xy = 0$	07	L2	CO3
		OR			

Q.6	a.	Solve $(x^2 + y^3 + 6x)dx + y^2x\,dy = 0$	06	L2	CO3
	b.	Find the general and singular solutions of $xp^2 + xp - yp + 1 - y = 0$	07	L3	CO3
	c.	Find the general solution of the equation $(px - y)(py + x) = 2p$ by reducing into Clairaut's form by taking the substitution $X = x^2$, $Y = y^2$.	07	L2	CO3
		Module – 4			
Q.7	a.	Find the least positive values of 'x' such that i) $78 + x \equiv 3 \pmod 5$ ii) $89 \equiv (x + 3) \pmod 4$	06	L2	CO4
	b.	Find the solution of the linear congruence $14x \equiv 12 \pmod{18}$	07	L2	CO4
	c.	Encrypt the message STOP using RSA with key (2537, 13) using the prime numbers 43 and 59.	07	L2	CO4
		OR			
Q.8	a.	i) Find the remainder when 2^{23} is divided by 47. ii) Find the last digit in 7^{118}.	06	L2	CO4
	b.	Solve the system of linear congruence $x \equiv 2 \pmod 3$; $x \equiv 3 \pmod 5$; $x \equiv 2 \pmod 7$ using Remainder Theorem.	07	L2	CO4
	c.	i) Find the remainder when $175 \times 113 \times 53$ is divided by 11. ii) Solve $x^3 + 2x - 3 \equiv 0 \pmod 9$	07	L2	CO4
		Module – 5			
Q.9	a.	Find the rank of the matrix $A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 1 & 3 \\ 6 & 3 & 0 & -7 \end{bmatrix}$	06	L2	CO4
	b.	Test for consistency and solve $2x + 5y + 7z = 52$; $2x + y - z = 0$; $x + y + z = 9$.	07	L2	CO4
	c.	Using Rayleigh's power method find the dominant eigen value and the corresponding eigen vector of $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ by taking $X_0 = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$.	07	L2	CO4
		OR			
Q.10	a.	Solve the system of equations $x + 2y - z = 3$; $3x - y + 2z = 1$; $2x - 2y + 3z = 2$ by using Gauss-Jordan method.	07	L2	CO4
	b.	Solve the system of equations $20x + y - 2z = 17$, $3x + 20y - z = -18$; $2x - 3y + 20z = 25$ by using Gauss – Seidel method.	08	L2	CO4
	c.	Using modern mathematical tool write a program/code to find the largest eigen value of $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ by power method.	05	L3	CO5

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CBCS SCHEME

USN

BMATE101

First Semester B.E./B.Tech. Degree Examination, June/July 2023
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. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

			M	L	C
		Module – 1			
Q.1	a.	With usual notations prove that $\tan\phi = r.\dfrac{d\theta}{dr}$.	6	L1	CO1
	b.	Find the angle between the curves $r = a(1+\cos\theta)$ and $r = b(1-\cos\theta)$.	7	L2	CO1
	c.	Find the radius of curvature for the Cardiod $r = a(1+\cos\theta)$.	7	L2	CO1
		OR			
Q.2	a.	If p be the perpendicular from the pole on to the tangent then show that $\dfrac{1}{p^2} = \dfrac{1}{r^2} + \dfrac{1}{r^4}\left(\dfrac{dr}{d\theta}\right)^2$.	6	L1	CO1
	b.	Find the pedal equation of the curve $r^n = a^n \cos n\theta$.	7	L2	CO1
	c.	Using modern mathematical tool, write a program/code to plot the curve $r = 2(\cos 2\theta)$.	7	L3	CO5
		Module – 2			
Q.3	a.	Expand $f(x) = \sin x + \cos x$ by MaClaurin's series upto the terms containing x^4.	6	L3	CO1
	b.	If $u = f(2x-3y, 3y-4z, 4z-2x)$, show that $6u_x + 4u_y + 3u_z = 0$.	7	L2	CO1
	c.	If $u = \dfrac{yz}{x}$, $v = \dfrac{zx}{y}$, $w = \dfrac{xy}{z}$ show that $\dfrac{\partial(u,v,w)}{\partial(x,y,z)} = 4$.	7	L2	CO1
		OR			
Q.4	a.	Evaluate $\lim\limits_{x\to 0}\left(\dfrac{a^x + b^x + c^x + d^x}{4}\right)^{1/x}$.	6	L2	CO1
	b.	Show that the function $f(x,y) = x^3 + y^3 - 3xy + 1$ is minimum at the point (1, 1).	7	L2	CO1
	c.	Using modern mathematical tool, write a program/code to show that $u_{xx} + u_{yy} = 0$, given $u = e^x(x\cos y - y\sin y)$.	7	L3	CO5

