

I B.Tech Examinations, December 2010

MATHEMATICAL METHODS

Common to BME, IT, ICE, E.COMPE, ETM, EIE, CSE, ECE, EEE Time:  
3 hours

Max Marks: 75

Answer any FIVE Questions  
All Questions carry equal marks  
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1. Verify Cayley Hamilton theorem and find the inverse of  $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ . [15]

2. (a) Find a real root of the equation,  $x \sin x + \cos x = 0$  using regula falsi method.  
(b) Find  $y(32)$  if  $y(10)=35.3$ ,  $y(15) = 32.$ ,  $y(20) = 29.2$   $y(25) = 26.1$   $y(30) = 23.2$ ,  $y(35) = 20.5$  using Newton's forward interpolation formula. [8+7]

3. (a) Compute the first and second derivatives at  $x=2.03$  of the following table:

x	1.96	1.98	2.00	2.02	2.04
y	0.7825	0.7739	0.7651	0.7563	0.7473

- (b) From the following table of values of  $x$  and  $y$  find  $\frac{dy}{dx}$  at  $x=0.5$

x	0.35	0.40	0.45	0.5	0.55	0.6	0.65
y	1.521	1.506	1.488	1.467	1.444	1.418	1.389

[8+7]

4. (a) Find the maximum and minimum values of  $f = 3x^2 + 5y^2 + 3z^2 - 2xy + 2zx - 2yz$  subject to  $x + y + z = 1$ . Also find the point at which the maximum and minimum exists.

- (b) Find the nature of the quadratic form  $10x^2 + 2y^2 + 5z^2 - 4xy - 10zx + 6yz$ . [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. If  $f(x) = \begin{cases} x & \text{for } 0 < x < \frac{1}{2} \\ -x & \text{for } \frac{1}{2} < x < 1 \end{cases}$ . then prove that

$$\int_0^1 f(x) dx = \frac{1}{3^2} [\sin x - \frac{1}{3} \sin 3x + \frac{1}{5^2} \sin 5x - \dots]$$

$$\int_0^1 f(x) dx = \frac{1}{4} - \frac{2}{1^2} [\cos 2x + \frac{1}{3^2} \cos 6x + \frac{1}{5^2} \cos 10x + \dots]. \quad [8+7]$$

7. (a) Solve  $\frac{p}{x^2} + \frac{q}{y^2} = 1$ .

(b) Solve  $p^2 + q^2 = z^2(x^2 + y^2)$ . [7+8]

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

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R09

Set No. 2

- (b) Find whether the following system of equations are consistent. If so solve them.  $5x + 3y + 7z = 0$ ,  $3x + 26y + 2z = 9$ ,  $7x + 2y + 10z = 5$ . [7+8]

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1. Find the eigen values and the corresponding eigen vectors of  $\begin{bmatrix} 1 & 3 & 7 \\ 1 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}$ . [15]

2. Reduce the quadratic form to the canonical  $3x^2 - 2y^2 - z^2 - 4xy + 8xz + 12yz$ . [15]

3. (a) Solve  $(x^3 + 3xy^2)p + (y^3 + 3x^2y)q = 2(x^2 + y^2)z$ .

(b) Solve  $x(y^2 - z^2)p - y(z^2 + x^2)q = z(x^2 + y^2)$ . [7+8]

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

(b) Solve the following tridiagonal system  $3x - y = 5$ ,  $x + 2y - 2z = 6$ ,  $4y + 3z = 1$ . [8+7]

5. Evaluate  $\int_0^1 \frac{1}{1+x} dx$

(a) By Trapezoidal rule and Simpson's  $\frac{1}{3}$  rule.

(b) Using Simpson's  $\frac{3}{8}$  rule. [8+7]

6. If  $f(x) = \begin{cases} 1 & \text{in } 0 < x < \frac{1}{2} \\ -1 & \text{in } \frac{1}{2} < x < \end{cases}$  Expand  $f(x)$  in a series of cosines. [15]

7. Find  $y(1)$  and  $y(2)$  using Runge-Kutta fourth order formula given that  $\frac{dy}{dx} = x^2 - y$  and  $y(0) = 1$ . [15]

8. (a) Find a real root of the equation  $xe^x = \cos x$  by Newton Raphson method.

