P P SAVANI UNIVERSITY

Seventh Semester of B. Tech. Examination
December 2021
SEME4040 Operations Research

11.12.2021, Saturday

Time: 09:00 a.m. To 11:30 a.m

Maximum Marks: 60

Instructions:
1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

Q - 1 An animal feed company must produce on a daily basis 200 kg of a mixture that consists **[10]** ingredients x1 and x2 ingredient. x1 costs Rs 3 per kg and x2 costs Rs 8 per kg. Not more than 80 kg of x1 can be used and at least 60 kg of x2 must be used.
Find out how much of each ingredient should be used if the company wants to minimize costs. Use Big-M Method of LP.

OR

Q - 1 A manufacturer of leather belts makes three types of belts A, B and C which are processed on **[10]** three machines M1, M2 and M3. Belt A requires 2 hours on machine M1 and 3 hours on machine M2 and 2 hours on machine M3. Belt B requires 3 hours on machine M1, 2 hours on machine M2 and 2 hours on machine M3 and Belt C requires 5 hours on machine M2 and 4 hours on machine M3. There are 8 hours of time per day available on machine M1, 10 hours of time per day available on machine M2 and 15 hours of time per day available on machine M3. The profit gained from belt A is Rs 3.00 per unit, from Belt B is Rs 5.00 per unit, from belt C is Rs 4.00 per unit. What should be the daily production of each type of belt so that the products yield the maximum profit? Use Simplex Method of LP.

Q - 2 A company has three plants and four warehouses. The supply and demand in units and the **[10]** corresponding transportation costs are given. The table below has been taken from the solution procedure of a transportation problem:

		I	II	III	IV	Supply
				Warehouses		
Plants	A	5	10	4 (10)	5	10
	B	6 (20)	8	7	2 (5)	25
	C	4 (5)	2 (10)	5 (5)	7	20
Demand		25	10	15	5	55

Answer the following questions, giving brief reasons for the same:
(a) Is this solution feasible?
(b) Is this solution degenerate?
(c) Is this solution optimum?
(d) Does this problem have more than one optimum solution? If so, show all of them.
(e) If the cost for the route B-III is reduced from Rs 7 to Rs 6 per unit, what will be the optimum solution?

OR

Q - 2 A departmental head has four subordinates and four tasks to be performed. The subordinates **[10]** differ in efficiency and the tasks differ in their intrinsic difficulty. His estimates of the times that each man would take to perform each task is given in the matrix below:

		Tasks			
		I	II	III	IV
	A	8	26	17	11
	B	13	28	4	26
Subordinates	C	38	19	18	15
	D	19	26	24	10

How should the tasks be allocated to subordinates so as to minimize the total man-hours?

Q - 3 The mean rate of arrival of planes at an airport during the peak period is 20 per hour, and the actual number of arrivals in any hour follows a Poisson distribution. The airport can land 60 planes per hour on an average, in good weather, and 30 planes per hour in bad weather. The actual number landing in any hour follows a Poisson distribution with these respective averages. When there is congestion, the planes are forced to fly over the field in the stack awaiting the landing of other planes that arrived earlier. **[10]**

(a) How many planes would be flying over the field in the stack, on an average, in good weather conditions and in bad weather conditions?

(b) How long would a plane be in the stack and in the process of landing in good and in bad weather.

OR

Q - 3 A maintenance service facility has Poisson arrival rates, negative exponential service times, and operates on a first-come, first-served queue discipline. Breakdowns occur on an average of three per day, with a range of zero to eight. The maintenance crew can service, on an average, six machines per day, with a range from zero to seven. Find the: **[10]**

(a) Utilization factor of the service facility

(b) Mean waiting time in the system

(c) Mean number machines in the system

(d) Mean waiting time of machines in the queue

(e) Probability of finding 2 machines in the system

SECTION – II

Q - 1 The catering manager of La Vista Hotel, Lisa Ferguson, is disturbed by the amount of silverware she is losing every week. Last Friday night, when her crew tried to set up for a banquet for 500 people, they did not have enough knives. She decides she needs to order some more silverware, but wants to take advantage of any quantity discounts her vendor will offer. **[10]**

For a small order (2,000 or fewer pieces), her vendor quotes a price of $1.80Ypiece.

If she orders 2,001–5,000 pieces, the price drops to $1.60Ypiece. 5,001–10,000 pieces brings the price to $1.40Ypiece, and 10,001 and above reduces the price to $1.25.

