



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: November 2017

Module Number: EE8207

Module Name: Optimization Techniques for Engineers

[3 Hours]

[Answer all questions, each question carries 10 marks]

Q1 a) Consider the following two-player game with the payoff matrix for the player 1 (row player) given in Table Q1 a).

Table Q1 a)

Table with 3 columns (1, 2) and 3 rows (1, 2) containing entries a, b, c, d.

Suppose that, the game does not have a saddle point and a and d are the largest entries. Player 2 (column player) plays strategy 1 and 2 with probabilities x and (1-x) respectively.

i) Show that, the value of x which will equalise player 1's expectations for strategies 1 and 2 is given by;

x = (d-b) / ((a+d)-(b+c))

ii) Show that, the value of the game (v) is given by;

v = (ad-bc) / ((a+d)-(b+c))

iii) Show that, the game has a saddle point if a=2, b=c=1 and d=0.

[5.0 Marks]

b) Consider the following two-player game with the payoff matrix for the player 1 (row player) given in Table Q1 b).

Table Q1 b)

Table with 8 columns (A-G) and 8 rows (A-G) containing numerical payoff values.

- i) Simplify the game by eliminating dominated strategies.
ii) Determine the optimal strategy for player 2.
iii) Determine the optimal strategy for player 1.
iv) Determine the value of the game.
v) Is this a fair game?

[5.0 Marks]

- Q2 Galle PC repairing company is open from 8 am. to 4 pm. Owner has monitored the requirement of repairpersons at two sessions of the day, and determined that at most following number of repair persons are required as shown in Table Q2.

Table Q2

Session	Number of Repairpersons
8 am to Noon	8
Noon to 4 pm	6

Two types of repairpersons are available: full-time and part-time.

- A full-time repairperson works for 8 consecutive hours and repairs 5 PCs per hour.
- A part-time repairperson works any of these two sessions and repairs 6 PCs per hour.
- As an additional requirement, there must always be maximum three numbers of part-time repairpersons on duty.

- a) Formulate this problem as a linear programming model.

[2.0 Marks]

- b) Using the simplex tabular method, determine how many full-time and part-time repairpersons should work in each session to maximize the number of PCs repaired.

[8.0 Marks]

- Q3 a) The road system of Yala national park is shown in the Figure Q3 a), where location O is the entrance into the park, other letters designate the locations of ranger stations. The numbers give the distances of these winding roads in kilometers. Using dynamic programming techniques, find the shortest path/paths from main entrance O to ranger station G. (Answers without mathematical formulations and calculations carry no marks)

[5.0 Marks]

- b) A container which has a capacity of four ton can be loaded with one or more of three items as indicated in Table Q3 b). It give the unit weight w_i in tons and unit revenue r_i in thousands of rupees for each item. How should the container be loaded in order to maximize the return? (Answers without mathematical formulations and calculations carry no marks)

Table Q3 b)

Item (i)	Weight (w_i)	Revenue (r_i)
1	2	31
2	3	47
3	1	14

[5.0 Marks]

- Q4 a) Briefly explain the following under graph theory terminologies,

- Indegree and Outdegree
- A Complete Graph

[2.0 Marks]

- b) An oil pipe network in a central city along with the pipe capacities in liters is shown in Figure Q4 b).
- Using Ford-Fulkerson algorithm, find the maximum amount of liters of oil can be pumped from node A to node F.
 - Use Max-Flow-Min-Cut theorem to prove that you have arrived at the optimum solution.

[8.0 Marks]

- Q5 a) Explain the steps involved in solving an assignment problem using Hungarian method.

[2.5 Marks]

- b) Galle Electrical Company hires electricians on an hourly basis to solder LED bulbs to sign boards. There are five electricians and their charges and the speeds are given in Table Q5 b_1). One job is given only to one electrician and they are paid for the full hour even if he works for a fraction of an hour.

Table Q5 b_1)

Electrician	Rate per hour	Bulbs per hour
Kamal	35	26
Sahan	30	22
Aruna	40	38
Sarath	33	29
Gayan	22	20

The company got five new jobs. The number of bulbs in each project is given in the Table Q5 b_2).

Table Q5 b_2)

Job	A	B	C	D	E
No. of Bulbs	224	321	256	199	206

Find which job needs to be allocated for each electrician to minimize the total cost.

[7.5 Marks]

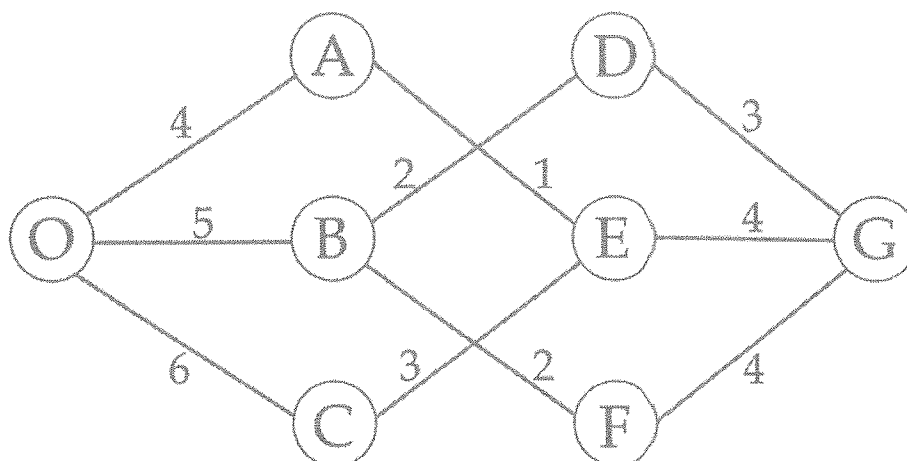


Figure Q3 a)

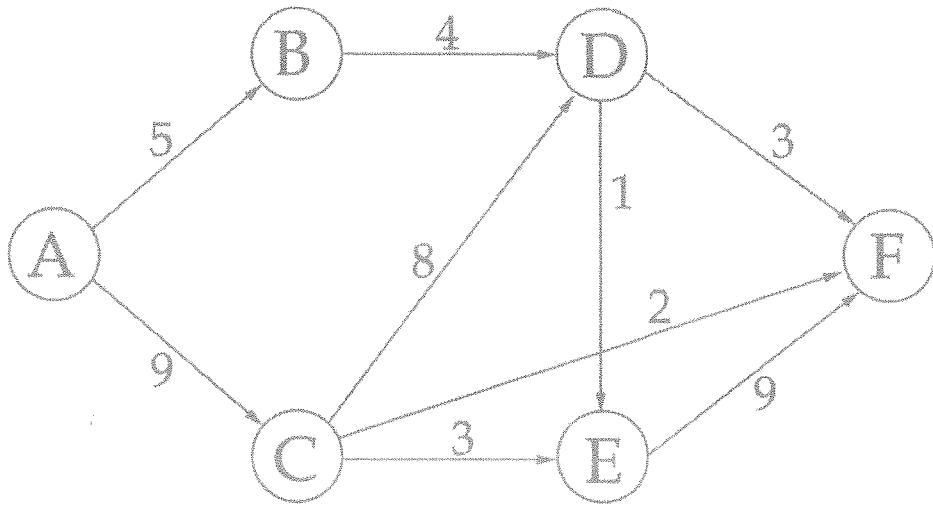


Figure Q4 b)