PREVIOUS YEAR QUESTION BANK

EXADEMY

LINEAR PROGRAMMING

Q1. The following table gives the cost for transporting material from supply points A, B, C, D to demand points E, F, G, H, J:

The present allocation is as follows:

A to E 90; A to F 10; B to F 150; C to F 10; C to G 50; C to J 120; D to H 210; D to J 70.

i. Check if this allocation is optimum. If not, find an optimum schedule.

ii. If in the above problem the transportation cost from A to G is reduce to 10, what will be the new optimum schedule?

	E	**F**	**G**	**H**	**J**
A	8	10	12	17	15
B	15	13	18	11	9
C	14	20	6	10	13
D	13	19	7	5	12

(Year 1992)

(20 Marks)

Q2. Solve the following linear programming problem

Maximize $Z = 3x_1 + 2x_2$

Subjected to

$x_1 + x_2 \leq 7$

$x_1 - x_2 \leq 2$

$x_1, x_2 \geq 0$

(Year 1992)

(20 Marks)

Q3. A departmental Head has four subordinates and four tasks are to be performed. The subordinates differ in efficiency and the tasks differ in their intrinsic difficulty. His estimates of the times each man would take to perform each task is given in the effectiveness matrix below. How should the tasks be allocated one to one man, so as to minimize the total man hours?

Man

Task	I	II	III	IV
A	8	26	17	11
B	13	28	14	26
C	38	19	18	15
D	19	26	24	10

(Year 1993)

(20 Marks)

Q4. Use Simplex method to solve:

Maximize $x_o = x_1 - 3x_2 + 2x_3$

Subjected to

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

$$-2x_1 + 4x_2 \leq 12$$

$$-4x_1 + 3x_2 + 8x_3 \leq 10$$

$$x_1, x_2, x_3 \leq 0$$

(Year 1993)

(20 Marks)

Q5. Consider the following Data: The cost of shipment from third source to the third destination is not known. How many units should be transported from the sources to the destinations so that the total cost of transporting all the units to their destinations is a minimum?

		Destination			
Source		**1**	**2**	**3**	**Capacities**
	1	2	2	3	10
	2	4	1	2	15
	3	1	3	x	40
	Demands	20	15	30	

(Year 1994)

(20 Marks)

Q6. Use Simplex method to solve:

Maximize $Z = 3x_1 + 2x_2 + 5x_3$

Subjected to

$x_1 + 2x_2 + x_3 \leq 430$

$3x_1 + 2x_2 \leq 460$

$x_1 + 4x_2 \leq 420$

$x_1, x_2, x_3 \geq 0$

(Year 1994)

(20 Marks)

Q7. There are five jobs each of which must go through two machines A and B in the order A, B. Processing times are given below: Determine a sequence for the jobs that will minimize the elapsed time. Compute the total idle times for the machines in this period.

Job	**1**	**2**	**3**	**4**	**5**
Time for A (in hours)	7	3	11	5	12
Time for B (in hours)	4	8	9	10	6

(Year 1995)

(20 Marks)

Q8. Solve the transportation problem below for minimizing the cost:

Costs	Store						Availability
	1	**2**	**3**	**4**	**5**	**6**	
1	9	12	9	6	9	10	5
2	7	3	7	7	5	5	6
3	6	5	9	11	3	11	2
4	6	8	11	2	2	10	9
Requirement	4	4	6	4	6	2	22

(Year 1995)

(20 Marks)

Q9. Solve the following linear programming problem

Maximize $z = x_1 + 2x_2 + 3x_3 - x_4$

Subjected to the constraints

$$x_1 + 2x_2 + 3x_3 = 15$$

$$2x_1 + x_2 + 5x_3 = 20$$

$$x_1 + 2x_2 + x_3 + x_4 = 10$$

$$x_1, x_2, x_3, x_4 \geq 0$$

(Year 1995)

(20 Marks)

Q10. Determine the optimal sequence of jobs that minimizes the total elapsed time required to complete the following jobs and find the total elapsed time. The jobs are to be processed on three machines M_1, M_2, M_3 in the same order M_1, M_2, M_3 and processing times are as below: Find also the idle times for the three machines.

