Name: _____

Instructions: All solutions should be prepared carefully and neatly. All solution sets shall be completed on this packet and submitted by uploading a scan or picture of your written work to D2L by 11:59 PM on the due date below. **Submit only a single pdf file of your entire packet. Submit any Excel or Python files as well.** The mobile app called *Genius Scan* works well. Use a PENCIL and if you make a mistake, use an eraser. Careless presentation (e.g. bad handwriting, pen scribbles, doodles, wasted space, etc) will result in a deduction of points at my discretion. Submitted work that does not demonstrate clearly the process by which one arrived at the answer will not receive credit of any kind. Academic dishonesty will not be tolerated.

Problem Set III

MAT 362-010 – Operations Research II

Due: Friday, April 5 by 11:59 PM on D2L

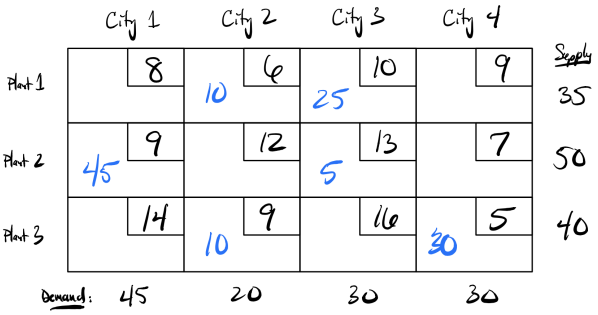
Read: Sections 7.4, 8.1–8.3, 8.5, and 8.6

Problem Number	Available Points	Your Points
1	8	
2	5	
3	5	
4	5	
5	5	
6	4	
Total	32	

1. Powerco has three electric power plants that supply the needs of four cities. Each power plant can supply the following number of kilowatt-hours (kwh) of electricity: plant 1 – 35 million; plant 2 – 50 million; plant 3 – 40 million. The peak power demands in these cities, which occur at the same time (2 PM), are as follows (in kwh): city 1 – 45 million; city 2 – 20 million; city 3 – 30 million; city 4 – 30 million. The costs of sending 1 million kwh of electricity from plant to city depend on the distance the electricity must travel. These costs are provided in the table below. The optimal solution to this Transportation LP is provided on the grid below. [(8)]

Electric Distribution Costs

From	City 1	City 2	City 3	City 4
Plant 1	\$8	\$6	\$10	\$9
Plant 2	\$9	\$12	\$13	\$7
Plant 3	\$14	\$9	\$16	\$5



(a) Determine the range of values for c_{14} for which the current basis remains optimal. [2]

(b) Determine the range of values for c_{34} for which the current basis remains optimal. [2]

(c) Suppose the supply for Plant 2 and the demand for City 3 are both increased by 3 units. What is the new optimal solution? [2]

