

Code No: R10107 / R10

I B.Tech I Semester Regular/Supplementary Examinations January 2012
MATHEMATICAL METHODS

(Common to Computer Science Engineering, Electrical & Electronic Engineering, Civil Engineering, Electronics & Instrumentation Engineering, Aeronautical Engineering, Bio-Technology & Automobile Engineering.)

Time: 3 hours

Max Marks: 75

Answer any FIVE Questions
 All Questions carry equal marks

1.(a) Reduce the matrix $\begin{bmatrix} 8 & 1 & 3 & 6 \\ 0 & 3 & 2 & 2 \\ -8 & -1 & -3 & 4 \end{bmatrix}$ in to its normal form and hence find its Rank.

(b) Solve the following system of equations using gauss elimination method

$$2x_1 + x_2 + 2x_3 + x_4 = 6, \quad 6x_1 - x_2 + 6x_3 + 12x_4 = 36$$

$$4x_1 + 3x_2 + 3x_3 - 3x_4 = 1, \quad 2x_1 + 2x_2 - x_3 + x_4 = 10.$$

[7M+8M]

2.(a) Prove that the sum of the Eigen values of a square matrix is equal to its trace of the matrix and Product of the Eigen values is equal to its determinant

(b) Verify cayley –Hamilton theorem and hence find its inverse of the matrix

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 2 & 1 & -1 \\ 1 & -1 & 1 \end{bmatrix}.$$

[7M+8M]

3. Reduce the quadratic form $x^2 + 3y^2 + 3z^2 + 4t^2 + 4xy - 2xz + 6xt + 4yt + 2yz$ the canonical form and hence find the nature, index, rank, and signature of the quadratic form.

[15M]

4.(a) Find a root of the equation $x^3 - x - 4 = 0$ using regula false method.

(b) Find a real root of the equation $xe^x - \cos x = 0$ using Newton-Raphson method.

[7M+8M]

5.(a) Evaluate (i) $\Delta \tan^{-1}\left(\frac{n-1}{n}\right) = \tan^{-1}\left(\frac{1}{2n^2}\right)$ (ii) $\Delta^2 \sin(px + q)$ (iii) $\Delta^n e^{ax+b}$

(b) Applying Newton's forward interpolation formula, compute the value of $\sqrt{5.5}$, given that $\sqrt{5} = 2.236$, $\sqrt{6} = 2.449$, $\sqrt{7} = 2.646$, $\sqrt{8} = 2.828$

[7M+8M]

Code No: R10107 / R10**Set No. 1**6.(a) Find the first derivative of the function tabulated below at the point $x=1.5$.

x	1.5	2.0	2.5	3.0	3.5	4.0
f(x)	3.375	7.0	13.625	24	38.87	59

(b) Evaluate $\int_0^1 e^{-x^2} dx$ using(i) Simpson's 1/3 rule taking $h=0.2$ (ii) Trapezoidal rule.

[7M+8M]

7. (a) Find $y(0.2)$ using modified Euler's method given that

$$\frac{dy}{dx} = x - y, \quad y(0) = 1, \quad \text{with } h=0.1$$

(b) Find $y(0.1)$ and $y(0.2)$ using Runge -Kutta method fourth order given that
 $y' = xy + y^2, \quad y(0) = 1.$

[7M+8M]

8.(a) Fit a power function to the following data and estimate y at $x=12$.

Price	20	16	10	11	14
Demand	22	14	120	89	56

(b) Fit a least square parabola to the following data.

x	0	0.2	0.4	0.7	0.9	1.0
y	1.016	0.768	0.648	0.401	0.272	0.193

[7M+8M]

Set No. 2

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- 1.(a) Reduce the matrix to Echelon form and hence find its Rank

$$A = \begin{bmatrix} 2 & -4 & 3 & -1 & 0 \\ 1 & -2 & -1 & -4 & 2 \\ 0 & 1 & -1 & 3 & 1 \\ 4 & -7 & 4 & -4 & 5 \end{bmatrix}$$

- (b) Solve the equations

$$10x_1 + x_2 + x_3 = 12, x_1 + 10x_2 - x_3 = 10 \text{ and } x_1 - 2x_2 + 10x_3 = 9 \text{ by Gauss Joldan method.}$$

[7M+8M]

- 2.(a) Find the Eigen Values and Eigen vectors of
- A^{-1}
- . Where

$$A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$

- (b) State and Prove Cayley – Hamilton theorem.