Jobs	**A**	**B**	**C**	**D**	**E**	**F**	**G**
M_1	3	8	7	4	9	8	7
M_2	4	3	2	5	1	4	3
M_3	6	7	5	11	5	6	12

(Year 1996)

Q11. Determine the

Maximum $Z = P_1P_2\ldots.P_n$

Subject to constraints

$$\sum_{i-1}^{n} \text{ci pi} \leq x, 0 \leq \text{pi} \leq 1 \ (I = 1, 2, \ldots\ n)$$

Assume that $c_i > x$ for all i

(Year 1996)

Q12. A company has four plants P_1, P_2, P_3, P_4 from which it supplies to three markets M_1, M_2, M_3. Determine the optimal transportation plan using MODI method from the following data giving the plant to market shifting costs, quantities available at each plant an quantities required at each market:

Market	Plants				Required at
	P_1	P_2	P_3	P_4	
M_1	21	16	25	13	11
M_2	17	18	14	23	13
M_3	32	27	18	41	19
Available at plant	6	10	12	15	43

(Year 1996)

(20 Marks)

Q13. A tax consulting firm has 4 service stations (counters) in its office to receive people who have problems and complaints about their income, wealth etc. The number of arrivals averages 80 persons in an eight hour service day. Each tax adviser spends an irregular amount average service time is 20 minutes. Calculate the average number of people waiting to be serviced, average time a person spends in the system and the average waiting time for a person. What is the expected number of idle tax adviser at any specified time?

(Year 1996)

(20 Marks)

Q14. Solve the assignment problem represented by the following for minimizations of costs. Find also alternate solutions if any.

	I	II	III	IV	V	VI
A	11	24	60	13	21	29
B	45	80	74	52	65	50
C	43	30	93	39	47	35
D	76	44	29	51	41	34
E	38	13	59	24	27	27
F	5	58	55	33	19	30

(Year 1996)

(20 Marks)

Q15. Use the simplex method to solve the following Linear Programming Problem:

Maximize $z = 3x_1 + 5x_2$

Subjected to

$x_1 \leq 4$

$x_2 \leq 6$

$3x_1 + 2x_2 \leq 18$

$x_1, x_2 \leq 0$

(Year 1996)

(20 Marks)

Q16. In factory, there are six jobs to perform and each should go through two machines A and B in the order A, B. The processing timings (in hours) for the jobs are given below. Determine the sequence form performing the jobs that would minimize the total elapsed time T. What is the value of T?

	Jobs					
	J_1	**J_2**	**J_3**	**J_4**	**J_5**	**J_6**
A	1	3	8	5	6	3
B	5	6	3	2	2	10

(Year 1997)

(20 Marks)

Q17. Use the simplex method to solve the following Linear Programming Problem:

Maximize $z = 4x_1 + 10x_2$

Subjected to

$2x_1 + x_2 \leq 50$

$2x_1 + 5x_2 \leq 100$

$2x_1 + 3x_2 \leq 90$

$x_1, x_2 \geq 0$

(Year 1997)

(20 Marks)

Q18. State the Transportation problem in general terms and explain the problem of degeneracy.

(Year 1997)

(20 Marks)

Q19. A book binder processes the manuscript of 5 books through the three stages of operation, viz., printing, binding and finishing. The time required to perform the printing, binding and finishing operations are given below:

Book	Processing Time (in hours)		
	Printing	Binding	Finishing
1	50	60	90
2	100	70	110
3	90	30	70
4	70	40	80
5	60	50	110

(Year 1998)

(20 Marks)

Q20. A bank has two tellers working on savings accounts. The first teller handles withdrawals only. The second teller handles depositors only. It has been found that the service time distributions of both deposits and withdrawals are exponential with a mean service time of 3 minutes per customer. Depositors and withdrawers are found to arrive in a Poisson fashion throughout the day with mean arrival rate of 16 and 14 per hour. What would be the effect on the average waiting time for depositors and withdrawers if each teller could handle both the withdrawals and deposits? What would be the effect if this could only be accomplished by increasing the service time to 3.5 minutes?

