(c) On an average 96 patients per 24 hour day require the service of an emergency clinic. Also, on an average, a patient requires 10 minutes of active attention. Assume that the facility can handle only one emergency at a time, it costs the clinic ₹100 per patient treated to obtain an average servicing time of 10 minutes, and that each minute of decrease in this average time would cost ₹10 per patient treated. How much would have to be budgeted by the clinic to decrease the average size of the queue to 1½ a patient.

(d) Explain

(i) The effect of change in resource level on optimality of linear programming problem

(ii) Transhipment problem

(e) A firm with an annual demand of approximately 5,000 units has an ordering cost of ₹50 per order and a holding cost of ₹18 per unit per year. If the lead time demand follows normal distribution with $\mu = 200$ units and $\sigma = 50$ units (i) find the economic order quantity (ii) what is the re-order point if the firm desires 2% probability of stock out in a given order cycle ? (20)

[This question paper contains 12 printed pages.]

7730 *Your Roll No. .....*

M.COM. : SEMESTER – II (NC) **E**

Paper No. – 4201

Quantitative Techniques for Business Decisions

Time : 3 Hours *Maximum Marks : 100*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt all parts of the question together.

1. (a) Formulate the given problem as LPP.

A financial advisor identified two companies that are likely candidates for a takeover in near future. Radix Cable is a leading manufacturer of flexible cable system used in the construction industry and Flex Switch is a new firm specializing in digital switching systems. Radix cable is currently trading for ₹400 per share, and Flex Switch is currently trading at ₹250 per share. If the takeover occurs, the financial advisor estimates that the price of Radix Cable will go to ₹550 per share and Flex Switch go to ₹430 per share. At this point in time the financial advisor has identified Flex Switch as

Inter-Arrival time		Service time		Random no. (start at NW corner and proceed along the row)				
Minutes	Probability	Minutes	Probability					
2	.15	1	.10					
4	.23	3	.22	9371	1463	7214	1053	2164
6	.35	5	.35	8142	8707	9054	3866	1053
8	.17	7	.23	2924	1725	1185	6885	9980
10	.10	9	.10	5119	4086	3083	5217	7105

(12)

OR

(c) What is Monte Carlo simulation ? Explain the areas of application of Monte Carlo simulation. State the limitations of simulation technique. (7)

(d) What do you understand by queuing discipline and service process ? State the applications of queuing theory in business context. (5)

(e) Solve the game whose payoff matrix is given below :

	B1	B2	B3	B4
A1	4	−2	3	−1
A2	−1	2	0	1
A3	−2	1	−2	0

(8)

(i) Is the solution degenerated ? Give reasons.

(ii) What are the shadow prices of resources used ?

(iii) Over what range in each of the RHS values are these shadow prices valid ?

(iv) What is the range over which the objective function coefficient can vary for each of the three decision variables ?

(v) If some capacities are to be increased, which of these would you suggest first and why ? (20)

2. (a) A bank plans to open a single server drive in a banking facility at a particular center. It is estimated that 28 customers will arrive each hour on an average. If on an average, it requires 2 minutes to process a customer's transaction, determine :

(i) The probability that the system will be idle.

(ii) On an average how long a customer would have to wait before reaching the server ?

(iii) The bank is ready to open a new counter if waiting time is more than 30 minutes. What has to be the minimum arrival rate for opening the new counter ?

P.T.O.

On the average it costs ₹1125 to overhaul a machine (including lost time) and ₹750 in production is lost if a machine is found inoperative. Using steady state probabilities, compute the expected per day cost of maintenance. (8)

(d) Solve the following mixed integer programming problem using cut plane method.

Max $Z = 4x + 6y + 2z$

Sub to: $4x - 4y \leq 5$

$-x + 6y \leq 5$

$-x + y + z \leq 5$

$x, y, z \geq 0$ and y and z are integers.

The optimum solution is given as :

Cj	Basic variable	Value	X	y	z	S1	S2	S3
4	x	5/2	1	0	0	3/10	1/5	0
6	y	5/4	0	1	0	1/20	1/5	0
2	z	25/4	0	0	1	1/4	0	1
		Z=30	0	0	0	2	2	2

(12)

Activity	Immediate predecessor	Normal		Crash	
		Time (weeks)	Cost (₹)	Time (weeks)	Cost (₹)
A	–	5	10,000	4	12,000
B	–	2	6,000	2	6,000
C	A	4	8,000	3	10,000
D	A	4	10,000	3	15,000
E	A	3	11,000	1	16,000
F	C	1	7,000	1	7,000
G	D	4	8,000	2	12,000
H	C,B,E	5	9,000	3	12,000
I	H	2	8,500	2	8,500
J	F,G,I	3	7,500	1	15,000

If the indirect cost is ₹5,000 per week and penalty of ₹500 per week in excess of 15 weeks find :

(i) Normal duration and associated cost of the project.