[7M+8M]

3. Reduce the Quadratic form
- $3x^2 + 3y^2 + 3z^2 + 2xy + 2xz - 2yz$
- into sum of squares form by an orthogonal transformation and hence find nature, rank, index and signature.

[15M]

- 4.(a) Find a real root of
- $xe^x = 2$
- using Regula–Falsi method.

- (b) Find real root of the equation
- $1 + \tan^{-1} x - x = 0$
- near
- $x = 1$
- correct up to 4 decimal places using iteration method.

[7M+8M]

- 5.(a) Find
- $f(1.28)$
- . If
- $f(1.15) = 1.0723$
- ,
- $f(1.20) = 1.0954$
- ,
- $f(1.25) = 1.1180$
- , and
- $f(1.30) = 1.1401$
- .

- (b) Find the cubic polynomial which takes the values

x	0	1	2	5
$f(x)$	2	3	12	147

using Lagranges interpolation formula.

[7M+8M]

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Set No. 2

6.(a) Find the values of $f'(1)$ using the data.

x	1.0	1.5	2.0	2.5	3.0
$f(x)$	27	106.75	324	783.75	1621

(b) Evaluate $\int_0^{\pi/2} e^{\sin x} .dx$ taking $h=\pi/6$ using

- (i) Trapezoidal rule.
(ii) Simpson's 1/3 rule.

[7M+8M]

7. Find the solution of $\frac{dy}{dx} = x - y$, $y(0) = 1$. at $x = 0.4$ and $h = 0.1$ using Miline's method. Use Euler's modified method to evaluate $y(0.1)$, $y(0.2)$ and $y(0.3)$.

[15M]

8.(a) Using least square method fit a second degree polynomial estimate y at $x = 6.5$

x	0	1	2	3	4	5	6	7	8
y	12	10.5	10	8	7	8	7.5	8.5	9

(b) Fit a power curve of the form $y(x) = ax^b$ to the data.

x	1	2	3	4	5	6
y	4.0	5.7	6.9	8.0	8.9	9.8

[7M+8M]

Set No. 3

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- 1.(a) Find the non-singular matrices P&Q such that
- $P A Q$
- is in the normal form where

$$A = \begin{bmatrix} 1 & 3 & 6 & -1 \\ 1 & 4 & 5 & 1 \\ 1 & 5 & 4 & 3 \end{bmatrix}$$

- (b) Solve
- $x + 2y + z = 3$
- ,
- $2x + 3y + 2z = 5$
- ,
- $3x - 5y + 5z = 2$
- ,
- $3x + 9y - z = 4$
- .

[7M+8M]

- 2.(a) Find the Eigen Values and the corresponding Eigen vectors of the matrix

$$\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$

- (b) State Cayley – Hamilton theorem. Find the characteristic Equation of the matrix

$$A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix} \text{ and hence find the matrix represented by}$$

$$A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I.$$

[7M+8M]

- 3.(a) Reduce the following Quadratic form to canonical form by diagonalization

$$6x^2 + 3y^2 + 3z^2 - 4yz - 4zx - 2xy$$

- (b) Using Lagrange's reduction, transform

$$x_1^2 - 4x_2^2 + 5x_3^2 + 2x_1x_2 - 4x_1x_3 + 2x_4^2 - 6x_3x_4 \text{ to canonical form and hence find}$$

rank, nature, index and signature.

[7M+8M]

- 4.(a) Using Bisection method find a square root of 26 correct up to three decimal places.

- (b) Using Newton Raphson method compute
- $\sqrt{41}$
- correct to Four decimal places.