(Year 1998)

(20 Marks)

Q21. Solve the unbalanced assignment problem in minimization where, C(ij) =

$$\begin{pmatrix} 12 & 10 & 15 & 22 & 18 & 8 \\ 10 & 18 & 25 & 15 & 16 & 12 \\ 11 & 10 & 3 & 8 & 5 & 9 \\ 6 & 14 & 10 & 13 & 13 & 12 \\ 8 & 12 & 11 & 7 & 13 & 10 \end{pmatrix}$$

(Year 1998)

(20 Marks)

Q22. Prove that a basic feasible solution to a linear programming problem must correspond to an extreme point of the set of all feasible solutions.

(Year 1998)

(20 Marks)

Q23. Give the economic interpretation of duality in linear programming.

(Year 1999)

(20 Marks)

Q24. Find the optimal assignment for the given assignment costs:

Machine

Job		1	2	3
	1	5	7	9
	2	14	10	12
	3	15	13	16

(Year 1999)

(20 Marks)

Q25. Develop mathematical model of a balanced transportation problem. Prove that it always has a feasible solution.

(Year 1999)

(20 Marks)

Q26. Respond True or False to the following, justify your answer in case of False:

1. If the number of primal variables is much smaller than the number of constraints, it is more efficient to obtain the solution of the primal by solving its dual,
2. When the primal problem is non-optimal, the dual problem is automatically infeasible.
3. An unrestricted primal variable will have the effect of yielding an equality dual constraint.
4. If the solution space is unbounded, the objective value will always be unbounded.
5. The selection of the entering variable from among the current non-basic variable as the one with the most negative objective coefficient guarantees the most increase in the objective value in the next iteration.
6. In the simplex method, the feasibility conditions for the maximization and minimization problems are different.
7. A simplex iteration (basic solution) may no necessarily coincide with a feasible extreme point of the solution space.
8. If the leaving variable does not correspond to the minimum ratio, at least one basic variable will definitely become negative in the next iteration.

(Year 1999)

(20 Marks)

Q27. Show that a problem in the theory of games can be expressed as a linear programming problem.

(Year 1999)

(20 Marks)

Q28. A police department has the following minimal daily requirements from police officers during its six shift periods:-

Time of Day	Period	Minimal Number Required
2 am – 6 am	1	22
6 am – 10 am	2	55
10 am – 2 pm	3	88
2 pm – 6 pm	4	110
6 pm – 10 pm	5	44
10 pm – 2 am	6	33

An officer must start at the beginning of 4 – hour shift and stay on duty for two consecutive shifts (an 8 hour tour). Any one starting during period 6 stays on duty during period 1 of the next day. The objective of the police department is to always have on duty the minimal number required in a period but to do so with the least number of officers. Develop the corresponding liner programming model.

(Year 1999)

(20 Marks)

Q29. Solve the following assignment problem for the given assignment costs:

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16
4	21	24	17	28	26
5	14	10	12	11	13

(Year 2000)

(20 Marks)

Q30. Two unbiased coins are tossed once (independently) and the number X of heads that turned up is noted. A number is selected at random from X, X + 1 and X + 2. If Y is the number selected, find the joint of distribution of X and Y. Also obtain the expectation of XY.

(Year 2000)

(20 Marks)

Q31. An explosion in a factory manufacturing explosives can occur because of

1. Leakage of electricity,
2. Defects in machinery,
3. Carelessness of workers or
4. Sabotage.

The probability that there is a leakage of electricity is 0.20, the machinery is defective is 0.30, the workers are careless is 0.40, there is sabotage is 0.10. The engineers feel that an explosion can occur with probability

I. 0.25 because of leakage of electricity

II. 0.20 because of defects in machinery,

III. 0.50 because of carelessness of workers and

IV. 0.75 because of sabotage.

Determine the most likely cause of explosion.

