Code No: RR210101 **Set No. 1**

II B.Tech I Semester Supplementary Examinations, March 2006
MATHEMATICS-II
(Common to Civil Engineering, Electrical & Electronic Engineering, Mechanical Engineering, Electronics & Communication Engineering, Computer Science & Engineering, Chemical Engineering, Electronics & Instrumentation Engineering, Bio-Medical Engineering, Information Technology, Electronics & Control Engineering, Mechatronics, Computer Science & Systems Engineering, Electronics & Telematics, Metallurgy & Material Technology, Electronics & Computer Engineering, Production Engineering, Aeronautical 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) Find the inverse of the matrix by elementary row transformations. [8]

$$\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$$

(b) Find whether the following equations are consistent, if so solve them.

$$x + 2y - z = 3$$

$$3x - y + 2z = 1$$

$$2x - 2y + 3z = 2$$

$$x - y + z = -1.$$

[8]

2. Diagonalize the matrix A = $\begin{bmatrix} 1 & 1 & 1 \\ 0 & 2 & 1 \\ -4 & 4 & 3 \end{bmatrix}$ and hence find A^4. [16]

3. Reduce the quadratic form $8x^2 + 7y^2 + 3z^2 - 12xy + 4yz - 8yz$ find the rank, index, signature and nature. [16]

4. (a) Expand f(x) = e^{-x} as a Fourier series in (-1, 1). [8]

(b) Expand x sin x as sine series in $0 < x < \pi$. [8]

5. (a) Form the partial differential equation by eliminating the arbitrary function from $\phi\left(\frac{y}{x}, x^2 + y^2 + z^2\right) = 0$. [5]

(b) Solve the partial differential equation $\frac{x^2}{p} + \frac{y^2}{q} = z$ [5]

(c) Solve the partial differential equation $x(y^2 + z)p - y(x^2 + z)q = z(x^2 - y^2)$.[6]

6. A bar 10cm long with insulated surfaces , has its ends A and B kept at 40^0C and 80^0C , respectively until steady state conditions prevail. Then both the ends are suddenly insulated and kept so. Find the subsequent temperature function u (x , t). [16]

7. Solve $\frac{\delta u}{\delta t} = \frac{\delta^2 u}{\delta t^2}$ for $x > 0, t > 0$, given that using Fourier transforms.
   (a) u (0, t) = 0 for $t > 0$
   (b) u (x, 0) = $\begin{cases} 1 & for\ 0 < x < 1 \\ 0 & for\ x \geq 1 \end{cases}$ and
   (c) u (x, t) is bounded. [16]

8. (a) Prove that Z (a^n f(t)) = F (z/a) [5]
   (b) Find
      i. $Z(-2)^n$ [5]
      ii. Z (na^n)
   (c) Find the inverse Z - transform of $\frac{z}{(z-1)\ (z-2)}$ [6]

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Find the rank of the matrix by reducing it to the normal form. [8]
$$\begin{bmatrix} 6 & 1 & 3 & 8 \\ 4 & 2 & 6 & -1 \\ 10 & 3 & 9 & 7 \\ 1b & 4 & 12 & 15 \end{bmatrix}$$
   (b) Find whether the following set of equations are consistent if so, solve them.[8]
$$2x - y + 3z - 9 = 0$$
$$x + y + z = 6$$
$$x - y + z - 2 = 0$$

2. Show that the matrix A = $\begin{bmatrix} 1 & -2 & 2 \\ 1 & 2 & 3 \\ 0 & -1 & 2 \end{bmatrix}$ Satisfies its characteristic equation. Hence Find A^{-1} [16]

3. (a) Show that $A = \begin{pmatrix} a+ic & -b+id \\ b+id & a-ic \end{pmatrix}$ is unitary matrix if $a^2+b^2+c^2+d^2 = 1$. [8]
   (b) Find the eigen values of $\begin{pmatrix} 4 & 1-3i \\ 1+3i & 7 \end{pmatrix}$. [8]

4. Expand f (x) = xsinx, $0 < x < 2\pi$ as a Fourier series. [16]

5. (a) Form the partial differential equations by eliminating the arbitrary function z = f(sin x + cos y). [5]
   (b) Solve the partial differential equation zpq = p+q. [6]
   (c) Solve the partial differential equation (x-y) (px-qy) = (p-q). [5]

6. Solve the boundary value problem
   $u_{tt} = a^2 u_{xx}; 0 < x < L; t > 0$; with
   u(0,t) = 0 = u(L,t) ; and u(x,0) = x(L-x) ;
   $u_t(x, 0) = 0.$ [16]

7. Solve $\frac{\partial u}{\partial t} = 2 \frac{\partial^2 u}{\partial x^2}$, $0 < x < 4, t > 0$ using Fourier Transforms
   given u (0, t) = 0, u(4, t) = 0,
   u(x, 0) = $3 sin \pi x - 2 sin 5\pi x.$ [16]

8. (a) Find the Z - Transform of $C^k \ cos\alpha k, \ \ k \geq 0$ [6]
   (b) Using Z - transforms, solve the difference equation: $y_{n+2} + y_n = 2$
   given that $y_0 = y_1 = 0$ [10]

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. Find the values of λ for which the equations. [16]

$$(\lambda-1)x+(3\lambda+1)y+2\lambda z=0$$
$$(\lambda-1)x+(4\lambda-2)y+(\lambda+3)z=0$$
$$2x+(3\lambda+1)y+3(\lambda-1)z=0$$

will have a nontrivial solution and solve them for each value of λ.

