

Reg. No. :

Code No. : 20091 E Sub. Code : SEMA 6 D

B.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2022.

Sixth Semester

Mathematics

Major Elective — OPERATIONS RESEARCH – II

(For those who joined in July 2017 onwards)

Time : Three hours

Maximum : 75 marks

PART A — ($10 \times 1 = 10$ marks)

Answer ALL questions.

Choose the correct answer :

1. The pay-off value for which each player in a game always selects the same strategy is called the

 - (a) equilibrium point
 - (b) saddle point
 - (c) both (a) and (b)
 - (d) maximum point

2. A mixed strategy game can be solved by _____
- (a) matrix method
 - (b) algebraic method
 - (c) graphical method
 - (d) all of the above
3. For the items that deteriorate gradually
- (a) Operating and maintenance costs steadily increase with passage of time, where as depreciation per year decrease with time
 - (b) Optimum replacement interval is the minimum time elapsing between the successive replacements
 - (c) The annual maintenance cost and annual depreciation tend to decrease
 - (d) All of the above
4. Staff replacement policy is _____
- (a) arises due to resignation, retirement or death of a staff member from time to time
 - (b) is like replacement policy for items whose values deteriorate gradually
 - (c) can be easily formulated because people retire at known times
 - (d) does not yield the optimum replacement interval

5. When there are more than one servers, customer behaviour in which he moves from one queue to another is known as _____
- (a) balking
 - (b) jockeying
 - (c) reneging
 - (d) alternating
6. Which of the following is not a key operating characteristic for a queuing system
- (a) average time a customer spent waiting in the system and queue
 - (b) utilization factor
 - (c) percent idle time
 - (d) none of the above
7. The main objective of network analysis is to _____
- (a) minimize total project cost
 - (b) minimize total project duration
 - (c) minimize production delays, interruption and conflicts
 - (d) all of the above
8. The slack for an activity in network, is equal to
- (a) $LS - ES$
 - (b) $LF - LS$
 - (c) $EF - ES$
 - (d) $EF - LS$

9. Economic Order Quantity (EOQ) results in ———
- equilisation of carrying cost and procurement cost
 - minimization of set up cost
 - favourable procurement price
 - reduced chances of stock outs
10. If small orders are placed frequently, then total inventory cost ———
- decreased
 - increased
 - either decreased or increased
 - no change

PART B — (5 × 5 = 25 marks)

Answer ALL questions choosing either (a) or (b).

11. (a) Consider the game with the following pay off matrix

$$A \begin{matrix} & B \\ \begin{pmatrix} 0 & 2 \\ -1 & 4 \end{pmatrix} \end{matrix}$$

Show that the game is strictly determinable.
Also find the value of the game.

Or

- (b) Consider a 'modified' form of 'matching biased coins' game problem. The matching player is paid Rs. 8.00 if the two coins turn both heads and Rs. 1.00 if the coins turn both tails. the non-matching player paid Rs. 3.00 when the two coins do not match. Given the choice of being the matching or non-matching player, which one would you choose and what would be your strategy?

12. (a) The data collected in running a machine, the cost of which is Rs. 60,000, are given below :

Year	1	2	3	4	5
Resale value (Rs.) :	42,000	30,000	20,400	14,400	9,000
Cost of spares (Rs.) :	4,000	4,270	4,880	5,700	6,800
Cost of labour (Rs.) :	14,000	16,000	18,000	21,000	25,000

Determine the optimum period for replacement of the machine.

Or

- (b) A pipeline is due for repairs. It will cost Rs. 10,000 and last for 3 years. Alternatively, a new pipeline can be laid at a cost of Rs. 30,000 and lasts for 10 years. Assuming cost of capital to be 10% and ignoring salvage value, which alternative should be chosen?

13. (a) In a railway marshaling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the inter-arrival time follows an exponential distribution and the service time distribution is also exponential with an average 36 minutes. Calculate the following :
(i) the mean queue size (line length), (ii) the probability that the queue size exceed 10.

Or

- (b) A super market has two girls serving at the counters. The customers arrive in a Poisson fashion at the rate of 12 per hour. The service time for each customer is exponential with mean 6 minutes. Find (i) the probability that an arriving customer has to wait for service (ii) the average number of customers in the system.

14. (a) Draw a network diagram for the following relation ships :

Activity :	A	B	C	D	E	F	G
Immediate predecessor :	-	-	-	A	B,C	A	C
Activity :	H	I	J	K	L	M	N
Immediate predecessor :	F,E,D	D	G	G	J,H	K	I,L

Or

- (b) Given the following information :

Activity :	0-1	1-2	1-3	2-4	2-5
Duration (in days) :	2	8	10	6	3
Activity :	3-4	3-6	4-7	5-7	6-7
Duration (in days) :	3	7	5	2	8

- (i) Draw the arrow diagram

- (ii) Identify critical path and find the total project duration.

15. (a) A manufacturing company purchases 9,000 parts of a machine for its annual requirements, ordering one month usage at a time. Each part costs Rs. 20. The ordering cost per order is Rs. 15 and the carrying charges are 15% of the average inventory per year. You have been assigned to suggest a more economical purchasing policy for the company. What advice would you offer and how much would it save the company per year?

Or

- (b) A contractor under takes to supply diesel engines to a truck manufacturer at the rate of 25 per day. There is a clause in the contract penalizing him Rs. 10 per engine per day late for missing the scheduled delivery date. He finds that the cost of

holding a complete engine in stock is Rs. 16 per month. His production process is such that each month he starts a batch of engines through the shops, and all these engines are available for delivery any time after the end of the month. What should his inventory level be at the beginning of each month?

