Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

MCA INTEGRATED– SEMESTER IV- EXAMINATION –SUMMER-2022

Subject Code: 2648602 **Date: 14/06/2022**

Subject Name: Operations Research

Time: 10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make Suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 (a) What is Operations Research? What are the significant features of OR? State any four application of OR. **7**

(b) Solve the following LP problem graphically **7**

$Min_z = 20x_1 + 10x_2$

Subject to constraints

$x_1 + 2x_2 \leq 40,$

$3x_1 + x_2 \geq 30,$

$4x_1 + 3x_2 \geq 60,$

And $x_1, x_2 \geq 0.$

Q.2 (a) Find the initial basic feasible solution for the following transportation problem using Vogel's Approximation Method: **7**

	D1	D2	D3	D4	Supply
S1	19	30	50	10	7
S2	70	30	40	60	9
S3	40	8	70	20	18
Demand	5	8	7	14	

(b) (i) Construct the dual of the problem **3**

$Min_z = 3x_1 - 2x_2 + 4x_3$

Subject to

$3x_1 + 5x_2 + 4x_3 \geq 7,$

$6x_1 + x_2 + 3x_3 \geq 4,$

$7x_1 - 2x_2 - x_3 \leq 10,$

$x_1 - 2x_2 + 5x_3 \geq 3,$

$4x_1 + 7x_2 - 2x_3 \geq 2,$

and $x_1, x_2, x_3 \geq 0.$

(ii) Explain the difference between PERT and CPM. **4**

OR

(b) A solicitor's firm employs typists on hourly piece-rate basis for their daily work. There are five typists and their charges and speed are different. According to an earlier understanding, only one job is given to one typist and the typist is paid for a full hour even when he works for a fraction of an hour. 7

Find the least cost allocation for the following data:

Typist	Rate/hour (Rs.)	No. of pages typed/hour	Job	No. of pages
A	5	12	P	199
B	6	14	Q	175
C	3	8	R	145
D	4	10	S	298
E	4	11	T	178

Q.3 (a) A tape recorder company manufactures models A, B and C, which have profit contributions per unit of Rs 15, Rs 40 and Rs 60, respectively. The weekly minimum production requirements are 25 units for model A, 130 units for model B and 55 units for model C. Each type of recorder requires a certain amount of time for the manufacturing of the component parts, for assembling and for packing. Specifically, a dozen units of model A require 4 hours for manufacturing, 3 hours for assembling and 1 hour for packaging. The corresponding figures for a dozen units of model B are 2.5, 4 and 2 and for a dozen units of model C are 6, 9 and 4. During the forthcoming week, the company has available 130 hours of manufacturing, 170 hours of assembling and 52 hours of packaging time. Formulate this problem as an LP model so as to maximize the total profit to the company (Do not solve). 7

(b) A small project is composed of 7 activities whose time estimates are listed in the table below. 7

Activity	1-2	1-3	1-4	2-5	3-5	4-6	5-6
Optimistic	1	1	2	1	2	2	3
Most likely	1	4	2	1	5	5	6
Pessimistic	7	7	8	1	14	8	15

(i) Draw PERT Diagram.
(ii) Find the expected duration and variance for each activity.
(iii) What is the expected project length.
(iv) Calculate the variance and standard deviation of the project length

OR

Q.3 **(a)** Define: Two- person zero- sum game, Saddle point.For the game with payoff matrix: 7

Player A	Player B			
	B_1	B_2	B_3	B_4
A_1	3	−5	0	6
A_2	−4	−2	1	2
A_3	5	4	2	3

Determine the best strategies for players A and B and the value of the game. Is this game (i) fair? (ii) Strictly determinable?

(b) The precedence relationships of the activities, and activity time estimates (in weeks) of a project is as follows: 7

Activity	A	B	C	D	E	F	G	H	I	J	K	L	M
Precedence	-	A	B	A	D	E	-	G	J,H	-	A	C,K	I,L
Time	6	4	7	2	4	10	2	10	6	13	9	3	5

i) Draw the network diagram of the project.
ii) Find Critical path and critical activities and expected completion time.
iii) Obtain the total, free and independent float values for non-critical activities.

Q.4 **(a)** An aircraft company uses rivets at a constant rate of 2500 per year. Each unit costs Rs. 30/-. The company personnel estimated that it costs Rs. 130/- to place an order and that the carrying cost of inventory is 10% per year. How frequently should orders be placed? Also, determine the optimum size of each order. 7

(b) What do you understand by (i) Queue discipline (ii) arrival process (iii) service process? 7

OR

Q.4 **(a)** A computer contains 10,000 resistors. When any resistor fails, it is replaced. The cost of replacing any resistor individually is Re. 1 only. If all the resistors are replaced at the same time, the cost per resistor would be reduced to 35 paise. The percentage of surviving resistors say S(t) at the end of month t and the probability of failure P(t) during the month t are as follow: 7

t	0	1	2	3	4	5	6
S(t)	100	97	90	70	30	15	0
P(t)	-	0.03	0.07	0.20	0.40	0.15	0.15

What is the optimal replacement plan?

(b) Define Simulation? Explain applications, advantages and disadvantages of Simulation. 7

Q.5 (a) Determine the optimal sequence of performing 4 jobs on 5 machines. The matching of each machine is required in the order ABCDE and the process timings as as follows. 7

Jobs	Machines				
	A	B	C	D	E
I	7	5	2	3	9
II	6	6	4	5	10
III	5	4	5	6	8
IV	8	3	3	2	6

Determine a sequence of these jobs that will minimize the total elapsed time T. Also find idle time for all machines.

(b) Solve the following LP problem using Simplex method. 7

Maximize $Z = 16x_1 + 17x_2 + 10x_3$

subject to the constraints

(i) $x_1 + x_2 + 4x_3 \leq 2000$ (ii) $2x_1 + x_2 + x_3 \leq 3600$ (iii) $x_1 + 2x_2 + 2x_3 \leq 2400$

(iv) $x_1 \leq 30$

and $x_1, x_2, x_3 \geq 0$

OR

Q.5 (a) Discuss the various costs involved in an inventory model. 7

(b) The arrival rate of a customer at a service window of a cinema hall follows a probability distribution with a mean rate of 45 per hour. The service rate of the clerk follows Poisson distribution with a mean of 60 per hour. 7

(a) What is the probability of having no customers in the system?

(b) What is the probability of having five customers in the system?

(c) Finds Ls, Lq, Ws and Wq.

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