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SJC INSTITUTE OF TECHNOLOGY
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Department of Mathematics
QUESTION BANK

SUBJECT TITLE	**Mathematics-1 for ME Stream**		
SUBJECT TYPE	**CORE**		
SUBJECT CODE	**1BMATM101**		
ACADEMIC YEAR	**2025-26**	**BATCH**	**2025-2029**
SCHEME	**CBCS 2024**		
SEMESTER	**I**		

QUESTION BANK

Module -1			
Q. No.	***Questions***	***Bloom's LL***	***COs***
1	Prove that $\tan\phi = r\frac{d\theta}{dr}$	L3	CO1
2	Find the angle between radius vector and tangent for the following curves a) $r = a(1+\cos\theta)$ b) $r = a(1+\sin\theta)$ c) $\frac{2a}{r} = (1+\cos\theta)$ d) $r^2\cos 2\theta = a^2$ e) $r^m = a^m(\cos m\theta + \sin m\theta)$	L3	CO1

3	Show that the given polar curves can intersect orthogonally. a) $r = a(1+Cos\theta)$, $r = b(1-Cos\theta)$ b) $r = a(1+\sin\theta)$, $r = a(1-\sin\theta)$ c) $r^n = a^n\, Cos\, n\theta$, $r^n = b^n\, Sin\, n\theta$ d) $r = aSec^2\left(\theta/2\right)$, $r = bCos^2\left(\theta/2\right)$	L2	CO1
4	Find the angle between the given pairs of polar curves. a) $r^2\sin 2\theta = 4, r^2 = 16\sin 2\theta$ b) $r = a\log\theta, r = \dfrac{a}{\log\theta}$ c) $r = a(1-\cos\theta)$, $r = 2aCos\theta$ d) $r = a\theta, r = a/\theta$	L2	CO1
5	Prove that $\dfrac{1}{p^2} = \dfrac{1}{r^2} + \dfrac{1}{r^4}\left(\dfrac{dr}{d\theta}\right)^2$	L3	CO1
6	Find the pedal equation to the following polar curves. a) $r(1-\cos\theta) = 2a$ b) $r = 2(1+\cos\theta)$ c) $r^n = a^n\, Cos\, n\theta$ d) $r^m = a^m(Cosm\theta + Sinm\theta)$	L3	CO1
7	Derive the formula to find radius of curvature in Cartesian form.	L3	CO1
8	Find the radius of curvature of the curve $x^3 + y^3 = 3axy$ at $(3a/2, 3a/2)$	L3	CO1
9	Find the radius of curvature for the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$	L3	CO1
10	Find the radius of curvature of the curve $y = alog(sec\frac{x}{a})$ at any point (x, y)	L3	CO1
11	Prove that for the curve $y = ccosh(x/c)$ the radius of curvature is $c\ cosh^2(x/c)$	L3	CO1
12	For the cardioids $r = a(1-cos\theta). show\ that\ \frac{\rho^2}{r}$ is constant	L4	CO1

13	If $r^n = a^n cosn\theta$, then show that ρ $varies\ inversly\ as\ r^{n-1}$.	L5	CO1
14	S.T for the equiangular spiral $r = ae^{\theta Cot\alpha}$, $\frac{\rho}{r}$ is constant.	L5	CO1
15	Show that for the curve $r^2 sec2\theta = a^2$, $\rho = a^2/3r$	L3	CO1

Module -2			
Q. No.	Questions	Bloom's LL	COs
1	Obtain the Maclaurin's series of $\log(1+Cos\,x)$.	L3	CO2
2	Obtain the Maclaurin's series of $\log Sec\,x$ .up to the term containing x^4.	L3	CO2
3	Obtain the Maclaurin's series of $\sqrt{1+Sin2x}$.	L3	CO2
4	Obtain the Maclaurin's series of $log(1+x)$	L3	CO2
5	Find the value of limit $\underset{x\to 0}{Lim}\left(\frac{a^x+b^x+c^x}{3}\right)^{\frac{1}{x}}$.	L5	CO2
6	Find the value of limit $\underset{x\to 0}{Lim}\left(\frac{a^x+b^x+c^x+d^x}{4}\right)^{\frac{1}{x}}$.	L5	CO2
7	Find the value of i) $\underset{x\to \pi/2}{Lim}(Sin\,x)^{Tan\,x}$ ii) $\underset{x\to 0}{Lim}\left(\frac{1}{x}\right)^{2Sin\,x\,x}$ iii) $\underset{x\to 0}{Lim}(x)^{\frac{1}{1-x}}$	L5	CO2
8	If $u = e^{ax+by}f(ax-by)$ then prove that $bu_x + au_y = 2abu$.	L3	CO2

