

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION MAY 2024
(Sixth Semester)

Branch – MATHEMATICS

OPERATIONS RESEARCH - II

Time: Three Hours

Maximum: 50 Marks

SECTION-A (5 Marks)

Answer ALL questions

ALL questions carry EQUAL marks

(5 x 1 = 5)

- 1 In a two person game if player I has 'm' strategies and player II has 'n' strategies then the game is said to be a _____ game.

(i) $m \times n$	(ii) m
(iii) n	(iv) m-n
- 2 There are _____ types of failures that are considered in replacement theory.

(i) three	(ii) four
(iii) five	(iv) two
- 3 The EOQ has been defined as the ordering quantity which minimizes the balance of cost between the inventory holding cost and the _____.

(i) maintenance cost	(ii) profit cost
(iii) ordering cost	(iv) loss
- 4 The waiting time in the queue and the service time of the customer together called the _____ in the system

(i) arrival time	(ii) waiting time
(iii) surplus time	(iv) steady time
- 5 The arrival of dead bodies to a burial ground is an example of

(i) Pure Birth Process	(ii) Pure death Process
(iii) Birth and Death Process	(iv) Constant rate of arrival

SECTION - B (15 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(5 x 3 = 15)

- 6 a Solve the following game

		Player B	
		B ₁	B ₂
Player A	A ₁	30	2
	A ₂	4	14
	A ₃	6	9

OR

- b For what value of λ , the game with following payoff matrix is strictly determinable?

		B ₁	B ₂	B ₃
A ₁	λ	6	2	
A ₂	-1	λ	-7	
A ₃	-2	4	λ	

Cont...

- 7 a Following table gives the maintenance cost per year and resale price of a certain equipment whose purchase price Rs.7,000.

Year	1	2	3	4	5	6	7	8
Maintenance Cost (Rs.)	900	1200	1600	2100	2800	3700	4700	5900
Resale Value (Rs.)	4000	2000	1200	600	500	400	400	400

When should the equipment be replaced?

OR

- b The following table gives the costs per year and the resale value of a certain equipment whose purchase price is Rs.6500. At what age is the replacement due optimally

Year	1	2	3	4	5	6	7	8
Running Cost (Rs.)	1400	1500	1700	2000	2400	2800	3300	3900
Resale Value (Rs.)	4000	3000	2200	1700	1300	1000	1000	1000

- 8 a The annual demand for an item is 3200 units. The unit cost is Rs. 6 and inventory carrying charges 25% per annum. If the cost of one procurement is Rs.150, then determine (i) Economic Order Quantity (ii) Number of orders per year (iii) Time between two consecutive orders (iv) The optimal cost

OR

- b Calculate the optimal ordering quantity for the following
- | | |
|------------------------|--------------------------|
| Annual usage | 100 pieces |
| Cost per piece | Rs.250 |
| Ordering cost | Rs.6/ order |
| Expediting cost | Rs.4 / order |
| Inventory holding cost | 20% of average inventory |

- 9 a A T.V. Repairman finds that the time spent on his jobs have an exponential distribution with mean of 30 minutes. If he repairs sets in the order in which they come 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 many jobs are ahead of the average set just brought in?

OR

- b In a departmental store one cashier is there to serve the customers, and the customers pick up their needs by themselves. The arrival rate is 9 customers for every 5 minutes and the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service rate, Calculate.
- Average number of customers in the system.
 - Average queue length.
 - Average time a customer spends in the system.
 - Average time a customer waits before being served.

- 10 a A telephone exchange has two long distance operators. The telephone company finds that during the peak load, long distance calls arrive in a Poisson fashion at an average rate of 15 per hour. The length of service on these calls is approximately exponentially distributed with mean length 5 minutes. What is the probability that a subscriber will have to wait for his long distance call during the peak hours of the day? If subscribers wait and are serviced in turn, calculate their expected waiting time.

OR

- b A colliery working one shift per day uses a large number of locomotives which breakdown at random intervals, on the average one failing per 8 - hour shift. The fitter carries out a standard maintenance schedule on each faulty locomotive. Each of the five main parts of this schedule takes an average of $1/2$ an hour but the time varies widely. How much time will the fitter have for other tasks and what is the average time a locomotive is out of service?

Cont...

SECTION -C (30 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks

(5 x 6 = 30)

- 11 a Consider a modified form of matching 'biased coins' problem. The matching player is paid Rs.8 if two coins turn both heads and Rs.1 if the coins turn both tails. The non-matching player is paid Rs.3 when 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?

