Code: 9ABS105

B. Tech I Year (R09) Regular & Supplementary Examinations, May 2012

MATHEMATICAL METHODS

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

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Prove that If A and B are square matrices and if A is invertible then matrices $A^{-1}B$ and BA^{-1} have same Eigen values.

(b) Prove that the product of the Eigen values of a matrix A is equal to its determinant.

2 Reduce the quadratic form q= $2x_1^2 + 2x_2^2 + 2x_3^2 + 2x_2x_3$ into a canonical form by Orthogonal reduction. Find the index, signature and nature of the quadratic form.

3 (a) Find and approximate value of the real root of $x^3 - x - 1 = 0$ using the bisection method

(b) Find the root of the Equation $x \log_{10}(x) = 1.2$ using false position method.

4 (a) Fit a second degree parabola to the following data:

x:	0	1	2	3	4
y :	1	5	10	22	38

(b) Evaluate $\int_0^{\pi/2} e^{\sin x}\,dx$ correct to four decimal places by Simpson's three- eighth rule.

5 Using modified Euler's method, find an approximate value of y when $x = 0.3,\ given\ that\ \frac{dy}{dx} = x + y\,, y(0) = 1$.

6 (a) If $f(x) = |\cos x|$, Expand $f(x)$ as a Fourier series in the interval $(-\pi, \pi)$.

(b) Express $f(x) = \begin{cases} 1 & for\ 0 \le\ x \le \pi \\ 0 & for\ \ x > \pi \end{cases}$ as a Fourier sine integral and hence evaluate $\int_0^\infty \frac{1-\cos(\pi\lambda)}{\lambda} \sin(x\lambda)\,d\lambda$.

7 A tightly stretched string with fixed end points $x = 0, x = l$ is initially at rest in its equilibrium position. If it is set vibrating by giving to each of its points a velocity $\lambda x(l - x)$, find the Displacement of the string at any distance x from one end at any time t.

8 (a) Find $Z\left\{\frac{1}{n(n+1)}\right\}$.

(b) Use convolution theorem to evaluate $Z^{-1}\left\{\left(\frac{z}{z-a}\right)^3\right\}$.

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1 Verify Cayley – Hamilton theorem for the matrix A = $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$, Hence find A^{-1}.

2 Reduce the following quadratic form by orthogonal reduction and obtain the corresponding transformation. Find the index, signature and nature of the quadratic form q= 2xy + 2yz + 2zx.

3 (a) Use Gauss's backward interpolation formula to find *f*(32) given that *f*(25) = 0.2707, F (30) = 0.3027, f (35) = 0.3386, f (40) = 0.3794.

(b) Evaluate f (10) given *f*(x) = 168, 192, 336 at x = 1, 7, 15 respectively, Use Lagrange interpolation.

4 Fit the second degree polynomial to the following data by the method of least squares

x:	10	12	15	23	20
y :	14	17	23	25	21

5 Using Runge-Kutta method of fourth order find $y(0.1)$, $y(0.2)$ and $y(0.3)$, given that $\frac{dy}{dx} = 1 + xy$, $y(0) = 2$.

6 (a) Find a Fourier series to represent $f(x) = x^2 - 2$, in the interval $(-2, 2)$.

(b) Find the Fourier sine transform of $f(x) = x^{n-1}, (0 < n < 1)$.

7 A rod of length 10 cm has its ends A and B kept at 50℃ and 100℃ until steady state conditions prevail. The temperature at A is suddenly raised to 90℃ and that at B is lowered 60℃ and they are maintained. Find the temperature at a distance x from one end at time t.

8 (a) Define the Z-transform and prove that Z-transform is linear.

(b) Use convolution theorem to evaluate $Z^{-1}\left\{\frac{z^2}{(z-4)(z-5)}\right\}$.

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1 Find the Eigen values and Eigen vectors of the matrix A= $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$.

2 Reduce the quadratic form, q= $3x^2 - 2y^2 - z^2 - 4xy + 12yz + 8xz$ to the canonical form by orthogonal reduction. Find its rank, index and signative. Find also the corresponding transformation.

3 (a) Find the unique polynomial P(x) of degree 2 or less such that P (1) =1, P(3)=27, P (4) = 64 using Lagrange's interpolation formula.

(b) Find the root of the equation $x\ e^x = \cos x$ using the regular false method correct to four decimal places

4 Fit a second degree polynomial to the following data by the method of least squares.

x:	0	1	2	3	4
y :	1	1.8	1.3	2.5	6.3

5 Using Runge-Kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y^2-x^2}{y^2+x^2}$ with $y(0) = 1$ at $x = 0.2, 0.4$.

6 (a) Find a Fourier series of $f(x) = x^3$ in the interval $(-\pi, \pi)$.

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

7 A tightly stretched string of length l has its ends fastened at $x = 0, x = l$. The mid-point of the string is then Taken to height 'h' and then released from rest in that position. Find the lateral displacement of a point of The string at time t from the instant of release.

8 (a) Find Z-transform of $(i).\frac{1}{n}$, $(ii).\frac{1}{(n+1)}$.

(b) Use convolution theorem to evaluate $Z^{-1}\left\{\frac{z^2}{(z-1)(z-3)}\right\}$.

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1 (a) Prove that the sum of the Eigen values of a matrix is the trace of the matrix.

(b) If λ is the Eigen value of A then prove that the Eigen value of B= $a_0A^2 + a_1I$ is $a_0 \lambda^2 + a_1 \lambda + a^2$.

2 (a) Prove that the Eigen values of a Hermitian matrix are all real.

(b) Reduce the quadratic form q= $x_1^2 + x_2^2 + x_3^2 + 4x_1x_2 - 4x_2x_3 + 6x_3x_1$ into a canonical form by diagonalising the matrix of the quadratic form.

3 (a) Find the real root of x $\log_{10}$ x= 1.2 correct to five decimal places by using Newton's iterative method.

(b) Given $f(2) = 10$, $f(1) = 8$, $f(0) = 5$, $f(-1) = 10$ estimate $f(1/2)$ by using Gauss's forward formula.

4 Fit a polynomial of second degree to the data points given in the following table:

x:	0	1.0	2.0
y :	1.0	6.0	17.0

5 Solve $\frac{dy}{dx} = 1 - y, y(0) = 0$ in the range $0 \le x \le 0.3$ by taking $h = 0.1$ by the modified Euler's method.

6 (a) Find a Fourier series of $f(x) = x^2$ in the interval $(-\pi, \pi)$. and deduce the value of $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots$.

(b) Find $f(x)$ if its Fourier sine transform is $\frac{s}{1+s^2}$.

7 The points of trisection of a string are pulled aside through the same distance on opposite sides of the position of equilibrium and the string is released from rest. Derive an expression for the displacement of the string at subsequent time and show that the mid-point of the string always remains at rest.

8 (a) Find $Z(a^n \cos n\theta)$ and $Z(a^n \sin n\theta)$.

(b) Use convolution theorem to evaluate $Z^{-1}\left\{\frac{z^2}{(z-a)(z-b)}\right\}$.

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