Lisa's order costs are $200 per order, her annual holding costs are 5%, and the annual demand is 45,000 pieces. For the best option:

(a) What is the optimal order quantity?

(b) What is the annual holding cost?

(c) What is the annual ordering (setup) cost?

(d) What are the annual costs of the silverware itself with an optimal order quantity?

(e) What is the total annual cost, including ordering, holding, and purchasing the silverware?

OR

Q - 1 Chris Sandvig Irrigation, Inc., has summarized the price list from four potential suppliers of an underground control valve. See the accompanying table. Annual usage is 2,400 valves; order cost is $10 per order; and annual inventory holding costs are $3.33 per unit. **[10]**

Which vendor should be selected and what order quantity is best if Sandvig Irrigation wants to minimize total cost?

VENDOR A		VENDOR B	
QUANTITY	PRICE	QUANTITY	PRICE
1–49	$35.00	1–74	$34.75
50–74	34.75	75–149	34.00
75–149	33.55	150–299	32.80
150–299	32.35	300–499	31.60
300–499	31.15	500+	30.50
500+	30.75		

VENDOR C		VENDOR D	
QUANTITY	PRICE	QUANTITY	PRICE
1–99	$34.50	1–199	$34.25
100–199	33.75	200–399	33.00
200–399	32.50	400+	31.00
400+	31.10		

Q - 2 Solve the following game after reducing it to a 2 × 2 game. [10]

Player B

Player A	B_1	B_2	B_3
A_1	1	7	2
A_2	6	2	7
A_3	5	1	6

OR

Q - 2 Machine A costs Rs 45,000 and its operating costs are estimated to be Rs 1,000 for the first [10] year increasing by Rs 10,000 per year in the second and subsequent years. Machine B costs Rs 50,000 and operating costs are Rs 2,000 for the first year, increasing by Rs 4,000 in the second and subsequent years. If at present we have a machine of type A, should we replace it with B? If so when? Assume that both machines have no resale value and their future costs are not discounted.

Q - 3 A reactor and storage tank are interconnected by a 3″ insulated process line that needs [10] periodic replacement. There are valves along the lines and at the terminals and these need replacing as well. No pipe and valves are in stock. Accurate, as built, drawings exist and are available. This line is overhead and requires scaffolding. Pipe sections can be shop-fabricated at the plant. Adequate craft labour is available.

You are the maintenance and construction superintendent responsible for his project. The works engineer has requested your plan and schedule for a review with the operating supervision. The plant methods and standards section has furnished the following data. The precedent for each activity have been determined from a familiarity with similar projects.

Activity	Description	Time (hrs)	Precedents
A	Develop required material list	8	–
B	Procure pipe	200	A
C	Erect scaffold	12	–
D	Remove scaffold	4	H, M
E	Deactivate line	8	–
F	Prefabricate sections	40	B
G	Place new pipes	32	F, K
H	Fit up pipe and valves	8	G, J
I	Procure valves	225	A
J	Place valves	8	I, K
K	Remove old pipe and valves	35	C, E
L	Insulate	24	G, J
M	Pressure test	6	H
N	Clean-up and start-up	4	D, M

(a) Sketch the network diagram of the project plan.

(b) Make the forward pass and backward pass calculations on this network, and indicate the critical path and its length.

(c) Calculate the total float and free float for each of the non-critical activities.

OR

Q - 3   A medical association prepares an annual programme each year, giving the monthly meeting   [10] dates, background on the speakers, an abstract of their talks, and an alphabetic listing, both by name and medical college/hospital affiliation, of all dues paying members. The programme is mailed to these members as well as to selected individuals and organizations. The activities to be performed are listed as follows:

Activity	Description	Preceding Activities	Estimated Time (weeks)
A	Decide on general orientation for this year's programme	–	1
B	Get commitments from speakers and abstracts of their talks	A	4
C	Solicit advertising to appear in the programme	A	3
D	Mail out dues notices and wait for response	–	6
E	Prepare list of dues-paying members	D	1
F	Give copy to printer before proofreadng	B, C, E	2
G	Get programme printed and assembled	F	2
H	Prepare final mailing list	E	1
I	Staff envelopes and mail programmes	G, H	1

(a) Develop a network diagram to show the relationship between all activities. Specify the activities on the critical path and the project completion time.

(b) The programme chairman now claims that it will take him 6 weeks to get commitments and abstracts from the speakers. Will this delay the project completion time? How will it affect the critical path?

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