Code No: RR210101

Set No.1

II B.Tech. I Semester Supplementary Examinations, May -2005
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 and Instrumentation & Control Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Define the rank of the matrix and find the rank of the following matrix.
$$\begin{bmatrix} 2 & 1 & 3 & 5 \\ 4 & 2 & 1 & 3 \\ 8 & 4 & 7 & 13 \\ 8 & 4 & -3 & -1 \end{bmatrix}$$
   (b) Find whether the following equations are consistent, if so solve them.
   x+y+2z = 4 ; 2x-y+3z= 9 ; 3x-y-z=2

2. Verify Cayley-Hamilton theorem for A = $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$ hence deduce A^{-1}

3. (a) Prove that the inverse of an orthogonal matrix is orthogonal and its transpose is also orthogonal.
   (b) Reduce the quadratic form $3x_1^2+3x_2^2+3x_3^2+2x_1x_2+2x_1x_3-2x_2x_3$ into sum of squares by an orthogonal transformation and give the matrix of transformation

4. (a) An alternating current after passing through rectifier has the form
$$i = \begin{cases} I_0 \sin x, & \text{for } 0 \le x \le \pi \\ 0, & \text{for } \pi \le x \le 2\pi \end{cases}$$
   where I_0 is the maximum current and the period is 2π. Express i as a Fourier series.
   (b) Represent the following function by Fourier sine series
$$f(x) = \begin{cases} 1, & 0 < x < \frac{m}{2} \\ 0, & \frac{m}{2} < x < m \end{cases}$$

5. (a) Form the partial differential equation by eliminating the arbitrary function from $z = f(y) + \phi(x+y)$.
   (b) Solve the partial differential equation $p^2z^2sin^2x + q^2z^2cos^2y = 1$
   (c) Solve the partial differential equation $q^2y^2 = z(z - px)$

6. A square plate has its faces x = 0 and $x = \pi (0 < y < \pi)$ insulated . Its edges y = 0 and $y = \pi$ are kept at temperatures 0 and f(x) respectively. Derive the formula for steady state temperature.

7. (a) Find the finite Fourier cosine transform of f(x) = $\begin{cases} x & if\ 0 < x < \pi/2 \\ \pi - x & if\ \pi/2 < x < \pi \end{cases}$

   (b) Find the Fourier cosine transforms of e^{-ax} sin ax.

8. (a) State and prove final value theorem

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

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

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1. (a) Find the non singular matrices P and Q such that PAQ is in the normal form of the matrix and find the rank of matrix A = $\begin{bmatrix} 1 & 2 & 3 & -2 \\ 2 & -2 & 1 & 3 \\ 3 & 0 & 4 & 1 \end{bmatrix}$

   (b) Show that the only real value of λ for which the following equations have non trivial solution is 6 and solve them, when $\lambda = 6$.
   x +2y + 3z = λx; 3x + y + 2z = λy; 2x + 3y + z = λz.

2. Verify cayley Hamilton theorem for the matrix A = $\begin{bmatrix} 8 & -8 & 2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$

3. (a) Prove that every hermitian matrix can be written as A+iB where A is real and Symmetric and B is real and Skew-Symmetric.

   (b) Reduce the quadratic form $x_1^2 + 3x_2^2 + 3x_3^2 - 2x_2x_3$ to a canonical form.

4. (a) Show that for $-\pi <$ x $< \pi$,
   Sinax = $\frac{2\sin a\pi}{\pi}\left[\frac{\sin x}{1^2-a^2} - \frac{2\sin 2x}{2^2-a^2} + \frac{3\sin 3x}{3^2-a^2} - ....\right]$

   (b) Find the half range cosine series for the function $f(x) = (x-1)^2$ in the interval $0 < x < 1$ Hence show that $\sum\limits_{n=1}^{\infty} \frac{1}{(2n-1)^2} = \frac{\pi^2}{8}$.

5. (a) Form the partial differential equation by eliminating the arbitrary function from $z = xy + f(x^2 + y^2)$.

   (b) Solve the partial differential equation $2q(z - px - qy) = 1 + q^2$.

   (c) Solve the partial differential equation x (y - z) p + y (z - x) q = z (x - y)

6. The temperature at one end of a bar is 50 cm long with insulated sides is kept at 0^0c and that the other end is kept at 100^0c until steady state condition prevails. The two ends are then suddenly insulated so that the temperature gradient is zero at each end thereafter. Find the temperature distribution.

7. Solve $\frac{\partial^2 u}{\partial t^2} = \alpha^2 \frac{\partial^2 u}{\partial x^2}$ $-\infty < x < \infty$
   $t \geq 0$ with boundary conditions

   (a) u(o, t) = 0

   (b) u(π, t) = 0

   (c) u(x, 0) = f(x)

   (d) $\left(\frac{\partial u}{\partial t}\right)_{(x,0)} = 0, \ \ for \ \ 0 < x < \pi, t > 0$

8. (a) Find $Z\left(\frac{1}{(n+2)\ (n+1)}\right)$

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

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

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1. (a) Find the rank of the matrix
$$A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -3 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$$ by reducing it to the normal form.

