

**GOVERNMENT DEGREE COLLEGE,
RAZOLE,
EAST GODAVARI DISTRICT**



**DEPARTMENT OF MATHEMATICS
CERTIFICATE COURSE
FOR
2020-21
“GRAPH THEORY”**

GOVERNMENT DEGREE COLLEGE RAZOLE
EAST GODAVARI DISTRICT

DEPARTMENT OF MATHEMATICS
MINUTES OF THE DEPARTMENT

A staff meeting has been conducted in the department on 05-12-2020

- It is resolved to introduce “certificate course for the academic year 2020-21.
- It is resolved to conduct certificate course for the second year students.
- It is resolved to conduct classes for 30 working hours on the syllabus presented.
- It is resolved to approve the syllabus and model paper. it is resolved to conduct external examination for 50 marks as objective questions.



(VSV Krishna Murty)

GOVERNMENT DEGREE COLLEGE RAZOLE

DEPARTMENT OF MATHEMATICS

NOTICE

Razole
27-01-2021

To
The Principal
Government Degree College,
Razole.

Sir,

Sub: Government Degree College, Razole – Introduction of **Certificate Course** in “**Graph Theory**” during 2020-21- Proposal submitted for permission - Regarding.

I humbly submit that the Department of Mathematics proposes to conduct a Certificate course in “**Graph Theory**” during 2020 -21 based on the need of the students and resolution made in the Departmental Minutes book .

Hence, I request you to permit us to conduct the said course for the benefit of our students.

Thanking you sir

Yours faithfully,



(Lecturer in Mathematics)

GOVERNMENT DEGREE COLLEGE, RAZOLE

EAST GODAVARI DISTRICT

DEPARTMENT OF MATHEMATICS

CERTIFICATE COURSE

IN GRAPH THEORY DURING 2020-21

OUTCOMES OF THE COURSE:

At the end of the course , the student is expected to learn the following outcomes

- He is able to learn the types of graphs
- He is able to learn and understand various types of paths like Euler and Hamiltonian paths
- He identifies shortest path problems and learns graph coloring.
- He understands the meaning of TREES in graph theory and its applications
- He learns about Minimum Spanning Trees by using Prim's Algorithm and Kurskal's Algorithms.



(Lecturer in Mathematics)



Principal
Govt. Degree College
NAAC 'B' Grade
RAZOLE - E.G.D.

GOVERNMENT DEGREE COLLEGE, RAZOLE
DEPARTMENT OF MATHEMATICS
CERTIFICATE COURSE IN GRAPH THEORY
FOR 2020-21

SYLLABUS
(No. of hours : 30)
UNIT I- GRAPHS

1. TYPES OF GRAPHS:-

Simple Graph, Multi Graph, Pseudo Graph, Directed multigraph, Complete Graph, Bipartite Graphs

2. GRAPH ISOMORPHISM:-

Adjacency Matrices, Isomorphism of Graphs

3. CONNECTIVITY:-

Connectedness in undirected Graphs, Connected ness in Directed Graphs, Paths and Isomorphisms, Counting paths between Vertices

4. EULER AND HAMILTONIAN PATHS:-

Euler paths and circuits, Necessary and sufficient conditions for Euler circuits and paths, Hamiltonian paths and circuits

5. SHORTEST PATH PROBLEMS:-

Shortest path algorithm, Dijkstra's algorithm, Traveling salesman problem

6. PLANAR GRAPHS:-

K_4 , Q_3 , $K_{3,3}$ Graphs, Eulers formula, Kuratowskis Algorithms, Homeomorphic Graphs

7. GRAPH COLORING:-

Chromatic Number, Application of Graph colorings

UNIT II - TREES

1. INTRODUCTION TO TREES:-

Tree, Rooted Trees, properties of Trees

2. APPLICATIONS OF TREES:-

Binary search Trees, prefix codes, Huffmans coding,

3. TREE TRAVERSAL:-

Preorder, post order, In order Traversals, Infix, Prefix and Postfix, Notations

4. SPANNING TREES:-

Depth First search, Breadth First

5. MINIMUM SPANNING TREES:-

Minimum Spanning Trees, Prim's Algorithm, Kruskal's Algorithms

SUGGESTED READINGS :

1. A Text Book of Discrete Mathematics & Its Applications by Kenneth H Rosen
2. A Text Book of Discrete Mathematics by Trembley & Manohar

Pattern of Examination

Theory (50 Marks)

The students have to write the theory examination Objective type for 50 marks 2 hours duration


(Lecturer in Mathematics)

