CBCS SCHEME

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21MAT11

First Semester B.E./B.Tech. Degree Examination, June/July 2025
Calculus and Differential Equations

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. With usual notations prove that $\tan\phi = r\dfrac{d\theta}{dr}$. **(06 Marks)**

b. Show that the curves $r = a(1 + \sin\theta)$ and $r = a(1 - \sin\theta)$ intersect each other orthogonally. **(07 Marks)**

c. Find the radius of curvature of the curve $\sqrt{x} + \sqrt{y} = 4$ at point (4, 4). **(07 Marks)**

OR

2 a. Find the angle between the radius vector and the tangent for the curve $r^m = a^m(\cos m\theta + \sin m\theta)$ **(06 Marks)**

b. Find the pedal equation of the curve $\dfrac{2a}{r} = 1 + \cos\theta$. **(07 Marks)**

c. Show that the radius of curvature of the curve $r^n = a^n \cos n\theta$. **(07 Marks)**

Module-2

3 a. Obtain the Maclaurin's expansion of "$\ell og(1 + e^x)$" upto fourth degree terms. **(06 Marks)**

b. If $u = f\left(xz, \dfrac{y}{z}\right)$ prove that $x\dfrac{\partial u}{\partial x} - y\dfrac{\partial u}{\partial y} - z\dfrac{\partial u}{\partial z} = 0$. **(07 Marks)**

c. Show that $f(x, y) = x^3y^2(1 - x - y)$ for x, y # 0 is maximum at the point $\left(\dfrac{1}{2}, \dfrac{1}{3}\right)$ and find maximum value. **(07 Marks)**

OR

4 a. Evaluate : i) $\underset{x\to 0}{\ell t}\,(1+\sin x)^{\cot x}$ ii) $\underset{x\to 0}{\ell t}\left(\dfrac{1}{x}\right)^{\tan x}$ **(06 Marks)**

b. Find the total derivative of $u = xy + yz + zx$ where $x = t\cos t, y = t\sin t, z = t$. **(07 Marks)**

c. If $u = x^2 + y^2 + z^2$, $v = xy + yz + zx$, $w = x + y + z$. Find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$. **(07 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-3

5 a. Solve $\frac{dy}{dx}+\frac{y}{x}=y^2x$. **(06 Marks)**

b. Find the orthogonal trajectory of Cardioids $r = a(1 - \cos\theta)$. **(07 Marks)**

c. Solve $p^2 + py - x(x + y) = 0$. **(07 Marks)**

OR

6 a. Solve $(6x^2 + 4y^3 + 12y)dx + 3x(1 + y^2) = 0$ **(06 Marks)**

b. A cup of coffee at 80ºC is placed in a room with temperature 20ºC and it cools to 50ºC in 5 minutes. Find its temperature after a further interval of 5 minutes. **(07 Marks)**

c. Show that the equation $xp^2 + px - py + 1 - y = 0$ is Clairaut's equation and general solution. **(07 Marks)**

Module-4

7 a. Solve $\frac{d^3y}{dx^3}+2\frac{d^2y}{dx^2}+\frac{dy}{dx}=3e^{-x}$. **(06 Marks)**

b. Solve $(D^2 + 4D + 8)y = x + 1$. **(07 Marks)**

c. Using method of variation of parameters solve $y''+y=\text{Sec}\,x$. **(07 Marks)**

OR

8 a. Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=\text{Cos}\,2x$ **(06 Marks)**

b. Solve $4y''-y=e^{2x}$. **(07 Marks)**

c. Solve the Cauchy's differential equation $x^2y''+xy'+9y=\sin(3\log x)$. **(07 Marks)**

Module-5

9 a. Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 4 \\ -2 & -3 & 1 & 2 \\ -3 & -4 & 5 & 8 \\ 1 & 3 & 10 & 14 \end{bmatrix}$ **(06 Marks)**

b. Test for consistency and solve

$5x_1 + x_2 + 3x_3 = 20$

$2x_1 + 5x_2 + 2x_3 = 18$

$3x_1 + 2x_2 + x_3 = 14$ **(07 Marks)**

c. Solve the system of equations
$5x + 2y + z = 12$
$x + 4y + 2z = 15$
$x + 2y + 5z = 20$
Using Gauss – Seidel iteration method. Carryout four iterations taking (1, 0, 3) as initial approximate root. **(07 Marks)**

