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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF NATURAL SCIENCES

Mid-Semester Examination  
Course Number: MATH 4123  
Course Title: Matrix and Differential Equations

Winter Semester: 2024-2025  
Full Marks: 120  
Time: 2 Hours

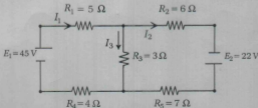
Please answer according to the order of the questions. Answer all the 4 (FOUR) questions. The symbols have their usual meanings. Marks of each question and the corresponding CO and PO are written in the brackets. Programmable calculators are not allowed. Do not write on this question paper.

- 1.(a) Define Transpose matrix. Verify that  $(AB)^T = B^T A^T$ , where (12)  
(CO1)  
(PO1)
- $$A = \begin{bmatrix} 1 & 0 & -1 \\ -2 & 2 & 1 \\ 0 & 3 & 2 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 1 & 2 \\ 3 & 1 & 0 \end{bmatrix}.$$

- (b) Using elementary row transformations, reduce  $A$  to  $I$ , find inverse of  $A$ , where (18)  
(CO1)  
(PO1)
- $$A = \begin{bmatrix} -3 & 1 & 2 & -1 \\ 3 & -1 & -3 & 2 \\ -2 & 3 & 0 & -1 \\ 1 & -2 & 1 & 0 \end{bmatrix}.$$

- 2.(a) Define cofactor of a matrix  $A$ . Find the adjoint matrix of (15)  
(CO1)  
(PO1)
- $$A = \begin{bmatrix} 2 & -1 & 1 & 2 \\ 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 2 \\ 1 & 0 & 0 & 1 \end{bmatrix}.$$

- (b) Using matrix method, find the currents  $I_1$ ,  $I_2$ , and  $I_3$  in an electrical network shown in the following figure (15)  
(CO1)  
(PO1)



- 3.(a) Find the differential equation by eliminating arbitrary constants  $c_1, c_2,$  and  $c_3$  from the equation given below. (10)  
(CO2)  
(PO1)

$$y = c_1 e^{-3x} + e^{2x}(c_2 \cos x + c_3 \sin x).$$

- (b) Solve the given differential equation using separation of variables method. (10)  
(CO2)  
(PO1)
- $$dx - dy + (\sin 2y + \cos 2y)dx - (\sin 2x + \cos 2x)dy = 0.$$

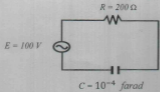
- (c) Solve the differential equation given below. (10)  
(CO2)  
(PO1)
- $$\sin y dy + \cos y(1 - \cos x \cos y)dx = 0.$$

- 4.(a) Solve the following differential equation by means of exact differential equations. (12)  
(CO2)  
(PO1)

$$xy^2 dx + 2x^2 y^3 dx + x^2 y dy - x^3 y^2 dy = 0.$$

- (b) Solve the given second order differential equation (10)  
(CO2)  
(PO1)
- $$\frac{d^2 y}{dx^2} - 6 \frac{dy}{dx} + 9y = e^{3x} \cos 2x.$$

- (c) A generator is connected in series shown in figure given below (8)  
(CO2)  
(PO1)



Find the charge  $q(t)$  if  $q(0) = 0$ .

\*\*\*THE END\*\*\*