MULTIPLE CHOICE QUESTIONS

M.Sc MATHEMATICS

SEMESTER IV

ME800402: ALGORITHMIC GRAPH THEORY

1. Every graph contains an even number of -------vertices.

   A) Even B) odd C) 2 D)1

2. If a graph G is r- regular of order p

   A) $0 < r < p$ B) $r > p$ C) $0 \leq r \leq p-1$ D) $0 \leq r \leq p$

3. A graph G is r-regular if

   A) Every vertex is of degree r B)every vertex is of degree r-1 C)every vertex is of degree< r D)None

4. In a graph G, sum of the degree of the vertices is equal to

   A) The number of edges B)the number of vertices C)twice the number of edges D)thrice the number of edges

5. Two graphs are equal if

   A) $V(G_1)= V(G_2)$ B) $E(G_1)= E(G_2)$ C) Both A and B D)None

6. A subgraph H of a graph G is a spanning subgraph of G if

   A) $V(H)= V(G)$ B) $V(H) \subseteq V(G)$ C) $V(H) \supseteq V(G)$ D) $V(H) \supset V(G)$

7. A trail is a walk in which

   A) No vertex is repeated

   B) No edge is repeated

   C) No vertex and no edge is repeated

   D) None of these

8. A non-trivial closed trail is a

   A) cycle B) closed walk C) circuit D) Semi walk

9. A vertex v in a graph G is called a cut vertex if

   A) $k(G-v) > k(G)$ B) $k(G-v) < k(G)$ C) $k(G-v) = 0$ D) None of these

10. An edge of a graph G is called a bridge if

    A) $K(G-e) > k(G)$ B) $k(G-e) < k(G)$ C) $k(G-e) = k(G)$ D) None of these

11. A non trivial connected graph without cut vertex is called a

    A) Non-separable graph

    B) block

    C) separable graph

    D) None of these

12. A non separable graph has

    A) Two blocks B) one block C)more than two blocks D) None

13. If e is a bridge of G, then G-e contains

    A) exactly one component

    B) exactly two components

    C) exactly three components

    D) None of these

14. A graph of order p in which every two distinct vertices are adjacent is a

    A) bipartite graph B) simple graph C) multigraph D)complete graph

15. A complete graph of order p has size

    A) $p(p+1)/2$ B) $p(p-1)/2$ C) $p/2$ D) $(p-1)/2$

16. Which is true?

    A) A bipartite graph contains even cycles

    B) A bipartite graph contains odd cycles

    C) A bipartite graph contains both even and odd cycles

    D) None of these

17. Two vertices u and v in a digraph are connected if D contains

    A) u-v walk B) u-v path C) u-v semi walk D) None

18. If for every two distinct vertices u and v of a digraph there is either a u-v path or a v-u path, then D is

    A) Weakly connected B) strongly connected C) unilateral D) connected

19. A digraph D is regular if

    A) od v =id v for every vertex v of D

    B) od v > id v for every vertex v of D

    C) od v< id v for every vertex v of D

    D) od v≠ id v for every vertex v of D

20. A digraph in which every two vertices are joined by exactly one arc is called

    A) Symmetric digraph B) asymmetric digraph C) unilateral D) tournament

21. Which measures the amount computational effort expended when the computer solves a problem?

    A) Algorithm B) efficiency C) speed D) complexity

22. If there exists an efficient algorithm for solving the problem it is called

    A) simple B) complex C) tractable D) intractable

23. The complexity of sequential search algorithm is

    A) $O(n^2)$ B) O(log n) C) O(n) D) $O(n^3)$

24. A list in which insertions and deletions are always made at one end is called

    A) Stack B) to do list C) queue D) top list

25. A list in which all insertions are made at one end and all deletions are made at the other end is called

    A) stack B) list C) queue D)None

26. Every component of a forest is a ……………..

A) cycle

B) tree

C) path

D) circuit

27. A tree is a connected graph with …………

A) no cycles

B) cycles

C) path

D) none of the above

28. A tree of order p has size …………

A) p

B) p-2

C) p-1

D) p+1

