SEMESTER 3

ME010305-OPTIMIZATION TECHNIQUES

1. In an LPP
   A. The objective function must be linear
   B. All the constraints must be linear
   C. Both A and B are true
   D. None of the above
2. In a less than or equal to constraint equation, variable which is used to balance both side of the equation is called
   A. condition variable
   B. Slack Variable
   C. Surplus Variable
   D. Artificial Variable
3. In simplex method, we add --------------- variables in the case of equality constraints.
   A. Slack Variables
   B. Surplus Variables
   C. Artificial Variables
   D. None of the above
4. If in an LPP a variable x is unrestricted in sign, when we write the LPP in standard form it can be replaced by two variables $x'$and x'' such that
   A. $x = x' + x'',\ x' \geq 0, x'' \leq 0$
   B. $x = x' + x'', x' \geq 0, x'' \leq 0$
   C. $x = x' - x'',\ x' \leq 0, x'' \geq 0$
   D. $x = x' - x'',\ x' \geq 0, x'' \geq 0$
5. If in an LPP, the value of a variable can be made infinity large without violating the constraints, then the solution is -------------------
   A. Infeasible
   B. Alternative
   C. Unbounded

D. None of the above

6. The existence of more than one solution to a linear programming problem implies the existence of
   A. Infinite number of optimal solutions
   B. Finite number of optimal solutions
   C. unbounded solution
   D. infeasible solution
7. Minimize Z=
   A. – Maximize Z
   B. – Maximize (-Z)
   C. Maximize (-Z)
   D. None of the above
8. If the value of the objective function can be increased or decreased indefinitely, such solution is called
   A. Feasible solution
   B. Bounded solution
   C. Unbounded solution
   D. Infeasible solution
9. The coefficient of a slack variable in the objective function is
   A. 1
   B. 0
   C. +M
   D. -M
10. The coefficients of the variables in the objective function of an LPP are called
    A. structural coefficients
    B. cost coefficients
    C. stipulations
    D. simplex coefficients
11. Any feasible solution which optimizes the objective function of an LPP is called its
    A. Basic feasible solution
    B. feasible solution

C. Optimum solution
D. None of these

12. In an LPP a basic solution satisfying the non-negativity conditions is called
    A. Basic feasible solution
    B. Basic solution
    C. Optimum solution
    D. Feasible Solution
13. In an LPP, any set of values of decision variables that satisfies the linear constraints and non-negativity conditions is called a
    A. Basic feasible solution
    B. Basic solution
    C. Optimum solution
    D. Feasible Solution
14. If there are m constraints and n variables in an LPP which of the following is true?
    A. $m = n$
    B. $m < n$
    C. $m > n$
    D. None
15. Which of the following is true?
    A. Every LP problem has at least one optimal solution
    B. Every LP problem has a unique solution
    C. If an LP problem has two optimal solutions, then it has infinitely many solutions.
    D. If a feasible region is unbounded then LP problem has no solution
16. A degenerate solution is one that
    A. has non-zero values for non-basic variables
    B. has zero value to one or more of the basic variables
    C. has one or more non-zero basic variables
    D. satisfies only the linear constraints of the LPP
17. Which method is used to solve the LP problems in primal infeasible and dual feasible situation?
    A. Simplex method

B. Dual Simplex method

C. Big-M method

D. Graphical Method

18. If either the primal or the dual has ----------- solution, then the solution to the other is infeasible.

A. unbounded optimum

B. bounded optimum

C. feasible

D. infeasible

19. Every LPP is associated with another LPP called -----------

A. Primal

B. Dual

C. Non- linear Programming

D. None of the above

20. If a primal LPP has n variables and m constraints then the dual LPP has

A. m+n constraints and m-n variables

B. m constraints and n variables

C. n constraints and m variables

D. m-n constraints and m+n variables

21. If the i^{th} constraint of a primal LP problem is of ≥ type, then which of the following is true about the dual variable y_i?

A. $y_i \geq 0$

B. y_i is unrestricted in sign

C. $y_i \leq 0$

D. $y_i = 0$

22. The value of the objective function $f(X)$ for any feasible solution of the primal is ----------- the value of the objective function $\phi(Y)$ for any feasible solution of the dual.

A. ≤

B. =

C. ≠

D. ≥

23. The optimum value of the objective function $f(X)$ of the primal if it exists is ---------- the optimum value of the objective function $\phi(Y)$ of the dual.

A. $\leq$

B. $\geq$

C. =

D. $\neq$

24. The dual of the dual

A. is primal

B. is self-dual

C. is primal-dual

D. does not exist

25. If the ith constraint of a primal LP problem is of equality type, then which of the following is true about the dual variable y_i?

