KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Marks scored:

Level : B.Sc.
Year : III

Course : MATH 303
Semester : I

Exam Roll No. : Time: 30 mins. F. M. : 20

Registration No.: Date : 06 MAR 2019

SECTION "A"
[10Q. × 1 = 10 marks]

Fill in the blank space(s) with the most appropriate word(s) or symbol(s).

1. The objective function of the primal Max Z = $\sum_{j=1}^{n} C_j X_j$ where b_i are the resources has the dual objective function ....

2. One application of convex hull is ....

3. The number of primal constraints reflects the number of .... of dual LP-problem.

4. The solution of LP-problem which tends to infinity then the problem is said to have .... solution.

5. Fathom is the terminology of ....

6. Effect of changes of cost/profit coefficient of objective function or in column matrix b on the optimal solution of the LP is called ....

7. If S be a set of vectors in $\boldsymbol{E^n}$, then the set of all convex combinations of every finite subset of S is called .... of set S.

8. The method in which auxiliary objective function is formed first is called ....

9. .... is the rate at which objective function improves if b_i corresponding to S_i is increased by a unit amount.

10. Mathematical measure of our aim in the linear programming problem is called ....

SECTION "B"
[10Q. × 1 = 10 marks]

Fill in the blank space(s) (**Q. N. 11 through 20**) by choosing the most appropriate answers from among the given ones. Do not tick the answers.

11. If for a given solution the value of surplus comes out to be non-zero then it indicates that...
    (i) The solution is optimal
    (ii) The solution is infeasible
    (iii) The entire amount of resource with the constraint in which the slack variable appears has been consumed.
    (iv) The shortage of resources.

12. If any basic variable in the optimal table is zero then the problem is said to have .... solution.
   (i) Non-degenerate
   (ii) Unbounded
   (iii) Degenerate
   (iv) Alternative solution

13. To convert $\geq$ inequality constraints into equality constraints, we must ....
   (i) Add a surplus variable
   (ii) Subtract an artificial variable
   (iii) Subtract a surplus variable and an artificial variable
   (iv) Add a surplus variable and subtract an artificial variable.

14. Which of the following is not the terminology of integer programming problem ....
   [Gomary constraint, Fathom, alternative solution, branch and bound]

15. A non-integer variable is chosen in the optimal simples table of the integer LP problem to ....
   (i) Leave the basis
   (ii) Enter the basis
   (iii) To construct a Gomory's cut
   (iv) Make branch and bound

16. Sensitivity analysis provides the range within which a parameter may change without offering ....
   (i) Old optimality
   (ii) New optimality
   (iii) Feasibility
   (iv) Ifeasibility

17. The extreme point graphical method of LP problem uses ....
   (i) Objective function equation
   (ii) Constraints equations
   (iii) Linear equations
   (iv) All of above three

18. For any primal problem and its dual ....
   (i) Optimal value of objective functions is same
   (ii) Primal will have an optimal solution if and only if dual does too,
   (iii) Both primal and dual con not be infeasible,
   (iv) Primal will have optimal solution but not dual

19. For a maximization problem the auxiliary objective function for two phase method is ....
   [Positive sum of artificial variables, -ve sum of artificial variables, Zero, $\pm$ of artificial variables]

20. Reduced cost of the linear programming problem always ....
   (i) Improves the objective function
   (ii) Worsens the objective function
   (iii) Modified the objective function
   (iv) Nothing can be said

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SECTION "C"
[3Q. × 7 = 21 marks]

1. LG Company has been a producer of picture tubes for television sets and certain printed circuits for radios. The company has just expanded into full scale production and marketing of AM and AM-FM radios. It has built a new plant that can operate for 48 hours per week. Production of an AM radio will require 2 hours and AM-FM radio will require 3 hours. Each AM radio will contribute Rs. 40 to profits while an AM-FM radio will contribute Rs. 80 to profits. The marketing department, after extensive research, has determined that a maximum of 15 AM radios and 10 AM-FM radios can be sold each week. [3.5+3.5]
   (i) Set up the mathematical model for the production mix of AM-FM radios.
   (ii) Find from the graphical method, the number of AM and AM-FM radios that maximize the total profit.

2. For the linear programming problem Minimize Z = $x_2 - 3x_3 + 2x_5$ subject to
   $3x_2 - x_3 + 2x_5 \le 7$
   $-2x_2 + 4x_3 \le 12$
   $-4x_2 + 3x_3 + 8x_5 \le 10$
   $x_2, x_3, x_5 \ge 0$
   Whose optimal table is

		C_j	1	-3	2	0	0	0
C_B	Basis	$X_B = b$	x_2	x_3	x_5	s_1	s_2	s_3
1	x_2	4	1	0	4/5	2/5	1/10	0
-3	x_3	5	0	1	2/5	1/5	3/10	0
0	s_3	11	0	0	10	1	-1/2	1
		$Z_j - C_j$	0	0	-12/5	-1/5	- 4/5	0

   Find the ranges within which C_2, the coefficient of non-basic variable can be varied without altering this current optimal solution. Also find the range of b_2 retaining the optimal solution. [3.5+3.5]

3. Linear programming problem: Maximize $Z = 5x_1 + 3x_2$ subject to the constraints $3x_1 + 5x_2 \le 15; 5x_1 + 2x_2 \le 10;$ $x_1, x_2, \ge 0$ has the following optimal table:

C_j			5	3	0	0
C_B	B	X_B	x_1	x_2	s_1	s_2
4	x_2	237/100	0	1	13/50	-4/25
2	x_1	21/25	1	0	-11/100	$-13/50$
$Z_j - C_j = 1237/100$			0	0	13/50	$21/25$

   Find the integer solution of this linear programming problem by using Gomory's Method.

OR

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Find the solution for the primal with the help of the solution of the following dual LP-problem:

$Maximize\ Z = 10y_1+20y_2 + 12y_3$ subject to the constraints

$7y_1+5y_2 + 2y_3 \leq 3$

$2y_1+4y_2 + 8y_3 \leq 2$

$y_1, y_2, y_3 \geq 0$

SECTION "D"

[5Q. × 6 = 30 marks]

4. Solve the following LP- problem by using the dual simplex method:

$Maximize\ Z = -3x_1 - 2x_2$ subject to the constraints

$x_1 + x_2 \geq 1$

$x_1 + x_2 \leq 7$

$x_1 + 2x_2 \geq 1$

5. State the general formula for linear programming problem and show by using the big-M method that the following linear programming problem has the unbounded solution.

$Maximize\ Z = 5x_1 + 7x_2$ subject to the constrains

$2x_1 - 2x_2 \geq 2$

$2x_1 + 2x_2 \geq 8$

$x_1, x_2 \geq 0$

6. Show that the necessary and sufficient condition for a set S to be convex is that every convex linear combination of points in S belongs to S.

OR

Solve the following LP-problem by two-phase method:

$Minimize\ z = 7.5x_1 - 3x_2$ subject to the constrains

$3x_1 - x_2 - x_3 \geq 3$

$x_1 - x_2 + x_3 \geq 2$

$x_1, x_2 \geq 0$

7. Solve the following LP problem by using the big-M method:

$Maximize\ Z = 6x_1 + 4x_2$ Subject to the constraints

$2x_1 + 3x_2 \geq 30$

$3x_1 + 2x_2 \leq 24$

$x_1, x_2 \geq 0$

8. Prove that Intersection of infinitely many convex sets is convex set.

SECTION "E"

[2Q. × 2 = 4 marks]

9. Discuss (i) Convex hull and (ii) Hyper plane.

10. State weak duality theorem.