9	If $u = log(x^3 + y^3 + z^3 - 3xyz)$ then prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = \frac{3}{x+y+z}$	L3	CO2
10	If $r^2 = (x-a)^2 + (y-b)^2 + (z-c)^2$, Show that $\frac{\partial^2 r}{\partial x^2} + \frac{\partial^2 r}{\partial y^2} + \frac{\partial^2 r}{\partial z^2} = \frac{2}{r}$	L3	CO2
11	If $u = log\left(\frac{x^2+y^2}{x+y}\right)$ show that $xu_x + yu_y = 1$	L3	CO2
12	If $v = e^{a\theta} cos(alogr)$, prove that $\frac{\partial^2 v}{\partial r^2} + \frac{1}{r}\frac{\partial v}{\partial r} + \frac{1}{r^2}\frac{\partial^2 v}{\partial \theta^2} = 0$	L3	CO2
13	Find $\frac{du}{dt}$ at $t = 0,\ if\ u = x^2 + y^2 + z^2\ and\ x = e^{2t}$, $y = e^{2t} Cost,\ z = e^{2t} Sint.$	L3	CO2
14	If $u = f(x-y, y-z, z-x)$, then prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$.	L3	CO2
15	If $u = 3x + 2y - z$, $v = x - 2y + z$, $w = x^2 + 2xy - z$, then find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$.	L3	CO2
16	If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, then deduce that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$.	L4	CO2
17	If $u = f(y-z, z-x, x-y)$, then prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	L3	CO2
18	If $u = f(x-y, y-z, z-x)$, then prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	L3	CO2

Module -3			
Q. No.	Questions	Bloom's LL	COs
1	Solve $\frac{dy}{dx} + \frac{y}{x} = y^2 x$	L3	CO3

2	Solve $\frac{dy}{dx} - y\tan x = \frac{Sin x Cos^2 x}{y^2}$	L3	CO3
3	Solve $xy(1+xy^2)\frac{dy}{dx} = 1$.	L3	CO3
4	Solve $x^3\frac{dy}{dx} - x^2 y = -y^4 cosx$	L3	CO3
5	Solve $(2x+y+1)dx + (x+2y+1)dy = 0$	L3	CO3
6	Solve $\frac{dy}{dx} + \frac{y\,Cos\,x + Sin\,y + y}{Sin\,x + x\,Cosy + x} = 0$	L3	CO3
7	Solve $(4xy+3y^2-x)\,dx + x(x+2y)\,dy = 0$.	L3	CO3
8	Solve $(x^2+y^2+x)dx + xydy = 0$	L3	CO3
9	Solve $y(2x-y+1)dx + x(3x-4y+3)dy = 0$	L3	CO3
10	Solve $y(2xy+1)dx - xdy = 0$	L3	CO3
11	Prove that the orthogonal trajectories of family of circles $x^2+y^2=a^2$ is straight lines.	L3	CO3
12	Find the orthogonal trajectories of the family of curves $\frac{x^2}{a^2} + \frac{y^2}{b^2+\lambda} = 1$, λ is parameter.	L3	CO3
13	Prove that the family of curve $\frac{x^2}{a^2+\lambda} + \frac{y^2}{b^2+\lambda} = 1$ is self orthogonal.	L3	CO3
14	Prove that the family of curves $y^2 = 4a(x+a)$ is self orthogonal.	L3	CO3
15	Find the orthogonal trajectories of family of curves i) $r^n = a^n \cos n\theta$ ii) $r = a(1+\sin\theta)$ iii) $r^n \cos n\theta = a^n$ iv) $\frac{2a}{r} = 1 - \cos\theta$	L3	CO3
16	Show that the orthogonal trajectories of the family of curves $r = acos^2\left(\frac{\theta}{2}\right)$ is another family of cardioides $r = bsin^2\left(\frac{\theta}{2}\right)$	L3	CO3

17	A body in air at 25^0C cools from 100^0C to 75^0C in 1 minute. Find the temperature of the body at the end of 3 minutes.	L3	CO3
18	If the temperature of the air is 30^0C and a metal ball cools from 100^0C to 70^0C in 15 minutes, find how long will it take for the metal ball to reach a temperature of 40^0C.	L3	CO3