2. (a) If A and B are n rowed square matices and if A is invertible show that A^{-1} B and BA^{-1} have the same eigen values. [6]
   (b) Find the eigen values and the corresponding eigen vectors of the matrix. [10]
$$\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$

3. (a) By Lagrange's reduction transform the quadratic form X^T A X to sum of squares form for $A = \begin{pmatrix} 1 & 2 & 4 \\ 2 & 6 & -2 \\ 4 & -2 & 18 \end{pmatrix}$. [8]
   (b) Reduce the matrix $9x^2+2y^2+2z^2+6xy+2yz-2zx$ to a canonical form and find the rank, index and the signature. [8]

4. (a) Express f (x) = |x| , $-\pi <$ x $< \pi$ as Fourier series. Hence show that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\frac{1}{7^2}........=\frac{\pi^2}{8}$ [8]
   (b) $f(x) = \begin{cases} \frac{\pi}{3}, \text{for } 0 \le x < \frac{\pi}{3} \\ 0, \text{ for } \frac{\pi}{3} \le x < \frac{2\pi}{3} \\ \frac{-\pi}{3} \text{for } \frac{2\pi}{3} \le x < \pi \end{cases}$ show that
   $f(x) = \frac{2}{\sqrt{3}}\left[\cos x - \frac{\cos 5x}{5} + \frac{\cos 7x}{7} - ....\right]$ [8]

5. (a) Form the partial differential equations by eliminating the arbitrary functions $Z = y^2 + 2f(1/x + logy)$ [5]
   (b) Solve the partial differential equation $(x^2 - y^2 - z^2)p + 2xyq = 2xz.$ [6]
   (c) Solve the partial differential equation $z^2(p^2x^2 + q^2) = 1.$ [5]

6. Solve $\delta^2u/\delta x^2 + \delta^2u/\delta y^2 = 0$. Subject to the boundary conditions u(0,y) = u(L,y) = u(x,0)=0 and $u(x, 0) = sin\Pi x/L.$ [16]

7. (a) State and prove Fourier Integral Theorem. [8]
   (b) Find the Fourier transform of $f(x) = \begin{cases} e^{ikx} & a < x < b \\ 0 & x < a \text{ and } x > b \end{cases}$ [8]

8. (a) Find $Z^{[a^{|n|}]}$ [8]
   (b) Solve the difference equation, using Z - transforms $4u_n - u_{n+2} = 0$ given that $u_o = 0, u_1 = 2.$ [8]

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) For what value of K the matrix [8]
$\begin{bmatrix} 4 & 4 & -3 & 1 \\ 1 & 1 & -1 & 0 \\ k & 2 & 2 & 2 \\ 9 & 9 & k & 3 \end{bmatrix}$ has rank 3.

   (b) Find whether the following set of equations are consistent if so, solve them. [8]

$$x_1 + x_2 + x_3 + x_4 = 0$$
$$x_1 + x_2 + x_3 - x_4 = 4$$
$$x_1 + x_2 - x_3 + x_4 = -4$$
$$x_1 - x_2 + x_3 + x_4 = 2.$$

2. (a) If λ is an eigen value of a non singular matrix A, show that
      i. $\frac{I}{\lambda}$ is an eigen value of $A^{-1}$and hence deduce that [4]
      ii. $\frac{|A|}{\lambda}$ is an eigen value of the matrix adj A. [2]

   (b) Find the eigen values and the corresponding eigen vectors of the matrix
$\begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$

3. (a) By Lagrange's reduction transform the quadratic form X^T A X to sum of squares form for $A = \begin{pmatrix} 1 & 2 & 4 \\ 2 & 6 & -2 \\ 4 & -2 & 18 \end{pmatrix}$. [8]

   (b) Reduce the matrix $9x^2 + 2y^2 + 2z^2 + 6xy + 2yz - 2zx$ to a canonical form and find the rank, index and the signature. [8]

4. (a) Expand f(x) = cos ax as a Fourier series in $(-\pi, \pi)$ where a is not an integer. Hence prove that cot$\theta = \frac{1}{\theta} + \frac{2\theta}{\theta^2 - \pi^2} + \frac{2\theta}{\theta^2 - 4\pi^2} + \ldots\ldots\ldots\ldots$ [8]

   (b) If f(x) = x, $\quad 0 < x < \frac{\pi}{2}$

$$= \pi - x, \ \frac{\pi}{2} < x < \pi$$

   Show that f(x)= $\frac{4}{\pi}\left[\sin\, x - \frac{1}{3^2}\sin\ 3x + \frac{1}{5^2}\sin\ 5x - \ \ldots\ldots\ldots\ldots\right]$ [8]

5. (a) Form the partial differential equation by eliminating the arbitrary function from z =$f\left(\frac{xy}{z}\right)$. [5]

   (b) Solve the partial differential equation $p^2x + q^2y = z$ [5]

   (c) Solve the partial differential equation (1 + y) p + (1 + x) q = z. [6]

6. A homogeneous rod of conducting material of length 100cm has its ends kept at zero temperature and the temperature initially is
$u(x, 0) = x; \quad 0 \le x \le 50$
$= 100 - x; \quad 50 \le x \le 100.$
Find the temperature u(x,0) at any t. [16]

7. (a) Find the finite Fourier cosine transform of f(x) = x^2 in (0, l). [6]

   (b) Find the Fourier sine transform of $\frac{e^{-ax}}{x}$ $(a > 0)$ and deduce that
$\int\limits_0^\infty \frac{e^{-ax} - e^{-bx}}{x}$sin sx dx =$tan^{-1}(\frac{b}{s}) - tan^{-1}(\frac{a}{s})$ [10]

8. (a) Find Z $\left[n^2 3^n + 2.\frac{4^n}{n}\right]$ [8]

   (b) Solve the difference equation, using Z-transforms $u_{n+2} - u_n = 2^n$ where $u_0 = 0, \quad u_1 = 1.$ [8]

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