		Module – 3			
Q.5	a.	Solve $\frac{dy}{dx} + y\tan x = y^3 \sec x$.	6	L2	CO2
	b.	Prove that the system of parabola's $y^2 = 4a(x+a)$ is self orthogonal.	7	L2	CO2
	c.	Solve $xyp^2 - (x^2+y^2)p + xy = 0$.	7	L2	CO2
		OR			
Q.6	a.	Solve $(x^2+y^2+x)dx + xydy = 0$.	6	L2	CO2
	b.	When a resistance R ohms connected in series with an inductance L henries with an emf of E volts, the current i amperes at time t is given by $L\frac{di}{dt} + Ri = E$. If $E = 100\sin t$ volts and $i = 0$ when $t = 0$, find i as a function of t.	7	L3	CO2
	c.	Find the general solution of the equation $(px-y)(py+x) = a^2p$ by reducing into Clairaut's form, taking the substitution $X = x^2$, $Y = y^2$.	7	L2	CO2
		Module – 4			
Q.7	a.	Evaluate $\int_{-c}^{c}\int_{-b}^{b}\int_{-a}^{a}(x^2+y^2+z^2)dxdydz$.	6	L2	CO3
	b.	Evaluate $\int_0^1\int_x^{\sqrt{x}} xydydx$ by changing the order of integration.	7	L2	CO3
	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	CO3
		OR			
Q.8	a.	Evaluate $\int_0^1\int_0^{\sqrt{1-y^2}}(x^2+y^2)dxdy$ by changing into polar coordinates.	6	L2	CO3
	b.	Prove that relation between beta and gamma function $\beta(m,n) = \frac{\Gamma m \Gamma n}{\Gamma m + m}$.	7	L3	CO3
	c.	Using double integration find the area between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$.	7	L3	CO3
		Module – 5			
Q.9	a.	Find the rank of the matrix $A = \begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$	6	L2	CO4

	b.	Solve the system of equations by Jordan method. $2x+5y+7z=52,\quad 2x+y-z=0,\quad x+y+z=9$	**7**	**L2**	**CO4**
	c.	Using Rayleigh's power method, find the largest eigen value and the corresponding eigen vector of $A=\begin{bmatrix}2&0&1\\0&2&0\\1&0&2\end{bmatrix}$ by taking $[1\ \ 0\ \ 0]^T$ as initial eigen vector. (Carry out 6 iterations)	**7**	**L3**	**CO4**
		OR			
Q.10	**a.**	Solve the following system of equations by Gauss elimination method: $x+y+z=9,\quad x-2y+3z=8,\quad 2x+y-z=3$	**7**	**L2**	**CO4**
	b.	For what values of λ and μ the system of equations $x+y+z=6,\quad x+2y+3z=10,\quad x+2y+\lambda z=\mu$ has (i) no solution (ii) unique solution (iii) many solutions.	**8**	**L2**	**CO4**
	c.	Using modern mathematical tool, write a program/code to find the largest eigen value of $A=\begin{bmatrix}1&1&3\\1&5&1\\3&1&1\end{bmatrix}$ by power method.	**5**	**L3**	**CO5**

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USN

First Semester B.E./B.Tech. Degree Examination, Jan./Feb. 2023

Mathematics – I for Computer Science 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.

			M	L	C
		Module – 1			
Q.1	a.	With usual notations, prove that $\tan\phi = r\dfrac{d\theta}{d\gamma}$.	6	L2	CO1
	b.	Find the angle of intersection between the curves $\gamma = \dfrac{a\theta}{1+\theta}$, $\gamma = \dfrac{a}{1+\theta^2}$.	7	L2	CO1
	c.	Find radius of curvature of the curve $y = a \log \sec\left(\dfrac{x}{a}\right)$ at any point (x, y).	7	L2	CO1
		OR			
Q.2	a.	With usual notations prove that $\dfrac{1}{p^2} = \dfrac{1}{r^2} + \dfrac{1}{r^4}\left(\dfrac{dr}{d\theta}\right)^2$.	8	L2	CO1
	b.	Find the radius of the curvature of the curve $r = a(1 + \cos\theta)$.	7	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.	Using Maclaurin's series prove that $\sqrt{1+\sin 2x} = 1 + x - \dfrac{x^2}{2!} - \dfrac{x^3}{3!} + \dfrac{x^4}{4!} + \ldots\ldots$	6	L2	CO1
	b.	If $Z = e^{ax+by} f(ax-by)$, prove that $b\dfrac{\partial z}{\partial x} + a\dfrac{\partial z}{\partial y} = 2abz$.	7	L2	CO1
	c.	Find the extreme values of the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$.	7	L3	CO1
		OR			
Q.4	a.	Evaluate $\lim\limits_{x \to 0}\left(\dfrac{a^x + b^x + c^x + d^x}{4}\right)^{1/x}$.	8	L2	CO1
	b.	If $u = \dfrac{2yz}{x}$, $v = \dfrac{3xz}{y}$, $w = \dfrac{4xy}{z}$ find $J\left(\dfrac{u, v, w}{x, y, z}\right)$.	7	L2	CO1