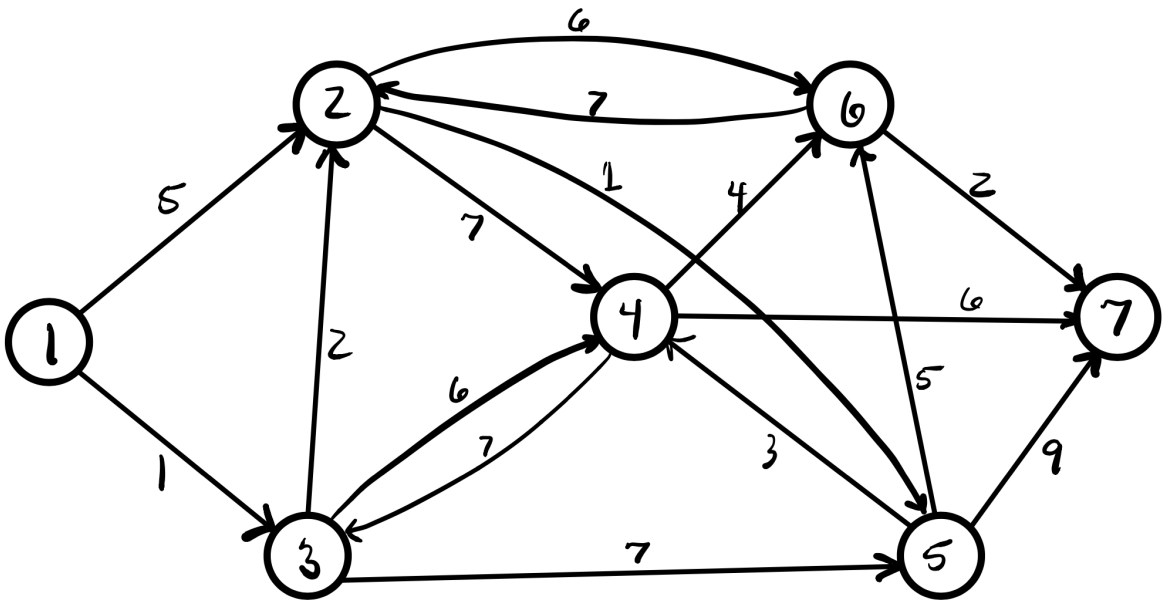
(d) Suppose the supply for Plant 3 and the demand for City 3 are both decreased by 2 units. What is the new optimal solution? [2]

2. At the beginning of year 1, a new machine must be purchased. The cost of maintaining a machine i years old is given in the table on the left below. The cost of purchasing a machine at the beginning of each year is given in the table on the right below. There is no trade-in value when a machine is replaced. Your goal is to minimize the total cost (purchase plus maintenance) fo having a machine for five years. Create a graph that represents this problem. Then, formulate it below as a transportation problem and solve it in Excel. [(5)]

Age at Beginning of Year	Maintenance Cost for Next Year ($)
0	38,000
1	50,000
2	97,000
3	182,000
4	304,000

Year	Purchase Cost ($)
1	170,000
2	190,000
3	210,000
4	250,000
5	300,000

3. Use Dijkstra's algorithm to determine the shortest path from node 1 to every other node in the graph below. Be sure to write out every labeling. Also, be sure to write out the set of edges for each shortest path, the minimum cost, and any alternative solutions. [(5)]



4. The Hatfields, Montegues, McCoys, and Capulets are going on their annual family picnic. Four cars are available to transport the families to the picnic. The cars can carry the following number of people: car 1, four; car 2, three; car 3, three; and car 4, four. There are four people in each family and no car can carry more than two people from any one family. Formulate the problem of transporting the maximum number of people to the picnic as a maximum-flow problem. Sketch a graph to represent the situation and report your solution from Excel. [(5)]

5. Fordco produces cars in Detroit and Dallas. The Detroit plant can produce as many as 6,500 cars, and the Dallas plant can produce as many as 6,000 cars. Producing a car costs $2,000 in Detroit and $1,800 in Dallas. Cars must be shipped to three cities. City 1 must receive 5,000 cars, city 2 must receive 4,000 cars, and city 3 must receive 3,000 cars. The cost of shipping a car from each plant to each city is given below. At most, 2,200 cars may be sent from a given plant to a given city. Formulate an MCFNP to minimize the cost of meeting demand. Solve it in Excel. [(5)]

Shipping Costs from Plant to City

	City 1	City 2	City 3
Detroit	$800	$600	$300
Dallas	$500	$200	$200

6. The graph below shows the mileage of the feasible links connecting nine offshore natural gas wellheads with an inshore delivery point. Suppose that the wellheads can be divided into two groups depending gas pressure: a high-pressure group that includes wells 2, 3, 4, and 6, and a low-pressure group that includes wells 5, 7, 8, and 9. Because fo the pressure difference, it is not possible to link the wellheads of the two groups. At the same time, both groups must be connected to the delivery point. Determine the minimum pipeline network for this situation. [(4)]