Matlab Group Assignment #1

Section #:________

Names: UINs:

________________________________ ________________________

________________________________ ________________________

________________________________ ________________________

________________________________ ________________________

1. Write the system of equations below in matrix form, then solve using matrix division in Matlab:

$$\begin{gathered} x + y + z + w = 10 \\ 3x - 2y + z + 4w = 18 \\ 2x + 3y - 5z - w = -11 \\ x + 4y - 2z + 3w = 15 \end{gathered}$$

2. Repeat for the following system of equations. In the space below, explain Matlab's warning and what is actually happening (if you are not sure, try using the **solve** command as well).

$$x + y + z = 1$$
$$x + z = 1$$
$$2x + y + 2z = 0$$

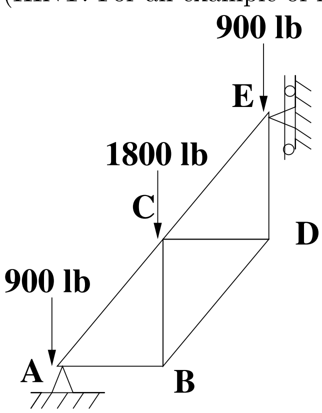
3. Repeat for the following system of equations. In the space below, explain Matlab's warning and what is actually happening.

$$x + y + z = 3$$
$$2y + z = 4$$
$$x - y = -1$$

For the remainder of this lab, we will be applying matrices and systems of equations to Engineering applications. **CHOOSE ONE OF THE FOLLOWING APPLICATIONS TO SOLVE.** Use the principles stated to set up a system of equations and solve in Matlab.

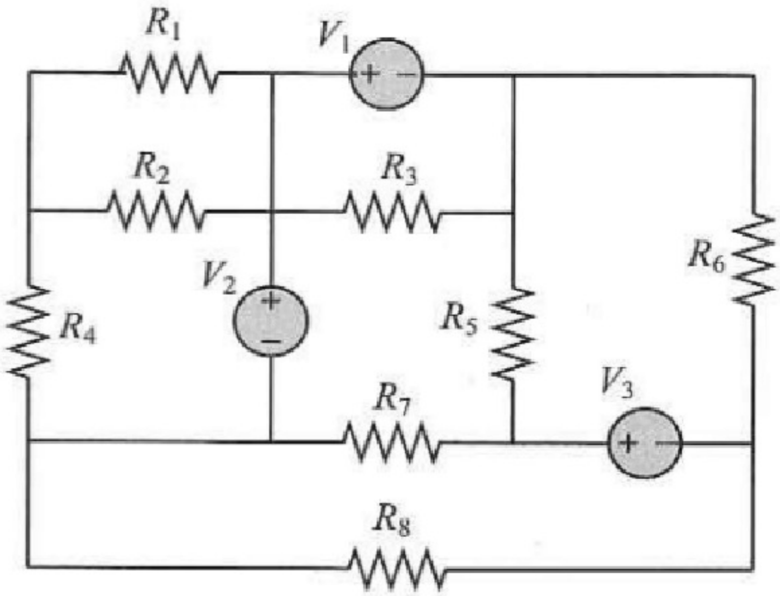
Truss Problem (for MEEN, CVEN, AERO, PETE majors especially)
Basis for this type of problem: Newton's Law $\sum F_x = 0$, $\sum F_y = 0$

The truss below was built to support an escalator with the loads shown. Horizontal bars are 1m long; vertical bars are 1.3m long. Find the force in each bar of the truss, and the reaction forces at points A and E. (NOTE: there is no vertical reaction force at E, only horizontal. There is a horizontal and vertical reaction force at A.)
(HINT: For an example of how to set up the equations, see Gilat, p130 #22-23)



Resistive Circuit Problem (for ECEN, CPSC majors especially)
Basis for this type of problem: Kirchhoff's Law $\sum V = 0$, $V = IR$

The electrical circuit shown consists of resistors and voltage sources. Determine the current in each resistor.
(HINT: The mesh current method is illustrated in Gilat p83)

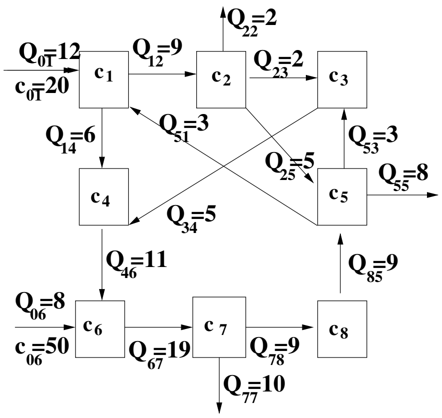


$V_1 = 38V$, $V_2 = 20V$, $V_3 = 24V$
$R_1 = 15\Omega$, $R_2 = 18\Omega$, $R_3 = 10\Omega$, $R_4 = 9\Omega$, $R_5 = 5\Omega$, $R_6 = 14\Omega$, $R_7 = 8\Omega$, $R_8 = 13\Omega$

(Problem choices continue on next page)

Mass-Balance Reactor Problem (for CHEN, BIEN, BICH majors especially)
Basis for this type of problem: Given a conservative material passing through a solution in a reactor, $\sum input = \sum output$ and $m = Qc$ (mass = flow rate times concentration). For further explanation, see http://www.math.tamu.edu/~dmanuel/math151/ChemReactorFlow.pdf.

The reactor below consists of 8 interconnected reactors. The flow rate (in m^3/min) and concentrations (in g/m^3) are given below. Find the concentration of solutions in each of the reactors.



Steady-State Markov Processes (for INEN and non-engineering majors especially)
Basis for this type of problem: if M is a probability matrix, the steady-state value of X is found by solving $(M - I)X = 0$ along with $sum(X) = 1$. See www.math.tamu.edu/~dmanuel/math151/Markov.pdf for more details.

The credit department of Wal-Markov has analyzed repayment habits of their charge account customers. Customers are labeled “Paid”, “Overdue 1 month”, “Overdue 2 months”, etc., up to 6 months, after which time their account is written off as “Unpayable”. Customers can lower their overdue number by paying back a portion of their charge account. (See http://www.crc.man.ed.ac.uk/conference/archive/2011/Kellett-Dan-Presentation-UK-Credit-Card-Loss-Forecasting-Using-Markov-Chain-Models.pdf for a practical example)
A summary of the data is given below.

- 70% of paid accounts remain paid the next month.
- 60% of accounts one month overdue are paid the next month; 25% remain one month overdue
- 50% of accounts two months overdue are paid the next month; 20% reduce to one month overdue; 10% remain two months overdue
- 40% of accounts three months overdue are paid the next month; 15% reduce to one month overdue; 5% reduce to two months overdue; 23% remain 3 months overdue
- 30% of accounts four months overdue are paid the next month; 10% reduce to one month overdue; 10% reduce to three months overdue; 32% remain four months overdue
- 20% of accounts five months overdue are paid the next month; 5% reduce to one month overdue; 5% reduce to three months overdue; 15% reduce to four months overdue; 35% remain five months overdue
- 10% of accounts six months overdue are paid the next month; 14% reduce to four months overdue; 14% reduce to five months overdue; 37% remain six months overdue
- 10% of unpayable accounts are able to reduce to six months overdue

Find the probability matrix M and determine the steady-state. What percentage of accounts will end up unpayable in the long term?