Question 1

(1). Consider the following data of a project.

Activity	Predecessor(s)	Duration (weeks)		
		t_0	t_m	t_p
A	__	3	5	8
B	__	6	7	9
C	A	4	5	9
D	C	A	4	5
D	B	3	5	8
E	A	4	6	9
F	C, D	5	8	11
G	C, D, E	3	6	9
H	F	1	2	9

(a) Construct the project network.

(b) Find the expected duration and variance of each activity.

(c) Find the critical path and the expected project completion time.

(d) What is the probability of completing the project on or before 30 weeks?

(e) If the probability of completing the project is 0.9, find the expected project completion time.

(ii). A network with the following activity durations and manpower requirement is given. Analyze the project from point of view of resources to bring out the necessary steps involved in the analysis and smoothing of resources.

Activity	1-2	2-3	2-4	3-5	4-6	4-7	5-8	6-8	7-9	8-10	9-10
Duration (weeks)	2	3	4	2	4	3	6	6	5	4	4
No. of men required	4	3	3	5	3	4	3	6	2	2	9

Question 2

ALI Electronics Incorporated manufactures the following six microcomputer peripheral devices: internal modems, external modems, graphics circuit boards, CD drives, hard disk drives, and memory expansion boards. Each of these technical products requires time, in minutes, on three types of electronic testing equipment, as shown in the table at the bottom of the page.

The first two test devices are available 120 hours per week. The third (device 3) requires

more preventive maintenance and may be used only 100 hours each week. The market for all six computer components is vast, and ALI Electronics believes that it can sell as many units of each product as it can manufacture. The table that follows summarizes the revenues and material costs for each product:

Revenue per	material cost	
Device	unit sow ($)	per unit ($)
Internal modem	200	35
External modem	120	25
Graphics circuit		
board	180	40
CD drive	130	45
Hard disk drive	430	170
Memory expansion		
board	260	60

In addition, variable labor costs are $15 per hour for test device 1, $12 per hour for test device 2, and $18 per hour for test device 3. ALI Electronics wants to maximize its profits.

(a) Formulate this problem as an LP model.

(b) Solve the problem by computer. What is the best product mix?

(c) What is the value of an additional minute of time per week on test device 1? Test device 2? Test device 3? Should ALI Electronics add more test device time? If so, on which equipment?

Question 3

A linear program has been formulated and solved. The optimal simplex tableau for this is given at the bottom of this page.

(a) What are the shadow prices for the three constraints? What does a zero shadow price mean? How can this occur?

(b) How much could the right-hand side of the first constraint be changed without changing the solution mix?

(c) How much could the right-hand side of the third constraint be changed without changing the

solution mix?

Optimal Tableau

C_j. 80 120 90 0 0 0

solution

Basic	X_I	X_2	X_3	S_1	S_2	S_3	quantity	
120	X_2	-1.5	1	0	0.125	-0.75	0	37.5
90	X_3	3.5	0	1	-0.125	1.25	0	12.5
0	S_3	-1.0	0	0	0	-0.5	1	10.0
Z_i	135	120	90	3.75	22.5	0	5,625	
$C_j - Z_1$	-55	0	0	-3.75	-22.5	0		

Question 4

(i) Consider the following transshipment problem involving 4 sources and 2 destinations The supply values of the sources S_1, S_2, S_3 and S_4 are 100 units, 200 units, 150 units and 350 units respectively. The demand values of destinations D, and D, are 350 units and 450 units, respectively The transportation cost per unit between different sources and destinations are summarized as in Table 1. Solve the transshipment problem.

Table 1 C_{ij} Values for Example 1

Destination

S_1	S_2	S_3	S_4	D_1	D_2	
S_1	0	4	20	5	25	12
S_2	10	0	6	10	5	20
S_3	15	20	0	8	45	7
S_4	20	25	10	0	30	6
D_1	20	18	60	15	0	10
D_2	10	25	30	23	4	0

(ii) A Company has taken the third floor of a multi-storeyed building for rent with a view to

locate one of their zonal offices. There are five main rooms in this floor to be assigned to five managers. Each room has its own advantages and disadvantages. Some have windows, some are closer to the washrooms or to the canteen or secretarial pool. The rooms are all of different sizes and shapes. Each of the five managers were asked to rank their room preferences amongst the rooms 301, 302, 303, 304 and 305.

Their preferences were recorded in a table as indicated below.

Table

Manager				
M_l,	M_2	M_3	M_4	M_5
302	302	303	302	301
303	304	301	305	302
304	305	304	304	304
	301	305	303	
		302		