

**I B.Tech Examinations, June 2011
MATHEMATICAL METHODS**

Common to BME, IT, ICE, E.COMP.E, ETM, EIE, CSE, ECE, EEE

Time: 3 hours

Max Marks: 75

**Answer any FIVE Questions
All Questions carry equal marks**

1. (a) Derive the normal equation to fit the parabola $y=a+bx+cx^2$.
(b) By the method of least square, find the straight line that best fits the following data:

x	1	2	3	4	5
y	14	27	40	55	68

[8+7]

2. (a) Find the Fourier Series to represent the function $f(x)=|\sin x|$ in $-\Pi < x < \Pi$
(b) Find the Fourier Series for the function $f(x)$ is given by

$$f(x) = \begin{cases} -\frac{1}{2}(\Pi + x) & \text{for } -\Pi < x \leq 0 \\ \frac{1}{2}(\Pi - x) & \text{for } 0 \leq x < \Pi \end{cases} . \quad [7+8]$$

3. Find the eigen values and the corresponding eigen vectors of $\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$. [15]

4. (a) Given $\frac{dy}{dx}=xy$ and $y(0)=1$ find $y(0.1)$ using Euler's method.
(b) solve by Euler's method $\frac{dy}{dx}=\frac{2y}{x}$ given $y(1)=2$ and find $y(2)$. [8+7]

5. (a) Solve $\frac{x^2}{p} + \frac{y^2}{q} = z$.
(b) Solve $x^2p^2 + xpq = z^2$. [7+8]

6. Reduce the quadratic form to the canonical form $6x^2 + 3y^2 + 3z^2 - 4xy + 4zx - 2yz$. [15]

7. (a) Reduce the Matrix A to its normal form Where $A = \begin{bmatrix} 1 & 2 & -2 & 3 \\ 2 & 5 & -4 & 6 \\ -1 & -3 & 2 & -2 \\ 2 & 4 & -1 & 6 \end{bmatrix}$ and

hence find the rank.

- (b) Find whether the following system of equations are consistent. If so solve them. [8+7]

8. (a) Establish the formula $x_{i+1} = \frac{1}{2} \left(x_i + \frac{N}{x_i} \right)$ and hence compute the value of upto four decimal places.

- (b) Find $y(25)$ given that $y(20) = 24, y(24) = 32, y(28) = 35, y(32) = 40$ using Gauss forward difference formula. [8+7]

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1. Find the eigen values and the corresponding eigen vectors of $\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$. [15]

2. Reduce the quadratic form to the canonical form $3x^2 - 3y^2 - 5z^2 - 2xy - 6yz - 6xz$. [15]

3. (a) From the following table, find the value of x for which y is maximum and find this value of y.

x	1.2	1.3	1.4	1.5	1.6
y	0.9320	0.9636	0.9855	0.9975	0.9996

- (b) From the following table find x, correct to four decimal places for which y is minimum and find this value of y.

x	0.60	0.65	0.70	0.75
y	0.6221	0.6155	0.6138	0.6170

[8+7]

4. (a) Solve $px + qy = pq$.

- (b) Solve $z^2 = pqxy$.

[8+7]

5. Find $y(0.1)$ and $y(0.2)$ using Euler's modified formula given that $\frac{dy}{dx} = x^2 - y$ and $y(0) = 1$. [15]

6. If $f(x) = x$ for $0 < x < \frac{\pi}{2}$
 $= \pi - x$ for $\frac{\pi}{2} < x < \pi$. then prove that

(a) $f(x) = \frac{4}{\pi} [\sin x - \frac{1}{3^2} \sin 3x + \frac{1}{5^2} \sin 5x - \dots]$.

(b) $f(x) = \frac{\pi}{4} - \frac{2}{\pi} [\frac{1}{1^2} \cos 2x + \frac{1}{3^2} \cos 6x + \frac{1}{5^2} \cos 10x + \dots]$. [8+7]

7. (a) Find a real root of the equation, $\log x = \cos x$ using regula falsi method.

