Code: 9ABS105

1

B.Tech I Year (R09) Regular & Supplementary Examinations, June 2013

MATHEMATICAL METHODS

(Common to EEE, ECE, CSE, EIE, E.Con.E, ECM, IT & CSS)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

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

(b) Test the system of equations 2x + y + 5z = 4; 3x - 2y + 2z = 2; 5x - 8y - 4z = 1 consistency. If consistent solve them.

2 Diagonalize the following matrix by an orthogonal transformation and also find the matrix of transformation. $\begin{bmatrix} 2 & 1 & -1 \\ 1 & 1 & -2 \\ -1 & -2 & 1 \end{bmatrix}$

3 (a) Using the Newton – Raphson method find the root of the equation $f(x) = e^x - 3x$ that lies between 0 and 1.

(b) State appropriate interpolation formula which is to be used to calculate the value of exp (1.75) from the following data and hence evaluate it from the given data.

x	1.7	1.8	1.9	2.0
$y = e^x$	5.474	6.050	6.686	7.389

4 Determine 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

5 Given $\frac{dy}{dx} - \sqrt{xy} = 2, y(1) = 1$ find the value of $y(2)$ in steps of 0.2 using modified Euler's method.

6 (a) Obtain the Fourier series for the function $f(x)$ is given by $f(x) = \begin{cases} 0 & , -\pi < x < 0, \\ \sin x, & 0 < x < \pi. \end{cases}$ Deduce that $\frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - \frac{1}{7.9} \ldots = \frac{1}{4}(\pi - 2)$.

(b) Find the Fourier cosine transform of $f(x) = e^{-ax} \cos ax, a > 0$.

7 Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$, which satisfies the conditions $u(0, y) = 0$, $u(L, y) = 0, u(x, 0) = 0$ *and* $u(x, a) = f(x)$.

8 (a) Find $Z\left\{\cos\left(\frac{n\pi}{2}\right)\right\}$ and $Z\left\{\sin\left(\frac{n\pi}{2}\right)\right\}$.

(b) State and prove convolution theorem for Z-transform.

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2

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1 (a) Reduce the $\begin{bmatrix} 1 & 0 & -3 & 2 \\ 0 & 1 & 4 & 5 \\ 1 & 3 & 2 & 0 \\ 1 & 1 & -2 & 0 \end{bmatrix}$ matrix, to normal form and find its rank.

(b) Solve the system 2x - y + 4z = 12; 3x + 2y + z = 10; x + y + z = 6; if it is consistent.

2 Diagonalize the following matrix by an orthogonal transformation and also find the matrix of transformation. $\begin{bmatrix} 7 & 0 & -2 \\ 0 & 5 & -2 \\ -2 & -2 & 6 \end{bmatrix}$

3 (a) Evaluate $\sqrt{28}$ to four decimal places by Newton's iterative method.

(b) Using Newton's forward interpolation formula, and the given table of values.

x	1.1	1.3	1.5	1.7	1.9
f(x)	0.21	0.69	1.25	1.89	2.61

Obtain the value of *f*(x) when x = 1.4.

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

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

5 Determine $y(0.8)$ and $y(1.0)$ by Milne's predictor-corrector method when $\frac{dy}{dx} = x - y^2, y(0) = 0$.

6 (a) Obtain a half-range cosine series for $f(x)$ is given by $f(x) = \begin{cases} kx & , 0 \le x \le \frac{L}{2}, \\ k(L-x), & \frac{L}{2} \le x \le L. \end{cases}$ Deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots = \frac{\pi^2}{8}$.

(b) Prove that Fourier cosine and sine transforms are linear.

7 Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ which satisfies the conditions $u(0, y) = 0$, $u(L, y) = 0$, $u(x, 0) = 0$ *and* $u(x, a) = \sin\left(\frac{n\pi x}{L}\right)$.

8 (a) Prove that $Z(n^p) = -z\frac{d}{dz}Z(n^{p-1}), p$ being a +ve integer. Hence evaluate $Z(n)$ and $Z(n^2)$.

(b) Find: $Z^{-1}\left\{\frac{2z}{(z-1)(z^2+1)}\right\}$.

