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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

Bachelor of Science in Applied Sciences
Third Year – Semester II Examination – Jan/Feb 2023

MAT 3302 – NETWORK OPTIMIZATION

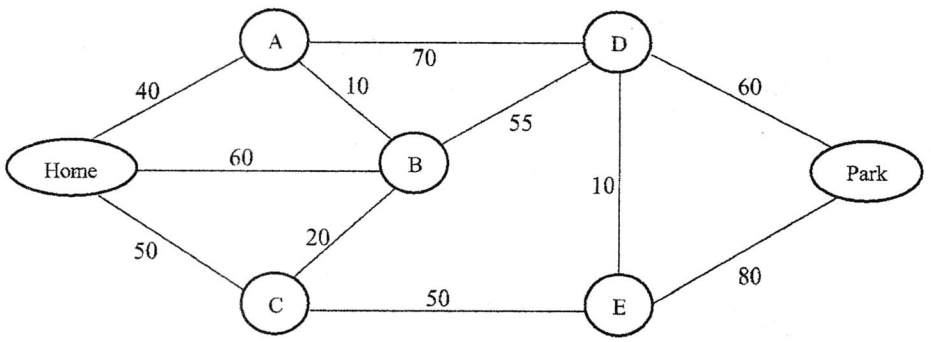
Time: Three (03) hours

Answer **all** questions
Calculators will be provided

1. a) Explain the circumstances in which Floyd's algorithm is preferred over Dijkstra's algorithm.

(20 marks)

b) Imagine you are going to visit a national park, and have never been there before. You are using a map to try and make the distance travelled as short as possible. There are 5 intermediate towns A, B, C, D, and E, you may go through on your way to the park. The distances between the locations are given in the following network.



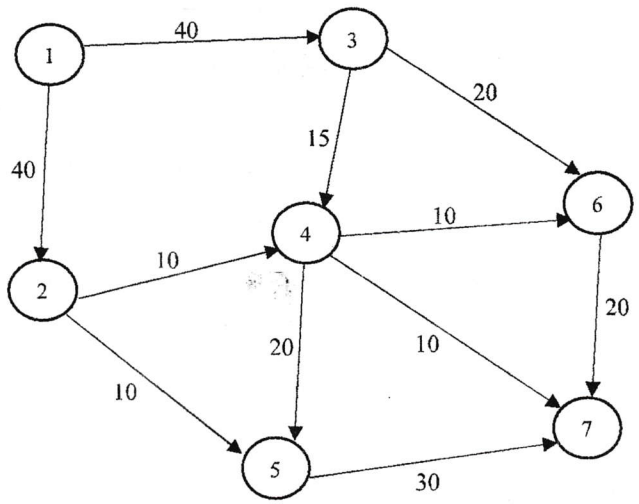
Use Dijkstra's algorithm step by step to find the shortest path to visit the park starting from home.

(80 marks)

2. a) What is the objective of the maximum flow problem? Write down the general mathematical formulation for the maximum flow problem.

(20 marks)

b) Find the maximum flow that can be sent from node 1 to node 7 of the following network using the Maximal flow algorithm.



(80 marks)

3. A railway construction company has been provided the responsibility of constructing a high-speed rail network that connects selected seven cities in Australia. The company wants to establish the most cost-effective rail network. The cost per kilometer of railway is estimated as $5 million. The following table shows the distances (in kilometers) between the considered seven cities in Australia.

Adelaide						
2075	**Brisbane**					
1209	1267	**Canberra**				
3041	3435	4034	**Darwin**			
732	1813	651	3773	**Melbourne**		
2721	4434	3930	4037	3453	**Perth**	
1419	978	289	3971	876	3975	**Sydney**

a) Apply a suitable algorithm to find the cheapest way to construct a high-speed rail network that connects the seven cities.

(80 marks)

b) How many kilometers of railway are required?

