P P SAVANI UNIVERSITY

Seventh Semester of B. Tech. Examination

December 2022

SEME4040 Operations Research

24.11.2022, Thursday **Time: 10:00 a.m. To 12:30 p.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

			CO	BTL
Q - 1	A person requires 10, 12 and 12 units of chemicals A, B and C, respectively for his garden. A typical liquid product contains 5, 2 and 1 unit of A, B and C, respectively per jar. On the other hand, a typical dry product contains 1, 2 and 4 units of A, B and C per unit. If the liquid product sells for Rs 3 per jar and the dry product for Rs 2 per carton, how many of each should be purchased in order to minimize the cost and meet the requirement?	**[10]**	**1**	**4**

OR

Q - 1	A scrap metal dealer has received an order from a customer for a minimum of 2,000 kg of scrap metal. The customer requires that at least 1,000 kg of the shipment of metal be of high-quality copper that can be melted down and used to produce copper tubing. Furthermore, the customer will not accept delivery of the order if it contains more than 175 kg metal that he deems unfit for commercial use, i.e. metal that contains an excessive amount of impurities and cannot be melted down and refined profitably. The dealer can purchase scrap metal from two different suppliers in unlimited quantities with following percentages (by weight) of high-quality copper and unfit scrap.	**[10]**	**1**	**5**

	Supplier A	*Supplier B*
Copper	25%	75%
Unfit scrap	5%	10%

The cost per kg of metal purchased from supplier A and B are Re 1 and Rs 4, respectively. Determine the optimal quantities of metal to be purchased for the dealer from each of the two suppliers.

Q - 2	The Purchase Manager, Mr. Chaudhry, of the State Road Transport Corporation must decide on the amount of fuel that should be bought from three possible vendors. The corporation refuels its buses regularly at the four depots within the area of its operations. The oil companies have said that they can furnish up to the following amounts of fuel during the coming month: 2,75,000 litres by oil company 1; 5,50,000 litres by oil company 2; and 6,60,000 litres by oil company 3. The required amount of the fuel is 1,10,000 litres by depot 1; 2,20,000 litres at depot 2; 3,30,000 litres at depot 3; and 4,40,000 litres at depot 4. When the transportation costs are added to the bid price per litre supplied, the combined cost per litre for fuel from each vendor, servicing a specific depot, is as under:	**[10]**	**2**	**4**

	Company 1	Company 2	Company 3
Depot 1	25.00	24.75	24.25
Depot 2	25.00	25.50	26.75
Depot 3	24.50	26.00	25.00
Depot 4	25.50	26.00	24.50

Determine the optimal schedule.

OR

Q - 2 A fast-food chain wants to build four stores. In the past, the chain has used six different construction companies, and having been satisfied with each, has invited each to bid on each job. The final bids (in lakh of rupees) are shown in the following table: Find the optimal assignment that will result in minimum man-hours needed. **[10] 2 4**

Construction Companies

	1	2	3	4	5	6
Store 1	85.3	88.0	87.5	82.4	89.1	86.7
Store 2	78.9	77.4	77.4	76.5	79.3	78.3
Store 3	82.0	81.3	82.4	80.6	83.5	81.7
Store 4	84.3	84.6	86.2	83.3	84.4	85.5

Since the fast-food chain wants to have each of the new stores ready as quickly as possible, it will award at the most one job to a construction company. What assignment would result in minimum total cost to the fast-food chain?

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] 3 4**

(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

OR

Q - 3 In a factory, the machines breakdown on an average rate of 10 machines per hours. The idle time cost of a machine is estimated to be Rs 20 per hour. The factory works 8 hours a day. The factory manager is considering 2 mechanics for repairing the machines. The first mechanic A takes about 5 minutes, on an average, to repair a machine and demands wages of Rs 10 per hour. The second mechanic B takes about 4 minutes in repairing a machine and demands wages at the rate of Rs 15 per hour. Assuming that the rate of machine breakdown is Poisson distributed and the repair rate is exponentially distributed, which of the two mechanics should be engaged? **[10] 3 5**

SECTION – II

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] 4 5**

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		

OR

Q - 1 Arthur Meiners is the production manager of WheelRite, a small producer of metal parts. WheelRite supplies CalTex, a larger assembly company, with 10,000 wheel bearings each year. This order has been stable for some time. Setup cost for Wheel-Rite is $40, and holding cost is $.60 per wheel bearing per year. Wheel-Rite can produce 500 wheel bearings per day. CalTex is a just-in-time manufacturer and requires that 50 bearings be shipped to it each business day. **[10] 4 5**

(a) What is the optimum production quantity?

