Assignment for linear equations

Problem 1 Solve the following problems using matrix inversion. Check your solutions.

a. $2x + y = 5$
   $3x - 9y = 7$

b. $-8x - 5y = 4$
   $-2x + 7y = 10$

c. $12x - 5y = 11$
   $-3x + 4y + 7x_3 = -3$
   $6x + 2y + 3x_3 = 22$

d. $6x - 3y + 4x_3 = 41$
   $12x + 5y - 7x_3 = -26$
   $-5x + 2y + 6x_3 = 16$

Problem 2

a. Solve the following matrix equation for the matrix C

$$A(BC + A) = B$$

b. Evaluate the solution obtained in part a for this case

$$A = \begin{bmatrix} 7 & 9 \\ -2 & 4 \end{bmatrix} \qquad B = \begin{bmatrix} 4 & -3 \\ 7 & 6 \end{bmatrix}$$

Problem 3 Use MATLAB to solve the following problems.

a. $-2x + y = -5$
   $-2x + y = 3$

b. $-2x + y = 3$
   $-8x + 4y = 12$

c. $-2x + y = -5$
   $-2x + y = -5.00001$

d. $x_1 + 5x_2 - x_3 + 6x_4 = 19$
   $2x_1 - x_2 + x_3 - 2x_4 = 7$
   $-x_1 + 4x_2 - x_3 + 3x_4 = 30$
   $3x_1 - 7x_2 - 2x_3 + x_4 = -75$

Problem 4

a. Use MATLAB to solve the following equations for x,y, and z as functions of the parameter c.

$$x - 5y - 2z = 11c$$

$$6x + 3y + z = 13c$$

$$7x + 3y - 5z = 10c$$

b. Plot the solutions for x,y, and z versus c on the same plot, for $-10 \leq c \leq 10$

c.

Problem 5

Engineers must be able to predict the rate of heat loss through a building wall to determine the heating system requirements. They do this by using the concept of *thermal resistance R*, which relates the heat ow rate q through a material to the temperature difference ΔT across the material: $q = \Delta T/R$. This relation is like the voltage-current relation for an electric resistor: $i = v/R$. So the heat ow rate plays the role of electric current, and the temperature difference plays the role of the voltage difference. The SI unit for q is the *watt* (W), which is 1 joule/second (J/s).

The wall shown in Figure P8 consists of four layers: an inner layer of plaster/lathe 10 mm thick, a layer of ber glass insulation 125 mm thick, a

(a)
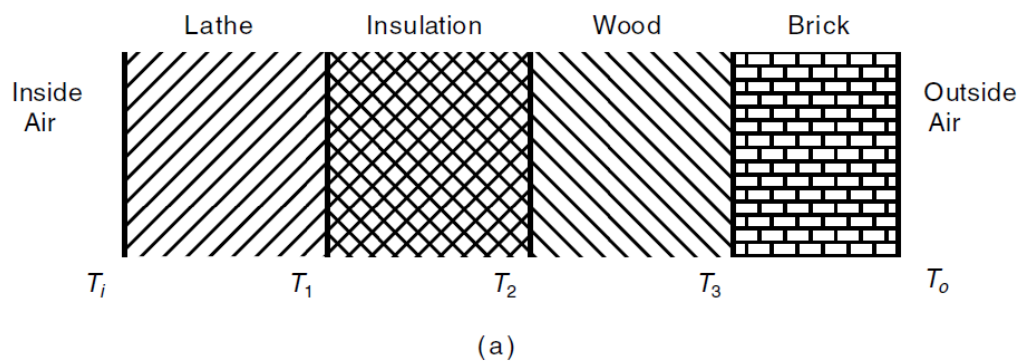
layer of wood 60 mm thick, and an outer layer of brick 50 mm thick. If we assume that the inner and outer temperatures T_i and T_o have remained constant for some time, then the heat energy stored in the layers is constant, and thus the heat ow rate through each layer is the same. Applying conservation of energy gives the following equations.

$$q = \frac{1}{R_1}(T_i - T_1) = \frac{1}{R_2}(T_1 - T_2) = \frac{1}{R_3}(T_2 - T_3) = \frac{1}{R_4}(T_3 - T_o)$$

The thermal resistance of a solid material is given by $R = D/k$, where D is the material thickness and k is the material's *thermal conductivity*. For the given materials, the resistances for a wall area of 1 m² are $R_1 = 0.036$, $R_2 = 4.01$, $R_3 = 0.408$, and $R_4 = 0.038$ K/W.

Suppose that $T_i = 20°C$ and $T_o = -10°C$. Find the other three temperatures and the heat loss rate q, in watts. Compute the heat loss rate if the wall's area is 10 m².
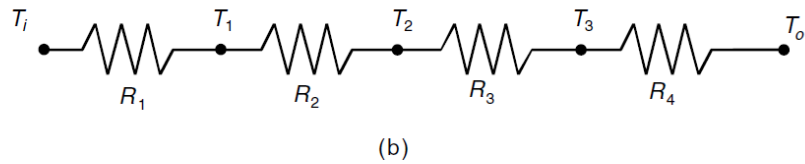

(b)

Figure P8

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