(Year 2000)

(20 Marks)

Q32. A manufacturer has distribution centers at Delhi, Kolkata and Chennai. These centers have available 30, 50 and 70 units of his product. His four retail outlets require the following number of units: A, 30; B, 20; C, 60; D, 40. The transportation cost per unit in rupees between each center and outlet is given in the following table: Determine the minimum transportation cost.

Distribution Centers	Retail outlets			
	A	B	C	D
Delhi	10	7	3	6
Kolkata	1	6	7	3
Chennai	7	4	5	3

(Year 2001)

(20 Marks)

Q33. Using duality or otherwise solve the linear programming problem

Maximize $z = 18x_1 + 12x_2$

Subjected to

$$2x_1 - 2x_2 \geq -3$$

$$3x_1 + 2x_2 \geq 3$$

$$x_1, x_2 \geq 0$$

(Year 2001)

(12 Marks)

Q34. Compute all basic feasible solutions of the linear programming problem:

Maximize $z = 2x_1 + 3x_2 + 2x_3$

Subjected to

$$2x_1 + 3x_2 - x_3 = 8$$

$$x_1 - 2x_2 + 6x_3 = -3$$

$$x_1, x_2, x_3 \geq 0$$

Hence indicate the optimal solution.

(Year 2001)

(12 Marks)

Q35. A company has 3 factories A, B and C which supply units to warehouses X, Y and Z. Every month the capacities of the factories per month are 60, 70 and 80 units. A, B and C respectively. The requirements of X, Y and Z are 50, 80 and 80 respectively. The necessary data in terms of unit transportation cost in rupees, factory capacities and warehouse requirements are given below:

Find the minimum distribution cost.

	X	Y	Z	
A	8	7	5	60
B	6	8	9	70
C	9	6	5	80
	50	80	80	210

(Year 2002)

(15 Marks)

Q36. Use the simplex method to solve the linear programming problem:

Maximize $z = 5x_1 + 3x_2$

Subjected to

$x_1 + x_2 \leq 2$

$5x_1 + 2x_2 \leq 10$

$3x_1 + 8x_2 \leq 12$

$x_1, x_2 \geq 0$

(Year 2002)

(15 Marks)

Q38. Find the optimal solution for the assignment problem with the following cost matrix:

Indicate clearly the rule you apply to arrive at the complete assignment.

$$\begin{pmatrix} 6 & 1 & 9 & 11 & 12 \\ 2 & 8 & 17 & 2 & 5 \\ 11 & 8 & 3 & 3 & 3 \\ 4 & 10 & 8 & 6 & 11 \\ 8 & 10 & 11 & 5 & 13 \end{pmatrix}$$

(Year 2003)

(15 Marks)

Q39. An animal feed company must produce 200 kg of a mixture consisting of ingredients X_1 and X_2 daily. X_1 costs Rs. 3 per kg and X_2 costs Rs. 8 per kg. No more than 80 kg of X_1 can be used, and at least 60 kg of X_2 must be used. Formulate a linear programming model of the problem and use Simplex method to determine the ingredients X_1 and X_2 to be used to minimize cost.

(Year 2003)

(15 Marks)

Q40. For the following system of equations

$$x_1 + x_2 + x_3 = 3$$

$$2x_1 - x_2 + 3x_3 = 4$$

Determine:

I. All basic solutions

II. All basic feasible solutions

III. A feasible solution which is not a basic feasible solution.

(Year 2003)

(15 Marks)

Q41. A department has 4 technicians and 4 tasks are to be performed. The technicians differ in efficiency and tasks differ in their intrinsic difficulty. The estimate of time (in hours), each technician would take to perform a task is given below. How should the task be allotted, one to a technician, so as to minimize the total work hours?

