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Engineering Mathematics – (CS 3334)
Final Exam – Jan. 13, 2005

1. Solve $X' = AX$, where
$$A = \begin{bmatrix} -0.02 & 0.02 \\ 0.02 & -0.02 \end{bmatrix}.$$

2. Solve $X' = AX$, where
$$A = \begin{bmatrix} 4 & 1 \\ -1 & 2 \end{bmatrix}.$$

$A-\lambda I$ $\quad -0.02x_1 + 0.02x_2 = x_1'$, $\quad 0.02x_1 - 0.02x_2 = x_2'$

3. Solve $X' = AX$, where
$$A = \begin{bmatrix} -1 & -4 & 2 \\ 2 & 5 & -1 \\ 2 & 2 & 2 \end{bmatrix}.$$

4. Solve problem 1 using the method of diagonalization.

5. Find a general solution of the nonhomogeneous linear system
$$X' = \begin{bmatrix} 2 & -4 \\ 1 & -3 \end{bmatrix} X + \begin{bmatrix} 2t^2 + 10t \\ t^2 + 9t + 3 \end{bmatrix}$$

6. Suppose that $\Omega(t)$ is the fundamental matrix of $X' = AX$. Show that the inverse of $\Omega(t)$ is equal to $\Omega(-t)$.

7. Find the Fourier series of the function
$$f(x) = \left\{ \begin{array}{ll} 0 & \text{if } -2 \le x < -1 \\ k & \text{if } -1 \le x < 1 \\ 0 & \text{if } 1 \le x < 2 \end{array} \right\}$$

$\Omega(t) \cdot \Omega(-t) = 1$

8. Find the Fourier series of $f(x)$ in complex form, where $f(x) = e^x$ if $-\pi \le x < \pi$ and $f(x + 2\pi) = f(x)$.

Note: The total score is 120. Each problem worths 15 points.