

-) 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, while holding costs are estimated at 25 percent of value held a year. Assume 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

The demand for an item in a company is 18,000 units per year, and the company can produce the items at a rate of 3,000 per month. The costs of one set-up is Rs. 500 and holding cost of 1 unit per month is 15 paise. The storage cost of one unit is Rs. 200 per month. Determine (i) optimum production batch quantity and the number of strategies, (ii) optimum cycle time and the production time, (iii) maximum inventory level in the cycle and (iv) total associated cost per year of the cost of the time is Rs. 20 per unit.

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B.Sc. (CBCS) DEGREE EXAMINATION, APRIL 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 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. A game is said to be fair, if _____
 - (a) upper value is more than lower value of the game
 - (b) upper and lower values are not equal
 - (c) upper and lower values are same and zero
 - (d) upper value is less than lower value of the game

2. The size of the pay-off matrix of a game can be reduced by using the principle of —————
 - (a) dominance (b) rotation reduction
 - (c) game inversion (d) game transpose

3. The problem of replacement is not concerned about the —————
 - (a) items are deteriorate graphically
 - (b) determination of optimum replacement interval
 - (c) items that fails suddenly
 - (d) maintenance of an item to work out profitability

4. Mortality problems —————
 - (a) are special type of problems, where failure is treated as birth and the replacement of an item on the failure is treated as death
 - (b) uses mortality tables to derive the probability distribution of the life span of an equipment/item
 - (c) are like replacement policies for items whose value does not deteriorate gradually
 - (d) none of the above

- (i) Find the critical path and the expected time of the project.
- (ii) Find the total and free-float for each activity.

Or

- (b) A project is composed of eight activities, the time estimates for which are given below.

Activity		Time required (days)		
Event	Name	t_o	t_m	t_p
1-2	A	6	6	24
1-3	B	6	12	18
1-4	C	12	12	30
2-5	D	6	6	6
3-5	E	12	30	48
4-6	F	12	30	42
5-6	G	18	30	54

- (i) Find the expected duration and variance of each activity.
- (ii) What is the expected project length?
- (iii) Calculate the variance and standard deviation of the project length.

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

- a) Explain the solution procedure of the queueing model (M/M/1) : (∞ /FIFO). Also obtain its characteristics.

Or

- b) Explain the queueing model (M/M/1) : (N/FIFO) and find its characteristics.

- a) The following are the details of estimated times of activities of a certain project.

Activity	Immediate predecessors	Normal time (days)
A	—	16
B	—	20
C	A	8
D	A	10
E	B,C	6
F	D,E	12

5. Queue can form only when —————

- (a) arrivals exceed service capacity
- (b) arrivals equals service capacity
- (c) service facility is capable to serve all the arrivals at a time
- (d) there are more than one service facilities

6. Priority queue discipline may be classified as —————

- (a) finite or infinite
- (b) limited or unlimited
- (c) pre-emptive or non-pre-emptive
- (d) all of the above

7. Network problems have advantage in terms of project —————

- (a) scheduling
- (b) planning
- (c) controlling
- (d) all of the above

8. In critical path analysis, CPM is —————

- (a) event oriented
- (b) probabilistic in nature
- (c) deterministic in nature
- (d) dynamic in nature

9. Which of the following is not an assumption underlying the fundamental problem of EOQ?
- demand is known and uniform
 - lead time is not zero
 - holding cost per unit time period is constant
 - stock-outs are not permitted
10. If the procurement cost used in the formula to compute EOQ is half of the actual procurement cost, the EOQ so obtained will be _____
- half of EOQ
 - 0.707 time EOQ
 - one third of EOQ
 - one fourth of EOQ

PART B — (5 × 5 = 25 marks)

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

Each answer should not exceed 250 words.