OR

- b Solve the game using graphical method.

$$\begin{array}{c}
 B_1 \quad B_2 \\
 \left[\begin{array}{cc}
 A_1 & \begin{bmatrix} -6 & 7 \end{bmatrix} \\
 A_2 & \begin{bmatrix} 4 & -5 \end{bmatrix} \\
 A_3 & \begin{bmatrix} -1 & -2 \end{bmatrix} \\
 A_4 & \begin{bmatrix} -2 & 5 \end{bmatrix} \\
 A_5 & \begin{bmatrix} 7 & -6 \end{bmatrix}
 \end{array} \right]
 \end{array}$$

- 12 a The following failure rates have been observed for a certain type of transistors in a digital computer.

End of week	1	2	3	4	5	6	7	8
Probability of failure to date	0.05	0.13	0.25	0.43	0.68	0.88	0.96	1.0

The cost of replacing an individual failed transistor is Rs.1.25. The decision is made to replace all these transistors simultaneously at fixed intervals and to replace the individual transistors as they fail in service. If the cost of group replacement is 30 paise per transistor what is the interval between group replacement? Is it preferable over individual replacement policy?

OR

- b It has been suggested by a data processing time that they adopt a policy of periodically replacing all the tubes in a certain piece of equipment. A given type of a tube is known to have the mortality distribution shown in the following table.

Week	1	2	3	4	5
Prob. Of failure during the week	0.3	0.1	0.1	0.2	0.3

There are approximately 1000 tubes of this type in all combined equipment. The cost of replacing the tubes on an individual basis is estimated to be Rs. 1.00 per tube and the cost of group replacement policy average to be Rs.0.30 per tube. Compare the cost preventive replacement with that of remedial replacement.

- 13 a A manufacturing company uses an EOQ approach in planning its production of gears. The following information is available. Each gear costs Rs.250 per unit, annual demand is 6000 gears; set up costs are Rs.4000 per setup and the inventory carrying cost per month is established 2% of the average inventory value. When in production, these gears can be produced at the rate of 400 units per day and this company works only for 300 days in a year. Determine the economic lot size, the number of production runs per year and the total inventory costs.

OR

- b A firm uses every year 12000 units of a raw material costing Rs.1.25 per unit. Ordering cost is Rs.15 per order and the holding cost is 5% per year of the average inventory. (i) Find the economic order quantity (ii) The firm follows EOQ purchasing policy. It operates for 300 days per year. Procurement time is 14 days and safety stock is 400 units. Find the reorder point, the maximum inventory and average inventory.

Cont...

- 14 a A branch of a Nationalized bank has only one typist. Since typing work varies in length (number of pages to be typed), the typing rate is randomly distributed approximating a Poisson distribution with a mean service rate of 8 letters per hour. The letter arrives at a rate of 5 per hour during the entire 8-hour workday. If the typist is valued at Rs. 1.50 per hour, determine: (a) Equipment utilization, (b) The percent time an arriving letter has to wait, (c) Average system time, and (d) Average idle time cost of the typewriter per day.

OR

- b A product manufacturing plant at a city distributes its products by trucks, loaded at the factory warehouse. It has its own fleet of trucks plus trucks of a private transport company. This transport company has complained that sometimes its trucks have to wait in line and thus the company loses money paid for a truck and driver of waiting truck. The company has asked the plant manager either to go in for a second warehouse or discount prices equivalent to the waiting time. The data available is: Average arrival rate of all trucks = 3 per hour. Average service rate is = 4 per hour. The transport company has provided 40% of the total number of trucks. Assuming that these rates are random according to Poisson distribution, determine: (a) The probability that a truck has to wait? (b) The waiting time of a truck that has to wait, (c) The expected waiting time of company trucks per day.
- 15 a A super market has two girls ringing up sales at the counters. If the service time from each customer is exponential with a mean of 4 minutes, and if people arrive in a Poisson fashion at the rate of 10 an hour, find (a) what is the probability of having an arrival has to wait for service? (b) What is the expected percentage of idle time for each girl?

OR

- b A tax-consulting firm has 3 counters in its office to receive people who have problems concerning their income, wealth and sales taxes. On the average 48 persons arrive in an 8- hour day. Each tax adviser spends 15 minutes on the average on an arrival. If the arrivals are Poisson distributed and service times are according to exponential distribution find:
- (a) The average number of customers in the system,
 - (b) Average number of customers waiting to be serviced,
 - (c) Average time a customer spends in the system
 - (d) Average waiting time for a customer,
 - (e) The number of hours each week a tax adviser spends performing his job,
 - (f) The probability that a customer has to wait before he gets service,
 - (g) The expected number of idle tax advisers at any specified time.

Z-Z-Z

END