ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF NATURAL SCIENCES

Mid Semester Examination   Summer Semester, A.Y 2022-2023
Course No.: Math 4411/Math 4699   Full Marks: 75
Course Title: Linear Algebra And Solid Geometry   Time: 1.5 Hours

There are 3 (Three) questions. Answer 3 (Three) questions. Programmable calculators are
not allowed. Do not write on this question paper. The figures in the right margin indicate full
marks and corresponding CO and PO in the brackets. Symbols convey their usual meanings.

1. (a) Show that every square matrix can be expressed in one and only one way as the   (5)
       sum of a symmetric and a skew-symmetric.   (CO1)
                                                                                         (PO1)

   (b) Justify that $A(adA) = |A| I$, where   (10)
       $$\begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 2 \\ 1 & 1 & 0 \end{bmatrix}$$ (CO1)
                                                                                         (PO2)

   (c) Using elementary row transformations, to reduce A to I, find the inverse of A, (10)
       where   (CO1)
       $$A = \begin{bmatrix} 5 & -2 & -2 \\ -1 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}.$$ (PO2)

2. (a) Define the direction cosines and direction ratio of a straight line?   (5)
                                                                                         (CO3)
                                                                                         (PO1)

   (b) Find the locus of the point such that the sum of the squares of its distances from (10)
       the planes $x + y + z = 0$, $x - z = 0$, and $x - 2y + z = 0$ is 9.   (CO3)
                                                                                         (PO2)

   (c) Solve the following system of equations using Gaussian elimination method: (10)
       $3x_1 - 4x_2 + 3x_3 = 4$ (CO1)
       $2x_1 + x_2 - 2x_3 = -2$ (PO2)
       $3x_1 - 2x_2 + x_3 = 2$
       $2x_1 - x_2 - 3x_3 = -9$

3. (a) If P, Q, R, S are the points (3,4,5), (4,6,3), (-1,2,4), and (1,0,5). Find the   (5)
       projection of RS on PQ.   (CO1)
                                                                                         (PO1)

   (b) The direction cosines of a moving line in two adjacent positions are l, m, n and (10)
       $l + \delta l, m + \delta m, n + \delta n$. Show that the small angle $\delta\theta$ between the positions is (CO1)
       given by $(\delta\theta)^2 = (\delta l)^2 + (\delta m)^2 + (\delta n)^2$.   (PO2)

   (c) Find the equation of the plane passing through the line of intersection of the   (10)
       planes $2x - y = 0$ and $3z - y = 0$ and perpendicular to the plane $4x + 5y -$ (CO1)
       $3z + 7 = 0$.   (PO2)

-----------------X----------------