National Institute of Technology Hamirpur
Department of Mathematics & Scientific Computing
End Semester Examination December 2020-12-07
Course Name: Numerical Analysis Course Code: MA-632

Date: December 17, 2020 Time:2:00 hrs Max. Mark: 50

Instructions:

- *All questions are compulsory. The marks allotted to a question are indicated against it.*
- *Single **pdf file** named as **RollNumberMA614** of your answer sheets to be uploaded.*
- *The first page of answer sheet must have Full Name & Signature, Roll No, Subject Name & Subject Code, Date of Exam, Number of sheets attached. All subsequent sheets must have Roll Number and page No on the top and signature at the bottom of the page.*
- *Extra 15 minutes time shall be given for scanning and uploading pdf file of your answer sheets. Late submission will attract penalty of marks.*
- *Ensure that all attached sheets are visible and in correct order & orientation.*

1. (a) A company making cold drinks has two bottling plants located at towns P_1 and P_2. Each plants produces three drinks D_1, D_2 and D_3 and their production capacity per day is given as:

Cold Drinks	Plant at	
	P_1	P_2
D_1	3000	3000
D_2	6000	2000
D_3	1000	2500

The marketing department of the company forecasts a demand per day of 40000 bottles of D_1, 80000 bottles of D_2 and 22000 bottles of D_3 in a month of June. The operating costs per day of plants P_1 and P_2 are Rs 6000 and Rs 4000. Formulate the problem as LPP and use graphical method to find number of days for which each plant must be run in June so as to minimize the operating costs while meeting the marketing demand.

(b) Use Big M (penalty) method to solve the following LPP;

$$Minimize\ Z = x_1 + 2x_2$$

Subject to

$$x_1 + 3x_2 = 3,\ 3x_1 + 4x_2 \geq 6,\ 2x_1 + x_2 \leq 3$$

$$x_1, x_2 \geq 0$$

[7, 7]

2. (a) Five jobs are to be done on five machines. The cost (in rupees) of producing i^{th} job on j^{th} machine is given in the following table

	M_1	M_2	M_3	M_4	M_5
J_1	40	28	40	32	38
J_2	36	21	28	40	24
J_3	37	30	33	41	27
J_4	36	36	41	22	38
J_5	39	35	40	29	33

Using Hungarian method assign jobs to machines so as to minimize the total cost.

(b) A manufacturer wants to ship his products to various destinations. The following matrix gives the distance in kilometres from various sources to destinations;

		Destinations					
		D_1	D_2	D_3	D_4	D_5	Supply
Sources	S_1	8	4	6	6	4	9
	S_2	5	8	6	6	3	8
	S_3	4	7	7	6	5	5
	Demand	4	4	5	4	8	

The shipping cost is Rs. 10 per kilometre. Using Vogel's approximation method find initial basic feasible solution and by U-V method to find optimal shipping assignment to minimize the total transportation cost. **[7, 8]**

3. (a) An owner of a firm produces two types of products X and Y. The plant has a normal production capacity of 400 hours a month. According to past experience the production of either products X or Y requires an average of one hour in the plant. The maximum number of products X and Y sold in a month are 240 and 300 respectively and profit from the sale of products X and Y are Rs. 800 and Rs. 400. The manager of the firm has set the following goals arranged in the order of importance (pre-emptive priority factors):

P_1: He wants to avoid any under-utilization of normal production capacity.

P_2: He wants to sell maximum possible units of products X and Y. Since the net profit from the sale of product X is twice the amount from product Y, the manager has twice as much desire to achieve sales of product X as for product Y.

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

Formulate and solve by graphical method of goal programming.

(b) Use the relation of dominance to solve the rectangular game whose payoff matrix to A is:

		B					
		I	II	III	IV	V	VI
A	I	0	0	0	0	0	0
	II	4	2	0	2	1	1
	III	4	3	1	3	2	2
	IV	4	3	7	-5	1	2
	V	4	3	4	-1	2	2
	VI	4	3	3	-2	2	2

(c) A project is composed of 7 activities whose completion time estimates are listed below in the table. Activities are identified by their tail and head nodes;

Activity (i - j)	Estimated duration (in weeks)		
	Optimistic	Most Likely	Pessimistic
1–2	1	1	7
1–3	1	4	7
1–4	2	2	8
2–5	1	1	1
3–5	2	5	14
4–6	2	5	8
5–6	3	6	15

(a) Draw the project diagram.

(b) Find the expected duration and variance for each activity. What is the expected project length?

(c) Calculate the variance and the standard deviation of the expected project length. Also find the probability that the project will be completed at least 4 weeks earlier than the expected time.

(d) If the project due date is 19 weeks, what is the probability of not meeting the due date given the following values of the relevant probability distributions?

Z:	0.50	0.67	1.00	1.33	2.00	
Prob.:	0.3085	0.2514	0.1587	0.0918	0.0228	**[7, 7, 7]**