



**RAJARATA UNIVERSITY OF SRI LANKA**  
**FACULTY OF APPLIED SCIENCES**

**B.Sc. (General) Degree in Applied Sciences**  
**Third Year - Semester II Examination – October / November 2017**

**MAT 3302 – NETWORK OPTIMIZATION**

**Time: Three (03) hours**

**Answer all questions.**

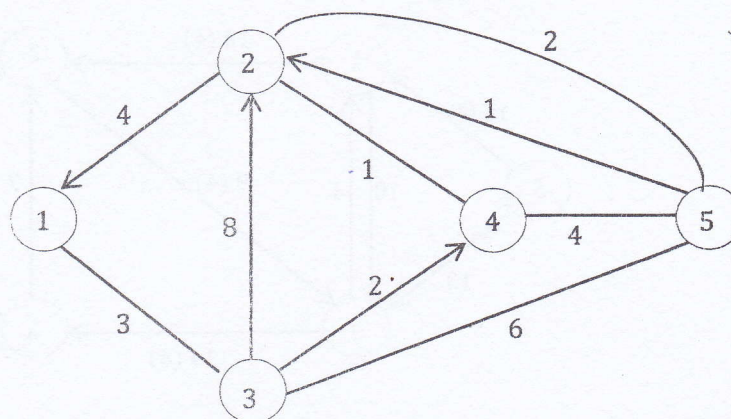
1.

a) Define each of the following terms.

- (i) Network
- (ii) Connected graph
- (iii) Spanning tree

(30 marks)

b) The network in below figure gives the distances in miles between pairs of cities 1,2,...,5. Find the shortest paths between all pairs of cities using **Floyd's algorithm**.



(50 marks)

c) Set up the linear programming model for the shortest path problem of the above network.

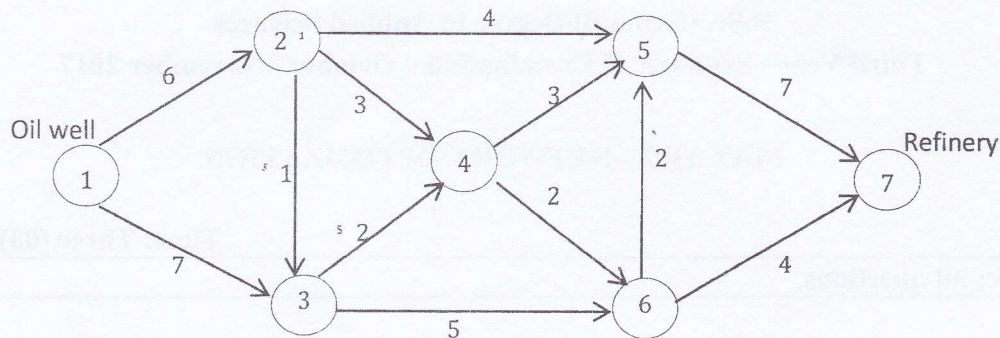
(20 marks)



2.

- a) Write down the general mathematical formulation for a maximum flow problem. (30 marks)

- b) Consider the following network of pipelines that transport oil from an oil well to a refinery. The below figure gives the maximum discharge rate of oil through each pipe segment.

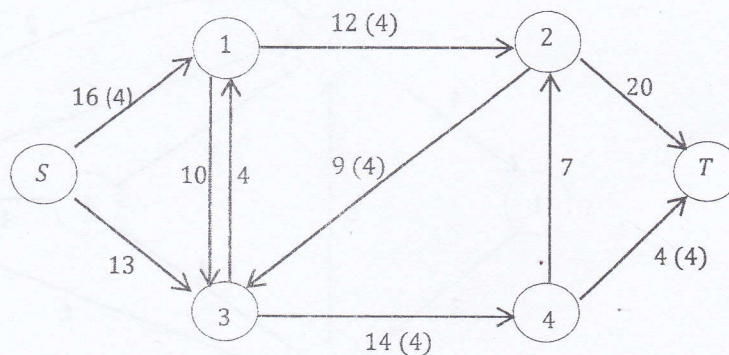


- Find the maximum capacity of the network between the well (node 1) and the refinery (node 7) by using the **Maximum flow algorithm**.
- Justify the above result by using **Maximum flow - minimum cut theorem**.

(70 marks)

4.

- a) Consider the following network:



Find the maximum flow from node  $S$  to  $T$  by using **Ford- Fulkerson algorithm** starting with the initial flow value of 4 along  $S \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow T$ .

(50 marks)



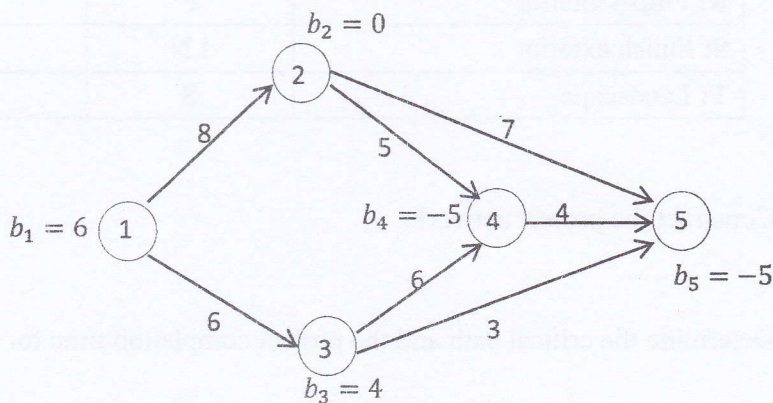
- b) The following table shows the mileage of feasible links connecting nine natural gas well heads.

From To	W1	W2	W3	W4	W5	W6	W7	W8	W9
W1	-	5	9	20	4	-	-	14	15
W2	5	-	6	-	-	-	-	-	-
W3	9	6	-	15	10	-	-	-	-
W4	20	-	15	-	20	7	12	-	-
W5	4	-	10	20	-	3	5	13	6
W6	-	-	-	7	3	-	-	-	-
W7	-	-	-	12	5	-	-	7	-
W8	14	-	-	-	13	-	7	-	5
W9	15	-	-	-	6	-	-	5	-

- State the steps of minimal spanning tree algorithm.
- Determine the minimum pipeline network that links the wellheads.

(50 marks)

4.



Consider the above network:

- Starting with  $x_{12}$ ,  $x_{24}$ ,  $x_{34}$  and  $x_{45}$  as a part of the basis, find the minimum cost through the network using the **Network simplex method**.

(80 marks)

- Formulate the linear programme model for the above minimal cost network flow problem.

(20 marks)



5. The activities in the following table describe the construction of a new house.

Activities	Predecessors	Duration(days)
A: Clear site	-	1
B: Bring utilities to site	-	2
C: Excavate	A	1
D: Pour foundation	C	2
E: Outside plumbing	B,C	6
F: Frame house	D	10
G: Do electric wiring	F	3
H: Lay floor	G	1
I: Lay roof	F	1
J: Inside plumbing	E,H	5
K: Shingling	I	2
L: Outside sheathing insulation	F,J	1
M: Install windows and doors	F	2
N: Do brick work	L,M	4
O: Insulate walls and ceiling	G,J	2
P: Cover walls and ceiling	O	2
Q: Insulate roof	I,P	1
R: Finish interior	P	7
S: Finish exterior	I,N	7
T: Landscape	S	3

- a) Construct the project network. (20 marks)
- b) Determine the critical path and the project completion time for the above network. (40 marks)
- c) Calculate the total floats and free floats for the above network. (40 marks)