PART C — (5 × 8 = 40 marks)

Answer ALL questions choosing either (a) or (b).

16. (a) Obtain the optimal strategies for both persons and the value of the game for zero-sum - two - person game whose pay-off matrix is as follows :

$$\begin{bmatrix} 1 & -3 \\ 3 & 5 \\ -1 & 6 \\ 4 & 1 \\ 2 & 2 \\ -5 & 0 \end{bmatrix}$$

Or

- (b) Two firms are competing for business under the condition so that one firm's gain is another firm's loss. Firm A's payoff matrix is given below :

		Firm B		
		No ad	Med.ad.	Heavy ad.
Firm A	No advertising	10	15	-2
	Medium advertising	13	12	15
	Heavy advertising	16	14	10

Suggest optimum strategies for the two firms and the net outcome thereof.

17. (a) (i) Machine A costs Rs. 9,000. Annual operating costs are Rs. 200 for the first year, and then increase by Rs. 2,000 every year. Determine the best age at which to replace the machine. If the optimum replacement policy is followed, what will be the average yearly cost of owning and operating the machine?
- (ii) Machine B cost Rs. 10,000. Annual operating costs are Rs. 400 for the first year, and then increase by Rs. 800 every year. You now have a machine of type A which is one-year old, should you replace its with B; if so when?

Or

- (b) A computer has a large number of electric tubes. They are subject to mortality as given below :

Period	Age of failure (hours)	Probability of failure
1	0-200	0.10
2	201-400	0.26
3	401-600	0.35
4	601-800	0.22
5	801-1000	0.07

If tubes are group replaced, the cost of replacement is Rs. 15 per tube. Group replacement can be done at fixed intervals in the night shift when the computer is not normally used. Replacement of individual tubes which fail in service costs Rs. 60 per tube. How frequently should the tubes be replaced.

18. (a) The arrival rate of customers at a public telephone booth follows. Poisson distribution with an average time of 10 minutes between one customer and the next. The duration of phone call is assumed to follow exponential distribution, with mean time of 3 minutes.

- (i) What is the probability that a person arriving at the booth will have to wait?

- (ii) What is the average length of the non-empty queues that form from time to time?

- (iii) The Mahanagar telephone Nigam Ltd., will install a second booth when it is convinced that the customers would expect waiting for atleast 3 minutes for their turn to make a call. By how much time should the flow of customers increase in order to justify a second booth?

- (iv) Estimate the fraction of a day that the phone will be in use.

Or

- (b) A bank has two tellers working on savings accounts. The first teller handles withdrawals only. The second teller handles deposits only. It has been found that the service time distribution for booth deposits and withdrawals is exponential with mean service time 3 minutes per customer. Depositors are found to arrive in Poisson fashion throughout the day with mean arrival rate of 16 per hour. Withdrawers also arrive in Poisson fashion with mean arrival rate of 14 per hour. What would be the effect on the average waiting time for depositors and withdrawers if each teller could handle both withdrawals and deposits? What could be the effect if this could be accomplished by increasing the mean service time to 3.5 minutes?

19. (a) A project consists of a series of tasks labeled A, B, ..., H, I with the following relationship (W < X, Y means X and Y cannot start until both X and Y are completed). With this notation construct the network diagram having the following constraints : A < D, E; B, D < F; C < G; B, G < H; F, G < I. Find also the minimum time of completion of the project, when the time (in days) of completion of each task is as follows :

Task :	A	B	C	D	E	F	G	H	I
Time :	23	8	20	16	24	18	19	4	10

Or

- (b) A small project is composed of seven activities whose time estimates are listed in the table as follows :

Activity		Estimated duration		
i	j	Optimistic	Most likely	Pessimistic
1	2	1	1	7
1	3	1	4	7
1	4	2	2	8
2	5	1	1	1
3	5	2	5	14
4	6	2	5	8
5	6	3	6	15

- Draw the project network
- Find the expected duration and variance of each activity. What is the expected project length?
- Calculate the variance and standard deviation of project length.

What is the probability that the project will be completed :

- atleast 4 weeks earlier than expected?
- no more than 4 weeks later than expected?

20. (a) A company operating 50 weeks in a year is concerned about its stocks of copper cable. This costs Rs. 240 a metre and there is a demand for 8,000 metres a week. Each replenishment costs Rs. 1,050 for administration and Rs. 1,650 for delivery, which holding costs are estimated at 25 percent of value held a year. Assuming no shortages are allowed, What is the optimal inventory policy for the company? How would this analysis differ if the company wanted to maximize profit rather than minimize cost? What is the gross profit if the company sell cable for Rs. 360 a metre.

Or

- (b) A dealer supplies you the following information with regard to a product dealt in by him :

Annual demand - 10,000 units; ordering cost - Rs. 10 per order; price - Rs. 20 per unit.

Inventory carrying cost - 20% of the value of inventory per year.

The dealer is considering the possibility of allowing some back - order (stock - out) to occur. He has estimated that the annual cost of back - ordering will be 25% of the value of inventory.

- (i) What should be the optimum number of units of the product he should buy in one lot?
- (ii) What quantity of the product should be allowed to be back-ordered, if any?
- (iii) What would be the maximum quantity of inventory at any time of the year?
- (iv) Would you recommend to allow back-ordering?

If so, what would be the annual cost saving by adopting the policy of back - ordering?