A. y_i is unrestricted in sign

B. $y_i \geq 0$

C. $y_i \leq 0$

D. $y_i = 0$

26.Types of integer programming models are ______________

A) total
B) 0 - 1
C) mixed
D) all of the above

27.Which of the following is not an integer linear programming problem?

A) pure integer
B) mixed integer
C) 0-1integer
D) Continuous

28. If a maximization linear programming problem consist of all less-than-or-equal-to constraints with all positive coefficients and the objective function consists of all positive objective function coefficients, then rounding down the linear programming optimal solution values of the decision variables will ______ result in an optimal solution to the integer linear programming problem.

A) always

B) sometimes

C) never

D)all the wbove

29. If the optimal solution to the linear programming relaxation problem is integer, it is _____________ to the integer linear programming problem.

A) a real solution
B) a degenerate solution
C) an infeasible solution
D) the optimal solution

30.In cutting plane algorithm, each cut which is made involves the introduction of

A. An '=' constraint

B. An artificial variable

C. A '≤' constraint

D. A '≥' constraint

31.Which of the following effects does the addition of a Gomory have?

(i) adding a new variable to the tableau;

(ii) elimination of non-integer solutions from the feasibility region;

(iii) making the previous optimal solution infeasible by eliminating that part of the feasible region which contained that solution.

A) (i) only
B) (i) and (ii) only
C) (i) and (iii) only
D) All the above

32. Mark the incorrect statement about Branch and Bound method.

A) It is not a particular method and is used differently in different kinds of problems.
B) It is generally used in combinatorial problems.
C) It divides the feasible region into smaller parts by the process of branching.
D) It can be used for solving any kind of programming problem

33.Solving an integer programming problem by rounding off answers obtained by solving it as a linear programming problem (using simplex), we find that

A) The values of decision variables obtained by rounding off are always very close to the optimal values.
B) The value of the objective function for a maximization problem will likely be less than that for the simplex solution.
C) The value of the objective function for a minimization problem will likely be less than that for the simplex solution.
D) All constraints are satisfied exactly.

34.When using the branch and bound method in integer programming maximization problem, the stopping rule for branching is to continue until

A) The objective function is zero.
B) The new upper bound exceeds the lower bound.
C) The new upper bound is less than or equal to the lower bound or no further branching is possible.
D) The lower bound reaches zero.

35.1. Branch and bound is a ___________

A) Problem solving technique
B) Data structure
C) Sorting algorithm
D) Type of tree

36.In a Branch-and-Bound problem, if X1 = 5 and X2 = 3.7, then which of the following would be a possible branching option?

A) $X2 \leq 4$
B) $X2 \geq 4$
C) $X1 \leq 5$
D) $X2 \geq 3$

37. In a branch and bound technique the number of decision variables is only___________

A) 1
B) 2
C) 3
D) 4

38.Who developed Cutting plane algorithm?

A) Ralph. E. Gomory
B) A. G . Doyng
C) A. H. Land
D) E. Balas

39.In a Branch-and-Bound problem, if X1 = 5 and X2 = 2.5, then which of the following would be a possible branching option?

A) $X2 \leq 2$

B) $X2 \geq 2$
C) $X1 \leq 3$
D) $X2 \geq 1$

40.The additional constraints in an ILPP is called

A) Node
B) Cut
C) Fathomod
D) All the above

41.Cutting plane methods can be applied for ___________ problems.

A) Only LP
B) Only ILP
C) Only MILP
D) Both ILP and MILP

42.In 0-1 programming problem,at any node of the tree,a binary variable is said to be called ___________ variable.

A) Free
B) Complex
C) Point
D) JiNone of the above.

43.Mark the correct statement about integer programming problems (IPPs):

A) Pure IPPs are those problems in which all the variables are negative integers.
B) The 0-1 IPPs are those in which all variables are either 0 or all equal to 1.
C) Mixed IPPs are those where decision variables can take integer values only but the slack/surplus variables can take fractional values as well.
D) In real life, no variable can assume fractional values.

44.Consider the following problem: Max. $Z = 28x1 + 32x2$, subject to $5x1 + 3x2 \leq 23$, $4x1 + 7x2 \leq 33$, and $x1 \geq 0$, $x2 \geq 0$. This problem is:

A) A pure IPP.
B) A 0-1 IPP.
C) A mixed IPP.
D) Not an IPP.

45.The number of constraints allowed in an integer linear program is which of the following?