	c.	Using modern mathematical tool write a program code to evaluate $\underset{x \to \infty}{\mathrm{Lt}} \left(1+\frac{1}{x}\right)^x$.	5
		Module – 3	
Q.5	a.	Solve $\frac{dy}{dx} + y \tan x = y^3 \sec x$.	6
	b.	Find orthogonal trajectories of family of curves $r^n = a^n \cos n\theta$.	7
	c.	Solve $x^2p^2 + 3xyp + 2y^2 = 0$.	7
		OR	
Q.6	a.	Solve $(x^2 + y^2 + x)dx + xydy = 0$.	6
	b.	Find the general solution of the equation $(px - y)(py + x) = 2p$ by reducing into Clairaut's form by taking the substitution $X = x^2$, $Y = y^2$.	7
	c.	A 12 volts battery is connected to a series circuit in which the inductance is $\frac{1}{2}$ Henry and resistance is 10 ohms. Determine current I, if the initial current is zero.	7
		Module – 4	
Q.7	a.	i) Find the last digit in 13^{37}. ii) Find the remainder when 7^{118} is divided by 10.	6
	b.	Find the solutions of the linear congruence $12x \equiv 6 \pmod{21}$.	7
	c.	Find the general solution of linear Dio-phantine equation $70x + 112y = 168$.	7
		OR	
Q.8	a.	Find the remainder when 14! Is divided by 17.	6
	b.	Find the solution of system of linear congruences $7x + 3y \equiv 10 \pmod{16}$ $2x + 5y \equiv 9 \pmod{16}$	7
	c.	Solve $x \equiv 3 \pmod 5$, $x \equiv 2 \pmod 6$, $x \equiv 4 \pmod 7$ using Chinese remainder theorem.	7
		Module – 5	
Q.9	a.	Find the rank of matrix $A = \begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$.	6

	b.	Solve the system of equations by Gauss-Jordan method. $x+y+z=9$; $2x+y-z=0$; $2x+5y+7z=52$.	7	L3	CO4
	c.	Find the largest eigen value and the corresponding eigen vector of the matrix $A=\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ taking $[1 \;\; 1 \;\; 1]^T$ as initial eigen vector, using power method.	7	L3	CO4
		OR			
Q.10	a.	Find the values of λ and μ for which the system $x+y+z=6$; $x+2y+3z=10$; $x+2y+\lambda z=\mu$ has i) Unique solution ii) Infinitely many solutions iii) no solution.	8	L2	CO4
	b.	Solve the following system of equations by Gauss-Elimination method $2x+y+4z=12$, $4x+11y-z=33$, $8x-3y+2z=20$.	7	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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CBCS SCHEME

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BMATE101

First Semester B.E./B.Tech. Degree Examination, Jan./Feb. 2023
Mathematics - I for Electrical and Electronics 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.

			M	L	C
		Module – 1			
Q.1	a.	If ϕ is the angle between the radius vector and tangent to the polar curve $r = f(\theta)$, prove that $\tan\phi = r\dfrac{d\theta}{dr}$.	6	L2	CO1
	b.	Find the angle between the curves $r = \sin\theta + \cos\theta$ and $r = 2\sin\theta$.	7	L2	CO1
	c.	Find the radius of curvature of the curve $x^3 + y^3 = 3axy$ at $\left(\dfrac{3a}{2}, \dfrac{3a}{2}\right)$.	7	L2	CO1
		OR			
Q.2	a.	Prove that the polar curves $r = a(1+\cos\theta)$ and $r = b(1-\cos\theta)$ intersect orthogonally.	6	L2	CO1
	b.	Find the radius of curvature of the curve $y = 4\sin x - \sin 2x$ at $x = \dfrac{\pi}{2}$.	7	L2	CO1
	c.	Using Modern mathematical tool, write a program / code to plot the curve $r = 2\lvert\cos 2\theta\rvert$.	7	L3	CO5
		Module – 2			
Q.3	a.	Expand $f(x) = \cos x + \sin x$ in a Maclaurin series upto the term involving x^5.	6	L2	CO2
	b.	If $U = \log(\tan x + \tan y + \tan z)$, show that $\sin 2x\dfrac{\partial u}{\partial x} + \sin 2y\dfrac{\partial u}{\partial y} + \sin 2z\dfrac{\partial u}{\partial z} = 2$.	7	L2	CO2
	c.	If $u = x^2 + y^2 + z^2$, $v = xy + yz + zx$, $w = x + y + z$, find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$.	7	L2	CO2
		OR			
Q.4	a.	Evaluate $\lim\limits_{x\to 0}\left(\dfrac{a^x + b^x + c^x + d^x}{4}\right)^{\frac{1}{x}}$.	6	L1	CO2
	b.	If $V = f(x-y, y-z, z-x)$, show that $\dfrac{\partial v}{\partial x} + \dfrac{\partial v}{\partial y} + \dfrac{\partial v}{\partial z} = 0$.	7	L2	CO2
	c.	Using modern mathematics tool, write a program / code to show that $U_{xx} + U_{yy} = 0$. Given $U_3 = e^x(x\cos y - y\sin y)$.	7	L3	CO2