Technician \ Task	I	II	III	IV
A	8	26	17	11
B	13	28	4	26
C	38	19	18	15
D	19	26	24	10

(Year 2004)

(15 Marks)

Q42. A travelling salesman has to visit 5 cities. He wishes to start from a particular city, visit each city once and then return to his starting point. Cost of going from one city to another is given below: You are required to find the least cost route.

	A	B	C	D	E
A	∞	4	10	14	2
B	12	∞	6	10	4
C	16	14	∞	8	14
D	24	8	12	∞	10
E	2	6	4	16	∞

(Year 2004)

(15 Marks)

Q43. Use the simplex method to solve the linear programming problem:

Maximize $z = 3x_1 + 2x_2$

Subjected to

$x_1 + x_2 \leq 4$

$x_1 - x_2 \leq 2$

$x_1, x_2 \geq 0$

(Year 2004)

(12 Marks)

Q44. Use the simplex method to solve the problem:

Maximize $z = 5x_1 + 2x_2$

Subjected to

$$6x_1 + x_2 \geq 6$$

$$4x_1 + 3x_2 \geq 12$$

$$x_1 + 2x_2 \geq 4$$

$$x_1, x_2 \geq 0$$

(Year 2005)

(30 Marks)

Q45. Put the following program in standard form:

Maximize $z = 25x_1 + 30x_2$

Subjected to

$$4x_1 + 7x_2 \geq 1$$

$$8x_1 + 5x_2 \geq 3$$

$$6x_1 + 9x_2 \geq -2$$

$$x_1, x_2 \geq 0$$

(Year 2005)

(12 Marks)

Q46. Use the simplex method to solve the problem

Maximize: $u = 2x + 3y$

Subject to

$-2x + 3y \leq 2$

$3x + 2y \leq 5$

$x, y \geq 0$

(Year 2006)

(30 Marks)

Q47. Use the simplex method to solve the problem

Maximize: $u = 5x + 2y$

Subject to

$x + 3y \leq 12$

$3x - 4y \leq 9$

$7x + 8y \leq 20$

$x, y \geq 0$

(Year 2006)

(12 Marks)

Q48. Solve the following by Simplex method:

Maximize: $u = 4x + 3y$

Subject to

$$x + y \leq 1$$

$$x - 2y \leq 4$$

$$x, y \geq 0$$

(Year 2007)

(30 Marks)

Q49. Put the following in slack form and describe which of the variables are 0 at each of the vertices of the constraint set and hence determine the vertices algebraically:

Maximize: $Z = 4x + 3y$

Subject to

$$x + y \leq 4$$

$$-x + y \leq 2$$

$$x, y \geq 0$$

(Year 2007)

(12 Marks)

Q50. Solve the following transportation problem: by finding the initial solution by Matrix Minima Method (F – Factories, D – Destinations)

	D_1	D_2	D_3	D_4	D_5	D_6	**Availability**
F_1	2	1	3	3	2	5	50
F_2	3	2	2	4	3	4	40
F_3	3	5	4	2	4	1	60
F_4	4	2	2	1	2	2	30
Demand	30	50	20	40	30	10	180

(Year 2008)

(30 Marks)

Q51. Find the dual of the following linear programming problem:

Maximize $z = 2x_1 - x_2 + x_3$

Subjected to

$x_1 + x_2 - 3x_3 \leq 8$

$4x_1 - x_2 + x_3 = 2$

$2x_1 + 3x_2 - x_3 \geq 5$

$x_1, x_2, x_3 \geq 0$

(Year 2008)

(12 Marks)

Q52. Solve the following linear programming problem:

Maximize $z = 3x_1 + 5x_2 + 4x_3$

Subjected to

$2x_1 + 3x_2 \leq 8$

$3x_1 + 2x_2 + 4x_3 \leq 15$

$2x_2 + 5x_3 \leq 10$

$x_1, x_2, x_3 \geq 0$

(Year 2008)

(30 Marks)