A) 1
B) 2
C) 3
D) None of the above

46. Which of the following is true for an ILPP?

A) All variables are positive integers.
B) All variables are negative integers.
C) All variables are real numbers.
D) There is no restriction for variables.

47. Mark the correct statement about MILPP

A) All variables are integers
B) Some of the variables are integers.
C) There is no restriction for variables
D) Variables may be either 1 or 0

48. Ralph. E. Gomory invented

A) Graphical method
B) Branch and bound technique
C) Cutting plane method
D) Maximum flow problem

49.Branch and bound method was first proposed by

A) A. H. Land and A. G. Doig
B) Ralph .E.Gomory
C) E.Balas
D) None of the above

50.Graphical method is used to solve

A) Only Linear programming problems
B) Only integer linear programming problems
C) Only mixed integer linear programming problems
D) All the above

51. A graph with directed arcs is called………………………..

a. Undirected graph

b. Directed graph

c. Induced graph

d. None of the above

52. Every path is a …………………..

a. Circuit

b. Cycle

c. Chain

d. None of the above

53. A graph G(V,U) is finite if

a. V and U are finite

b. V is finite

c. U is infinite

d. None of the above

54. A connected graph has …………….components

a. 0

b. 1

c. 2

d. 3

55. ………………………is a cycle in which all the arcs are directed in the same sense

a. Circuit

b. Path

c. Cycle

d. None of the above

56. A tree is a connected graph with atleast 2 vertices and ………………….

a. Cycles

b. No cycles

c. No path

d. None of the above

57. A tree with n vertices has ………….. arcs.

a. n

b. n-1

c. n-2

d. n+1

58. A graph is ……………………….. if there is a path connecting every pair of vertices in it.

a. Weakly connected

b. Connected

c. Cycle

d. Strongly connected

59. Minimum path problem is to find the path of ……………..

a. Longest length

b. Equal length

c. Smallest length

d. None of the above

60. Every …………….. of a strongly connected graph is a center.

a. Arc

b. Path

c. Cycle

d. Vertex

61. A tree can at the most have only ……………..centre.

a. 0

b. 1

c. 2

d. 3

62. A tree with a ………….. is called arborescence.

a. Path

b. Cycle

c. Circuit

d. Center

63. Spanning tree problem is to find the spanning tree of …………… length

a. equal

b. unequal

c. minimum

d. None of the above

64. If u_i=(v_j, v_k) is an arc, then ……………is the potential difference of the arc u_i

a. f_k

b. f_j

c. f_j- f_k

d. f_k- f_j

65. The potential difference in a cycle is …………

a. 2

b. 1

c. 3

d. 0

66. If the arcs are undirected, …………….for all arcs.

a. $x_{kj} = x_{jk}$

b $x_{kj} \neq x_{jk}$

c. $x_{kj} = x_{jk} + 1$

d. None of the above

67. In terms of potential, the constraints $x_{jk} \leq c_{jk}$ can be put as ……………..

a. $f_k - f_j \leq 0$

b. $f_k - f_j \leq c_{jk}$

c. $f_k - f_j \leq -c_{jk}$

d. None of the above

68. Critical path problem is to find the …………………….with arc length c_{jk}.

a. equal length

b. unequal length

c. minimum length

d. maximum length

69. The problem of maximum flow is to find a flow such that x_0 is maximum subject to …………

a. $0 \leq x_i \leq c_i$

b. $0 \leq x_i$

c. $x_i \leq c_i$

d. None of the above

70. If in the graph G(V,U) of the maximum flow problem, $W_2 \subseteq V$ such that $v_b \in W_2$ and $v_a \notin W_2$, then $\Omega^+(W_2)$ is a ……………

a. vertex

b. cut

c. edge

d. None of the above

71. Capacity of a cut is the ………….. of the capacities of the arcs contained in the cut.

a. product

b. quotient

c. sum

d. none of the above

72. For any feasible flow $\{x_i\}$ i=1,2,…m in the graph, the flow x_0 in the return arc is not ……………..the

capacity of any cut in the graph.

a. greater than

b. less than

c. equal to

d. None of the above

73. Max Flow Min Cut theorem states that ………………

a. Maximum flow of a graph = minimum of the capacities of all possible cuts in it

b. Maximum flow of a graph ≠ minimum of the capacities of all possible cuts in it

c. Maximum flow of a graph > minimum of the capacities of all possible cuts in it

d. Maximum flow of a graph < minimum of the capacities of all possible cuts in it