OR

10 a. Find the rank of the matrix $\begin{bmatrix} 1 & 0 & 2 & -2 \\ 2 & -1 & 0 & -1 \\ 1 & 0 & 2 & -1 \\ 4 & -1 & 3 & -1 \end{bmatrix}$ **(06 Marks)**

b. Solve the system of equations
$2x + 5y + 7z = 52$
$2x + y - z = 0$
$x + y + z = 9$
using Gauss – Jordan method. **(07 Marks)**

c. Find the dominant eigen value and the corresponding eigen vector of $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ by using Rayleigh's power method, taking initial vector as $[1, 1, 1]^T$. **(07 Marks)**

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BMATC101

First Semester B.E/B.Tech. Degree Examination, June/July 2025
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. M : Marks , L: Bloom's level , C: Course outcomes.
3. VTU Formula Hand Book is permitted.

			M	L	C
		Module – 1	**M**	**L**	**C**
1	a.	With usual notation, prove that $\tan\phi = \dfrac{r}{\left(\frac{dr}{d\theta}\right)}$.	7	L3	CO1
	b.	Find the pedal equation for the curve $r^m = a^m \sec m\theta$.	7	L1	CO1
	c.	Find the radius of curvature for the curve $y = 4\sin x - \sin 2x$ at $x = \pi/2$.	6	L1	CO1
		OR			
2	a.	Find the angle between the curves $r = a\log\theta$ and $r = \dfrac{a}{\log\theta}$.	7	L1	CO1
	b.	Derive an expression for radius of curvature for polar curve $r = f(\theta)$.	7	L1	CO1
	c.	Using modern mathematical tool, write a programme to plot the sine and cosine curves.	6	L3	CO5
		Module – 2			
3	a.	Obtain the Maclaurin's series expansion of $y(x) = \sqrt{1+\sin 2x}$.	7	L3	CO2
	b.	Find $\dfrac{df}{dt}$ by using partial differentiation, given that $f = x^3 + y^3 + z^3$, when $x = e^{-t}$, $y = e^{-t}$ and $z = e^{-t}\cos t$.	7	L2	CO2
	c.	If $u = x + 3y^2 - z^2$, $v = 4x^2yz$, $w = 2z^2 - xy$, find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$ at $(1, -1, 0)$.	6	L2	CO2
		OR			
4	a.	Evaluate : i) $\lim\limits_{x\to 0}\left(\dfrac{a^x + b^x + c^x}{3}\right)^{1/x}$ ii) $\lim\limits_{x\to\pi/4}(\tan x)^{\tan 2x}$.	7	L1	CO2
	b.	Find the extreme values of the function : $x^3 + y^3 - 3x - 12y + 20 = 0$.	7	L2	CO2
	c.	Use modern mathematical tool, write a programme to show that $u_{xx} + u_{yy} = 0$, given $u = e^x\{x\cos y - y\sin y\}$	6	L3	CO5
		Module – 3			
5	a.	Solve $x\dfrac{dy}{dx} + y = x^3y^6$.	7	L3	CO3
	b.	Solve that the family of parabolas $y^2 = 4a(x + a)$ are self orthogonal.	7	L3	CO3
	c.	Solve $\dfrac{dy}{dx} - \dfrac{dx}{dy} = \dfrac{x}{y} - \dfrac{y}{x}$.	6	L2	CO3
		OR			
6	a.	Solve $(y\log y)\,dx + (x - \log y)\,dy = 0$.	7	L3	CO3
	b.	A body originally at 80°C cools down to 60°C in 20 minutes in the surrounding temperature 40°C. Find the temperature of the body after 40 minutes.	7	L2	CO3
	c.	Find the general and singular solutions of $p = \log(px - y)$.	6	L2	CO3