GOVERNMENT DEGREE COLLEGE RAZOLE
DEPARTMENT OF MATHEMATICS
GRAPH THEORY 2020-21
(1st FEBRUARY 2021 to 17 th MARCH 2021)
Work done statement of Certificate Course

Name of the Lecturer : VSV KRISHNA MURTY
Subject : MATHEMATICS
Batch : 1

S.NO	DATE	BATCH TIME	TOPIC	Name of the Lecturer taught
		(4.00 to 5.00 PM)		
1	1/2/2021	1Hr	Simple Graph, Multi Graph, Pseudo Graph,	VSV KRISHNA MURTY
2	2/2/2021	1Hr	Directed multi graph, Complete Graph, Bipartite Graphs	VSV KRISHNA MURTY
3	3/2/2021	1Hr	Adjacency Matrices,	VSV KRISHNA MURTY
4	4/2/2021	1Hr	Isomorphism of Graphs	VSV KRISHNA MURTY
5	5/2/2021	1Hr	Connectedness in undirected Graphs, Connected ness in Directed Graphs,	VSV KRISHNA MURTY
6	6/2/2021	1Hr	Paths and Isomorphisms	VSV KRISHNA MURTY
7	8/2/2021	1Hr	Counting paths between Vertices	VSV KRISHNA MURTY
8	9/2/2021	1Hr	Euler paths and circuits,	VSV KRISHNA MURTY
9	10/2/2021	1Hr	Necessary and sufficient conditions for Euler circuits and paths,	VSV KRISHNA MURTY
10	11/2/2021	1Hr	Hamiltonian paths and circuits	VSV KRISHNA MURTY
11	12/2/2021	1Hr	Shortest path algorithm,	VSV KRISHNA MURTY
12	15/2/2021	1Hr	Dijkstra's algorithm,	VSV KRISHNA MURTY
13	16/2/2021	1Hr	Traveling salesman problem	VSV KRISHNA MURTY
14	17/2/2021	1Hr	K4, Q3, K3,3 Graphs,	VSV KRISHNA MURTY
15	22/2/2021	1Hr	Eulers formula,	VSV KRISHNA MURTY
16	23/2/2021	1Hr	Kuratowskis Algorithms,	VSV KRISHNA MURTY
17	24/2/2021	1Hr	Homeomorphic Graphs	VSV KRISHNA MURTY
18	25/2/2021	1Hr	Chromatic Number,	VSV KRISHNA MURTY
19	26/2/2021	1Hr	Application of Graph colorings	VSV KRISHNA MURTY
20	27/2/2021	1Hr	Tree, Rooted Trees, properties of Trees	VSV KRISHNA MURTY
21	1/3/2021	1Hr	Binary search Trees,	VSV KRISHNA MURTY
22	2/3/2021	1Hr	prefix codes, Huffmans coding	VSV KRISHNA MURTY
23	3/3/2021	1Hr	preorder, post order, In order Traversals,	VSV KRISHNA MURTY
24	4/3/2021	1Hr	Infix, Prefix and Postfix	VSV KRISHNA MURTY
25	5/3/2021	1Hr	Notations	VSV KRISHNA MURTY
26	12/3/2021	1Hr	Depth First search Algorithm	VSV KRISHNA MURTY
27	13/3/2021	1Hr	Breadth First search Algorithm	VSV KRISHNA MURTY
28	15/3/2021	1Hr	Minimum Spanning Trees,	VSV KRISHNA MURTY
29	16/3/2021	1Hr	Prim's Algorithm	VSV KRISHNA MURTY
30	17/3/2021	1Hr	Kruskal's Algorithm	VSV KRISHNA MURTY

GOVERNMENT DEGREE COLLEGE, RAZOLE, EGD.T.
ATTENDANCE PARTICULARS OF THE STUDENTS WHO ATTENDED
CERTIFICATE COURSE IN GRAPH THEORY
2020-21

Duration: 1st February 2021 to 17th March 2021 (30 hours)