74. The generalized problem of maximum flow is to find a flow $\{x_i\}$ in G such that x_0 is maximum subject

to …………

a. $0 \leq x_i \leq c_i$

b. $0 \leq x_i$

c. $x_i \leq c_i$

d. $b_i \leq x_i \leq c_i$

75. Spanning tree T of a graph G has vertex set ………………….

a. V(T)=V(G)

b. V(T)<V(G)

c. V(T)>V(G)

d. None of the above

76) The optimal solution to a Non-Linear Programming Problem can occur at

A. Extreme point
B. Point interior to the feasible region
C. Point of discontinuity
D. Any of the above

77) A Non-Linear Programming Problem can have

A. Linear objective function and non-linear constraints
B. Non-linear objective function and linear constraints
C. Non-linear objective function and non-linear constraints
D. Any of the above

78) What is the condition for a constrained non-linear programming problem to have one maximizing solution.

A. Objective function is concave and constraint set forms a convex region
B. Objective function is concave and constraint set forms a concave region
C. Objective function is convex and constraint set forms a concave region
D. Objective function is convex and constraint set forms a convex region

79) What is the condition for a constrained non-linear programming problem to have one global minimizing solution.

A. Objective function is concave and constraint set forms a convex region
B. Objective function is concave and constraint set forms a concave region
C. Objective function is convex and constraint set forms a concave region
D. Objective function is convex and constraint set forms a convex region

80) In Taylor's series expansion which of the following conditions are sufficient for a function f to have a local minimum at x*.

((∇f)* - Gradient vector at the point x*

H*(x) – Hessian matrix at the point x*)

A. (∇f)*=0, | H*(x) | is positive definite
B. (∇f)*=0, | H*(x) | is negative definite
C. (∇f)*=0, | H*(x) | is indefinite
D. (∇f)*≠0, | H*(x) | is negative definite

81) In Taylor's series expansion which of the following conditions are sufficient for a function f to have a local maximum at x*.

((∇f)* - Gradient vector at the point x*

H*(x) – Hessian matrix at the point x*)

A. (∇f)*=0, | H*(x) | is positive definite
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C. (∇f)*=0, | H*(x) | is indefinite
D. (∇f)*≠0, | H*(x) | is negative definite

82) Which method can be used to solve constrained multivariate non-linear programming problem.

A. Lagrange Multiplier Method
B. Taylor's Expansion Method
C. Golden Section Search Method
D. Hooke & Jeeves Method

83) What conditions are required for applying Fibonacci Search Method.

A. Non-linear constrained objective function of one variable
B. Non-linear unconstrained objective function of multi variable
C. Non-linear unconstrained objective function of one variable
D. Non-linear constrained objective function of multi variable

84) A linear function is

A. Concave but not convex
B. Convex but not concave
C. Neither concave nor convex
D. Both concave and convex

85) A function is concave if

A. A line drawn connecting any two points on the surface of the function lies above that function.
B. A line drawn connecting any two points on the surface of the function lies below that function.
C. It is always positive
D. A line drawn connecting any two points on the surface of the function intersects the function at least once.

86) Consider Min f(x) such that

$$g_j(x) \geq 0 , \; j = 1, 2, \ldots, m.$$

The Kuhn-Tucker conditions for the above problem are also sufficient if

A. f(x) is concave and all $g_j(x)$ is convex
B. f(x) is convex and all $g_j(x)$ is concave
C. f(x) and $g_j(x)$ are all concave
D. f(x) and $g_j(x)$ are all convex

87) A problem is convex programming problem if

A. The objective function is convex and constraints are linear
B. The objective function is linear and constraints are convex
C. The objective function is concave and constraints are linear
D. The objective function is linear and constraints are concave

88) Lagrange multipliers method convert

A. Inequality constrained optimization problem into equality constrained optimization problem
B. Equality constrained optimization problem into unconstrained optimization problem
C. Equality constrained optimization problem into inequality constrained optimization problem
D. Inequality constrained optimization problem into unconstrained optimization problem

89) what is the length of the interval of uncertainty after 2 functional evaluations (L_2) in golden search method? (N = Number of experiments)

A. $L_2 = \frac{F_{N-1}}{F_N} L_0$
B. $L_2 = \frac{F_N}{F_{N-1}} L_0$
C. $L_2 = \frac{L_0}{F_{N-1}}$
D. $L_2 = \frac{F_{N-2}}{F_N} L_0$

90) Select the correct option.