		Module – 4			
7	a.	Solve $(D^3 - 7D^2 + 14D - 8)y = 0$.	**7**	**L2**	**CO3**
	b.	Solve $(D^2 + 1)y = \text{cosec } x \cdot \cot x$ by the method of variation of parameters.	**7**	**L3**	**CO3**
	c.	Solve $x^2y'' + 4xy' + 2y = x^2$.	**6**	**L3**	**CO3**
		OR			
8	a.	Solve $[(D^2 + 6D + 9)D^2]y = 0$.	**7**	**L2**	**CO3**
	b.	Solve $(D^3 + 4D)y = \sin 2x$.	**7**	**L3**	**CO3**
	c.	Solve $(1 + x)^2y'' + (1 + x)y' + y = 2 \sin [\log (1 + x)]$.	**6**	**L3**	**CO3**
		Module – 5			
9	a.	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 4 \\ -2 & -3 & 1 & 2 \\ -3 & -4 & 5 & 8 \\ 1 & 3 & 10 & 14 \end{bmatrix}$.	**7**	**L1**	**CO4**
	b.	Solve the system of equations : $x + 0y + 2z = 2$ $0x + y + z = 3$ $2x + y + 0z = 1$ By Gauss elimination method.	**7**	**L3**	**CO4**
	c.	Using Rayleigh's power method, find the largest eigen value and the corresponding eigen vector of the matrix $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & 1 & 3 \end{bmatrix}$, taking $x^{(0)} = [1,1,1]^T$.	**6**	**L3**	**CO4**
		OR			
10	a.	Apply Gauss-Seidel method to solve the equations : $10x + 2y + z = 9$ $2x + 20y - 2z = -44$ $-2x + 3y + 10z = 22$.	**7**	**L2**	**CO4**
	b.	Find for what values of α and β, so that the equations : $x + y + z = 6$ $x + 2y + 3z = 10$ $x + 2y + \alpha z = \beta$ have : i) no solution ii) many solutions iii) unique solution.	**7**	**L2**	**CO4**
	c.	Using modern mathematical tools, write a programme to test consistency of the equations : $x + 2y - z = 1$ $2x + y + 4z = 2$ $3x + 3y + 4z = 1$.	**6**	**L3**	**CO5**

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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 $r = a(1 - \cos\theta)$ and $r = 2a\cos\theta$.	**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 $\lim\limits_{x\to 0}\left(\frac{a^x+b^x+c^x}{3}\right)^{1/x}$.	**7**	**L2**	**CO2**
	c.	Using modern mathematical tool, write a programs/code. Show that $u_{xx}+u_{yy}=0$, given $u = e^x[x\cos y - y\sin y]$	**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 $\int_{-1}^{+1}\int_{0}^{z}\int_{x-z}^{x+z}(x+y+z)\,dydxdz$.	**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 $\int_0^a\int_y^a\frac{x}{x^2+y^2}\,dxdy$.	**7**	**L2**	**CO4**
OR					
Q.8	**a.**	Evaluate $\int_0^\infty\int_0^\infty e^{-(x^2+y^2)}\,dxdy$ 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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BMATM101

First Semester B.E./B.Tech. Degree Examination, June/July 2025
Mathematics - I for ME 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 Mathematics formula Handbook is permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Derive an expression for Angle between radius vector and tangent.	**6**	**L2**	**CO1**
	b.	Find the pedal equation for the curve $r^2 = a^2 \sec 2\theta$.	**7**	**L2**	**CO1**
	c.	Find the radius of curvature of the curve $x^3 + y^3 = 2a^3$ at the point (a, a).	**7**	**L3**	**CO1**
		OR			
Q.2	**a.**	With usual notation prove that $\rho = \dfrac{(1+y_1^2)^{3/2}}{y_2}$.	**7**	**L2**	**CO1**
	b.	Prove that the pair of polar curves intersect orthogonally $r^n = a^n \cos n\theta$, $r^n = b^n \sin n\theta$.	**8**	**L2**	**CO1**
	c.	Using modern mathematical tool, write a programme code to plot sine and cosine curves.	**5**	**L3**	**CO5**
		Module – 2			
Q.3	**a.**	Expand cos x by Maclaurin's series upto the containing x^4.	**6**	**L2**	**CO2**
	b.	If $u = \tan^{-1}\left(\dfrac{y}{x}\right)$ where $x = e^t - e^{-t}$ and $y = e^t + e^{-t}$, find $\left(\dfrac{du}{dt}\right)$.	**7**	**L2**	**CO2**
	c.	Show that $f(x, y) = x^3 + y^3 - 3xy + 1$ is minimum at the point (1, 1).	**7**	**L3**	**CO2**
		OR			
Q.4	**a.**	Evaluate $\underset{x \to 0}{\text{Lt}} \left(\dfrac{\sin x}{x}\right)^{1/x^2}$.	**8**	**L2**	**CO2**
	b.	If $U = x + y + z$, $V = y - z$, $W = z$, find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$.	**7**	**L2**	**CO2**
	c.	Using modern mathematical tool, write a program to prove $u_{xx} + u_{yy} = 0$. If $u = e^x [x \cos y - y \sin y]$.	**5**	**L3**	**CO5**

