Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2019

IT3EA09 Graph Theory

Programme: B.Tech. Branch/Specialisation: IT

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. The maximum number of edges in a bipartite graph on 12 vertices is _____ **1**

(a) 36 (b) 48 (c) 12 (d) 24

ii. If the origin and terminus of a walk are same, the walk is known as _____ **1**

(a) Open (b) Closed (c) Path (d) None of these

iii. A minimal spanning tree of a graph G is _____? **1**

(a) A spanning sub graph (b) A tree

(c) Minimum weights (d) All of these

iv. Which one of the following is a partition of the vertices of a graph in two disjoint subsets that are joined by at least one edge? **1**

(a) Minimum cut (b) Maximum flow

(c) Maximum cut (d) Graph cut

v. What is the chromatic number of an n-vertex simple connected graph which does not contain any odd length cycle? (Assume n>=2) **1**

(a) 2 (b) 3 (c) n-1 (d) n

vi. A set of vertices K which can cover all the edges of graph G is called as **1**

(a) Vertex cover (b) Edge cover

(c) Vertex covering number (d) Minimum vertex cover

vii. In how many ways can 10 examination papers be arranged so that the best and the worst papers can never come together? **1**

(a) $8 \times 9!$ (b) $8 \times 8!$ (c) $7 \times 9!$ (d) $9 \times 8!$

P.T.O.

viii. Determine the probability when a die is thrown 2 times such that there are no fours and no fives occur? **1**
(a) 4/9 (b) 56/89 (c) 13/46 (d) 3/97

ix. Find the value of a_4 for the recurrence relation $a_n=2a_{n-1}+3$, with $a_0=6$. **1**
(a) 320 (b) 221 (c) 141 (d) 65

x. Which of the following is not a generative function? **1**
(a) Lambert series (b) Bell Series
(c) Stalling Series (d) Dirichlet Series

Q.2 i. Define the terms with respect to graph: walk and path. **2**
ii. Explain any 3 properties of tree. **3**
iii. Define Bipartite graph. Give a suitable example. **5**
OR iv. Prove that the number of vertices of odd degree in a graph is always even. **5**

Q.3 i. Define connectivity and separability. **2**
ii. Define planer graph. Also explain different representations of a planer graph with example. **8**
OR iii. Prove the following: **8**
For any spanning tree T, a branch b_i that determines a fundamental cut-set S is contained in every fundamental circuit associated with the chords in S and in no others.

Q.4 i. Explain types of digraphs, with example. **4**
ii. State and prove four-colour theorem. **6**
OR iii. Prove that a connected graph G is an Euler graph if all vertices of G are of even degree. **6**

Q.5 i. Explain derangement with suitable example. **3**
ii. In how many different ways can the letters of the word 'ENGINEERING' be arranged so that the vowels always come together? **7**
OR iii. Explain the principle of inclusion and exclusion. Using this, find the number of prime numbers not exceeding 100. **7**

Q.6 Attempt any two:
i. Find the generating function of the sequence 7,8,9,10…. **5**
ii. Define summation operator, also write down its properties. **5**
iii. What is recurrence relation, explain with suitable example? **5**

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Marking Scheme
IT3EA09 Graph Theory

Q.1	i.	The maximum number of edges in a bipartite graph on 12 vertices is _____ (a) 36		**1**
	ii.	If the origin and terminus of a walk are same, the walk is known as _____ (b) Closed		**1**
	iii.	A minimal spanning tree of a graph G is _____? (d) All of these		**1**
	iv.	Which one of the following is a partition of the vertices of a graph in two disjoint subsets that are joined by at least one edge? (a) Minimum cut		**1**
	v.	What is the chromatic number of an n-vertex simple connected graph which does not contain any odd length cycle? (Assume n>=2) (a) 2		**1**
	vi.	A set of vertices K which can cover all the edges of graph G is called as (a) Vertex cover		**1**
	vii.	In how many ways can 10 examination papers be arranged so that the best and the worst papers can never come together? (a) $8 \times 9!$		**1**
	viii.	Determine the probability when a die is thrown 2 times such that there are no fours and no fives occur? (a) 4/9		**1**
	ix.	Find the value of a_4 for the recurrence relation $a_n=2a_{n-1}+3$, with $a_0=6$. (c) 141		**1**
	x.	Which of the following is not a generative function? (c) Stalling Series		**1**
Q.2	i.	Define the terms with respect to graph:		**2**
		walk	1 mark	
		path	1 mark	
	ii.	Any three properties of tree		**3**
		1 mark for each property	(1 mark * 3)	
	iii.	Definition of Bipartite graph	3 marks	**5**
		Example	2 marks	
OR	iv.	Prove that the number of vertices of odd degree in a graph is always even. Stepwise marking		**5**
Q.3	i.	Connectivity	1 mark	**2**
		Separability	1 mark	
	ii.	Define planer graph	4 marks	**8**
		Representations of a planer graph with example.		
		2 marks for each (2 marks * 2)	4 marks	
OR	iii.	Complete proof		**8**
Q.4	i.	Types of digraphs, with example		**4**
		1 mark for each	(1 mark * 4)	
	ii.	State and prove four-colour theorem. Stepwise marking		**6**
OR	iii.	Prove that a connected graph G is an Euler graph if all vertices of G are of even degree. Stepwise marking		**6**
Q.5	i.	Definition of derangement	2 marks	**3**
		Example	1 mark	
	ii.	In how many different ways can the letters of the word 'ENGINEERING' be arranged so that the vowels always come together? Stepwise marking		**7**
OR	iii.	Principle of inclusion and exclusion	3 marks	**7**
		Solution	4 marks	
Q.6		Attempt any two:		
	i.	Find the generating function of the sequence 7,8,9,10….		**5**
	ii.	Definition of summation operator	2 marks	**5**
		Properties	3 marks	
	iii.	Recurrence relation	2 marks	**5**
		Example	3 marks	

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