

C037531(037)

B. Tech. (Fifth Semester) Examination, Nov.-Dec. 2021

AICTE (New Scheme)

(Mechanical Engineering Branch)

OPERATION RESEARCH

(BT3037)

Time Allowed : Three hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : Attempt all questions. Each question consists of four parts. Part (a) is compulsory. Attempt any two parts from part (b), (c) and (d). Use of graph paper is permitted. The figures in the right-hand side margin indicate marks.

1. (a) List different phases of Operation Research. Also explain the term degeneracy. 4
- (b) Mahalakshmi Fabricator uses three machines X , Y and Z to produce two machine parts P and Q as shown in the table. This table represents the

[2]

machining times required for each part, the machining time available on different machines and the profit on each machine part :

Type of Machine	Machining time required (minutes)		Maximum time available per week (minutes)
	P	Q	
X	12	6	3,000
Y	4	10	2,000
Z	2	3	900
Profit per unit (Rupees)	40	100	

Using Graphical method find the numbers of parts P and Q to be manufactured per week to maximize the profit.

8

(c) Solve by Simplex method the following linear programming problem :

8

$$\text{Minimize } Z = X_1 - 3 X_2 + 3 X_3$$

$$\text{Subject to } 3 X_1 - X_2 + 2 X_3 \leq 7$$

$$2 X_1 + 4 X_2 \geq 2 - 12$$

$$-4 X_1 + 3 X_2 + 8 X_3 \leq 10$$

$$X_1, X_2, X_3 \geq 0$$

C037531(037)

[3]

(d) Solve by Big M-method the following linear programming problem :

8

$$\text{Maximize } Z = 3 X_1 - X_2$$

$$\text{Subject to } 2 X_1 + X_2 \geq 2$$

$$X_1 + 3 X_2 \leq 3$$

$$X_2 \leq 4$$

$$X_1, X_2 \geq 0$$

2. (a) Write four differences between Transportation Problem and Assignment Problem.

4

(b) The Pepsico Company has to work out a minimum cost transportation schedule to distribute crates of soft drinks from three of its industries A, B and C to its three warehouses X, Y and Z. The required particulars are given below. Find the least cost transportation schedule using VAM.

8

Transportation cost in Rs per crate

From / To	X	Y	Z	Crates Available
A	75	50	50	1040
B	50	25	75	975
C	25	125	25	715
Crates	1300	910	520	2730
Required				

C037531(037)

PTO

[4]

- (c) From three warehouses A, B and C orders for certain commodities are to be supplied to demand points 1, 2, 3, 4 and 5 monthly. The relevant information is given below :

Warehouses	Demand points (Transportation cost in Rs per unit)					Availability in units
	1	2	3	4	5	
A	4	1	2	6	9	100
B	6	4	3	5	7	120
C	5	2	6	4	8	120
Units demand	40	50	70	90	90	

Compare the cost of transportation through Least Cost Method and North West Corner Method. 8

- (d) A captain of a cricket team has to allot five middle order batting positions to five batsman. The average runs scored by each batsman / these positions are given in the table :

[5]

	Batting Position					
	III	IV	V	VI	VII	
Batsman	A	40	40	35	25	50
	B	42	30	16	25	27
	C	50	48	40	60	50
	D	20	19	20	18	25
	E	58	60	59	55	53

Make the assignment so that the expected total average runs scored by these batsman are maximize. 8

3. (a) Explain Kendall's notation to designate 4
- (b) List and discuss characteristics of queuing models. 8
- (c) Patrons arrive at a reception counter at an average inter-arrival rate of 2 minutes. The receptionist in duty takes an average of one minute per patron. 8
- What is the chance that a patron will straight way meet the receptionist?
 - For what portion of time the receptionist busy?
 - What is the average queue length?
 - What is the average number of patrons in the system?
 - What is the average waiting time of a patron?
 - What average time a patron spends in a system?

- (d) Customers arrive at one-person barber shop according to a Poisson process with a mean inter-arrival time of 20 minutes. Customers spend on an average 15 minutes in the barber's chair. 8
- (i) What is the probability that a new arrival need not wait for the barber to be free?
 - (ii) What is the expected number of customers in the barber shop?
 - (iii) How much time can a customer expect to wait for his turn?
 - (iv) How much time can a customer expect to spend in the shop?
 - (v) Management will put another chair and hire another barber when a customer's average time in the shop exceeds 1.25 hours. How much must the average rate of arrivals increase to warrant a second barber?
4. (a) Discuss three time estimates in PERT. 4
- (b) Draw a network diagram for the project in which the pre-operations and post-operations are as given below : 8

Operations	Pre-Operation	Post-Operation
A	None	D, F
B	None	G
C	None	E, H
D	A	G
E	C	G
F	A	None
G	A, B, C, D, E	None
H	C	None

(c) A project schedule has the following characteristics.

Activity	Duration	Activity	Duration
1-2	3	4-8	6
1-4	2	5-6	5
1-7	1	6-9	4
2-3	3	7-8	4
3-6	2	8-9	5
4-5	4		

- Construct a network and find critical path, total duration of the project and various time estimates. 8
- (d) A small engineering project consists of six activities. The three time estimates in number of days for each activity are given below : 8

[8]

Activity	t_o	t_m	t_p
1-2	2	5	8
2-3	1	1	1
3-5	0	6	18
5-6	7	7	7
1-4	3	3	3
4-5	2	8	14

- (i) Calculate the values of expected time (t_e), standard deviation (σ_i) and variance (V_i) for each activity.
- (ii) Draw the network diagram and mark t_e on each activity.
- (iii) Calculate EST and LFT and mark them on the network diagram.
- (iv) Calculate total slack for each activity.
- (v) Identify the critical path and calculate the total project duration.

5. (a) Explain Saddle point.

4

(b) Define the following terms :

[9]

(i) Pure strategy

(ii) Mixed Strategy

(iii) Dominance

(iv) Value of game

8

(c) Explain Monte Carlo simulation.

8

(d) Reduce the following game by dominance property and solve it.

8

		Player B				
		1	2	3	4	5
Player A	I	1	3	2	7	4
	II	3	4	1	5	6
	III	6	5	7	6	5
	IV	2	0	6	3	1