		Module – 3			
Q.5	**a.**	Solve : $\frac{dy}{dx}+\frac{y}{x}=y^2x$.	**6**	**L2**	**CO3**
	b.	Solve $(5x^4+3x^2y^2-2xy^3)\,dx+(2x^3y-3x^2y^2-5y^4)dy=0$.	**7**	**L2**	**CO3**
	c.	Solve $yp^2+(x-y)\,p-x=0$.	**7**	**L2**	**CO3**
		OR			
Q.6	**a.**	Obtain the General and Singular solution of the equation $p=\log(px-y)$.	**6**	**L2**	**CO3**
	b.	Define Newton's law of cooling. A body in air at 25ºC cools from 100ºC to 75 ºC in 1 minute. Find the temperature of the body at the end of 3 minutes.	**7**	**L3**	**CO3**
	c.	Solve the equation $(px-y)(py+x)=2p$ by reducing into Clairaut's from taking the substitution $X=x^2$, $Y=y^2$.	**7**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Solve : $y'''+6y''+11y'+6y=0$.	**6**	**L2**	**CO3**
	b.	Solve : $y''+2y'+y=2x+x^2$.	**7**	**L2**	**CO3**
	c.	Solve : $y''+4y=4\sec^2 2x$ by the method of variation of parameter.	**7**	**L2**	**CO3**
		OR			
Q.8	**a.**	Solve : $(6D^2+17D+12)\,y=e^{-x}$.	**6**	**L2**	**CO3**
	b.	Solve : $x^2y''+xy'+9y=\sin(3\log x)$.	**7**	**L2**	**CO3**
	c.	Solve : $(1+x)^2y''+(1+x)\,y'+y=2\cos[\log(1+x)]$.	**7**	**L2**	**CO3**
		Module – 5			
Q.9	**a.**	Find the rank of the matrix $\begin{bmatrix}0&2&3&4\\2&3&5&4\\4&8&13&12\end{bmatrix}$	**6**	**L2**	**CO4**
	b.	Solve the system of equations $x+y+z=9$; $x-2y+3z=8$; $2x+y-z=3$ by Gauss Elimination method.	**7**	**L3**	**CO4**
	c.	Solve the following system of equations by Gauss – Seidal method : $10x+y+z=12$; $x+10y+z=12$; $x+y+10z=12$ for 4 Iterations.	**7**	**L3**	**CO4**
		OR			

Q.10	**a.**	Test for consistency and solve : $x - 4y + 7z = 14$, $3x + 8y - 2z = 13$; $7x - 8y + 26z = 5$.	**7**	**L2**	**CO4**
	b.	Find the largest eigen value and corresponding eigen vector of matrix $\begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$ by power method, by taking initial eigen vector $(1, 1, 1)^T$ carryout upto 5 Iteration.	**8**	**L3**	**CO4**
	c.	Using modern mathematical tool write a programme to sovle the system of equations $5x - y - z = -3$; $x - 5y + z = -9$; $2x + y - 4z = 15$ by Gauss Siedal method.	**5**	**L3**	**CO5**

