PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2024
(First Semester)

Branch - **STATISTICS**

OPERATIONS RESEARCH

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	What is the purpose of post-optimal analysis in linear programming? a. To find the initial basic feasible solution b. To identify changes in problem coefficients c. To calculate the optimal objective function value d. To determine the number of constraints in the problem	K1	CO1
	2	In the Dual Simplex method, when is the solution considered optimal? a. When the reduced costs are all zero b. When the dual variables are all zero c. When the constraints are all binding d. When the objective function value is maximized	K2	CO1
2	3	Which of the following costs is associated with carrying inventory? a. Ordering Cost b. Shortage Cost c. Holding Cost d. Setup Cost	K1	CO2
	4	In one-price-break inventory models, what typically happens at the price breakpoint? a. The order quantity decreases b. The order quantity remains constant c. The order quantity increases d. The order quantity becomes unpredictable	K2	CO2
3	5	Which probability distribution is commonly used to model service times in queuing systems when service times are constant and known? a. Poisson distribution b. Exponential distribution c. Binomial distribution d. Uniform distribution	K1	CO3
	6	What is the formula for the average number of customers in the system (L) in a single-server queuing model? a. $L = \lambda / \mu$ b. $L = \mu / \lambda$ c. $L = \lambda + \mu$ d. $L = \lambda - \mu$	K2	CO3
4	7	What is the primary goal of crashing in project management? a. Increasing the project budget b. Extending project deadlines c. Reducing project costs d. Shortening the project duration	K1	CO4
	8	What types of problems are particularly suitable for Monte Carlo simulations? a. Problems with exact and deterministic solutions b. Complex problems involving uncertainty and randomness c. Linear problems with no uncertainty d. Problems that can be solved analytically	K2	CO4

Cont...

5	9	In non-linear programming with inequality constraints, what is the feasible region? a. The set of all possible objective function values b. The region where constraints are ignored c. The region of all possible variable values that satisfy the constraints d. The region of infeasible solutions	K1	CO5
	10	In Quadratic Programming (QP), which of the following best describes the objective function and constraints? a. The objective function is linear, and the constraints are quadratic. b. The objective function and constraints are both linear. c. The objective function and constraints are both quadratic. d. The objective function is quadratic, and the constraints are linear.	K2	CO5

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.	Discuss the key principles and mathematical foundations of the Dual Simplex method.	K3	CO1
		(OR)		
	11.b.	Differentiate between Pure Integer Programming (PIP) and Mixed Integer Programming (MIP) in the realm of optimization techniques.		
2	12.a.	The demand for an item is 8000 units per annum and the unit cost is Re.1/-. Inventory carrying charges of 20% of the average inventory cost and the ordering cost is Rs. 12.50 per order. Calculate i) optimal order quantity, ii) optimal order time, iii) optimal inventory cost and iv) number of orders.	K4	CO2
		(OR)		
	12.b.	Explain the Economic Order Quantity (EOQ) model with two price breaks, considering the complex dynamics involved in optimizing inventory management.		
3	13.a.	Analyze in-depth two significant applications of queueing theory, delving into the intricate nuances of how this mathematical discipline plays a pivotal role in optimizing complex systems.	K4	CO3
		(OR)		
	13.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 arrival rate and exponential distribution for service rate, find: a. Average number of customers in the system. b. Average number of customers in the queue or average queue length. c. Average time a customer spends in the system. d. Average time a customer waits before being served		

<table>
<tr><td rowspan="3">4</td><td>14.a.</td><td>Compose detailed short notes on the following two aspects of network analysis.
i) Critical Path analysis
ii) Resource allocation.</td><td rowspan="3">K5</td><td rowspan="3">CO4</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>14.b.</td><td>The following details are available regarding a project. Determine the critical path, the critical activities and the project completion time.
<table><tr><td>Activity</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td></tr><tr><td>Predecessor Activity</td><td>-</td><td>A</td><td>A</td><td>B</td><td>C</td><td>D, E</td></tr><tr><td>Duration (weeks)</td><td>3</td><td>5</td><td>7</td><td>10</td><td>5</td><td>4</td></tr></table></td></tr>
<tr><td rowspan="3">5</td><td>15.a.</td><td>Compose an in-depth and advanced descriptive note on Non-Linear Programming with real-world examples that illustrate the challenges and methodologies involved in solving it.</td><td rowspan="3">K5</td><td rowspan="3">CO5</td></tr>
<tr><td colspan="2">(OR)</td></tr>
<tr><td>15.b.</td><td>State and prove Kuhn-Tucker necessary and sufficient conditions in non-linear programming problem.</td></tr>
</table>

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

<table>
<tr><th>Module No.</th><th>Question No.</th><th>Question</th><th>K Level</th><th>CO</th></tr>
<tr><td>1</td><td>16</td><td>Solve the following linear programming problem using dual simplex method.
$Max\ Z = 4x_1 + 3x_2$
Subject to:
$2x_1 + 3x_2 \leq 12$
$x_1 + 2x_2 \leq 6$
$x_1, x_2 \geq 0$</td><td>K3</td><td>CO1</td></tr>
<tr><td>2</td><td>17</td><td>What is an ABC inventory system? Describe its application.</td><td>K4</td><td>CO2</td></tr>
<tr><td>3</td><td>18</td><td>a. Explain the queuing system or process.

b. Ships arrive at a port at the rate of one in every 4 hours with exponential distribution of inter-arrival times. The time a ship occupies a berth for unloading has exponential distribution with an average of 10 hours. If the average delay of ships waiting for berths is to be kept below 14 hours, how many berths should be provided at the port?</td><td>K4</td><td>CO3</td></tr>
<tr><td>4</td><td>19</td><td>A small project is composed of 7 activities whose time estimates are listed below. Activities are being identified by their beginning (i) and ending (j) node numbers.
<table><tr><td rowspan="2">Activities</td><td>i</td><td>1</td><td>1</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>j</td><td>2</td><td>3</td><td>4</td><td>5</td><td>5</td><td>6</td><td>6</td></tr><tr><td rowspan="3">Time (in week)</td><td>t_o</td><td>1</td><td>1</td><td>2</td><td>1</td><td>2</td><td>2</td><td>3</td></tr><tr><td>t_l</td><td>1</td><td>4</td><td>2</td><td>1</td><td>5</td><td>5</td><td>6</td></tr><tr><td>t_p</td><td>7</td><td>7</td><td>8</td><td>1</td><td>14</td><td>8</td><td>15</td></tr></table>1. Draw the network
2. Calculate the expected variances for each
3. Find the expected project completed time
4. Calculate the probability that the project will be completed at least 3 weeks than expected
5. If the project due date is 18 weeks, what is the probability of not meeting the due date?</td><td>K5</td><td>CO4</td></tr>
<tr><td>5</td><td>20</td><td>Explore Goal Programming at an advanced level, discussing its principles, methodologies, and applications.</td><td>K5</td><td>CO5</td></tr>
</table>

Z-Z-Z END