		Module – 3		
Q.5	**a.**	Solve $(5x^4 + 3x^2y^2 - 2xy^3)\,dx + (2x^3y - 3x^2y^2 - 5y^4)\,dy = 0$.	6	L2
	b.	Find the Orthogonal trajectory of the family of confocal ellipses $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2 + \lambda} = 1$, where λ is a parameter.	7	L3
	c.	Solve $xyp^2 - (x^2 + y^2)\,p + xy = 0$.	7	L2
		OR		
Q.6	**a.**	Solve $\dfrac{dy}{dx} + y\ \tan x = y^2 \sec x$.	6	L2
	b.	Find the current i at any time t, if initially there is no current in the circuit governed by the differentiate equation $L\left(\dfrac{di}{dt}\right) + Ri = 200\ \text{Sin}\ 300t$, when $L = 0.05$ and $R = 100$.	7	L3
	c.	Find the general solution of the equation $(px - y)(py + x) = a^2p$ by reducing into Clairaut's form, taking the substitution $X = x^2$, $Y = y^2$.	7	L2
		Module – 4		
Q.7	**a.**	Evaluate $\displaystyle\int_0^1 \int_x^{\sqrt{x}} xy\ dy\ dx$, by changing the order of integration.	6	L2
	b.	Evaluate $\displaystyle\int_{-p}^{1} \int_0^z \int_{x-z}^{x+z} (x + y + z)\,dy\,dx\,dz$.	7	L2
	c.	Prove that $\beta(m, n) = \dfrac{\Gamma(m)\,(n)}{\Gamma(m+n)}$.	7	L1
		OR		
Q.8	**a.**	Evaluate $\displaystyle\int_0^1 \int_0^{\sqrt{1-y^2}} (x^2 + y^2)\,dx\,dy$ by changing to polar coordinates.	6	L2
	b.	Using double integration, find the area bounded by the parabolas $y^2 = 4ax$ and $x^2 = 4ay$.	7	L3
	c.	Show that $\displaystyle\int_0^{\pi/2} \sqrt{\text{Sin}\ \theta}\ d\theta \times \int_0^{\pi/2} \frac{d\theta}{\sqrt{\text{Sin}\ \theta}} = \pi$ by using Beta and Gamma functions.	7	L2
		Module – 5		
Q.9	**a.**	Find the rank of the matrix $\begin{bmatrix} 2 & 1 & 3 & 5 \\ 4 & 2 & 1 & 3 \\ 8 & 4 & 7 & 13 \\ 8 & 4 & -3 & -1 \end{bmatrix}$.	6	L2

	b.	Solve the system of linear equations by Gauss – Jordan method. $x + y + z = 11$ $3x - y + 2z = 12$ $2x + y - z = 3$.	7	L2	CO5
	c.	Determine the largest eigen value and the corresponding eigen vector of the matrix. $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ by using Power method with initial eigen vector $X_o = [1\ 0\ 0]^T$. Carry out six iterations.	7	L2	CO5
		OR			
Q.10	a.	For what values of λ and μ the system of equations $x + y + z = 6$, $x + 2y + 3z = 10$ and $x + 2y + \lambda z = \mu$ may have i) Unique solution ii) Infinite number of solution iii) No solution.	6	L2	CO5
	b.	Solve by using Gauss elimination method the equations $3x + y - z = 3$; $2x - 8y + z = -5$; $x - 2y + 9z = 8$.	7	L2	CO5
	c.	Using modern mathematical tool, write a program / code to find the largest eigen value of $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ by power method.	7	L3	CO5