			1/2/2021	2/2/2021	3/2/2021	4/2/2021	5/2/2021	6/2/2021	8/2/2021	9/2/2021	10/2/2021	11/2/2021	12/2/2021	15/2/2021	16/2/2021	17/2/2021	22/2/2021	23/2/2021	24/2/2021	25/2/2021	26/2/2021	27/2/2021	1/3/2021	2/3/2021	3/3/2021	4/3/2021	5/3/2021	12/3/2021	13/3/2021	15/3/2021	16/3/2021	17/3/2021
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
S.NO	NAME OF THE STUDENT	REGD .NO.																														
1	A. Mass Raju	191077101001	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A	P	P	P	P	A	P	P	P	P	A	P	P	P
2	M. Sri	191077101005	P	A	P	P	A	P	P	P	A	P	P	P	P	P	P	A	P	P	P	P	P	A	P	P	P	P	P	P	P	P
3	S.D.N. Varma	191077101009	P	P	P	P	A	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
4	V.K.Sai Krishna	191077101011	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	A	P	P
5	A. Sai	191077102012	P	P	P	A	P	P	P	P	P	A	P	P	P	P	P	P	A	P	P	A	P	P	P	P	P	A	P	P	P	P
6	A.Lakshman Kumar	191077102013	P	P	P	P	P	P	A	P	P	P	P	P	P	A	P	P	A	P	P	P	P	P	P	P	P	P	P	P	A	P
7	D.Venkata Surya	191077102017	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A	P	P	P	P
8	K.Sravani	191077102019	P	A	P	P	P	P	P	P	P	P	P	A	P	P	A	P	P	A	P	P	P	P	A	P	P	P	P	P	P	P
9	K.Durga Prasad	191077102021	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	A	P	P	P	A	P	P	P	P	P	P	P	P	P	P
10	K.Tanuja	191077102022	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	A	P	P	P	P	A	P	P	P	P
11	K.S.G.Sivani	191077102024	P	P	P	A	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
12	N.Navya Sri	191077102026	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P
13	P.Geethanjali	191077102029	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P
14	P.Kiran Kumar	191077102030	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	A

VSNa

Lecturer in Mathematics

GOVERNMENT DEGREE COLLEGE RAZOLE
DEPARTMENT OF MATHEMATICS
CERTIFICATE COURSE FOR 2020-21
GRAPH THEORY

Time: 2Hrs	Max Marks:50M
Answer the following questions.	50 x 1M = 50 M
1. A graph is a collection of.... ? A) Row and columns B) Vertices and edges C) Equations D) None of these	()
2. The degree of any vertex of graph is ? A)The number of edges incident with vertex B)Number of vertex in a graph C) Number of vertices adjacent to that vertex D) Number of edges in a graph	()
3..A graph with no edges is known as empty graph. Empty graph is also know as... ? A) Trivial graph B) Regular graph C) Bipartite graph D) None of these	()
4..If the origin and terminus of a walk are same, the walk is known as... ? A) Open B) Closed C) Path D) None of these	()
5 .Radius of a graph, denoted by $\text{rad}(G)$ is defined by.... ? A) $\max \{e(v): v \text{ belongs to } V\}$ B) $\min \{e(v): v \text{ belongs to } V\}$ C) $\max \{d(u,v): u \text{ belongs to } v, u \text{ does not equal to } v\}$ D) $\min \{d(u,v): u \text{ belongs to } v, u \text{ does not equal to } v\}$	()
6. A graph G is called a if it is a connected acyclic graph A Cyclic graph B Regular graph CTree D Not a graph	()
7. A graph is a collection of A) Row and columns B) Vertices and edges C) Equations D)None of these	()
8 How many relations are there on a set with n elements that are symmetric and a set with n elements that are reflexive and symmetric ? A) $2n(n+1)/2$ and $2n.3n(n-1)/2$ B) $3n(n-1)/2$ and $2n(n-1)$ C) $2n(n+1)/2$ and $3n(n-1)/2$ D) $2n(n+1)/2$ and $2n(n-1)/2$	()
9 In a graph if $e=(u, v)$ means A) u is adjacent to v but v is not adjacent to u B). e begins at u and ends at v C) u is processor and v is successor D) both b and c	()
10 A minimal spanning tree of a graph G is A) A spanning sub graph B) A tree C)Minimum weights D) All of above	()
11. A partial ordered relation is transitive, reflexive and A) Antisymmetric B) Bisymmetric C) Anti reflexive D) Asymmetric	()
12 A graph with n vertices will definitely have a parallel edge or self loop if the total number of edges are A) greater than $n-1$ B) less than $n(n-1)$ C)greater than $n(n-1)/2$ D) less than $n^2/2$	()
13 A vertex of a graph is called even or odd depending upon A) Total number of edges in a graph is even or odd B) Total number of vertices in a graph is even or odd C) Its degree is even or odd D) None of these	()
14 The expression $a + ac$ is equivalent to A) a B) $a + c$ C) c D) 1	()
15 A graph with no edges is known as empty graph. Empty graph is also known as A)Trivial graph B) Regular graph C)Bipartite graph D)None of these	()
16 A continuous non intersecting curve in the plane whose origin and terminus coincide A) Planer B) Jordan C) Hamiltonian D) All of these	()
17)A graph with n vertices will definitely have a parallel edge or self loop of the total number of edges are A) more than n B) more than $n+1$ C) more than $(n+1)/2$ D) more than $n(n-1)/2$	()
18) Which of the following pair is not congruent modulo 7? A) 10, 24 B) 25, 56 C) 31, 11 D) 64, -15	()
19) The maximum degree of any vertex in a simple graph with n vertices is A) $n-1$ B) $n+1$ C) $2n-1$ D) n	()
20) Consider a weighted undirected graph with positive edge weights and let (u, v) be an edge in the graph. It is known that the shortest path from source vertex s to u has weight 53 and shortest path from s to v has weight 65. Which statement is always true ? A) $\text{Weight}(u, v) \leq 12$ B) $\text{Weight}(u, v) = 12$ C) $\text{Weight}(u, v) \geq 12$ D) $\text{Weight}(u, v) > 12$	()
21 How many onto (or surjective) functions are there from an n-element ($n \Rightarrow 2$) set to a 2-element set? A) $2n$ B) $2n - 1$ C) $2n - 2$ D) $2(2n - 2)$	()
22).Hasse diagram are drawn A Partially ordered sets B Lattices C Boolean algebra D None of these	()
23) In how many ways can 5 balls be chosen so that 2 are red and 3 are black A) 910 B) 990 C) 970 D) None of these	()
24) Circle has _____ A) No vertices B) Only 1 vertex C) 8 vertices D) None of these	()
25) The proposition $\sim q \vee p$ is equivalent to A) $p \vee q$ B) $q \vee p$ C) $p \wedge q$ D) $p \vee q$	()