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BMATS101

First Semester B.E./B.Tech. Degree Examination, June/July 2025

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 $$\tan\phi = r\frac{d\theta}{dr}$$	**06**	**L2**	**CO1**
	b.	Find the angle between the curves $$r = \frac{a\theta}{1+\theta} \quad ; \quad r = \frac{a}{1+\theta^2}$$	**07**	**L2**	**CO1**
	c.	Find the radius of curvature for the curve $$y^2 = \frac{a^2(a-x)}{x}$$ where the curve meets the x-axis.	**07**	**L2**	**CO1**
		OR			
Q.2	**a.**	Show that the curves $r = a(1 + \cos\theta)$ and $r = a(1 - \cos\theta)$ cuts each other orthogonally.	**08**	**L2**	**CO1**
	b.	Find the pedal equation of the curve $$\frac{\ell}{r} = 1 + e\cos\theta$$	**07**	**L2**	**CO1**
	c.	Using modern mathematical tool write a programme code to plot the curve $r = 2(\cos 2\theta)$	**05**	**L2**	**CO5**
		Module – 2			
Q.3	**a.**	Expand $\log(\sec x)$ upto the term containing x^4 using Maclaurin's series.	**06**	**L2**	**CO2**
	b.	If $z = e^{ax+by} f(ax - by)$ prove that $$b\frac{\partial z}{\partial x} + a\frac{\partial z}{\partial y} = 2abz$$	**07**	**L2**	**CO2**
	c.	Find the extreme value of the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$	**07**	**L2**	**CO2**
		OR			
Q.4	**a.**	Evaluate $$\lim_{x\to 0}\left[\frac{a^x + b^x + c^x + d^x}{4}\right]^{1/x}$$	**08**	**L3**	**CO2**
	b.	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$	**07**	**L2**	**CO2**
	c.	Using modern mathematical tool write a programme / code to show that $u_{xx} + u_{yy} = 0$. Given $u = e^x[x\cos y - y\sin y]$	**05**	**L3**	**CO5**
		Module – 3			
Q.5	**a.**	Solve $x\frac{dy}{dx} + y = x^3y^6$	**06**	**L3**	**CO3**
	b.	Find the orthogonal trajectories of $y^2 = 4ax$ where a is parameter.	**07**	**L2**	**CO3**
	c.	Solve $\frac{dy}{dx} - \frac{dx}{dy} = \frac{x}{y} - \frac{y}{x}$	**07**	**L3**	**CO3**

		OR			
Q.6	**a.**	Solve $(xy^3 + y)dx + 2(x^2y^2 + x + y^4)dy = 0$	**06**	**L3**	**CO3**
	b.	Find the orthogonal trajectory of the cardioid $r = a(1 - \cos\theta)$.	**07**	**L2**	**CO3**
	c.	Find the general solution of the equation $(px - y)(py + x) = a^2p$ by reducing into Clairaut's form taking the substitution $X = x^2$, $Y = y^2$.	**07**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Find the least positive values of x such that i) $71 \equiv x(\bmod 8)$ ii) $67 + x \equiv 1(\bmod 4)$ iii) $89 \equiv (7 + 3)(\bmod 5)$	**06**	**L2**	**CO4**
	b.	Find the solutions of the linear congruence $14x \equiv 12 (\bmod 18)$	**07**	**L2**	**CO4**
	c.	Encode STOP using RSA algorithm with key (2537, 13) using the prime numbers 43 and 59.	**07**	**L3**	**CO4**
		OR			
Q.8	**a.**	(i) Find the last digit of 7^{2013} (ii) Find the last digit of 13^{37}	**06**	**L2**	**CO4**
	b.	Solve the system of linear congruence $x \equiv 2(\bmod 3)$; $x \equiv 3(\bmod 5)$; $x \equiv 2(\bmod 7)$, using Remainder theorem.	**07**	**L3**	**CO4**
	c.	Show that $2^{340} \equiv 1 \bmod 31$ by Fermat's little theorem.	**07**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	Find the rank of the matrix $\begin{bmatrix} 1 & 3 & -1 & 2 \\ 0 & 11 & -5 & 3 \\ 2 & -5 & 3 & 1 \\ 4 & 1 & 1 & 5 \end{bmatrix}$	**06**	**L2**	**CO4**
	b.	Solve the system of equations by using Gauss-Jordan method. $2x + y + 3z = 1$; $4x + 4y + 7z = 1$; $2x + 5y + 9z = 3$	**07**	**L3**	**CO4**
	c.	Using power method find the largest eigen value and the corresponding eigen vector of the matrix $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$ by taking $[1 \quad 0 \quad 0]^T$ as the initial eigen vector upto two decimal places (Perform 5 iterations).	**07**	**L2**	**CO4**
		OR			
Q.10	**a.**	Solve the following system of equations by Gauss-Seidel method. $7x + 52y + 13z = 104$; $3x + 8y + 29z = 71$; $83x + 11y - 4z = 95$ (Carry out 4 iterations).	**08**	**L3**	**CO4**
	b.	For what values of a and b the system of equations $x + y + z = 6$; $x + 2y + 3z = 12$; $x + 2y + az = b$ has (i) no solution (ii) a unique solution and (iii) infinite number of solutions.	**07**	**L2**	**CO4**
	c.	Using modern mathematical tool write a programme / code to find the largest eigen value of $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$	**05**	**L3**	**CO5**

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