

**I B.Tech - Regular Examinations, June 2009****MATHEMATICAL METHODS**

( Common to Electrical & Electronic Engineering, Mechanical Engineering, Electronics & Communication Engineering, Computer Science & Engineering, Electronics & Instrumentation Engineering, Bio-Medical Engineering, Information Technology, Electronics & Control Engineering, Mechatronics, Computer Science & Systems Engineering, Electronics & Telematics, Electronics & Computer Engineering, Production Engineering, Instrumentation & Control Engineering and Automobile Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions

All Questions carry equal marks

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1. (a) Show that the system of equations  $x + 2y + z = 3$ ,  $2x + 3y + 2z = 5$ ,  $3x - 5y + 5z = 2$ ,  $3x + 9y - z = 4$  are consistent and solve them  
 (b) Write the following equations in matrix form  $AX = B$  and solve for  $X$  by finding  $A^{-1}$ :  $x + y - 2z = 3$ ,  $2x - y + z = 0$ ,  $3x + y - z = 8$ . [8+8]
2. Verify Cayley-Hamilton Theorem for the matrix  $A = \begin{bmatrix} 3 & 4 & 1 \\ 2 & 1 & 6 \\ -1 & 4 & 7 \end{bmatrix}$ . Hence find  $A^{-1}$ . [16]
3. Reduce the quadratic form  $3x^2 + 5y^2 + 3z^2 - 2yz + 2zx - 2xy$  to the canonical form and specify the matrix of transformation. [16]
4. (a) Find a positive root of  $x - \cos x = 0$  by bisection method.  
 (b) Using Newton-Raphson method, find a real root of  $x^3 - x - 2 = 0$ . [8+8]
5. (a) Fit a second degree parabola to the following data:  

x:	0	1	2	3	4
f(x):	1	1.8	1.3	2.5	6.3

 (b) The velocity  $v$  of a particle moving in a straight line covers a distance  $x$  in time  $t$ . They are related as follows: Find  $f'$  (15).  

x:	0	10	20	30	40
v:	45	60	65	54	42

 [8+8]
6. Find  $y(0.1)$ ,  $y(0.2)$ ,  $z(0.1)$ ,  $z(0.2)$  given  $\frac{dy}{dx} = x + z$ ,  $\frac{dz}{dx} = x - y^2$  and  $y(0) = 2$ ,  $z(0) = 1$  by using Taylor's series method. [16]
7. (a) Using Parseval's Identity evaluate  $\int_0^{\infty} \frac{x^2 dx}{(a^2 + x^2)^2}$ ,  $a > 0$   
 (b) Evaluate  $\int_0^{\infty} \frac{dx}{(a^2 + x^2)(b^2 + x^2)}$ . using transforms. [8+8]
8. (a) Form the partial differential equations by eliminating the arbitrary functions

- i.  $z = f(x^2 + y^2)$
- ii.  $z = yf(x) + xg(y)$ .

(b) Find the Z-transform of the sequences  $\{x(n)\}$  where  $x(n)$  is

- i.  $n \cdot 2^n$
- ii.  $an^2 + bn + c$ .

[8+8]

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1. (a) Express the following system in matrix form and solve by Gauss elimination method.

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

$$4x_1 + 3x_2 + 3x_3 - 3x_4 = -1; 2x_1 + 2x_2 - x_3 + x_4 = 10.$$

- (b) Show that the system of equations  $3x + 3y + 2z = 1$ ;  $x + 2y = 4$ ;  $10y + 3z = -2$ ;  $2x - 3y - z = 5$  is consistent and hence solve it. [8+8]

2. Verify Cayley-Hamilton Theorem for the matrix  $A = \begin{bmatrix} 3 & 4 & 1 \\ 2 & 1 & 6 \\ -1 & 4 & 7 \end{bmatrix}$ . Hence find  $A^{-1}$ . [16]

3. Verify whether the matrix  $\begin{bmatrix} 1/3 & 2/3 & 2/3 \\ 2/3 & 1/3 & -2/3 \\ 2/3 & -2/3 & 1/3 \end{bmatrix}$  is orthogonal: [16]

4. (a) Using Lagrange's formula, fit a polynomial to the data

X:	0	1	3	4
Y:	-12	0	6	12

Also find y at x = 2.

- (b) If the interval of differencing is unity, prove that  $\Delta \tan^{-1} \left( \frac{n-1}{n} \right) = \tan^{-1} \frac{1}{2n^2}$ . [8+8]

5. (a) Determine  $f'(4)$  from the following data:

$$x: 1 \quad 2 \quad 4 \quad 8 \quad 10$$

$$y: 0 \quad 1 \quad 5 \quad 21 \quad 27$$

- (b) Fit a curve of the form  $y = ab^x$  to the data given below:

$$x: 1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6$$

$$y: 151 \quad 100 \quad 61 \quad 50 \quad 20 \quad 8$$

[8+8]

6. (a) Obtain  $y(0.1)$  given  $y' = \frac{y-x}{y+x}$ ,  $y(0) = 1$  by Picard's method.

(b) Using Taylor's series method solve  $y' = xy + y^2$ ,  $y(0) = 1$  at  $x = 0.1, 0.2, 0.3$ .  
[8+8]

7. (a) Find the Fourier series for  $f(x) = 2lx - x^2$  in  $0 < x < 2l$  and hence deduce  
 $1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots = \frac{\pi^2}{12}$ .

