Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/MBA (O)/SEM-(2FT & 4PT)/MB-205/2010

2010
OPERATIONS RESEARCH

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Graphs sheets are to be supplied by the Institution.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) We use Big M method in solving those LPPs in which at least one of the constraint is of the type

w) ≤ x) ≥ y) = z) <

Now choose the answer from the codes given below :

a) (w) only b) (w) or (z)

b) (x) or (y) d) (z) only.

ii) In game theory, the dominance rule for column states that every element in the dominating column must be ..... the corresponding value of the dominated column.

a) less than or equal to

b) less than

c) greater than

d) greater than or equal to.

iii) Which of the following is not true about slack variables in the Simplex method ?

a) They are used to convert less-than-or-equal to constraint inequalities to equalities

b) They represent unused resources

c) They require the addition of an artificial variable

d) They may represent machine time, labour hours or warehouse space.

iv) The type of environment in which more than one state of nature exist but the decision maker lacks sufficient knowledge to allow him assign probabilities to the various states of nature is called

a) Decision making under conditions of certainty

b) Decision making under conditions of uncertainty

c) Decision making under conditions of risk

d) Decision making under conditions of variety.

v) The optimality condition for minimization LPP in the Simplex method is

a) $Z_j - C_j \geq 0 \forall_j$ b) $Z_j - C_j \leq 0 \forall_j$

c) $Z_j - C_j < 0 \forall_j$ d) None of these.

vi) What is the method to solve an LPP involving artificial variables ?

a) Simplex method b) Charnes-M-method

c) VAM d) None of these.

vii) A two-person zero-sum game is said to be fair if

a) both the players have equal number of strategies

b) the game has saddle point

c) the game does not have a saddle point

d) the value of the game is zero.

viii) Which of the following is not an assumption in common queuing mathematical models ?

a) Arrivals come from an infinite or very large population

b) Arrivals follow Poisson distribution

c) Arrivals are treated on a first-in, first-out basis and do not balk or renege

d) The average arrival rate is faster than the average service rate.

ix) In an assignment problem involving four workers and three jobs, the total number of assignments possible are

a) 4 b) 3

c) 7 d) 21.

x) Given a system of m simultaneous equations in n unknowns ($m < n$), the number of basic variables will be

a) m b) n

c) $m - n$ d) $m + n$.

xi) The solution to the dual LP problem

a) presents the marginal profits of each additional unit of resource

b) can always be derived by examining the Z_j row of the primal's optimal Simplex tableau

c) is better than the solution to the primal

d) all of these.

xii) The problem of replacement is not concerned about

a) items that deteriorates gradually

b) items that fail suddenly

c) optimum replacement interval

d) maintenance of an item to work out profitability.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Obtain the dual of the following primal LPP :

Minimize $Z = x_1 - 3x_2 - 2x_3$

Subject to $3x_1 - x_2 + 2x_3 \leq 7$

$2x_1 - 4x_2 \geq 12$

$-4x_1 + 3x_2 + 8x_3 = 10$

$x_1, x_2 \geq 0$; x_3 unrestricted in sign.

3. Solve the following problem graphically or otherwise :

		B		
A	1	2	–3	7
	2	5	4	–6

4. Solve the assignment problem :

	1	2	3
A	7	5	6
B	8	4	7
C	9	6	4

5. Find the basic solution or solutions, if there be any, of the set of equations :

$2x_1 + 4x_2 - 2x_3 = 1$

$10x_1 + 3x_2 - 7x_3 = 33.$

6. Find the initial basic feasible solution of the following transportation problem by North-West corner method :

	W_1	W_2	W_3	W_4	Capacity
F_1	10	30	50	10	7
F_2	70	30	40	60	9
F_3	40	8	70	20	18
Requirement	5	8	7	14	34

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Solve the following LPP by using the Simplex method :

Maximize $Z = 3x_1 + 2x_2$

Subject to $2x_1 + x_2 \le 5$

$x_1 + x_2 \le 3$

$x_1, x_2 \ge 0$

b) Solve graphically :

