

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
BSc DEGREE EXAMINATION MAY 2026
(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 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Service mechanism in a queuing system is characterized by (i) Customer behaviour (ii) Server behaviour (iii) Customer in the system (iv) Both server and customer	K1	CO1
	2	Customer behavior in which the customer moves from one queue to another in a multiple channel situation is (i) Balking (ii) Reneging (iii) Jockeying (iv) Alternating	K2	CO1
2	3	In M/M/S: N/FIFO the following does not apply (i) Poisson arrival (ii) Exponential Service (iii) Single server (iv) Limited service	K1	CO1
	4	For an M/G/1 queueing system, what does 'G' represent? (i) General arrival distribution (ii) General service time distribution (iii) Geometric service time distribution (iv) Group arrival	K2	CO1
3	5	Group replacement policy is best suited for: (i) Expensive machines (ii) Items that fail suddenly (iii) Items that deteriorate slowly (iv) one-of-a-kind equipment	K1	CO2
	6	A machine should be replaced when its maintenance cost becomes (i) Less than the previous year (ii) Equal to the salvage value (iii) Zero (iv) Equal to the average annual total cost	K2	CO2
4	7	What does Economic Order Quantity (EOQ) represent? (i) minimum Inventory level (ii) Quantity, minimizes tot. inventory costs (iii) maximum Inventory level (iv) Quantity, maximizes revenue	K1	CO3
	8	Which cost can vary with order quantity. (i) Unit cost (ii) Reorder cost (iii) Holding cost (iv) all the above	K2	CO3
5	9	Monte Carlo simulation is primarily used for which type of problems (i) Deterministic (ii) Stochastic. (iii) Only linear (iv) Small scale simple problems	K1	CO4
	10	Simulation is a process of designing a model of a (i) Real system (ii) Experimental system (iii) Probabilistic system (iv) Deterministic system	K2	CO4

Cont...

SECTION - B (35 Marks)

Answer ALL questions

ALL questions carry EQUAL Marks

(5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO																		
1	11.a.	Derive the Average number of customers in queue and in the system for the queueing model $M/M/1: \infty / FCFS$.	K2/ K3	CO1																		
	OR																					
	11.b.	In a given $M/M/1$ queueing system the average arrivals is 4 customers per minute : $\rho = 0.7$. What are 1) mean number of customers L_s in the system 2) mean number of customers L_q in the queue 3) probability that the server is idle 4) mean waiting time W_s in the system																				
2	12.a.	In a heavy machine shop, the overhead crane is 75% utilized. Time study observation gave the average service time 10.5 minutes and S.D 8.8 minutes. What is the average calling rate for the service of the crane and What is the average delay in getting service.	K3	CO1																		
	OR																					
	12.b.	A petrol pump station has 4 pumps. The service times follow the exponential distribution with a mean of 6 minutes and cars arrive for service in a Poisson process at the rate of 30 cars per hour. Find the average waiting time, average time spent in the system and the average number of cars in the system?																				
3	13.a.	The initial cost of a machine is Rs. 15000. The maintenance cost during the respective years are given below <table border="1"><tr><td>Year:</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>Maintenance Cost(Rs.):</td><td>2500</td><td>3000</td><td>4000</td><td>5000</td><td>6500</td><td>8000</td><td>10000</td></tr></table> Find the optimum replacement period if the capital is worth 10% and no salvage value.	Year:	1	2	3	4	5	6	7	Maintenance Cost(Rs.):	2500	3000	4000	5000	6500	8000	10000	K4	CO2		
	Year:	1	2	3	4	5	6	7														
Maintenance Cost(Rs.):	2500	3000	4000	5000	6500	8000	10000															
OR																						
	13.b.	The cost of a machine is Rs. 6100 and its scrap value is Rs. 100. <table border="1"><tr><td>Year:</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>Maintenance Cost(Rs.):</td><td>100</td><td>250</td><td>400</td><td>600</td><td>900</td><td>1200</td><td>1600</td><td>2000</td></tr></table> When should the machine be replaced?	Year:	1	2	3	4	5	6	7	8	Maintenance Cost(Rs.):	100	250	400	600	900	1200	1600	2000		
Year:	1	2	3	4	5	6	7	8														
Maintenance Cost(Rs.):	100	250	400	600	900	1200	1600	2000														
4	14.a.	A stockist has to supply 12,000 units of a product per year to his customer. The demand is fixed and known, the shortage cost is assumed to be infinite. The inventory holding cost is Re. 0.20 per unit per month and the ordering cost per order is Rs.350. Determine the optimal quantity, optimum scheduling period and the minimum total variable yearly cost.	K5	CO3																		
	OR																					
	14.b.	An item is produced at the rate of 50 items per day. The demand occurs at the rate of 25 items per day. If the setup cost is Rs. 100 per setup and holding cost is Re.0.01 per unit of the item per day. Find the economic lot size for one run, assuming that shortages are not permitted. Also find the time of cycle and minimum daily cost.																				