11. (a) Solve the game whose payoff matrix is given by

		Player B		
		B ₁	B ₂	B ₃
Player A	A ₁	1	3	1
	A ₂	0	-4	-3
	A ₃	1	5	-1

Or

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17. (a) A manufacturer is offered two machines A and B. A is priced at Rs. 5,000 and running costs are estimated at Rs. 800 for each of the first years, increasing by Rs. 200 per year in the sixth and subsequent years. Machine B which has the same capacity as A costs Rs. 2,500 but will have running costs of Rs. 1,200 per year for six years, increasing by Rs. 200 per year thereafter. If money is worth 10% per year, which machine should be purchased? (Assume that the machine will eventually be sold for scrap at a negligible price)

Or

- (b) A computer has a large number of electronic 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

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- o) The demand for a certain items is 16 units per period. Unsatisfied demand causes a shortage cost of Re. 0.75 per unit per short period. The cost of initializing purchasing action is Rs. 15.00 per purchase and the holding cost is 15% of average inventory valuation per period. Item cost is Rs. 8.00 per unit. (Assume that shortages are being back ordered at the above mentioned cost). Find the minimum cost purchase quantity.

PART C — (5 × 8 = 40 marks)

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

Each answer should not exceed 600 words.

- o) Use graphical method in solving the following game :

$$\begin{array}{c} \text{Player A} \\ \text{Player B} \end{array} \begin{pmatrix} 2 & 2 & 3 & -2 \\ 4 & 3 & 2 & 6 \end{pmatrix}$$

Or

- o) Solve the following game by using dominance property.

$$\begin{array}{c} \text{Player A} \\ \text{I} \\ \text{II} \\ \text{III} \\ \text{IV} \end{array} \begin{pmatrix} 3 & 2 & 4 & 0 \\ 3 & 4 & 2 & 4 \\ 4 & 2 & 4 & 0 \\ 0 & 4 & 0 & 8 \end{pmatrix}$$

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- (b) For the game with the following payoff matrix, determine the optimum strategies and the value of the game :

$$\begin{array}{c} P_2 \\ P_1 \end{array} \begin{pmatrix} 5 & 1 \\ 3 & 4 \end{pmatrix}$$

12. (a) A firm is considering replacement of a machine, whose cost price is Rs. 12,200 and the scrap value, Rs. 200.

The running (maintenance and operating) cost in rupees are found from experience to be as follows :

Years :	1	2	3	4
Running cost :	200	500	800	1,200
Years :	5	6	7	8
Running cost :	1,800	2,500	3,200	4,000

When should the machine be replaced?

Or

- (b) The cost of new machine is Rs. 15,000. The maintenance cost of n^{th} year is given by

$C_n = 500(n-1)$; $n = 1, 2, \dots$ suppose that the discount rate per year is 0.5. After how many years it will be economical to replace the machine by a new one?

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13. (a) A T.V. repairman finds that the time spent on his jobs has an exponential distribution with 30 minutes. If he repairs sets in the order in which they came in and if the arrival of sets is approximately.

Poisson with an average rate of 10 per 8 hour day. What is repairman's expected idle time each day? How much jobs are ahead of the average set just brought in?

Or

- (b) At a railway station, only one train is handled at a time. The railway yard is sufficient only for two trains to wait while other is given signal to leave the station. Trains arrive at the station at an average rate of 6 per hour and the railway station can handle them on an average of 12 per hour. Assuming Poisson arrivals and exponential service distribution, find the steady-state probabilities for the various number of trains in the system. Also find the average waiting time of a new train coming into the yard.

14. (a) 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 project duration.

Or

- (b) Consider the data of the project, find its critical path and project duration.

Activity	A	B	C	D	E	F	G	H	I
Predecessor	-	-	A	B	C,D	B	E	E	F,G
Duration (days)	4	7	2	9	6	5	2	10	4

15. (a) A company plans to consume 760 pieces of a particular component. Past records indicate that purchasing department had used Rs. 12,000 for placing 15,000 orders. The average inventory was valued at Rs. 45,000 and the total storage cost was Rs. 7,650 which included wages, rent, taxes, insurance, etc., related to store department. The company borrows capital at the rate of 10% a year. If the price of a component is Rs. 12 and the order size is of 10 component, determine; purchase cost, purchase expenses, storage expenses, capital cost and total cost per year.

Or