- 26) If B is a Boolean Algebra, then which of the following is true ()
 A) B is a finite but not complemented lattice B) B is a finite, complemented and distributive lattice
 C) B is a finite, distributive but not complemented lattice D) B is not distributive lattice
- 27) If R is a relation "Less Than" from $A = \{1,2,3,4\}$ to $B = \{1,3,5\}$ then $R \circ R^{-1}$ is
 A) $\{(3,3), (3,4), (3,5)\}$ B) $\{(3,1), (5,1), (3,2), (5,2), (5,3), (5,4)\}$
 C) $\{(3,3), (3,5), (5,3), (5,5)\}$ D) $\{(1,3), (1,5), (2,3), (2,5), (3,5), (4,5)\}$ ()
- 28) The number of distinguishable permutations of the letters in the word BANANA are,
 A) 60 B) 36 C) 20 D) 10 ()
- 29) Let G be a simple undirected planar graph on 10 vertices with 15 edges. If G is a connected graph, then the number of bounded faces in any embedding of G on the plane is equal to
 A) 3 B) 4 C) 5 D) 6 ()
- 30) A graph is tree if and only if ()
 A) Is planar B) Contains a circuit C) Is minimally D) Is completely connected
- 31) How many different words can be formed out of the letters of the word VARANASI?
 A) 64 B) 120 C) 40320 D) 720 ()
- 32) Suppose v is an isolated vertex in a graph, then the degree of v is ()
 A) 0 B) 1 C) 2 D) 3
- 33) The complete graph with four vertices has k edges where k is ()
 A) 3 B) 4 C) 5 D) 6
- 34) Which one of the following statements is incorrect ? ()
 A) The number of regions corresponds to the cyclomatic complexity B) Cyclomatic complexity for a flow graph G is $V(G) = N - E + 2$, where E is the number of edges and N is the number of nodes in the flow graph
 C) Cyclomatic complexity for a flow graph G is $V(G) = E - N + 2$, where E is the number of edges & N is the number of nodes in the flow graph D) Cyclomatic complexity for a flow graph G is $V(G) = P + 1$, where P is the number of predicate nodes contained in the flow graph G
- 35) Choose the most appropriate definition of plane graph ()
 A) A graph drawn in a plane in such a way that any pair of edges meet only at their end vertices
 B) A graph drawn in a plane in such a way that if the vertex set of graph can be partitioned into two non - empty disjoint subset X and Y in such a way that each edge of G has one end in X and one end in Y C) A simple graph which is Isomorphic to Hamiltonian graph D) None of these
- 36) Length of the walk of a graph is ()
 A) The number of vertices in walk W B) The number of edges in walk W
 C) Total number of edges in a graph D) Total number of vertices in a graph
- 37). A graph with one vertex and no edges is ()
 A) multigraph B) digraph C) isolated graph D) trivial graph
- 38) In any undirected graph the sum of degrees of all the nodes ()
 A) Must be even B) Are twice the number of edges C) Must be odd D) Need not be even
- 39). In a graph if $e = [u, v]$, Then u and v are called ()
 A) Endpoints of e B) Adjacent nodes C) Neighbors D) All of above
- 40). The number of leaf nodes in a complete binary tree of depth d is ()
 A) $2d$ B) $2d-1+1$ C) $2d+1+1$ D) $2d+1$
- 41). An undirected graph possesses an eulerian circuit if and only if it is connected and its vertices are
 A) All of even degree B) All of odd degree C) of any degree D) even in number ()
- 42). The relation $\{(1,2), (1,3), (3,1), (1,1), (3,3), (3,2), (1,4), (4,2), (3,4)\}$ is ()
 A) Reflexive B) Transitive C) Symmetric D) None of these
- 43). In an undirected graph the number of nodes with odd degree must be ()
 A Zero B Odd C Prime D Even
44. What is the probability of choosing correctly an unknown integer between 0 and 9 with 3 chances ?
 A) $963/1000$ B) $966/1000$ C) $968/1000$ D) None of these ()
- 45). The complete graph K, has... different spanning trees? ()
 A) $nn-2$ B) $n*n$ C) nn D) n^2
- 46). Eccentricity of a vertex denoted by $e(v)$ is defined by.... ? ()
 A) $\max \{ d(u,v) : u \text{ belongs to } v, u \text{ does not equal to } v : \text{ where } d(u,v) \text{ is the distance between } u \& v \}$
 B) $\min \{ d(u,v) : u \text{ belongs to } v, u \text{ does not equal to } v \}$ C) Both A and B D) None of these
- 47). A graph G is called a if it is a connected acyclic graph ? ()
 A) Cyclic graph B) Regular graph C) Tree D) Not a graph
- 48). Length of the walk of a graph is ? ()
 A) The number of vertices in walk W B) The number of edges in walk W
 C) Total number of edges in a graph D) Total number of vertices in a graph
- 49). If for some positive integer k, degree of vertex $d(v)=k$ for every vertex v of the graph G, then G is called...?
 A) K grap B) K-regular graph C) Empty graph D) All of above ()
- 50). The number of colours required to properly colour the vertices of every planer graph is ()
 A 2 B 3 C 4 D 5