Q53. A paint factory produces both interior and exterior paint from two raw materials M_1 and M_2. The basic data is as follows:

	Tons of raw material per ton of		Maximum Daily Availability
	Exterior Paint	Interior Paint	
Raw Material M1	6	4	24
Raw Material M2	1	2	6
Profit per ton (Rs. 1000)	5	4	

A market survey indicates that the daily demand interior paint cannot exceed that of the exterior paint by more than 1 ton. The maximum daily demand of interior paint in 2 tons. The factory wants to determine the optimum product mix of interior and exterior paint that maximizes daily profits. Formulate the LP problem for this situation.

(Year 2009)

(12 Marks)

Q54. Determine the optimal transportation programme so that the transportation cost of 340 tons of a certain type of material from three factories to five warehouses W_1, W_2, W_3, W_4 & W_5 is minimized. The five warehouses must receive 40 tons, 50 tons, 70 tons, 90tons and 90 tons respectively. The availability of the material F_1, F_2, F_3 is 100 tons, 120 tons, 120 tons respectively. The transportation costs per ton from factories to warehouses are given in the table below. Use Vogel's approximation method to determine the basic feasible solution.

	$\mathbf{W_1}$	$\mathbf{W_2}$	$\mathbf{W_3}$	$\mathbf{W_4}$	$\mathbf{W_5}$
$\mathbf{F_1}$	4	1	2	6	9
$\mathbf{F_2}$	6	4	3	5	7
$\mathbf{F_3}$	5	2	6	4	8

(Year 2010)

(30 Marks)

Q55. Construct the dual of the primal problem:

Maximize $z = 2x_1 + x_2 + x_3$

Subjected to

$x_1 + x_2 + x_3 \geq 6$

$3x_1 - 2x_2 + 3x_3 = 3$

$-4x_1 + 3x_2 - 6x_3 = 1$

$x_1, x_2, x_3 \geq 0$

(Year 2010)

(12 Marks)

Q56. Solve by Simplex method the following LP problem:

Maximize $z = 5x_1 + x_2$

Subjected to

$3x_1 + 5x_2 \leq 15$

$5x_1 + 2x_2 \leq 10$

$x_1, x_2 \geq 0$

(Year 2011)

(12 Marks)

Q57. Write down the dual of the following LP problem and hence solve it by graphical method:

Minimize $z = 6x_1 + 4x_2$

Subjected to

$2x_1 + x_2 \geq 1$

$3x_1 + 4x_2 \geq 1.5$

$x_1, x_2 \geq 0$

(Year 2011)

(20 Marks)

Q58. For each hour per day that Ashok studies mathematics, it yields him 10 marks and for each hour that he studies physics, it yields him 5 marks. He can study at most 14 hours a day and he must get at least 40 marks in each. Determine graphically how many hours a day he should study mathematics and physics each in order to maximize his marks?

(Year 2012)

(12 Marks)

Q59. By the method of Vogel, determine an initial basic feasible solution for the following transportation problem: Products P_1, P_2, P_3 & P_4 have to be sent of destinations D_1, D_2 & D_3. The cost of sending product P(i) to destinations D(j) is C(ij) where the matrix is:

$$C(ij) = \begin{bmatrix} 10 & 0 & 15 & 5 \\ 7 & 3 & 6 & 15 \\ 0 & 11 & 9 & 13 \end{bmatrix}$$

The total requirements of destinations D_1, D_2 & D_3 are given by 45, 45, 95 respectively and the availability of the products P_1, P_2, P_3 & P_4 are respectively 25, 35, 55 and 70.