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1 (a) Determine the rank of the matrix A = $\begin{bmatrix} 2 & 1 & 3 & 5 \\ 4 & 2 & 1 & 3 \\ 8 & 4 & 7 & 13 \\ 8 & 4 & -3 & -1 \end{bmatrix}$

(b) Test the following system for consistency and if consistent solve it.
u + 2v + 2w =1, 2u + v + w = 2, 3u + 2v + 2w = 3, v + w = 0.

2 Diagonalize the following matrix by an orthogonal transformation and also find the matrix of transformation. $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & -1 \\ 1 & -1 & 0 \end{bmatrix}$

3 (a) Find the root between 0 and 1 of the equation $x^3 - 6x + 4 = 0$ correct to five decimal places.

(b) Find the values of cos 1.747 using the values given in the table below:

x:	1.70	1.74	1.78	1.82	1.86
sin x:	0.9916	0.9857	0.9781	0.9691	0.9584

4 Obtain a relation of the form $y = ae^{bx}$ for the following data by the method of least squares.

x:	2	3	4	5	6
y :	8.3	15.4	33.1	65.2	127.4

5 Find $y(0.8)$ by Milne's method for $\frac{dy}{dx} = y - x^2,\ y(0) = 1$. Obtaining the starting values by Taylor's series method.

6 (a) Obtain the Fourier series for the function $f(x)$ is given by $f(x) = \begin{cases} x & , 0 \le x \le \pi, \\ 2\pi - x, & \pi \le x \le 2\pi. \end{cases}$ and Deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots = \frac{\pi^2}{8}$.

(b) Find the Fourier transform of $f(x) = e^{-\frac{x^2}{2}}, -\infty < x < \infty$.

7 Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ within the rectangle $0 \le x \le$ a, $0 \le y \le$ b, given that $u(0,y) = u(0,y) = u(0,y) = 0$ and $u(0,y) = x(a-x)$.

8 (a) Find $Z\{(\cos\theta + i\sin\theta)^n\}$. Hence evaluate $Z(\cos n\theta)$ and $Z(\sin n\theta)$.

(b) Find $Z^{-1}\left\{\frac{3z^2+z}{(5z-1)(5z+2)}\right\}$.

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4

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

(b) Solve the system of homogeneous equations given by 2x + y + 2z = 0, x + y + 3z = 0, 4x + 3y + 8z = 0.

2 Diagonalize the following matrix by an orthogonal transformation and also find the matrix of transformation. $\begin{bmatrix} 1 & 2 & 0 \\ 2 & 2 & 2 \\ 0 & 2 & 3 \end{bmatrix}$

3 (a) Find the root for the following equation using bisection method correct to two decimal places: $e^x - x + 2 = 0$ in 1, 1.4

(b) Find *f*(2.5) using the following table:

x	1	2	3	4
f(x)	1	8	27	64

4 Fit the curve $y = ae^{bx}$ for the following data.

x:	0	1	2	3	4	5	6	7	8
y :	20	30	52	77	135	211	326	550	1052

5 Using Runge-Kutta method of 4th order ,find the solution of $\frac{dy}{dx} = x^2 + 0.25y^2, y(0) = -1$ on $[0,0.5]$ with $h = 0.1$.

6 (a) Express $f(x) = x$ as a half-range sine series in the interval $0 < x < 2$.

(b) Find the Fourier cosine transform of $f(x) = \begin{cases} x & , for\ 0 < x < 1 \\ 2 - x, & for\ 1 < x < 2 \\ 0 & , for\ x > 2 \end{cases}$

7 Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ for $0 \le x \le \pi$, $0 \le y \le \pi$ which satisfies the conditions $u(0,y) = 0$, $u(\pi, y) = 0, u(x,\pi) = 0\ and\ u(x,a) = \sin^2 x$.

8 (a) If $Z(u_n) = \bar{u}(z)$ prove that $Z(a^n u_n) = \bar{u}\left(\frac{z}{a}\right)$.

(b) Using Z- transform, solve $4u_n - u_{n+2} = 0$, given that $u_0 = 0,\ u_1 = 2$.

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