VSVa

Answers

- 1.B-Vertices and edges
- 2.A-The number of edges incident with vertex
3. A-Trivial graph
- 4.B-Closed
- 5.A- $\max \{e(v): v \text{ belongs to } V\}$
- 6.C-Tree
- 7.B-Vertices and edges
- 8.D- $2n(n+1)/2$ and $2n(n-1)/2$
- 9.D- both b and c
- 10.D- All of above
- 11.A- Antisymmetric
- 12.A-greater than $n-1$
- 13.Its degree is even or odd
- 14.B-a+c
- 15.A- Trivial graph
- 16.C-Jordan
- 17.D-more than $n(n-1)/2$
- 18.B- 25, 56
- 19.A. $n-1$
- 20.C. Weight $(u, v) \geq 12$
- 21.C. $2n - 2$
- 22.A. Partially ordered sets
- 23.B 990
- 24.A. No vertices
- 25.B. $q \geq p$
- 26.B. B is a finite, complemented and distributive lattice
27. C $\{(3,3), (3,5), (5,3), (5,5)\}$
28. A 60
- 29.D 6
30. C Is minimally
31. D 720
32. A 0
33. D 6
34. B Cyclometric complexity for a flow graph G is $V(G) = N-E+2$, where E is the number of edges and N is the number of nodes in the flow graph
- 35.A A graph drawn in a plane in such a way that any pair of edges meet only at their end vertices
- 36.B The number of edges in walk W
37. D. trivial graph
38. B Are twice the number of edges
39. D All of above
- 40 A 2d
- 41 A all of even degree
- 42 B Transitive
43. D Even
44. A 963/1000
- 45 A $nn-2$
- 46 A $\max \{ d(u,v): u \text{ belongs to } v, u \text{ does not equal to } v : \text{ where } d(u,v) \text{ is the distance between } u \& v \}$
- 47 C Tree
- 48 B The number of edges in walk W
- 49 B K-regular graph
- 50 D 5

