JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATION-2023

M.Tech-II Semester (CSE)

COURSE CODE (CREDITS): L-22M1WCI231 MAX. MARKS: 35

COURSE NAME: Advanced Computational Techniques in Engineering

COURSE INSTRUCTORS: Dr. Nishant Sharma MAX. TIME: 2 Hours

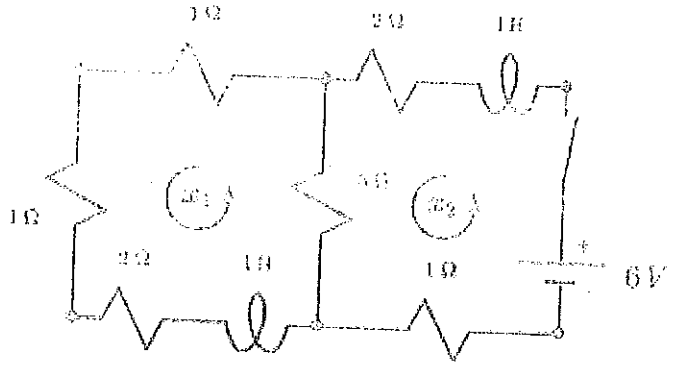
Note: All questions are compulsory. Marks are indicated against each question in square brackets.

Q1. (A) Describe some basic applications of singular values with help of suitable examples.

(B) What is Singular Value Decomposition theorem? Describe SVD theorem along with proof.

[4 + 4 marks] [CO-1]

Q2. (A) Use system of differential equations to solve for time-varying loop currents in given figure.

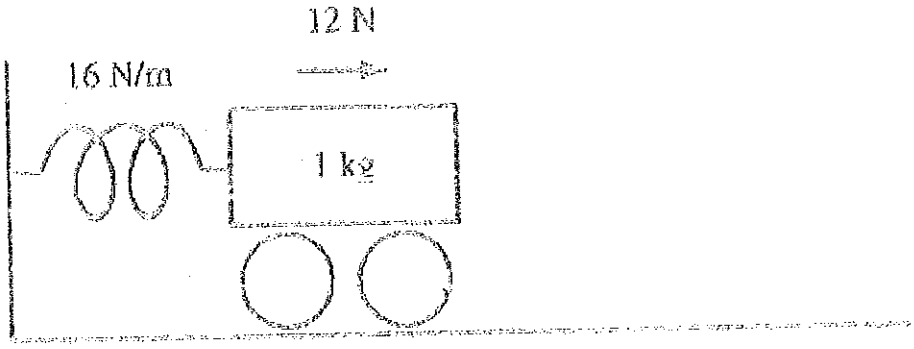


(B) Solve below given non-homogeneous differential equation using system of differential equations to find eigen values and eigen vectors.

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} -9 & 5 \\ 5 & -8 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} - \begin{bmatrix} 0 \\ -6 \end{bmatrix}$$

[4 + 3 marks] [CO-3, CO-4]

Q3. Consider a cart attached to a wall by a spring. At time zero the cart is at rest at its equilibrium position x = 0. At that moment a steady force of 12 Newtons is applied, pushing the cart to the right. Assume that the rolling friction is — k x`(t) Newtons.



(A) Set up a system of two first-order differential equations of the form x` = Ax — b for $x_1(t) = x(t)$ and $x_2(t) = x`(t)$.

(B) Find the steady-state solution of the differential equation.

(C) Find the characteristic equation of A and solve it by the quadratic formula to obtain an expression (involving k) for the eigen values of A. [3 + 3 + 4 marks] [CO-4, CO-5]

Q4. Define Symmetric Positive-Definite (SPD) matrices. Write down characteristic properties of SPD matrices [4 marks] [CO-2]

Q5. Explain QR algorithm. Establish the global correspondence between QR algorithm and simultaneous iteration without coordinate transformations. [2 + 4 marks] [CO-4, CO-5]