Max. Time: 180 Minutes   Date: 19-12-2022   Max. Marks: 60

1. For each network in Figure1.i and Figure1.ii determine (a) a path, (b) a cycle, (c) a tree, and (d) a spanning tree.
[4]

2. Determine the sets N and A for the networks in Figure1.i and Figure1.ii (where, N is the set of nodes and A is the set of arcs)
[4]

3. Draw the network defined by
N = {1,2,3,4,5,6}
A = {{1,2),(1,5), (2,3), (2,4),(3,4), (3,5), (4,3),(4,6), (5,2),(5,6)}
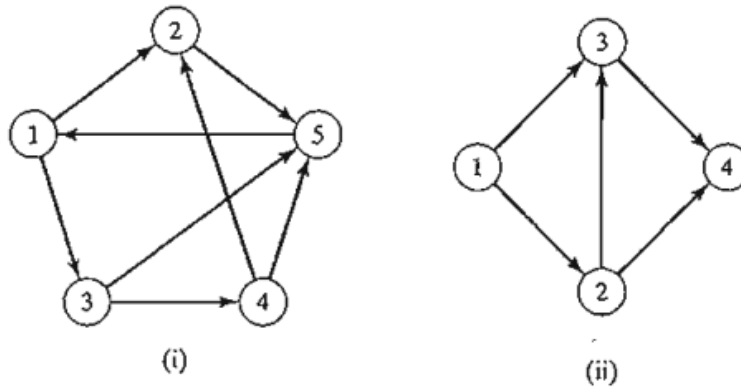[2]

Figure1: Networks for Problem I - 3

4. The owner of a machine shop is planning to expand by purchasing some new machines—presses and lathes. The owner has estimated that each press purchased will increase profit by $100 per day and each lathe will increase profit by $150 daily. The number of machines the owner can purchase is limited by the cost of the machines and the available floor space in the shop. The machine purchase prices and space requirements are as follows.

Machine	Required Floor Space (ft²)	Purchase Price
Press	15	$8,000
Lathe	30	4,000

The owner has a budget of $40,000 for purchasing machines and 200 square feet of available floor space. The owner wants to know how many of each type of machine to purchase to maximize the daily increase in profit. Use Branch and Bound Method to answer the owner's concern.
[14]

5. A manufacturing firm produces two types of product - A and B. According to past experience, production of either Product A or Product B requires an average of one hour in the plant. The plant has a normal production capacity of 400 hours a month. The marketing department of the firm reports that because of limited market, the maximum number of Product A and Product B that can be sold in a month are 240 and 300 respectively. The net profit from the sale of Product A and Product B are Rs. 800 and lbs. 400 respectively. The manager of the firm has set the following goals arranged in the order of importance (preemptive priority factors).

P_1 : He wants to avoid any underutilization of normal production capacity.

P_2 : He wants to sell maximum possible units of Product A and Product B. Since the net profit from the sale of Product A is twice the amount from that of Product B, the manager has twice, as much desire to achieve sales for Product A as for Product B.

P_3: He wants to minimize the overtime operation of the plant as much as possible.

(Use Graphical Approach to find the solution) [12]

6. The Reliance Company is in the process of providing pipeline network that connects nine offshore natural gas wellheads with an inshore delivery point. The location of wellhead 1 is the closest to the shore, so it is equipped with adequate pumping and inventory capacity to pump the output of the remaining eight wellheads to the delivery point. The mileages of the feasible links (nodes 1 to 9) connecting to the inshore delivery point are shown in the network below:
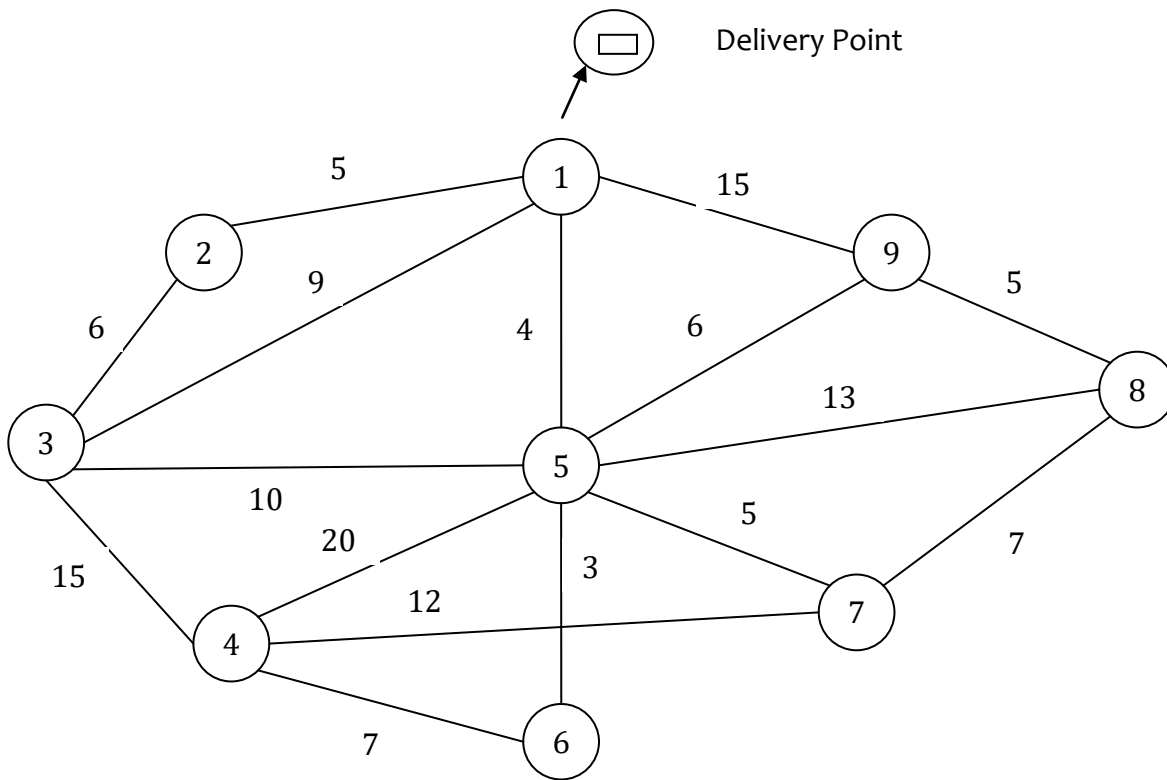
Determine the economical pipeline network for the Reliance Company that links the offshore wellheads to the inshore delivery point (Minimal Pipeline Spanning). [12]

7. A monopolist can purchase up to 17.25 oz of a chemical for \$10/oz. At a cost of \$3/oz, the chemical can be processed into an ounce of product 1; or, at a cost of \$5/oz, the chemical can be processed into an ounce of product 2. If x_1 oz of product 1 are produced, it sells for a price of $30 - x_1$ per ounce. If x_2 oz of product 2 are produced, it sells for a price of $50 - 2x_2$ per ounce. Determine how the monopolist can maximize profits. [12]