(b) What is the maximum number of wheel bearings that will be in inventory at Wheel-Rite?

(c) How many production runs of wheel bearings will Wheel-Rite have in a year?

(d) What is the total setup 1 holding cost for Wheel-Rite?

Q - 2 A new tempo costs Rs 80,000 and may be sold at the end of any year at the following prices: **[10] 5 5**

Year (end)	:	1	2	3	4	5	6
Selling price (Rs) (*at present value*)	:	50,000	33,000	2,000	1,100	6,000	1,000

The corresponding annual operating costs are:

Year (end)	:	1	2	3	4	5	6
Cost/year (Rs) (*at present value*)	:	10,000	12,000	15,000	20,000	30,000	50,000

It is not only possible to sell the tempo after use but also to buy a second-hand tempo.

It may be cheaper to do so than to replace it with a new tempo.

Age of tempo	:	0	1	2	3	4	5
Purchase price (Rs): (*at present value*)		80,000	58,000	40,000	26,000	16,000	10,000

Determine the time at which it is profitable to sell the tempo and to minimize its average annual cost?

OR

Q - 2 Consider a modified form of 'matching coins' game problem. The matching player is paid Rs 8, if the two coins turn both heads and Re 1 if the coins turn both tails. The non-matching player is paid Rs 3 when the two coins do not match. Given the choice of being a matching or non-matching player, which one would you choose and what would be your strategy? **[10] 5 5**

Q - 3 Delhi Medical Association is considering to hold a conference. The following table gives the list of activities involved, their immediate predecessors, and their duration (in days): **[10] 6 5**

Activity	Description	Predecessor	Duration (days)
A	Design conference meetings and theme	–	3
B	Design front cover of the conference proceedings	A	2
C	Prepare brochure and send request for papers	A	6
D	Compile list of distinguished speakers/guests	A	3
E	Finalize brochure and print it	C, D	7
F	Make travel arrangements for speakers/guests	D	4
G	Despatch brochures	E	3
H	Receive papers for conference	G	25
I	Edit papers and assemble proceedings	F, H	10
J	Print proceedings	B, I	20

(a) Prepare a network diagram showing the interrelationships of the various activities.

(b) Find the total time required to hold the conference.

(c) Compute the total float for the non-critical activities

OR

Q - 3 A management student identifies the following list of activities and sequencing requirements along with the time estimates for various activities related to the completion of his project: **[10] 6 5**

Activity	Description	Immediate Predecessor	Activity Time (days)		
			Optimistic	Likely	Pessimistic
A	Search of Literature	–	3	6	9
B	Deciding the project	–	2	4	12
C	Preliminary work	B	1	1.5	5
D	Formal proposal	C	1	2	3
E	Project committee's approval	A, D	1.5	2	4.5
F	Progress report	E	0.5	1	1.5
G	Formal research	A, D	4.5	5	11.5
H	Data collection	E	2	5	8
I	Analysis	G, H	4	5.5	10
J	Conclusion	I	1.5	2.5	4.5
K	Draft	I, F	2	3.4	8
L	Final Draft	J, K	2.5	3	1.4
M	Presentation	L	0.5	1	1.5

With the help of an arrow diagram, determine the minimum time required to complete the project. From the network, identify the activities that can be delayed without affecting the project duration and the extent of delay that is possible for such activities.

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CO : Course Outcome Number BTL : Blooms Taxonomy Level

Level of Bloom's Revised Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create