GOVERNMENT DEGREE COLLEGE RAZOLE
DEPARTMENT OF MATHEMATICS
CERTIFICATE COURSE FOR 2020-21
GRAPH THEORY

Time: 2Hrs	Max Marks:50M
Answer the following questions.	50 x 1M = 50 M
1. A graph is a collection of.... ? A) Row and columns B) Vertices and edges C) Equations D) None of these	()
2. The degree of any vertex of graph is ? A)The number of edges incident with vertex B)Number of vertex in a graph C) Number of vertices adjacent to that vertex D) Number of edges in a graph	()
3..A graph with no edges is known as empty graph. Empty graph is also know as... ? A) Trivial graph B) Regular graph C) Bipartite graph D) None of these	()
4..If the origin and terminus of a walk are same, the walk is known as... ? A) Open B) Closed C) Path D) None of these	()
5 .Radius of a graph, denoted by $\text{rad}(G)$ is defined by.... ? A) $\max \{e(v): v \text{ belongs to } V\}$ B) $\min \{e(v): v \text{ belongs to } V\}$ C) $\max \{d(u,v): u \text{ belongs to } v, u \text{ does not equal to } v\}$ D) $\min \{d(u,v): u \text{ belongs to } v, u \text{ does not equal to } v\}$	()
6. A graph G is called a if it is a connected acyclic graph A Cyclic graph B Regular graph CTree D Not a graph	()
7. A graph is a collection of A) Row and columns B) Vertices and edges C) Equations D)None of these	()
8 How many relations are there on a set with n elements that are symmetric and a set with n elements that are reflexive and symmetric ? A) $2n(n+1)/2$ and $2n.3n(n-1)/2$ B) $3n(n-1)/2$ and $2n(n-1)$ C) $2n(n+1)/2$ and $3n(n-1)/2$ D) $2n(n+1)/2$ and $2n(n-1)/2$	()
9 In a graph if $e=(u, v)$ means A) u is adjacent to v but v is not adjacent to u B). e begins at u and ends at v C) u is processor and v is successor D) both b and c	()
10 A minimal spanning tree of a graph G is A) A spanning sub graph B) A tree C)Minimum weights D) All of above	()
11. A partial ordered relation is transitive, reflexive and A) Antisymmetric B) Bisymmetric C) Anti reflexive D) Asymmetric	()
12 A graph with n vertices will definitely have a parallel edge or self loop if the total number of edges are A) greater than $n-1$ B) less than $n(n-1)$ C)greater than $n(n-1)/2$ D) less than $n^2/2$	()
13 A vertex of a graph is called even or odd depending upon A) Total number of edges in a graph is even or odd B) Total number of vertices in a graph is even or odd C) Its degree is even or odd D) None of these	()
14 The expression $a + ac$ is equivalent to A) a B) $a + c$ C) c D) 1	()
15 A graph with no edges is known as empty graph. Empty graph is also known as A)Trivial graph B) Regular graph C)Bipartite graph D)None of these	()
16 A continuous non intersecting curve in the plane whose origin and terminus coincide A) Planer B) Jordan C) Hamiltonian D) All of these	()
17)A graph with n vertices will definitely have a parallel edge or self loop of the total number of edges are A) more than n B) more than $n+1$ C) more than $(n+1)/2$ D) more than $n(n-1)/2$	()
18) Which of the following pair is not congruent modulo 7? A) 10, 24 B) 25, 56 C) 31, 11 D) 64, -15	()
19) The maximum degree of any vertex in a simple graph with n vertices is A) $n-1$ B) $n+1$ C) $2n-1$ D) n	()
20) Consider a weighted undirected graph with positive edge weights and let (u, v) be an edge in the graph. It is known that the shortest path from source vertex s to u has weight 53 and shortest path from s to v has weight 65. Which statement is always true ? A) $\text{Weight}(u, v) \leq 12$ B) $\text{Weight}(u, v) = 12$ C) $\text{Weight}(u, v) \geq 12$ D) $\text{Weight}(u, v) > 12$	()
21 How many onto (or surjective) functions are there from an n-element ($n \Rightarrow 2$) set to a 2-element set? A) $2n$ B) $2n - 1$ C) $2n - 2$ D) $2(2n - 2)$	()
22).Hasse diagram are drawn A Partially ordered sets B Lattices C Boolean algebra D None of these	()
23) In how many ways can 5 balls be chosen so that 2 are red and 3 are black A) 910 B) 990 C) 970 D) None of these	()
24) Circle has _____ A) No vertices B) Only 1 vertex C) 8 vertices D) None of these	()
25) The proposition $\sim q \vee p$ is equivalent to A) $p \vee q$ B) $q \vee p$ C) $p \wedge q$ D) $p \wedge q$	()