29. If u and v are distinct vertices of a tree T, then T contains exactly ……….. u-v path

A) 0

B) 1

C) 2

D) 3

30. Let T be a tree of order m and let G be a graph with ……………. Then T is isomorphic to some subgraph of G

A) $\delta(G) \geq m$

B) $\delta(G) \geq m$+1

C) $\delta(G) \geq m + 1$

D) $\delta(G) \geq m$-1

31. A directed tree T is a rooted tree if T contains a vertex r with $id\ r = 0$ and

$id\ v =$ ____ for all other vertices v of T

A) 0

B) 1

C) 2

D) 3

32. The largest integer h for which there exists a vertex at level h in a rooted tree is called its …………

A) weight

B) length

C) height

D) none of the above

33. If a vertex v of T is adjacent to u and u lies in the level below v, then u is called …………of v.

A) child

B) parent

C) ancestor

D) descendant

34. Binary tree is a …………ary tree in which each child is designated as left or right child

A) 0

B) 1

C) 2

D) 3

35. In a complete binary tree, every vertex has …….children or no children

A) 0

B) 1

C) 2

D) 3

36. A complete m-ary tree with i internal vertices has order ………

A) i

B) mi

C) mi-1

D) mi+1

37. Every complete binary tree with i internal vertices has …………leaves.

A) i

B) i-1

C) i+1

D) i+2

38. If T is a binary tree with height h and order p, then ………..

A) $h + 1 \le p \le 2^{h+1} - 1$

B) $h + 1 \ge p \ge 2^{h+1} - 1$

C) $h \le p \le 2^{h+1}$

D) $h + 1 \le p + 2 \le 2^{h+1} - 1$

39. If T is a balanced complete binary tree of height h and order p, then ………

A) $h > \lceil log_2(\frac{p+1}{2}) \rceil$

B) $h < \lceil log_2(\frac{p+1}{2}) \rceil$

C) $h \ne \lceil log_2(\frac{p+1}{2}) \rceil$

D) $h = \lceil log_2(\frac{p+1}{2}) \rceil$

40. The label assigned to a vertex v in G by depth first search is called …………

A) index of G

B) depth first search index of v

C) length of v

D) none of the above

41. Every back edge of a graph joins an ancestor and …………

A) child

B) parent

C) vertex

D) descendant

42. Branch of G at v is a maximal connected subgraph H of G containing v such that………………

A) v is a cut vertex of H

B) v is not a cut vertex of H

C) e is a cut edge

D) e is a back edge

43. Complexity of DFS Algorithm is …………..

A) O{q}

B) O(max{p,q})

C) O({q})

D) None of the above

44. Minimum spanning tree problem is to find a minimum spanning tree of ………………

A) maximum weight

B) equal weight

C) minimum weight

D) None of the above

45. Kruskal's Algorithm is to determine a ……………….in a non trivial connected weighted graph

A) minimum spanning tree

B) minimum tree

C) maximum spanning tree

D) maximum tree

46. Let G be a complete labelled graph of order p. Then there are …………unequal spanning trees of G

A) p

B) p^p

C) p^{p-1}

D) p^{p-2}

47. Let G be a graph. Then

A) $rad(G) \geq diam(G) \leq 2rad(G)$

B) $rad(G) \geq diam(G) \geq 2rad(G)$

C) $rad(G) \leq diam(G) \leq 2rad(G)$

D) None of the above

48. The centre of every tree is isomorphic to K_1 or …………

A) K_3

B) K_2

C) K_4

D) K_5

49. Complexity of Critical Path Algorithm is …………..

A)O(p)

B) $O(p^2)$

C) O(max{p,q})

D) O(q)

50. ………………………is used to determine the shortest u-v path, if it exist.

A) Kruskal's Algorithm

B) Moore's BFS Algorithm

C) Prim's Algorithm

D) Boruvka's Algorithm

51. In a digraph D with vertex set V and arc set E ,the out neighborhood of a vertex x is defined as

A) $N^+(x) = \{y \in V \,/\, (y,x) \in E\}$
B) $N^+(x) = \{y \in V \,/\, (x,y) \in E\}$
C) $N^+(x) = \{y \in V \,/\, d(x,y) \geq 0\}$
D) $N^+(x) = \{y \in V \,/\, d(x,y) \leq 0\}$

52. In a digraph D with vertex set V and arc set E, ,the in-neighborhood of a vertex x is defined as

A) $N^+(x) = \{y \in V \,/\, (y,x) \in E\}$
B) $N^+(x) = \{y \in V \,/\, (x,y) \in E\}$
C) $N^+(x) = \{y \in V \,/\, d(x,y) \geq 0\}$
D) $N^+(x) = \{y \in V \,/\, d(x,y) \leq 0\}$