Module -4			
Q. No.	Questions	Bloom's LL	COs
1	Solve $(D^4 + 8D^2 + 16)y = 0$. (June/July 2024)	L3	CO4
2	Solve $(4D^4 - 8D^3 - 7D^2 + 11D + 6)y = 0$	L3	CO4
3	Solve $\frac{d^3y}{dx^3} + y = 0$	L3	CO4
4	Solve $\frac{d^3y}{dx^3} + y = \cos 2x$	L3	CO4
5	Solve $(D^2 - 4D + 3)y = (e^x + 1)^2$	L3	CO4
6	Solve $y'' + 9y = \cos 2x \cos x$. (June/July 2024)	L3	CO4
7	Solve $\frac{d^2y}{dt^2} - 4\frac{dy}{dt} + 13y = e^{3t} \cosh 2t$. (June/July 2024)	L3	CO4
8	Solve $\frac{d^2y}{dx^2} - 4y = cosh(2x) + 3^x$	L3	CO4
9	Solve $(D^2 + 4)y = x^2 + e^{-x}$	L3	CO4
10	Solve $\frac{d^3y}{dx^3} + 3\frac{dy}{dx} + 2y = 1 + 3x + x^2$	L3	CO4
11	Solve $(D^3 - D)y = 2x + 1$	L3	CO4

12	Solve $\frac{d^3y}{dx^3} - 7\frac{dy}{dx} + 6y = 1 - x + x^2$	L3	CO4
13	Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}$ using the variation of parameters.	L3	CO4
14	Solve $\frac{d^2y}{dx^2} + y = Secx.Tanx$ using the variation of parameters.	L3	CO4
15	Solve $\frac{d^2y}{dx^2} + y = \frac{1}{1+Sinx}$ using the variation of parameters.	L3	CO4
16	Solve $\frac{d^2y}{dx^2} + y = x\sin x$ using the variation of parameters.	L3	CO4
17	Solve $(2x+1)^2y'' - 2(2x+1)y' - 12y = 6x+5$. (June/July 2024)	L3	CO4
18	Solve $(2x-1)^2\frac{d^2y}{dx^2} + (2x-1)\frac{dy}{dx} - 2y = 8x^2 - 2x + 3$.	L3	CO4

Module -5			
Q. No.	Questions	Bloom's LL	COs
1	Find the rank of i) $\begin{bmatrix} 1 & 2 & 3 & 2 \\ 2 & 3 & 5 & 1 \\ 1 & 3 & 4 & 5 \end{bmatrix}$ ii) $\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$ $iii) A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$ $iv) A = \begin{bmatrix} 91 & 92 & 93 & 94 & 95 \\ 92 & 93 & 94 & 95 & 96 \\ 93 & 94 & 95 & 96 & 97 \\ 94 & 95 & 96 & 97 & 98 \\ 95 & 96 & 97 & 98 & 99 \end{bmatrix}$	L3	CO5
2	Test for the consistency and solve $x + y + z = 6; x - y + 2x = 5;\ \ 3x + y + z = 8$	L3	CO5
3	For what values λ and μ the system of equations $x+y+z=6$, $x+2y+3z=10$, $x+2y+\lambda z=\mu$ has i) Unique solution ii) No Solution iii) Infinite solution .	L3	CO5

4	Investigate the value of p and q so that the equations $2x+3y+5z=9,\ 7x+3y-2z=8,\ 2x+3y+pz=q$ have (i) Unique solution (ii) No solution (iii) infinite number of solutions.	L3	CO5
5	Test the consistency and solve the equations by Gauss jordan method. $2x+y+4z=12$ $4x+11y-z=33$ $8x-3y+2z=20$	L3	CO5
6	Solve the system of equations by using Gauss-Jordon method $2x+y+3z=1$, $4x+4y+7z=1$, $2x+5y+9z=3$	L3	CO5
7	Solve the system of equations by using Gauss-Jordon method $x+y+z=8$, $-x-y+2z=-4$, $3x+5y-7z=14$	L3	CO5
8	Solve the system of equations by using Gauss seidel method $x+y+54z=110$,$27x+6y-z=85$,$6x+15y+2z=72$	L3	CO5
9	Solve the system of equations by using Gauss seidel method $10x+y+z=12$,$x+10y+z=12$,$x+y+10z=12$	L3	CO5
10	Solve by Gauss Seidel method given the system of equation $5x+2y+z=12, \quad x+4y+2z=15, \quad x+2y+5z=20$ initially taking $x_0=1,\ y_0=0,\ z_0=3$ (Perform 4 iterations).	L3	CO5
11	Solve by Gauss Seidel method given the system of equation $x+y+54z=110, 27x+6y-z=85, 6x+15y+2z=72$	L3	CO5
12	Find the largest Eigen value and its corresponding Eigen vector of the following matrices by power method. $\begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$	L3	CO5
13	Find the largest Eigen value and its corresponding Eigen vector of the following matrices by power method. $\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$	L4	CO5
14	Find the largest Eigen value and its corresponding Eigen vector of the following	L4	CO5

	matrices by power method. $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$		
15	Find the largest Eigen value and its corresponding Eigen vector of the following matrices by power method. $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$	L5	CO5