5	15.a.	Define Simulation and outline the limitations of simulation	K2/ K4	CO4
	OR			
	15.b.	Customers arrive at a service facility to get the required service. The interarrival and service times are constant and are 1.8 minutes and 4 minutes respectively. Simulate the system for 14 minutes. Determine the average waiting time of a customer and idle time of the service facility.		

SECTION -C (30 Marks)

Answer ANY THREE questions

ALL questions carry EQUAL Marks

(3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO														
1	16	Arrivals at a telephone booth are considered to be Poisson with an average time of 12 minutes between one arrival and the next. The length of a phone call assumed to be distributed exponentially with mean 4 min. a) Find the average number of persons waiting in the system. b) What is the probability that a person arriving at the booth will have to wait in the queue? c) What is the probability that it will take him more than 10 minutes altogether to wait for the phone and complete his call? d) Estimate the fraction of the day when the phone will be in use?	K2	CO1														
2	17	A 2-person barber shop has 5 chairs to accommodate waiting customers. Potential customers who arrive when all 5 chairs are full, leave without entering barber shop. Customers arrive at the average rate of 4 per hour and spend an average of 12 minutes in the barber's chair. Compute P_0, P_1, and λ_{eff}.	K3	CO1														
3	18	A computer contains 10,000 resistors where any resistor fails it is replaced. The cost of replacing a resistor is Re.1. If all the resistors are replaced at the same time the cost per item would be reduced to 35 p. The probability of failure of a resistor every month is given as follows: <table><tr><td>T</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>P(t)</td><td>0.03</td><td>0.07</td><td>0.2</td><td>0.4</td><td>0.15</td><td>0.15</td></tr></table> Identify the optimum replacement policy?	T	1	2	3	4	5	6	P(t)	0.03	0.07	0.2	0.4	0.15	0.15	K5	CO2
T	1	2	3	4	5	6												
P(t)	0.03	0.07	0.2	0.4	0.15	0.15												
4	19	A company has a demand of 12,000 units/year for an item and it can produce 2000 such items per month. The cost of one setup is Rs.400 and the holding cost/unit/month is Re 0.15. Determine the optimum lot size and the total cost per year, assuming the cost of 1 unit as Rs. 4. Also obtain the maximum inventory, manufacturing time and total time.	K4	CO3														
5	20	The Lajwaab Bakery Shop keeps stock of a popular brand of cake. Previous experience indicates the daily demand as given below: <table><tr><td>Daily demand</td><td>0</td><td>15</td><td>25</td><td>35</td><td>45</td><td>50</td></tr><tr><td>Probability</td><td>0.01</td><td>0.15</td><td>0.20</td><td>0.50</td><td>0.12</td><td>0.02</td></tr></table> Consider the following sequence of random numbers: 21, 27, 47, 54, 60, 39, 43, 91, 25, 20 Using this sequence, simulate the demand for the next 10 days. Find out the stock situation, if the owner of the bakery shop decides to make 30 cakes every day. Also estimate the daily average demand for the cakes on the basis of simulated data.	Daily demand	0	15	25	35	45	50	Probability	0.01	0.15	0.20	0.50	0.12	0.02	K5	CO4
Daily demand	0	15	25	35	45	50												
Probability	0.01	0.15	0.20	0.50	0.12	0.02												