53. A flow f in a network N satisfies
   A) $0 < f(a) < c(a)$ for every arc a
   B) $f(a) \leq c(a)$ for every arc a
   C) $0 \leq f(a) \leq c(a)$ for every arc a
   D) $0 \leq f(a)$ for every arc a
54. Which one of the following is not true
   A) The flow in an arc never exceed its capacity.
   B) A flow in an arc a in a network N is any real number less than the capacity of the arc a.
   C) If x is a vertex that is neither source nor sink, then the net flow out of x and net flow into x both equal to 0.
   D) The value of the flow f(N) in a network N is the net flow out of the source s.
55. Let N be a network and f a flow in N. If $(P, \bar{P})$ is a cut of N, then f(N) is
   A) $f(P, \bar{P}) - f(\bar{P}, P)$
   B) $f(P, \bar{P}) + f(\bar{P}, P)$
   C) $f(\bar{P}, P) - f(P, \bar{P})$
   D) $f(\bar{P}, P) - f(P, \bar{P}) + c(P, \bar{P})$
56. In every network
   A) Value of a maximum flow less than or equal to the capacity of a minimum cut.
   B) Value of a maximum flow greater than or equal to the capacity of a minimum cut.
   C) Value of a minimum flow greater than or equal to the capacity of a maximum cut.
   D) Value of a maximum flow equal to the capacity of a minimum cut.
57. Let f be a flow and c be the capacity in a network N, then a semipath is said to satisfy f-unsaturated if
   A) $a_i = (u_{i-1}, u_i)\ and\ f(a_i) < c(a_i)$
   B) $a_i = (u_i, u_{i-1})\ and\ f(a_i) > 0$
   C) $either\ a_i = (u_{i-1}, u_i)\ and\ f(a_i) < c(a_i)\ or\ a_i = (u_i, u_{i-1}) and\ f(a_i) > 0$
   D) $either\ a_i = (u_i, u_{i-1})\ and\ f(a_i) < c(a_i)\ or\ a_i = (u_{i-1}, u_i)\ and\ f(a_i) > 0$
58. Let N be a network with underlying digraph D, then
   A) A flow in N is maximum iff there is no f-augmenting path.
   B) A flow in N is minimum iff there is no f-augmenting path.
   C) A flow in N is maximum iff there exist an f-augmenting path.
   D) A flow in N is minimum iff there exist an f-augmenting path.
59. An f -augmenting semipath is
   A) A maximal f-unsaturated semipath.
   B) An f-unsaturated s-t semipath with source s and sink t.
   C) A minimal f-unsaturated semipath.
   D) Any f-unsaturated semipath.
60. Let f be a flow in a network N with capacity function c. $(X, \bar{X})$is a cut in N such that $f(a) = c(a) for\ every\ a \in (X, \bar{X})\ and\ f(a) = 0 for\ every\ a \in (\bar{X}, X)$ then
   A) f is a minimum flow in N and $(X, \bar{X})$is a minimum cut.
   B) f is a minimum flow in N and $(X, \bar{X})$is a maximum cut.
   C) f is a maximum flow in N and $(X, \bar{X})$is a maximum cut.
   D) f is a maximum flow in N and $(X, \bar{X})$is a minimum cut.

61. Edmonds-Karp algorithm is for finding
   A) a maximum flow and minimum cut in a network N
   B) a minimum flow and maximum cut in a network N
   C) a maximum flow in a network N
   D) a minimum cut in a network N
62. Let N be a network with underlying digraph D. Let D' be the digraph with the same vertex set as D and arc set $E(D') = \{(x, y)/\ (x, y) \in E(D)\ and\ c(x, y) > f(x, y)\ or\ (y, x)\ \in E(D)\ and\ f(y, x) > 0\}$ then D' contains a s-t path iff
   A) N contains a maximum flow
   B) N contains a maximum flow and minimum cut.
   C) D contains an f-augmenting semipath.
   D) D' contains an f-augmenting semipath.
63. Let N be a network with underlying digraph D. Let D' be the digraph with the same vertex set as D and arc set set $E(D') = \{(x, y)/\ (x, y) \in E(D)\ and\ c(x, y) > f(x, y)\ or\ (y, x)\ \in E(D)\ and\ f(y, x) > 0\}$ then
   A) A shortest s-t path in D has the same length as a shortest f-augmenting semipath in D
   B) A shortest s-t path in D' has the same length as a shortest f-augmenting semipath in D
   C) A shortest s-t path in D has the same length as a shortest f-augmenting semipath in D'
   D) A shortest s-t path in D' has the same length as a shortest f-augmenting semipath in D'
64. Let $\Delta(a_i) = \begin{cases} c(a_i) - f(a_i) & if\ a_i\ = (u_{i-1}, u_i) \\ f(a_i) & if\ ai = (u_i, u_{i-1}) \end{cases}$
   $and\ \Delta\ = min\{\ \Delta(ai)/1 \le i \le n\}$. If a_i is an arc such that $\Delta(a_i)$= Δ, then a_i is called
   A) f-augmenting arc
   B) sub-arc
   C) saturation arc
   D) None of the above
65. Max-flow Min-cut algorithm is also known as
   A) Edmonds-Ford algorithm
   B) Ford and Fulkerson algorithm
   C) Fulkerson-Karp algorithm
   D) Edmonds-Karp algorithm
66. If S is a subset of the vertex set of G such that G-S is disconnected, then S is a
   A) Vertex cutset of G
   B) Edge cutset of G
   C) Bridge of G
   D) Cut-vertex of G
67. Which of the following is not true
   A) $\lambda(K_1)=0$
   B) λ(G) is the minimum cardinality of an edge cutset of G.
   C) λ(G) is the minimum cardinality of a vertex cutset of G.
   D) λ(G) =0 if and only if G is disconnected or trivial.