(b) Find the Fourier sine series for  $f(x) = 2x - x^2$ , in  $0 < x < 3$  and  $f(x+3) = f(x)$ .  
[8+8]

8. (a) Form the partial differential equations by eliminating the arbitrary constants

i.  $x^2 + y^2 + (z - c)^2 = a^2$

ii.  $z = (x^2 + a)(y^2 + b)$

(b) Find the Z-transform of the sequences  $\{x(n)\}$  where  $x(n)$  is

i.  $\left(\frac{1}{3}\right)^n$

ii.  $(3)^n \cos \frac{n\pi}{2}$ .

[8+8]

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1. (a) Show that the system  $x + 2y - 5z = -9$ ,  $3x - y + 2z = 5$ ,  $2x + 3y - z = 3$ ,  $4x - 5y + z = -3$  is consistent and solve it.  
 (b) Solve the equations by finding the inverse of the coefficient matrix:  
 $x+y+z = 1$ ,  $3x+5y+6z = 4$ ,  $9x+26y+36z = 16$ . [8+8]
  
2. (a) Given  $A = \begin{bmatrix} 1 & -2 & -3 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ , find its inverse  
 (b) Find  $\tan A$  if  $A = \begin{bmatrix} 1 & 20 & 0 \\ -1 & 7 & 1 \\ 3 & 0 & -2 \end{bmatrix}$  [8+8]
  
3. Reduce the quadratic form  $3x^2+5y^2+3z^2-2yz+2zx-2xy$  to the canonical form and specify the matrix of transformation. [16]
  
4. (a) Given  $u_1 = 22$ ,  $u_2 = 30$ ,  $u_4 = 82$ ,  $u_7 = 106$ ,  $u_8 = 206$ , find  $u_6$ . Use Lagrange's interpolation formula.  
 (b) Find a real root of  $x^3-x-2=0$ . [8+8]
  
5. (a) Find the first and second derivative of the function tabulated below at  $x = 0.6$ .  

x:	0.4	0.5	0.6	0.7	0.8
y:	1.5836	1.7974	2.0442	2.3275	2.6511

 (b) Fit a straight line to the data given below:  

x:	1	3	5	7	9
y:	1.5	2.8	4.0	4.7	6.0

[8+8]
  
6. (a) Using R - K method of fourth order solve  $y' = \frac{y^2-x^2}{y^2+x^2}$ ,  $y(0) = 1$ . Find  $y(0.2)$  and  $y(0.4)$ .  
 (b) Solve numerically  $y' = y + e^x$ ,  $y(0) = 0$  for  $x = 0.2, 0.4$  by Euler's method. [8+8]

7. Find the Fourier Transforms of  $f(x) = \begin{cases} a^2 - x^2; & |x| < 1 \\ 0; & |x| > 1 \end{cases}$

Deduce that

$$\int_0^{\infty} \frac{\sin t - t \cos t}{t^3} dt = \frac{\pi}{4}. \text{ Using Parseval's identity prove that } \int_0^{\infty} \left(\frac{\sin t - t \cos t}{t^3}\right)^2 dt = \frac{\pi}{15}. \quad [16]$$

8. (a) Form the partial differential equations by eliminating the arbitrary constants

i.  $x^2 + y^2 + (z - c)^2 = a^2$

ii.  $z = (x^2 + a)(y^2 + b)$

- (b) Find the Z-transform of the sequences  $\{x(n)\}$  where  $x(n)$  is

i.  $\left(\frac{1}{3}\right)^n$

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- (b) Show that the system of equations  $3x + 3y + 2z = 1$ ;  $x + 2y = 4$ ;

$$10y + 3z = -2; 2x - 3y - z = 5$$
 is consistent and hence solve it. [8+8]

2. Diagonalise the matrix  $\begin{bmatrix} -1 & 2 & -2 \\ 1 & 2 & 1 \\ -1 & -1 & 0 \end{bmatrix}$  [16]

3. Find the rank and index of the quadratic forms and reduce it to canonical form  $3x^2 + 5y^2 + 6z^2 - 2xy + 2xz - 2yz$

4. (a) Given  $u_1 = 22$ ,  $u_2 = 30$ ,  $u_4 = 82$ ,  $u_7 = 106$ ,  $u_8 = 206$ , find  $u_6$ . Use Lagrange's interpolation formula.

- (b) Find a real root of  $x^3 - x - 2 = 0$ . [8+8]

5. (a) Evaluate  $\int_0^{\frac{\pi}{2}} e^{\sin x} dx$  taking  $h = \frac{\pi}{6}$

- (b) Given the following data, find  $f'(6)$

$$\begin{array}{cccccc} x: & 0 & 2 & 3 & 4 & 7 & 9 \\ y: & 4 & 26 & 58 & 112 & 466 & 922 \end{array} \quad [8+8]$$

6. Find  $y(0.1)$ ,  $y(0.2)$ ,  $z(0.1)$ ,  $z(0.2)$  given  $\frac{dy}{dx} = x + z$ ,  $\frac{dz}{dx} = x - y^2$  and  $y(0) = 2$ ,  $z(0) = 1$  by using Taylor's series method. [16]

7. (a) Expand  $f(x) = \begin{cases} 1; & 0 < x < \pi \\ 0; & \pi < x < 2\pi \end{cases}$

as a Fourier series.

(b) Obtain the Fourier series expansion of  $f(x)$  given that

$$f(x) = \begin{cases} 1; & 0 < x < 1 \\ 2; & 1 < x < 3 \end{cases} \text{ and } f(x) = 3/2 \text{ when } x = 0, 1, 3 \text{ and } f(x+3) = f(x) \text{ for all } x. \quad [8+8]$$

8. (a) Solve  $(2z - y)p + (x + z)q = -(2x + y)$

(b) Solve the difference equation, using Z-transform

$$x(k+2) - 5x(k+1) + 6x(k) = 4^n, \text{ given } x(0) = 0, x(1) = 1. \quad [8+8]$$

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