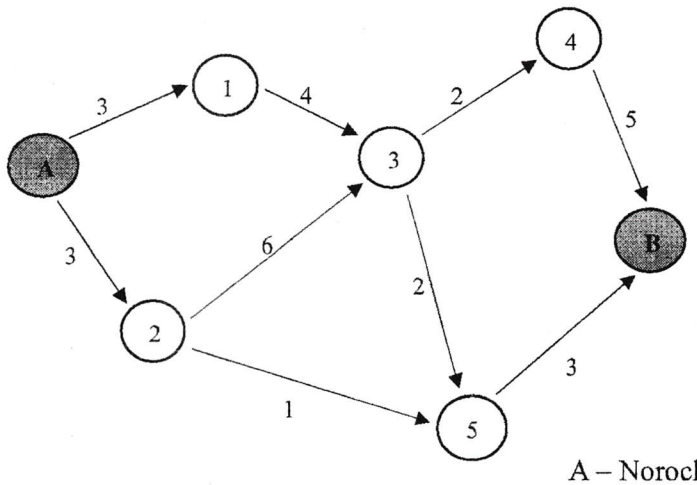
(10 marks)

c) How much would the most cost-effective rail network cost?

(10 marks)

4. a) A company plans to hold a super Light and Sound show in the Galle-face ground on new year evening. The organizing committee has asked the Electricity Board about the maximum electricity that can be supplied from the Mount Lavinia sub-station for use in the celebration events. The power generator for this is located at Norochchole. It will supply electricity to the Mount Lavinia sub-station for utilization for the event.

The following figure shows the maximum available capacity (after subtracting other normal usages) for transferring electricity between different sub stations. What is the maximum power that Electricity Board can provide to the event organizer?
(**Hint:** use the Ford-Fulkerson algorithm)



A – Norochchole plant
B – Mount Lavinia sub

(50 marks)

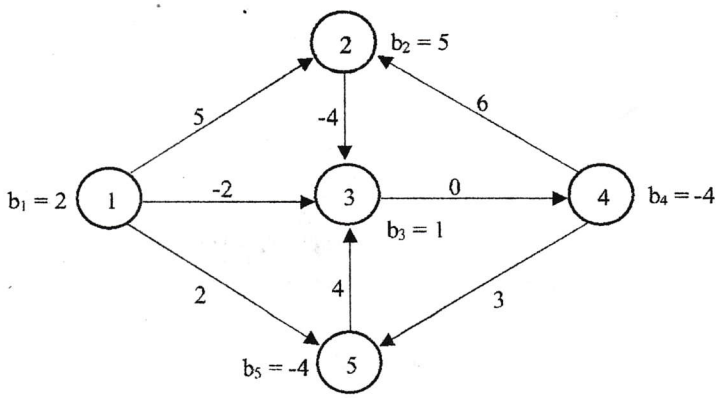
b) Verify your answer obtained in part a) using the Enumeration of cuts method.

(50 marks)

5. a) Distinguish between the transportation problem and the minimum cost network flow problem.

(10 marks)

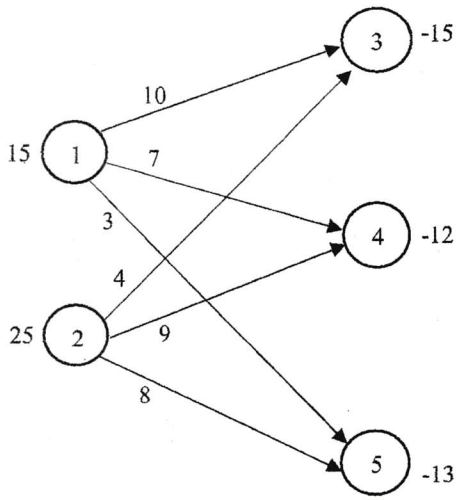
b) Consider the following Minimum cost network flow problem.



Construct a Linear programming model to represent the problem given in the above network diagram.

(30 marks)

c) Solve the following transportation problem by applying the Network simplex algorithm.



(60 marks)

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