- (b) Given that $f(20) = 24$, $f(24) = 32$, $f(28) = 35$, $f(32) = 40$, find $f(25)$ using Gauss forward interpolation formula. [7+8]

8. a) Find the Value of k if the Rank of Matrix A is 2 where $A = \begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & k & 0 \end{bmatrix}$

- (b) Determine whether the following equations will have a solution, if so solve them. $x_1 + 2x_2 + x_3 = 2$, $3x_1 + x_2 - 2x_3 = 1$, $4x_1 - 3x_2 - x_3 = 3$, $2x_1 + 4x_2 + 2x_3 = 4$. [7+8]

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1. Reduce the quadratic form to the canonical form $2x^2 + 5y^2 + 3z^2 + 4xy$. [15]
2. (a) Find the Values of Rank of the Matrix ,by reducing it to the normal form.

$$\begin{bmatrix} 1 & 2 & 1 & 2 \\ 1 & 3 & 2 & 2 \\ 2 & 4 & 3 & 4 \\ 3 & 7 & 5 & 6 \end{bmatrix}$$
- (b) Find the valves of p and q so that the equations $2x + 3y + 5z = 9$, $7x + 3y + 2z = 8$, $2x+3y + pz = q$ have
 - i. No solution
 - ii. Unique solution
 - iii. An infinite number of solutions. [7+8]
3. Find $y(0.1)$, $z(0.1)$ given $\frac{dy}{dx}=z-x$, $\frac{dz}{dx}=x+y$ and $y(0)=1$, $z(0)=1$ by using taylor's series method. [15]
4. (a) Express $f(x)=x^3$ as Fourier sine series in $(0,\Pi)$.
- (b) find the Fourier sine series of e^{ax} in $(0,\Pi)$. [7+8]
5. (a) Derive a formula to find the cube root of N using Newton Raphson method hence find the cube root of 15.
- (b) Find the interpolation polynomial for x, 2.4, 3.2, 4.0, 4.8, 5.6, $f(x) = 22, 17.8, 14.2, 38.3, 51.7$ using Newton's forward interpolation formula. [8+7]
6. (a) Prove that if the eigen values of a nonsingular square matrix are $\lambda_1, \lambda_2, \lambda_3, \dots, \lambda_n$, then the eigen values of $A - KI$ are $\lambda_1 - K, \lambda_2 - K, \lambda_3 - K, \dots, \lambda_n - K$.
- (b) Find the eigen values and the corresponding eigen vectors of $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$. [6+9]
7. (a) Solve $z(p^2 - q^2) = x - y$.
- (b) Solve $p^2 z^2 \sin^2 x + q^2 z^2 \cos^2 y = 1$. [7+8]
8. (a) Use the trapezoidal rule with $n=4$ to estimate $\int_0^1 \frac{dx}{1+x^2}$ correct to four decimal places.

Code No: 09A1BS04

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Set No. 1

(b) Evaluate $\int_0^\pi \left(\frac{\sin x}{x}\right) dx$ by using

- i. Trapezoidal rule.
- ii. Simpson's $\frac{1}{3}$ rule taking $n = 6$.

[8+7]

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1. By the method of least squares, fit a second parabola $y=a+bx+cx^2$ to the following data:

x	2	4	6	8	10
y	3.07	12.85	31.47	57.38	91.29

[15]

2. (a) Find a real root of the equation $e^x \sin x = 1$, using regula falsi method.
(b) Find $f(22)$, from the following data using Newton's Backward formula.

x	20	25	30	35	40	45
y	354	332	291	260	231	204

[8+7]

3. (a) $f(x)=x-\Pi$ as Fourier series in the interval $-\Pi < x < \Pi$.
(b) Find the fourier series to represent $f(x)=x^2$ in $(0,2\Pi)$.

[8+7]

4. (a) Find the Rank of the Matrix, by reducing it to the normal form.
- $$\begin{bmatrix} 1 & 2 & -2 & 3 \\ 2 & 5 & -4 & 6 \\ -1 & -3 & 2 & -2 \\ 2 & 4 & -1 & 6 \end{bmatrix}$$

- (b) Find whether the following system of equations are consistent. If so solve them. $x+2y-z=3$, $3x-y+2z=-1$, $2x-2y+3z=2$, $x-y+z=-1$.

[8+7]

5. Find $y(0.5)$, $y(1)$ and $y(1.5)$ given that $\frac{dy}{dx}=4-2x$ and $y(0)=2$ with $h=0.5$ using modified Euler's method.

[15]

6. Verify Cayley Hamilton theorem and find the inverse of $\begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$.

[15]

7. (a) Solve $p - x^2 = q + y^2$.

(b) Solve $q^2 - p = y - x$.

(c) Solve $q = px + p^2$.

[5+5+5]

8. Compute the full SVD for the following matrix $\begin{bmatrix} 2 & 2 & 0 \\ 2 & 5 & 0 \\ 0 & 0 & 3 \end{bmatrix}$.

[15]
