PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION MAY 2022
(Sixth Semester)

Branch – MATHEMATICS

OPERATIONS RESEARCH – II

Time: Three Hours   Maximum: 75 Marks

SECTION-A (10 Marks)
Answer ALL questions
ALL questions carry EQUAL marks   (10 x 1 = 10)

1. In two-person zero-games, the loss (gain) of one player is exactly _____ to the gain (loss) of the other.
   (i) equal   (ii) greater than   (iii) less than   (iv) none

2. Games which involve more than two players are called _____ games
   (i) biased   (ii) n-person   (iii) negotiable   (iv) conflicting

3. The problem of replacement is not concerned about the
   (i) items that deteriorate graphically   (ii) items that fail suddenly
   (iii) determination of optimum replacement interval
   (iv) maintenance of an item to work out profitability

4. When value of money changes with time, the optimum replacement policy of the equipment after 'n' periods is:
   (i) Do not replace the item if the next periods' operating cost is greater than the weighted average of previous costs.
   (ii) Replace the item if the next period' operating cost is less than the weighted average of previous costs.
   Choose the correct answer:
   (i) only (i) is correct
   (ii) only (ii) is correct
   (iii) both (i) and (ii) are correct
   (iv) both (i) and (ii) are not correct

5. Economic order quantity (EOQ) results in
   (i) equalisation of carrying cost and procurement cost
   (ii) minimization of set up cost
   (iii) favourable procurement price
   (iv) reduced chances of stock outs

6. If small orders are placed frequently, then total inventory cost is
   (i) reduced   (ii) increased   (iii) either (a) or (b)   (iv) none

7. Queue can form only when
   (i) arrivals exceed service capacity
   (ii) arrivals equals service capacity
   (iii) service facility is capable to serve all the arrivals at a time.
   (iv) there are more than one service facilities.

8. For a "Poisson exponential, single server and infinite population" queueing model,
   (i) the system has a single service facility,
   (ii) the arrivals occur in a Poisson fashion,
   (iii) the service rate is according to exponential distribution,
   (iv) all of the above.

9. Which of the following is not a key operating characteristic for a queueing system:
   (i) average time a customer spent waiting in the system and queue.
   (ii) utilization factor.
   (iii) per cent idle time
   (iv) none

10. Which of the following is correct?
    (i) The expected length of the system should be equal to the expected length of queue plus one.
    (ii) Expected length of non-empty queues would not exceed expected length of system in a single server queueing system.
    (iii) The only way the customers are serviced in queueing situations is the first-come-first service basis.
    (iv) Erlang service time distribution is a special case of exponential service time distribution.

SECTION - B (25 Marks)
Answer ALL questions
ALL questions carry EQUAL Marks   (5 x 5 = 25)

11. (a). Explain (i) Pay off Matrix   (ii) Saddle point.

(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 is 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	9,650
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 he laid at a cost of Rs. 30,000 and last for 10 years. Assuming cost of capital to be 10% and ignoring salvage value, which alternative should be chosen?

13. (a). Explain the types of inventories.

(OR)

(b). Find the optimum order quantity for a period for which the price breake are as follows:

Quantity	Purchasing cost per unit (Rs.)
$0 \le Q_1 < 100$	20
$100 \le Q_2 < 200$	18
$200 \le Q_3$	16

The monthly demand for the product is 400 units. The storage cost is 20% of the unit cost of the product and the cost of ordering is Rs. 25.00 per month.

14. (a). Explain the arrival process of the elements of a queueing system.

(OR)

(b). In a railway marshalling 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), and
    (ii)   the probability that the queue size exceeds 10.
If the input of trains increases to an average 33 per day, what will be the change in (i) and (ii)?

15. (a). Illustrate the birth-death process in Generalised model.

(OR)

(b). We have 5 machine, each of which when running, suffers breakdown at an average rate of 2 per hour. There are 2 service men and only one man can work on a machine at a time. If n machines are out of order when $n > 2$ then $(n - 2)$ of them wait until serviceman is free. Once a serviceman starts work on a machine the time to complete the repair has an exponential distribution with mean 5 minutes. Find the distribution of the number of machines out of action at a given time. Find also the average time an out-of-action machine has to spend waiting for the repairs to start.

SECTION -C (40 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** Marks   (5 x 8 = 40)

16. (a). Solve the game graphically.

		Player B
		B_1	B_2	B_3	B_4
Player A	A_1	2	1	0	-2
	A_2	1	0	3	2

(OR)

(b). Solve the following game:

$$\text{Player A} \begin{array}{c} \\ I \\ II \\ III \\ IV \end{array} \overset{\begin{array}{cccc} I & II & III & IV \end{array}}{\begin{bmatrix} 3 & 2 & 4 & 0 \\ 3 & 4 & 2 & 4 \\ 4 & 2 & 4 & 0 \\ 0 & 4 & 0 & 8 \end{bmatrix}} \quad \text{Player B}$$

17. (a). Determine the optimum replacement age of an item whose maintenance cost increases with time and the value of money remains static during that period.

(OR)

(b). The following failure rates have been observed for a certain type of transistors in a digital computer:

End of the 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	1.00

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 best interval between group replacements? At what group replacement price per transistor would a policy of strictly individual replacement become preferable to the adopted policy?

18. (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, while holding costs are estimated at 25 per cent 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). Discuss the problem of EOQ with instantaneous production and variable order cycle time in the deterministic inventory problem with shortages.

19. (a). Drive the Poisson distribution of arrivals (Pure birth process) in the probability distributions in queueing systems.

(OR)

(b). A road transport company has one reservation clerk on duty at a time. He handles information of bus schedules and makes reservations. Customers arrive at a rate of 8 per hour and the clerk can service 12 customers on an average per hour. After stating your assumptions, answer the following:
(i) What is the average number of customers waiting for the service of the clerk?
(ii) What is the average time a customer has to wait before getting service?
(iii) The management is contemplating to install a computer system to handle the information and reservations. This is expected to reduce the service time from 5 to 3 minutes. The additional cost of having the new system works out to Rs. 50 per day. If the cost of goodwill of having to wait is estimated to be 12 paise per minute spent waiting before being served. Should the company install the computer system? Assume 8 hours working day.

20. (a). A bank has two tellers working on saving accounts. The first teller handles withdrawals only. The second teller handles deposits only. It has been found that the service time distribution for both deposits and withdrawals is exponential with mean service time 3 minutes per customers. 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?

(OR)

(b). What are all the characteristics of Model I $\{(M/E_k/I):(\infty/FIFO)\}$ in non-Poisson queueing systems.

Z-Z-Z   END