- 26) If B is a Boolean Algebra, then which of the following is true ()
 A) B is a finite but not complemented lattice
 B)B is a finite, complemented and distributive lattice
 C)B is a finite, distributive but not complemented lattice
 D) B is not distributive lattice
- 27 If R is a relation “Less Than” from $A = \{1,2,3,4\}$ to $B = \{1,3,5\}$ then $R \circ R^{-1}$ is
 A) $\{(3,3), (3,4), (3,5)\}$ B) $\{(3,1), (5,1), (3,2), (5,2), (5,3), (5,4)\}$
 C) $\{(3,3), (3,5), (5,3), (5,5)\}$ D) $\{(1,3), (1,5), (2,3), (2,5), (3,5), (4,5)\}$ ()
- 28 The number of distinguishable permutations of the letters in the word BANANA are,
 A) 60 B) 36 C) 20 D) 10 ()
- 29 Let G be a simple undirected planar graph on 10 vertices with 15 edges. If G is a connected graph, then the number of bounded faces in any embedding of G on the plane is equal to
 A) 3 B) 4 C) 5 D) 6 ()
- 30)A graph is tree if and only if ()
 A) Is planar B) Contains a circuit C) Is minimally D) Is completely connected
- 31 How many different words can be formed out of the letters of the word VARANASI?
 A) 64 B) 120 C) 40320 D) 720 ()
- 32) Suppose v is an isolated vertex in a graph, then the degree of v is ()
 A) 0 B) 1 C) 2 D) 3
- 33) The complete graph with four vertices has k edges where k is ()
 A) 3 B) 4 C) 5 D) 6
- 34 Which one of the following statements is incorrect ? ()
 A) The number of regions corresponds to the cyclomatic complexity
 B) Cyclomatic complexity for a flow graph G is $V(G) = N - E + 2$, where E is the number of edges and N is the number of nodes in the flow graph
 C) Cyclomatic complexity for a flow graph G is $V(G) = E - N + 2$, where E is the number of edges & N is the number of nodes in the flow graph
 D) Cyclomatic complexity for a flow graph G is $V(G) = P + 1$, where P is the number of predicate nodes contained in the flow graph
- 35) Choose the most appropriate definition of plane graph ()
 A) A graph drawn in a plane in such a way that any pair of edges meet only at their end vertices
 B) A graph drawn in a plane in such a way that if the vertex set of graph can be partitioned into two non - empty disjoint subset X and Y in such a way that each edge of G has one end in X and one end in Y C) A simple graph which is Isomorphic to Hamiltonian graph D) None of these
- 36) Length of the walk of a graph is ()
 A) The number of vertices in walk W B) The number of edges in walk W
 C) Total number of edges in a graph D) Total number of vertices in a graph
- 37). A graph with one vertex and no edges is ()
 A) multigraph B) digraph C) isolated graph D) trivial graph
- 38 In any undirected graph the sum of degrees of all the nodes ()
 A) Must be even B) Are twice the number of edges C) Must be odd D) Need not be even
- 39) .In a graph if $e=[u, v]$, Then u and v are called ()
 A) Endpoints of e B) Adjacent nodes C) Neighbors D) All of above
- 40). The number of leaf nodes in a complete binary tree of depth d is ()
 A) $2d$ B) $2d-1+1$ C) $2d+1+1$ D) $2d+1$
- 41). An undirected graph possesses an eulerian circuit if and only if it is connected and its vertices are
 A) All of even degree B) All of odd degree C) of any degree D) even in number ()
- 42).The relation $\{ (1,2), (1,3), (3,1), (1,1), (3,3), (3,2), (1,4), (4,2), (3,4) \}$ is ()
 A) Reflexive B) Transitive C) Symmetric D) None of these
- 43). In an undirected graph the number of nodes with odd degree must be ()
 A Zero B Odd C Prime D Even
44. What is the probability of choosing correctly an unknown integer between 0 and 9 with 3 chances ? ()
 A) $963/1000$ B) $966/1000$ C) $968/1000$ D) None of these
- 45). The complete graph K, has... different spanning trees? ()
 A) $nn-2$ B) $n*n$ C) nn D) n^2
- 46). Eccentricity of a vertex denoted by $e(v)$ is defined by.... ? ()
 A) $\max \{ d(u,v): u \text{ belongs to } v, u \text{ does not equal to } v : \text{ where } d(u,v) \text{ is the distance between } u \& v \}$
 B) $\min \{ d(u,v): u \text{ belongs to } v, u \text{ does not equal to } v \}$
 C) Both A and B D) None of these
- 47). A graph G is called a if it is a connected acyclic graph ? ()
 A Cyclic graph B Regular graph C Tree D Not a graph
- 48). Length of the walk of a graph is ? ()
 A) The number of vertices in walk W B) The number of edges in walk W
 C) Total number of edges in a graph D) Total number of vertices in a graph
- 49). If for some positive integer k, degree of vertex $d(v)=k$ for every vertex v of the graph G, then G is called...?
 A K grap B K-regular graph C Empty graph D All of above ()
- 50). The number of colours required to properly colour the vertices of every planer graph is
 A 2 B 3 C 4 D 5 ()