(Year 2012)

(12 Marks)

Q60. Solve the following linear programming problem

Maximize $z = 5x_1 - 4x_2 + 6x_3 - 8x_4$

Subjected to the constraints

$$x_1 + 2x_2 - 2x_3 + 4x_4 \leq 40$$

$$2x_1 - x_2 + x_3 + 2x_4 \leq 8$$

$$4x_1 - 2x_2 + x_3 - x_4 \leq 10$$

$$x_1, x_2, x_3, x_4 \geq 0$$

(Year 2013)

(20 Marks)

Q61. Solve the minimum time assignment problem

	$\mathbf{M_1}$	$\mathbf{M_2}$	$\mathbf{M_3}$	$\mathbf{M_4}$
$\mathbf{J_1}$	3	12	5	14
$\mathbf{J_2}$	7	9	8	12
$\mathbf{J_3}$	5	11	10	12
$\mathbf{J_4}$	6	14	4	11

(Year 2013)

(15 Marks)

Q62. Solve the following linear programming problem:

Maximize $z = 2x_1 + 3x_2 - 5x_3$

Subjected to

$x_1 + x_2 + x_3 = 7$

$2x_1 - 5x_2 + x_3 \geq 10$

$x_1, x_2, x_3 \geq 0$

(Year 2013)

(10 Marks)

Q63. Find all optimal solutions of the following linear programming problem by the simplex method.

Maximize $z = 30x_1 + 24x_2$

Subjected to

$5x_1 + 4x_2 \leq 200$

$x_1 \leq 32$

$x_2 \leq 40$

$x_1, x_2 \geq 0$

(Year 2014)

(20 Marks)

Q64. Find the initial basic feasible solution of the following transportation problem using Vogel's approximation method and find the cost. (O – Origins, D – Destinations)

	D_1	**D_2**	**D_3**	**D_4**	**Supply**
O_1	6	4	1	5	**14**
O_2	8	9	2	7	**16**
O_3	4	3	6	2	**5**
Demand	**6**	**10**	**15**	**4**	

(Year 2014)

(20 Marks)

Q65. Solve graphically

Maximize $z = 6x_1 + 5x_2$

Subjected to

$2x_1 + x_2 \leq 16$

$x_1 + x_2 \leq 11$

$x_1 + 2x_2 \geq 6$

$5x_1 + 6x_2 \leq 90$

(Year 2014)

(20 Marks)

Q66. Solve the following linear programming problem by the simplex method. Write its dual. Also, write the optimal solution of the dual from the optimal table of the given problem:

Maximize $z = 2x_1 - 4x_2 + 5x_3$

Subjected to

$x_1 + 4x_2 - 2x_3 \leq 2$

$-x_1 + 2x_2 + 3x_3 \leq 1$

$x_1, x_2, x_3 \geq 0$

(Year 2015)

(20 Marks)

Q67. Consider the following linear problem

Maximize $z = x_1 + 2x_2 - 3x_3 + 4x_4$

Subjected to

$x_1 + x_2 + 2x_3 + 3x_4 = 12$

$x_2 + 2x_3 + x_4 = 8$

$x_1, x_2, x_3, x_4 \geq 0$

1. Using the definition, find its all *basic solutions*. Which of these are *degenerate basic feasible solutions* and which are *non-degenerate basic feasible solutions ?*
2. Without solving the problem, show that it has an optimal solution and which of the *basic feasible solution(s)* is/are *optimal ?*

(Year 2015)

(20 Marks)

Q68. Solve the following assignment problem to maximize the sales.

X axis: Territories Y axis: Salesmen	**I**	**II**	**III**	**IV**	**V**
A	3	4	5	6	7
B	4	15	13	7	6
C	6	13	12	5	11
D	7	12	15	8	5
E	8	13	10	6	9

(Year 2015)

(10 Marks)

Q69. Maximize $z = 2x_1 + 3x_2 + 6x_3$

Subjected to

$2x_1 + x_2 + x_3 \leq 5$

$3x_2 + 2x_3 \leq 6$

$x_1, x_2, x_3 \geq 0$

Is the optimal solution unique? Justify your answer..!