   (b) Test for consistency the set of equations and solve them if they are consistent.
$$x + 2y + 2z = 2$$
$$3x - 2y - z = 5$$
$$2x - 5y + 3z = -4$$
$$x + 4y + 6z = 0$$

2. (a) Find the characteristic roots of the matrix and the corresponding eigen values
$$\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$

   (b) If λ_1, λ_2,........, λ_n are the eigen values of A, then prove that the eigen values of (A -kI) are $\lambda_1 - k$, $\lambda_2 - k, \lambda_3 - k, ..., \lambda_n - k$.

3. (a) Define :
      i. Spectral Matrix
      ii. Quadratic Form
      iii. Canonical form.

   (b) Reduce the quadratic form $3x^2 + 5y^2 + 3z^2 - 2yz + 2zx - 2xy$ to the canonical form.

4. (a) Find the Fourier series to represent f(x) = $x^2 - 2$, when $-2 \leq x \leq 2$

(b) Obtain a half range cosine series for $f(x) = \begin{cases} kx, & 0 \le x \le \frac{L}{2} \\ k(L-x), & \frac{L}{2} \le x \le L \end{cases}$
Deduce the sum of the series $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} \ldots\ldots$

5. (a) Form the partial differential equation by eliminating the arbitrary function from $z = yf(x^2 + z^2)$.
   (b) Solve the partial differential equation $z(x-y) = px^2 - qy^2$
   (c) Solve the partial differential equation p-q = log (x+y).

6. An infinitely long plate is bounded by two parallel edges and an end at right angles to them. The breadth is π. This end is maintained at constant temperature u_0 at all points and the other edges are at zero temperature. Find the steady state temperature at any point (x,y) of the plate.

7. (a) Find the Fourier transform of $f(x) = \begin{cases} 1 - x^2 & if\ |x| < 1 \\ 0 & if\ |x| > 1 \end{cases}$
   Hence evaluate $\int_0^\infty \left[\frac{x\cos x - \sin x}{x^2}\right] \cos\frac{x}{2}\, dx$.
   (b) Find Fourier cosine transform of $f(x) = \begin{cases} \cos x & 0 < x < a \\ 0 & x \ge a \end{cases}$

8. (a) State and Prove damping rule.
   (b) Find Z (cos h at. sin bt)
   (c) Find the inverse Z transform of $\frac{Z}{Z^2+7Z+10}$

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

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1. (a) Find the value of λ for which the system of equations
$3x - y + 4z = 3$, $x + 2y - 3z = -2$
$6x + 5y + \lambda z = -3$ will have infinite no of solutions and solve them with that λ value.

   (b) Find the rank of the matrix A by reducing it to the normal form
Where A= $\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 3 & -4 \\ 2 & 3 & 5 & -5 \\ 3 & -4 & -5 & 8 \end{bmatrix}$

2. (a) If A and B are n rowed square metices and if A is invertible show that A^{-1} B and BA^{-1} have the same eigen values.

   (b) Find the eigen values and the corresponding eigen vectors of the matrix.
$\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

3. (a) Prove that every hermitian matrix can be written as A+iB where A is real and Symmetric and B is real and Skew-Symmetric.

   (b) Reduce the quadratic form $x_1^2 + 3x_2^2 + 3x_3^2 - 2x_2x_3$ to a canonical form.

4. (a) Show that for $-\pi < x < \pi$,
$\text{Sinax} = \frac{2\text{sina}\pi}{\pi}\left[\frac{\text{sinx}}{1^2-\text{a}^2} - \frac{2\text{sin2x}}{2^2-\text{a}^2} + \frac{3\text{sin3x}}{3^2-\text{a}^2} - \text{..........}\right]$

   (b) Find the half range cosine series for the function $f(x) = (x-1)^2$ in the interval $0 < x < 1$ Hence show that $\sum\limits_{n=1}^{\infty} \frac{1}{(2n-1)^2} = \frac{\pi^2}{8}$.

5. (a) Form the partial differential equation by eliminating the arbitrary function from xy + yz +zx = $f\left(\frac{z}{x+y}\right)$.

(b) Solve the partial differential equation $p^2x^4 + y^2zq = 2z^2$.

(c) Find the integral surface of the partial differential equation $(x^2 - a^2)p + (xy - aztan\alpha)q = xz - aycot\alpha$ which passes through the circle $x^2 + y^2 - a^2 = 0 = z$.

6. Solve the boundary value problem $u_t = u_{xx}; \quad 0 < x < l, t > 0 with$ $u(0,t) = 0; u_x(l,t) = 0 \ \ and \ \ u(x,0) = x$.

7. (a) Find the finite Fourier cosine transform of f(x) $= \begin{cases} x & if \ 0 < x < \pi/2 \\ \pi - x & if \ \pi/2 < x < \pi \end{cases}$

   (b) Find the Fourier cosine transforms of e^{-ax} sin ax.

8. (a) Prove that Z (a^n f(t)) = F (z/a)

   (b) Find

      i. $Z(-2)^n$

      ii. Z (na^n)

   (c) Find the inverse Z - transform of $\frac{z}{(z-1)\ (z-2)}$

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