(ii) Minimum duration and associated cost of the project.

(iii) Minimum cost at which the project can be completed. (15)

P.T.O.

(d) What is safety stock ? Why should management keep safety stock ? What are the cost considerations in keeping safety stock and their effect on determination of EOQ ? (5)

3. (a) A company has its warehouses in three cities which supply retail items to four retail stores in and around these cities. Distance (in km) from each of the warehouses to the three retail stores along with monthly demand and available supplies is give below :

Warehouse	Retail Stores				Monthly supplies
	P	Q	R	S	
A	200	100	50	100	10,000
B	200	400	500	300	12,000
C	300	300	60	600	8,000
Monthly demand	9,000	9,000	10,000	4,000	

Transportation cost is ₹ 25 per tonne per km. Suggest optimum transportation schedule and indicate the total minimum transportation cost. How will the initial solution change if the route B to R is not available due to problem in road ? (12)

(b) State the difference between :

(i) Feasible solution and basic feasible solution.

(ii) Fixed order quantity system and periodic review system.

(iii) State probabilities and transition probabilities.

(iv) Deterministic and probabilistic queuing models. (8)

OR

(c) A manufacturer company has certain piece of equipment that is inspected at the end of each day and classified as just overhauled, good, fair and inoperative. If the piece is inoperative it is overhauled and the procedure takes one day. Assume that the working condition of the equipment follows a Markov process with following transition matrix :

From State	To state			
	1	2	3	4
1	0	.25	.75	0
2	0	.75	.25	0
3	0	0	.5	.5
4	1	0	0	0

(iv) The length of the drive way required to accommodate all the arrivals on the average, if 20 feet of drive way is required for each car that is waiting for service. (8)

(b) A company has a contract to supply 5,000 units of an item per year to the retail store. An estimated ordering cost is ₹150 every time the order is made and the insurance cost is ₹30. The carrying cost is 25% of the unit price. The following are the quantity discounts that the company offers to ensure bulk purchases by the retailer :

Order size	Price per unit (₹)
Less than 1,000	500
1,000–2,999	450
3,000–4,999	400
5,000 or more	350

What should be the order size as a part of best inventory policy? Give justification for your recommendation. (12)

OR

In planning a project to introduce a new product in the market, a company lists various activities, their normal time and costs, and their crash times and costs. These are :

4. (a) A company has four sales representatives who are to be assigned to four different sales territories. The monthly sales increase estimated for each sales representative for different sales territories (in lakh rupee) are shown in the following table :

Sales representative	Sales Territories				
		I	II	III	IV
	A	200	150	170	220
	B	160	120	150	140
	C	190	195	190	200
	D	180	175	160	190

(i) Suggest optimum assignment and the total maximum sales increase per month.

(ii) If B cannot be assigned territory III, will the optimum assignment be different ? If so, find the schedule and effect on total sales. (8)

(b) Following are the inter-arrival duration and service duration in a single service channel system. Using random number table given below simulate the behaviour for a period of 60 minutes and estimate the probability of the service being idle and mean time spent by a customer waiting for a service.

the higher risk alternative. The client is willing to invest maximum of ₹50,00,000 in the two companies. The client wants to invest at least ₹15,00,000 in Radix Cable and at least ₹10,00,000 in Flex Switch. Because of higher risk associated with Flex Switch it is recommended that at the most ₹25,00,000 should be invested in Flex Switch. Formulate as LPP and use graphic method to find optimal solution that maximizes total return on investment. What will be the change in decision in case the advice is to invest at least two times more in Radix Cable than in the Flex Switch. (12)

(b) What is operation research? Explain the methodology of operation research in decision making process. (8)

OR

(c) Use simplex method to find optimum solution to the following problem:

Max : $Z = x - y + 3z$

Sub to :

$$x + y + z \leq 10$$

$$2x - z \leq 2$$

$$2x - 2y + 3z \leq 6$$

Non Neg.: $x, y, z \geq 0$

5. Attempt any **three** of the following :

(a) Write the dual of the following LPP

Max $Z = 6x + 7y - 8z$

Sub to:

$$2x - 3y + 6z \geq 80$$

$$-5x + 6y - 8z = 75$$

$$2x + 5y + 3z \leq 60$$

$x, y \geq 0$ and z is unrestricted in sign.

(b) A manufacturer has to supply his customer with 24,000 units of his product every year. This demand is fixed and known. Since the unit is used by the customer in an assembly operation and the customer has no storage space for units, the manufacturer must supply a day's requirement each day. If there is failure in supply; the shortage cost is ₹2 per unit per month. The inventory carrying cost is ₹1 per unit per month, and the set up cost per run is ₹3,500. Determine the optimum run size (Q), the optimum level of inventory (S) at the beginning of any period, the optimum scheduling period, and the minimum expected relevant yearly cost (TC).