[7M+8M]

Code No: R10107 / R10**Set No. 3**

- 5.(a) Using Newton's interpolation formula given $\sin 45^\circ = 0.7071$
 $\sin 50^\circ = 0.7660$, $\sin 55^\circ = 0.8192$ and $\sin 60^\circ = 0.8660$ find $\sin 52^\circ$.
- (b) Find $y(-2)$ & $y(1.5)$ from the following data using Lagrange's interpolation formula.

x	-4	-1	0	2	5
f(x)	1245	33	5	9	1335

[7M+8M]

- 6.(a) Find First and second derivatives from the data near $x = 1.5$ using central forward difference.

x	1	1.2	1.4	1.6	1.8	2
y	2.72	3.32	4.06	4.95	6.05	7.39

- (b) Using Simpson's rule. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ dividing the range into 6 equal parts.

[7M+8M]

7. Use Milne's Method to find $y(0.8)$ from $y' = 1+y^2$, $y(0) = 0$, find the initial values $y(0.2)$, $y(0.4)$ and $y(0.6)$ From Range Kutta method.

[15M]

- 8.(a) Fit a least square parabola to the following data

x	0	0.2	0.4	0.7	0.9	1.0
y	1.016	0.768	0.648	0.401	0.272	0.193

- (b) Fit an exponential curve of the form $y(x) = ae^{bx}$ to the following data

x	1	2	3	4	5
y	2.600	3.300	4.200	5.400	6.900

[7M+8M]

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Set No. 4

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- 1.(a) Find the values of a and b for which the equations $x + y + z = 3$, $x + 2y + 2z = 6$, $x + ay + 3z = b$ have
 (i) no solution (ii) infinitely number of solutions (iii) unique solutions.
 (b) Solve the following system of equations using Gauss – Seidel Iteration Method
 $27x + 6y - z = 85$, $6x + 15y + 2z = 72$, $x + y + 54z = 110$.
[7M+8M]
- 2.(a) Prove that the two Eigen vectors corresponding to the two different Eigen values are linearly independent .
 (b) Diagonalize the matrix $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ and find A^4 using the model matrix.
[7M+8M]
- 3.(a) Reduce the Quadratic form to canonical form $3x^2 + 2y^2 - 4xz$ by using orthogonal transformation.
 (b) Using Lagrange's Reduction Reduce the Quadratic Form
 $x_1^2 + 4x_2^2 + x_3^2 - 4x_1x_2 + 2x_3x_1 - 4x_2x_3$ to canonical form. Also find the nature, rank, index, signature.
[7M+8M]
- 4.(a) Using Bisection Method find the root between 2&3 of the equation $x^4 - x^3 - 2x^2 - 6x - 4 = 0$ up to three decimals
 (b) using iteration method find an approximate root of the equation $x^4 - x - 13 = 0$.
[7M+8M]
- 5.(a) Find log 58.75 from the following data.
- | | | | | | | |
|-------|---------|---------|---------|---------|---------|---------|
| x | 40 | 45 | 50 | 55 | 60 | 65 |
| log x | 1.60206 | 1.65321 | 1.69897 | 1.74036 | 1.77815 | 1.81291 |
- Using Newton's backward interpolation formula.
- (b) Using Gauss forward interpolation formula find the value of f(25) from the following data $f(20) = 24$, $f(24) = 32$, $f(28) = 35$, $f(32) = 40$.
[7M+8M]

Code No: R10107 / R10**Set No. 4**6.(a) find the values of $\cos(1.74)$ from the following data.

x	1.7	1.74	1.78	1.82	1.86
Sin x	0.9857	0.9916	0.9781	0.9691	0.9584

(b) Evaluate $\int_0^{\pi/2} \sqrt{\sin \theta} d\theta$ using(i) Simpson's 1/3 rule (ii) Simpson's 1/8 rule taking $n = 6$

[7M+8M]

7.(a) solve the differential equation $\frac{dy}{dx} = \frac{1}{x^2 + y}$, $y(4) = 4$ and compute $y(4.2)$ & $y(4.4)$ using

Taylor's series method.

(b) solve $y' = y - x^2$, $y(0) = 1$ by Picard's method up to the fourth approximation hence find the value of $y(0.1)$, $y(0.2)$.

[7M+8M]

8.(a) Using least square method, fit a second degree polynomial estimate y at $x=6.5$

x	0	1	2	3	4	5	6	7	8
y	12	10.5	10	8	7	8	7.5	8.5	9

(b) Fit a least square straight line for the following data.

x	1	2	3	4	5	6
y	6	4	3	5	4	2

[7M+8M]