1. Given a L. P. Problem

$$\max.\ Z = -2X_1 - X_2$$

s. t.

$$X_1 + X_2 \le 10$$
$$X_1 - 2X_2 = -8$$
$$X_1 + 3X_2 \ge 9$$
$$X_1,\ X_2 \ge 0$$

(a) Solve by graphical method

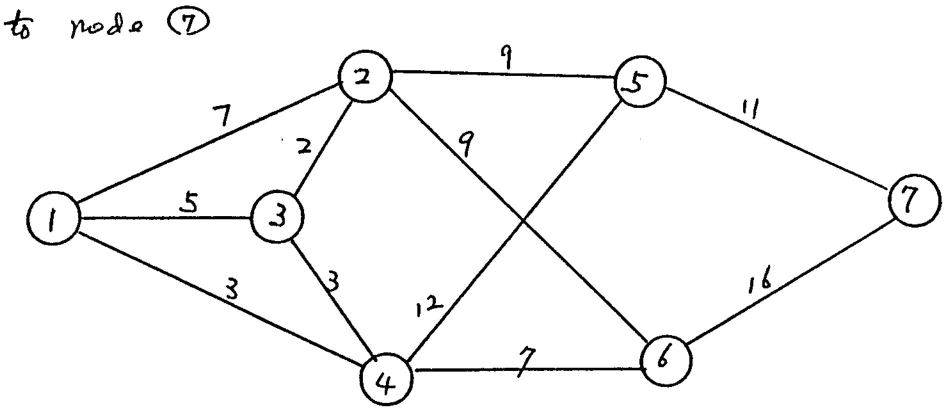
(b) Solve by Simplex method

(c) What does "the shadow price" mean, illustrate by this problem?

(d) Construct the dual problem for this primal problem and solve it.

(e) use the complementary slackness property and the optimal solution of (b) to find the optimal solution for the dual problem, check with (d). (40%)

2. Given the network shown in below, find the shortest route from node ① to node ⑦ (15%)



3. A one step transition matrix is given below

$$P = \begin{pmatrix} 0.7 & 0.2 & 0.1 \\ 0.2 & 0.3 & 0.5 \\ 0.4 & 0.2 & 0.4 \end{pmatrix}$$

(a) Find P_{23}^{2} (b) Find the two-step transition matrix

(c) What is the probability that this system is in state 3 after 2 transitions if it is originally in state 3?

(d) If the system is originally in state 1 with probability ½ and in state 3 with probability ½, what is the probability that it is in state 3 after 2 transitions? (15%)

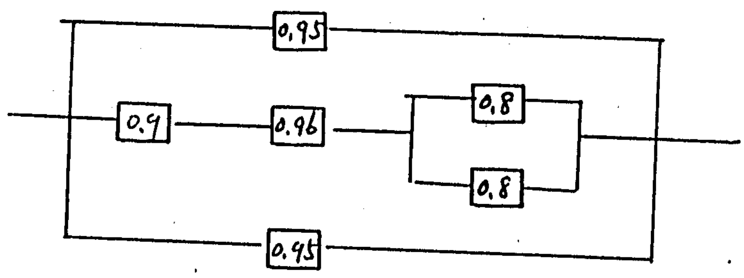
4. For each of the one sever queueing systems below, find the st state probabilities $\{P_n\}$, Expected number in system L and expected queue length L_q.

(a) $\lambda_0 = 1,\ \lambda_1 = \frac{1}{2},\ \lambda_2 = \frac{1}{4}$; $\lambda_n = 0\ \forall\ n \ge 3$; $\mu_1 = 2,\ \mu_2 = 1,\ \mu_3 = \frac{1}{2}$, $\mu_n = 0\ \forall\ n \ge 4$.

(b) $\lambda_n = 1$ for $n = 0, 1, 2$, $\lambda_n = 0\ \forall\ n \ge 3$; $\mu_1 = 4,\ \mu_2 = 2,\ \mu_3 = 1$ (20%)

5. Given the following component reliabilities, calculate the reliability of the two systems. (10%)

(a)



(b)