(b) The amount A of a substance remaining in a reaction system after an interval of time t in a certain chemical experiment is given by the following data.

t	2	5	8	14
A	94.8	87.9	813	68.7

Find value of A at  $t = 11$ . [8+7]

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1. Form the partial differential equations

(a)  $z = f(x-iy) + g(x+iy)$

(b)  $z = y^2 + 2f \frac{1}{x} + \log y$

(c)  $F(xy+z^2, x+y+z) = 0$

[5+5+5]

2. (a) Find a real root of the equation  $e^x \sin x = 1$  using Newton Raphson method(b) Find  $y(10)$ , Given that  $y(5) = 12$ ,  $y(6) = 13$ ,  $y(9) = 14$ ,  $y(11) = 16$  using Lagrange's formula. [8+7]3. (a) Find the maximum and minimum values of  $f = 2x^2 + 2y^2 + 2z^2 - 2xy + 2zx - 2yz$  subject to  $x + y + z = 1$ . Also find the point at which the maximum and minimum exists.(b) Find the nature of the quadratic form  $3x^2 + 2y^2 + 3z^2 - 2xy - 2yz$ . [8+7]4. Verify Cayley Hamilton theorem and find the inverse of  $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$ . [15]5. (a) Find the Rank of the Matrix, by reducing it to the normal form.  $\begin{bmatrix} 2 & 1 & 3 & 4 \\ 0 & 3 & 4 & 1 \\ 2 & 3 & 7 & 5 \\ 2 & 5 & 11 & 6 \end{bmatrix}$ (b) Solve the following equations by expressing the coefficient matrix as a product of a lower triangular and upper triangular matrices.  $x + y - z = 5$ ,  $2x + y + 2z = 5$ ,  $3x + 2y - 4z = 7$ . [7+8]6. Given  $y' = x + \sin y$  and  $y(0) = 1$  compute  $y(0.2)$  and  $y(0.4)$  with  $h = 0.2$  using Euler's modified method. [15]7. (a) Find the half-range sine series of  $f(x) = 1$  in  $[0, 1]$ .(b) Find the half-range cosine and sine series for  $f(x) = x$  in  $(0, 1)$ . [7+8]8. Evaluate  $\int_0^6 \frac{1}{(1+x)} dx$  by using(a) Simpson's  $\frac{1}{3}$  Rule.

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R09

Set No. 1

- (b) Trapezoidal Rule.
- (c) Simpson's  $\frac{3}{8}$  Rule.

[5+5+5]

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## MATHEMATICAL METHODS

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1. (a) Find the Rank of the Matrix, by reducing it to the normal form.

$$\begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -3 \\ 3 & -1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$$

- (b) Solve the following tridiagonal system

$$2x - y = 3, \quad x + 4y + 3z = 3, \quad 2y + 4z = 6.$$

[8+7]

2. (a) Express
- $f(x) = \frac{x^2}{12} - \frac{x}{4}$
- as a Fourier in
- $-\frac{\pi}{4} < x < \frac{\pi}{4}$
- .

- (b) Find the Fourier Series to represent the function
- $f(x) = \sin x$
- in
- $-\frac{\pi}{4} < x < \frac{\pi}{4}$
- .

[8+7]

3. (a) Find the constants
- $a$
- and
- $b$
- by the method of least squares such that
- $y = ae^{bx}$

x	2	4	6	8	10
y	4.077	11.084	30.128	81.897	222.62

- (b) Find the curve of best fit of the type
- $y = ae^{bx}$
- to the following data by method of least squares.

x	1	5	7	9	12
y	10	15	12	15	21

[8+7]

4. Given
- $\frac{dy}{dx} = \frac{y-x}{y+x}$
- and
- $y(0)=1$
- . Compute
- $y(0.1)$
- in steps of 0.02 using Euler's modified method. [15]

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

6. (a) Solve
- $2(z+px+qy)=p^2y$
- .

(b) Solve  $(p^2 + q^2)y=qz$ .

[8+7]

7. Diagonalize the matrix
- $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$
- . [15]

8. (a) Find a real root of the equation
- $x^3 - 9x + 1 = 0$
- using regula falsi method.

(b) Prove that  $E^{1/2} + E^{-1/2} (1 + \dots)^{1/2} = 2 + \dots$ .

[8+7]

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