Maximize $Z = x_1 + x_2$

Subject to $5x_1 + 9x_2 \le 45$

$x_1 + x_2 \ge 2$

$x_2 \le 4$

and $x_1, x_2 \ge 0$

c) Explain the concept of shadow price. 6 + 6 + 3

8. a) A news agency receives its weekly order for a magazine every Monday and cannot reorder during the week. Each copy costs Rs. 1·80 and is sold for Rs. 3·00. Unsold copies may be returned the following week for a Rs. 1·20 rebate. When the agency runs out of copies and cannot supply a customer, it estimates its "goodwill" loss at Rs. 2·40 in future profit, as the customer will take his business elsewhere for a couple of weeks at least. Demand has been remarkably constant between 28 and 40 copies a week, as shown below :

Demand (Copies)	28	32	36	40
Fraction of time	0·30	0·40	0·20	0·10

i) Construct a pay-off table and determine the optimal number of copies to stock.

ii) How much would it be worth to know the exact demand each week ? What would be the expected profit if this were possible ?

b) Considered the following 4 × 4 game played by players *A* and *B* :

		Player B			
		I	**II**	**III**	**IV**
Player A	**I**	6	2	4	8
	II	2	–1	1	12
	III	2	3	3	9
	IV	5	2	6	10

Obtain the optimal solution of the above game. 9 + 6

9. a) Three persons are being considered for three open positions. Each person has been given a rating for each position as shown in the following table :

	Position		
Person	**I**	**II**	**III**
1	7	5	6
2	8	4	7
3	9	6	4

Assign each person to one and only one position in such a way that the sum of ratings for all three persons is maximum.

b) An automobile company manufactures around 150 scooters. The daily production varies from 146 to 154 depending upon the availability of raw materials and other working conditions :

Production (Per day)	146	147	148	149	150	151	152	153	154
Probability	0·04	0·09	0·12	0·14	0·11	0·10	0·20	0·12	0·08

The finished scooters are transported in a specially arranged lorry accommodating 150 scooters using the following random numbers :

80, 81, 76, 75, 64, 43, 18, 26, 10, 12, 65, 68, 69, 61, 57. Simulate the process to find out :

i) What the average number of scooters will be waiting in the factory.

ii) What the average number of empty spaces will be in the lorry. 6 + 9

10. a) A company has received a contract to supply gravel for three new construction projects located in towns *A*, *B* and *C*. Construction engineers have estimated the required amounts of gravel which will be needed at these construction projects.

Project Location	***Weekly requirement (truckloads)***
A	72
B	102
C	41

The company has three gravel pits located in towns *X*, *Y* and *Z*. The gravel required by the construction projects can be supplied by three pits. The amount of gravel which can be supplied by each pit is as follows :

Plant	X	Y	Z
Amount available (truckloads)	76	82	77

The company has computed the delivery cost from each pit to each project site. These costs (in Rs.) are shown in the following table :

		Project Location		
		A	**B**	**C**
Pit	**X**	4	8	8
	Y	16	24	16
	Z	8	16	24

i) Find the initial solution of the above transportation problem by using Vogel's approximation method. Calculate the initial cost.

ii) Check whether the initial solution is optimal or not.

b) Explain the concept of Mixed strategy in game theory.

10 + 5

11. a) The following failure rates have been observed for a certain type of light bulb :

Week	1	2	3	4	5
% failed by end of week	10	25	50	80	100

There are 1000 bulbs in use and it costs Rs. 2 to replace an individual bulb which has burnt out. If all bulbs were replaced simultaneously, it would cost 50 paise per bulb. It is proposed to replace all bulbs at fixed intervals of time, whether or not they have burnt out and to continue replacing burnt out bulbs as and when they fail. At what interval should all the bulbs be replaced ? At what group replacement price per bulb would a policy of strictly individual replacement become preferable to the adopted policy ?

b) Briefly discuss the Kendall notation of queuing model.

10 + 5