

GUJARAT TECHNOLOGICAL UNIVERSITY
MCA – SEMESTER -III EXAMINATION –WINTER-2021

Subject Code: 639406**Date: 23/12/2021****Subject Name: Operation 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** Define Operations Research. Explain the features of Operations Research **07**
- B** a) Obtain the dual of the following primal LP problem **04**
 Maximize $Z_x = x_1 - 2x_2 + 3x_3$
 subject to the constraints
 (i) $-2x_1 + x_2 + 3x_3 = 2$,
 (ii) $2x_1 + 3x_2 + 4x_3 = 1$
 and $x_1, x_2, x_3 \geq 0$
- b) Explain the following terms in PERT/CPM **03**
 (i) Merge event
 (ii) Burst event
 (iii) Dummy activity
- Q.2 A** Use the simplex method to solve the following LP problem. **07**
 Maximize $Z = 3x_1 + 5x_2 + 4x_3$
 subject to the constraints
 (i) $2x_1 + 3x_2 \leq 8$,
 (ii) $2x_2 + 5x_3 \leq 10$,
 (iii) $3x_1 + 2x_2 + 4x_3 \leq 15$
 and $x_1, x_2, x_3 \geq 0$
- B** A company makes two kinds of leather belts, belt A and belt B. Belt A is a high quality belt and belt B is of lower quality. The respective profits are Rs 4 and Rs 3 per belt. The production of each of type A requires twice as much time as a belt of type B, and if all belts were of type B, the company could make 1,000 belts per day. The supply of leather is sufficient for only 800 belts per day (both A and B combined). Belt A requires a fancy buckle and only 400 of these are available per day. There are only 700 buckles a day available for belt B. Formulate this problem as an LP model. **07**
- OR**
- B** Explain components and assumptions of LP Model in detail. **07**
- Q.3 A** Describe the transportation problem with its general mathematical formulation, and Also define the following terms with reference to a transportation problem: **07**
 (i) Feasible solution
 (ii) Basic feasible solution
 (iii) Optimal solution
 (iv) Non-degenerate basic feasible solution
- B** Determine an initial basic feasible solution the following transportation problem by using **07**
 (a) North West Corner Rule
 (b) Least cost method
 (c) Vogel's Approximation Method

Source	Destination				Supply
		D ₁	D ₂	D ₃	
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

OR

- Q.3 A** A solicitors' 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 was given to one typist and the typist was paid for a full hour, even if he worked for a fraction of an hour. Find the least cost allocation for the following data: **07**

Typist	Rate per hour(Rs)	No. of Pages Typed/Hour
A	5	12
B	6	14
C	3	8
D	4	10
E	4	11

Job	No. of Pages
P	199
Q	175
R	145
S	298
T	178

- B** State and discuss the methods for solving an assignment problem. How is Hungarian method better than other methods for solving an assignment problem? **07**

- Q.4 A** An established company has decided to add a new product to its line. It will buy the product from a manufacturing concern, package it, and sell it to a number of distributors that have been selected on a geographical basis. Market research has already indicated the volume expected and the size of sales force required. The steps shown in the following table are to be planned. **07**

Activity	Description	Predecessors	Duration (days)
A	Organize sales office	-	6
B	Hire Salesman	A	4
C	Train salesman	B	7
D	Select advertising agency	A	2
E	Plan advertising campaign	D	4
F	Conduct advertising campaign	E	10
G	Design package	-	2
H	Setup packaging facilities	G	10
I	Package initial stocks	J, H	6
J	Order stock from manufacturer	-	13
K	Select distributors	A	9
L	Sell to distributors	C, K	3
M	Ship stocks to distributors	I, L	5

- (a) Draw an arrow diagram for this project.
 (b) Indicate the critical path.

B A manufacturer has to supply his customer with 24,000 units of his product per year. This demand is fixed and known. Since the unit used by the customer is an assembly-line operation and the customer has no storage space for the units, the manufacturer must ship a day's supply each day. If the manufacturer fails to supply the required units, he will lose the account and probably his business. Hence, the cost of shortage is assumed to be infinite, and, consequently, none will be tolerated. The inventory holding cost amounts to 0.10 per unit per month, and the set-up cost per run is Rs 350. Find the optimum lot size and the length of optimum production run. **07**

OR

Q.4 A We have five jobs, each of which must be processed on the two machines A and B, in the order AB. Processing times in hours are given in the table below: **07**

JOB	1	2	3	4	5
Machine A	5	2	9	3	10
Machine B	2	6	7	8	4

Determine a sequence for the five jobs that will minimize the elapsed time T .

B What is 'Inventory'? List and explain the different types of Inventories. **07**

Q.5 A Briefly explain the structure of Queuing system. **07**

B Machine A costs Rs 45,000 and its operating costs are estimated to be Rs 1,000 for the first 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. **07**

OR

Q.5 A A self-service store employs one cashier at its counter. Nine customers arrive on an average every 5 minutes while the cashier can serve 10 in 5 minutes. Assuming Poisson distribution in arrival rate and exponential distribution for service rate find: **07**

- (i) Average number of customers in the system
- (ii) Average number of customers in the queue
- (iii) Average time customers in the system
- (iv) Average time of waiting before service

B What is Replacement? Explain the types of failures with example. **07**