68. What is the vertex connectivity of the complete graph K_p.
   A) p
   B) p-1
   C) 2p
   D) p+1
69. Which of the following is true.
   A) For any graph G, $K(G) \leq \lambda(G) \leq \delta(G)$
   B) For any graph G, $\lambda(G) \leq K(G) \leq \delta(G)$
   C) If G is a graph of diameter 3, then $\lambda(G) \leq \delta(G)$
   D) If G is a graph of diameter 2, then $\lambda(G) < \delta(G)$
70. Find $\lambda(K_{m,n})$ where m<n.
   A) m+n
   B) n-m
   C) m
   D) n
71. Which of the following is not true.
   A) $\lambda(u, v) = M'(u, v)$
   B) M'(u,v) is the maximum number of edge disjoined u-v path in G.
   C) If u and v belongs to distinct components of G, then λ(u,v)=0.
   D) $\kappa(u, v) < M(u, v)$ where u and v are any pair of non-adjacent vertices of G.
72. State Mengers theorem
   A) $\kappa(u, v) < M(u, v)$ where u and v are any pair of non-adjacent vertices of G.
   B) $\kappa(u, v) = M(u, v)$ where u and v are any pair of non-adjacent vertices of G.
   C) $\lambda(u, v) < M(u, v)$ where u and v are any pair of non-adjacent vertices of G.
   D) $\lambda(u, v) = M(u, v)$ where u and v are any pair of non-adjacent vertices of G.
73. If G is an n-edge connected graph then, $G + K_1$ is
   A) n+1 edge connected.
   B) n-1 edge connected.
   C) n-edge connected.
   D) None of the above.
74. Which of the following is true
   A) There exist a graph with $\lambda(G) = \delta(G)$
   B) There exist a graph with $\lambda(G) \neq \delta(G)$
   C) There exist a graph with $\kappa(G) = \lambda(G) = \delta(G)$
   D) All of the above
75. The theorem stating “ If G is a connected graph and u and v is a pair of non adjacent vertices of G ,then $\kappa(u, v) = M(u, v)$” is known as
   A) Dijkstra’s theorem
   B) Whitney’s theorem
   C) Menger’s Theorem
   D) None of the above

76. A matching in a graph G is a
   A) regular subgraph of G
   B) 1-regular subgraph of G
   C) 2-regular subgraph of G

D) None of these

77. Number of edges in a perfect matching in a Graph with p vertices is
    A) p
    B) p/2
    C) 2p
    D) 2
78. The complexity of Kuhn-Munkres algorithm is
    A) $O(p)$
    B) $O(p^3)$
    C) $O(p^4)$
    D) $O(pq)$
79. A spanning cycle in a graph is called
    A) Hamiltonian cycle
    B) Spanning tree
    C) Odd cycle
    D) Even cycle
80. Which of the following is not true
    A) Peterson graph is a cubic graph
    B) Peterson graph is 1- factorable
    C) Peterson graph is not 1-factorable
    D) Peterson graph admits a perfect matching

81. A factor of a graph is a
    A) Spanning subgraph of G
    B) Regular subgraph of G
    C) Induced subgraph of G
    D) None of these
82. An r-factor of a graph G is a
    A) Spanning subgraph of G
    B) r-regular subgraph of G
    C) r-regular factor of G
    D) None of these
83. The number of edges in a maximum matching of the n-cube has
    A) 2^n
    B) 2^{n-2}
    C) 2^{2n}
    D) 2^{n-1}
84. 'A non-trivial graph G has a 1-factor if and only if , for every proper subset S of V(G), the number of odd components of G-S does not exceed $|S|$'- this theorem is
    A) Tutte theorem
    B) Peterson Theorem
    C) Perfect tree conjecture
    D) Hall's Marriage theorem
85. 'If n is a positive integer and T_i is tree of size i for each $i(1 \leq i \leq n)$, then K_{n+1} can be decomposed into the trees $T_1, T_2, \dots . T_n$.'- this theorem is
    A) Tutte theorem