Answers

- 1.B-Vertices and edges
- 2.A-The number of edges incident with vertex
3. A-Trivial graph
- 4.B-Closed
- 5.A- $\max \{e(v): v \text{ belongs to } V$
- 6.C-Tree
- 7.B-Vertices and edges
- 8.D- $2n(n+1)/2$ and $2n(n-1)/2$
- 9.D- both b and c
- 10.D- All of above
- 11.A- Antisymmetric
- 12.A-greater than $n-1$
- 13.Its degree is even or odd
- 14.B-a+c
- 15.A- Trivial graph
- 16.C-Jordan
- 17.D-more than $n(n-1)/2$
- 18.B- 25, 56
- 19.A. $n-1$
- 20.C. Weight $(u, v) \geq 12$
- 21.C. $2n - 2$
- 22.A. Partially ordered sets
- 23.B 990
- 24.A. No vertices
- 25.B. q^p
- 26.B. B is a finite, complemented and distributive lattice
27. C $\{(3,3), (3,5), (5,3), (5,5)\}$
28. A 60
- 29.D 6
30. C Is minimally
31. D 720
32. A 0
33. D 6
34. B Cyclometric complexity for a flow graph G is $V(G) = N-E+2$, where E is the number of edges and N is the number of nodes in the flow graph
- 35.A A graph drawn in a plane in such a way that any pair of edges meet only at their end vertices
- 36.B The number of edges in walk W
37. D. trivial graph
38. B Are twice the number of edges
39. D All of above
- 40 A 2d
- 41 A all of even degree
- 42 B Transitive
43. D Even
44. A 963/1000
- 45 A $nn-2$
- 46 A $\max \{ d(u,v): u \text{ belongs to } v, u \text{ does not equal to } v : \text{ where } d(u,v) \text{ is the distance between } u \& v \}$
- 47 C Tree
- 48 B The number of edges in walk W
- 49 B K-regular graph
- 50 D 5

GOVERNMENT DEGREE COLLEGE, RAZOLE				
EAST GODAVADI DISTRICT				
DEPARTMENT OF MATHEMATICS				
CERTIFICATE COURSE ON GRAPH THEORY				
FOR THE YEAR 2020-21				
MARKS OBTAINED IN THE EXAMINATION				
S.NO	NAME OF THE STUDENT	GROUP	REGD .NO.	MAX. MARKS
				50
1	A. Mass Raju	II BSC (MPC)	191077101001	35
2	M. Sri	II BSC (MPC)	191077101005	32
3	S.D.N. Varma	II BSC (MPC)	191077101009	27
4	V.K.Sai Krishna	II BSC (MPC)	191077101011	26
5	A. Sai	II BSC (MPCS)	191077102012	25
6	A.Lakshman Kumar	II BSC (MPCS)	191077102013	26
7	D.Venkata Surya	II BSC (MPCS)	191077102017	27
8	K.Sravani	II BSC (MPCS)	191077102019	31
9	K.Durga Prasad	II BSC (MPCS)	191077102021	28
10	K.Tanuja	II BSC (MPCS)	191077102022	26
11	K.S.G.Sivani	II BSC (MPCS)	191077102024	34
12	N.Navya Sri	II BSC (MPCS)	191077102026	32
13	P.Geethanjali	II BSC (MPCS)	191077102029	25
14	P.Kiran Kumar	II BSC (MPCS)	191077102030	25

VSVA

Lecturer in Mathematics





GOVERNMENT DEGREE COLLEGE

RAZOLE, Dr B R AMBEDKAR KONASEEMA (Dist), A.P-533242

NAAC Re-Accredited with 'B' Grade



DEPARTMENT OF MATHEMATICS

Razole
18-03-2021

To,
The Principal
Government Degree College
Razole

Sir,

Sub: Government Degree College, Razole - Department of Mathematics - Certificate
Course in **Graph Theory** for 2020-21 - Submission of Work done statements
and related documents -- Regarding.

I humbly submit that the Department of Mathematics has organized a Certificate course from 01-02-2021 to 17-03-2021 under the title "**Graph Theory** during 2020-21. The statement showing the work done together with the details of number of hours and the name of the faculty taught are submitted herewith.

Thanking you sir

Yours faithfully,

(VSV KRISHNA MURTHY)

(Lecturer in Mathematics)