A. Fibonacci search method is used to find the maximum / minimum of a non-linear, unconstrained multivariate objective function.
B. The exploratory search phase in Hooke & Jeeves algorithm establishes a direction of improvement in the solution.
C. The objective function of the Fibonacci search method is to increase the value of the resolution parameter (ε).
D. Golden section search method requires prior information about resolution parameter (ε) and number of experiments to be performed (N)

91) Sufficient conditions for a univariate function f to have a local maximum at the point x* is

A. $\left(\frac{df}{dx}\right)^* = 0$ and $\left(\frac{d^2f}{df^2}\right) \geq 0$
B. $\left(\frac{df}{dx}\right)^* > 0$ and $\left(\frac{d^2f}{df^2}\right) \geq 0$
C. $\left(\frac{df}{dx}\right)^* = 0$ and $\left(\frac{d^2f}{df^2}\right) < 0$
D. $\left(\frac{df}{dx}\right)^* < 0$ and $\left(\frac{d^2f}{df^2}\right) < 0$

92) If the objective function of unconstrained non-linear programming problem is convex then

A. Unique optimum solution exists
B. Unique optimization solution exists in the exterior of feasible region

C. Multiple solutions exist
D. Unique optimum solution exists in the interior of the feasible region where all derivatives doesn't vanish.

93) Sufficient conditions for a univariate function f to have a local maximum at the point x* is
A. $\left(\frac{df}{dx}\right)$* = 0 and $\left(\frac{d^2f}{df^2}\right) > 0$
B. $\left(\frac{df}{dx}\right)$* > 0 and $\left(\frac{d^2f}{df^2}\right) > 0$
C. $\left(\frac{df}{dx}\right)$* = 0 and $\left(\frac{d^2f}{df^2}\right) < 0$
D. $\left(\frac{df}{dx}\right)$* < 0 and $\left(\frac{d^2f}{df^2}\right) < 0$

94) Which of the following is a concave function?
A. $f(x) = 10^x$
B. $f(x) = (x + 1)^2$
C. $f(x) = -x^2$
D. $f(x) = e^x$

95) A Hessian nxn matrix is positive definite if
(D_i is the leading principal minor)
A. $D_i > 0$, I =1, 2, …, n
B. $D_{j[} < 0$, j =1, 3, 5, …
$D_j > 0$, j =2, 4, 6, …
C. $D_j > 0$, j =1, 3, 5, …
$D_j < 0$, j =2, 4, 6, …
D. $D_i < 0$, I =1, 2, …, n

96) Consider the complementary problem

w = Mz+q
w, z ≥ 0
w'z = 0

where M is an (nxn) matrix and w, z, q are n-dimensional column vectors and w' is the transpose of w. The problem has a complementary solution if
A. All the elements of M are positive
B. The matrix M is positive definite
C. All the principal determinants of M are positive
D. Any of the above

97) When minimizing a concave function, the optimal solution

A. Doesn't exist
B. Exist and found at one of the extreme points of the constraint set
C. Exist and found at the exterior of the feasible region
D. Exist and is always positive

98) A function increases (decreases) to a certain point and then decreases (increases) monotonically is called

A. Multimodal function
B. Convex function
C. Concave function
D. Unimodal function

99) Consider the problem Min $f(x) = -x^2 - 2x + 8$. The point $x = -1$ is

A. Local minimum
B. Local maximum
C. Neither local minimum nor local maximum
D. Global minimum

100) Let M = $\begin{bmatrix} 1 & 1 & 2 \\ 3 & 4 & -1 \\ 0 & 7 & -2 \end{bmatrix}$. M is

A. Positive definite
B. Negative definite
C. Indefinite
D. Negative semidefinite.

ANSWER KEY

1. C
2. B
3. C
4. D
5. C
6. A
7. C
8. C
9. B
10. B
11. C
12. A
13. D
14. B
15. C
16. B
17. B
18. A
19. B
20. C
21. A
22. D
23. C
24. A
25. A

26. D

27. D

28. B

29. D

30. B

31. B

32. D

33. A

34. C

35. A

36. B

37. B

38. A

39. A

40. B

41. D

42. A

43. B

44. D

45. D

46. A

47. B

48. C

49. A

50. D

51. B

52. C

53. A

54. B

55. A

56. B

57. B

58. D

59. C

60. D

61. B

62. D

63. C

64. D

65. D

66. A

67. B

68. D

69. A

70. B

71. C

72. A

73. A

74. D

75. A

76.D

77.D

78.A

79.D

80.A

81.B

82.A

83.C

84.D

85.B

86.B

87.A

88.B

89.A

90.B

91.C

92.A

93.A

94.C

95.A

96.D

97.B

98.D

99.B

100.A