B) Peterson Theorem
C) Perfect tree conjector
D) Hall's Marriage theorem

86. Let r and p be integers such that $0 \leq r < p$. Then there exist r-regular graph of order p if and only is
A) pr is odd
B) pr is even
C) pr is a prime
D) pr is a square
87. $K_{3,3}$ is
A) $2K_2 - decomposable$
B) $3K_2 - decomposab$
C) $K_2 - decomposable$
D) $4K_2 - decomposable$
88. Every non-empty graph is
A) $2K_2 - decomposable$
B) $3K_2 - decomposable$
C) $K_2 - decomposable$
D) $4K_2 - decomposable$
89. In a (b, v, r, k, λ) design
A) bk=vr
B) bv=kr
C) kv=br
D) rk=bv
90. In a (b, v, r, k, λ) design
A) $\lambda < r$
B) $\lambda > r$
C) $\lambda = r$
D) Both B & C are correct
91. In a (b, v, r, k, λ) design
A) $\lambda(v-1) = k(r-1)$
B) $\lambda(k-1) = r(v-1)$
C) $v(\lambda-1) = r(k-1)$
D) $\lambda(v-1) = r(k-1)$
92. Which of the following is Fisher's inequality
A) In a (b, v, r, k, λ) design, $k \geq v$
B) In a (b, v, r, k, λ) design, $b \leq v$
C) In a (b, v, r, k, λ) design, $b \geq r$
D) In a (b, v, r, k, λ) design, $b \geq v$
93. A (b, v, r, k, λ) design is called a Steiner triple system if
A) $k = 2$ & $\lambda = 1$
B) $k = 3$ & $\lambda = 2$
C) $k = 3$ & $\lambda = 1$
D) $k = 3$ & $\lambda = 3$
94. The values of k & r in a BIBD with parameters $b = 14, v = 7$ & $\lambda = 2$

A) 2,3
B) 3,6
C) 3,4
D) 4,6

95. Which of the following is true
   A) Every regular multigraph of degree $r \geq 1$ is $1 -$ factorable.
   B) Every bipartite multigraph of degree $r \geq 1$ is $1 -$ factorable.
   C) Every regular bipartite multigraph of degree $r \geq 1$ is $1 -$ factorable.
   D) Every regular bipartite multigraph of degree $r \geq 2$ is $1 -$ factorable.
96. The number of edges in a maximum matching of the Peterson graph is
   A) 4
   B) 5
   C) 3
   D) 6
97. Which of the following is true
   A) Every bridgeless cubic graph is 1-factorable
   B) Every bridgeless cubic graph contains 1-factor
   C) A &B are true
   D) A & B are false
98. An algorithm to find a maximum weight perfect matching in a weighted complete bipartite graph is
   A) Maximum matching algorithm
   B) Prim's algorithm
   C) Kuhn-Munkres algorithm
   D) None of these
99. Which of the following is not a cubic graph
   A) K_5
   B) K_4
   C) $K_{3,3}$
   D) Peterson graph
100. A (b, v, r, k, λ) design is called symmetric if
   A) $b = k$
   B) $b = v$
   C) $b = r$
   D) $b = \lambda$

.Multiple Choice Questions

Semester IV

ME800402: ALGORITHMIC GRAPH THEORY

ANSWER KEY

1. B

2.C

3. A

4. C

5.C

6.A

7.B

8.C

9.A

10.A

11.A

12.B

13.B

14.D

15.B

16. A

17. C

18.C

19. A

20. D

21. D

22.C

23.C

24.A

25.C

26. B

27.A

28. C

29. B

30. D

31. B

32. C

33. A

34. C

35. C

36. D

37. C

38. A

39. D

40. B

41. D

42. B

43. B

44. C

45. A

46. D

47. C

48. B

49. D

50. B

51. B

52. A

53. C

54. B

55. A

56. D

57. C

58. A

59. B

60. D

61. A

62. C

63. B

64. C

65. D

66. A

67. C

68. B

69. A

70. C

71. D

72. B

73. A

74. D

75. C

76. B

77. B

78. C

79. A

80. B

81. A

82. C

83. D

84. A

85. C

86. B

87. B

88. C

89. A

90. A

91. D

92. D

93. C

94. B

95. C

96. B

97. B

98. C

99. A

100. B