(Year 2016)

(20 Marks)

Q70. Using graphical method, find the maximum values of $(5x + 2y)$ subject to

$x + 2y \geq 1$

$2x + y \leq 1$

$x, y \geq 0$

(Year 2016)

(10 Marks)

Q71. Find the initial basic feasible solution of the following transportation problem using Vogel's approximation method and find the cost. (O – Origin, D – Destination)

	D_1	D_2	D_3	D_4	D_5	
O_1	4	7	0	3	6	**14**
O_2	1	2	-3	3	8	**9**
O_3	3	-1	4	0	5	**17**
	8	**3**	**8**	**13**	**8**	

(Year 2017)

(15 Marks)

Q72. Solve the following linear programming problem by simplex method:

Maximize $z = 3x_1 + 5x_2 + 4x_3$

Subject to

$$2x_1 + 3x_2 \leq 8$$

$$2x_2 + 5x_3 \leq 10$$

$$3x_1 + 2x_2 + 4x_3 \leq 15$$

$$x_1, x_2, x_3 \geq 0$$

(Year 2017)

(20 Marks)

Q73. Using graphical method, find the maximum values of $(2x + y)$ subject to

$$4x + 3y \leq 12$$

$$4x + y \leq 8$$

$$4x - y \leq 8$$

$$x, y \geq 0$$

(Year 2017)

(10 Marks)

Q74. An agriculture firm has 180 tons of nitrogen fertilizer, 250 tons of phosphate and 220 tons of potash. It will be able to sell a mixture of these substances in their respective ratio 3:3:4 at a profit of Rs. 1500 per ton and a mixture in the ratio 2:4:2 at a profit of Rs. 1200 per ton. Pose a linear programming problem to show how many tons of these two mixtures should be prepared to obtain the maximum profit.

(Year 2018)

(10 Marks)

Q75. Solve the following linear programming problem by Big-M method and show that the problem has finite optimal solutions. Also find the value of the objective function:

Minimize: $z = 3x_1 + 5x_2$

Subject to

$x_1 + 2x_2 \geq 8$

$3x_1 + 2x_2 \geq 12$

$5x_1 + 6x_2 \leq 60$

$x_1, x_2 \geq 0$

(Year 2018)

(20 Marks)

Q76. In a factory there are five operators O_1, O_2, O_3, O_4, O_5 and five machines M_1, M_2, M_3, M_4, M_5. The operating costs are given when O_i operator operates the M_j machine (I, j = 1, 2, …. 5). But there is a restriction that O_3 cannot be allowed to operate the third machine M_3 and O_2 cannot be allowed to operate the fifth machine M_5. The cost matrix is given above. Find the optimal assignment and the optimal assignment cost also.

		Machine				
		M_1	M_2	M_3	M_4	M_5
	O_1	24	29	18	32	19
	O_2	17	26	34	22	21
Operator	O_3	27	16	28	17	25
	O_4	22	18	28	30	24
	O_5	28	16	31	24	27

(Year 2018)

(15 Marks)

Q77. Solve the following linear programming problem by Graphical method:

Minimize: $z = 3x_1 + 2x_2$

Subject to

$$x_1 - x_2 \geq 1$$

$$x_1 + x_3 \geq 3$$

$$x_1, x_2, x_3 \geq 0$$

(Year 2019)

(10 Marks)

Q78. Consider the following linear programming problem

Maximize $z = x_1 + 2x_2 - 3x_3 - 2x_4$

Subjected to

$$x_1 + 2x_2 - 3x_3 + x_4 = 4$$

$$x_1 + 2x_2 + x_3 + 2x_4 = 4$$

$$x_1, x_2, x_3, x_4 \geq 0$$

(Year 2019)

(15 Marks)

Q79. Consider the following linear programming problem

Maximize $z = 2x_1 + 4x_2 + 4x_3 - 3x_4$

Subjected to

$$x_1 + x_2 + x_3 = 4$$

$$x_1 + 4x_2 + x_4 = 8$$

$$x_1, x_2, x_3, x_4 \geq 0$$

Use the dual problem to verify that the basic solution (x_1, x_2) is not optimal.

(Year 2019)

(10 Marks)