

# UTTARAKHAND TECHNICAL UNIVERSITY

Paper ID and Roll No. to be filled in your Answer book

Roll. No.

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EVEN SEMESTER EXAMINATION-2019

## GRAPH THEORY

Subject Code: TCS-604

Time- 3 Hrs

MM-100

### Section A

(Attempt any four. All question carries equal marks)

4\*5 = (20 marks)

Q1. Define the following terms:

- What is the application of isomorphism in real world?
- Are Isomorphic Graphs reflexive, symmetric and transitive?
- Define binary trees and discuss two important applications of it?
- Explain Reduced incidence matrix of a connected graph with suitable example.
- Define the adjacency matrix of a graph? Find the rank of the regular graph with  $n$  vertices and with degree  $p$  ( $<n$ ) of any vertex?

### Section B

(Attempt any four. All question carries equal marks)

4\*5 = (20 marks)

- Draw a graph with
  - Edge connectivity = 4
  - Vertex connectivity = 3
  - Degree of every vertex  $\geq 5$
- Show that the complete bipartite graph  $K_{3,3}$  is non-planer?
- Define a planar graph? Prove that for a connected planar with  $n$  vertices and  $e$  edges  $e \leq 3n - 6$  and  $e \leq 2n - 4$ ?
- State and prove five colour theorem?
- Define the chromatic polynomial of graph  $G$ .

### Section C

(Attempt any four. All question carries equal marks)

4\*5 = (20 marks)

1. What is Bipartite Graph?
2. What is chromatic Number?
3. Define basis vectors of a graph? Find the number of distinct basis possible in a cut-set subspace?
4. Define isomorphism of graphs? For the following pair of graphs, determine whether or not the graphs are isomorphic. Explain your answer?
5. Define the following with one example each:
  - a. Infinite graph
  - b. Hamiltonian path
  - c. Component of a graph
  - d. Euler graph
  - e. Spanning subgraph

### Section D

(Attempt any two. All question carries equal marks)

2\*10= (20 marks)

- 1) Construct a graph  $G$  with the following properties: edge connectivity of  $G=4$ , vertex connectivity of  $G=3$  and degree of every vertex of  $G \geq 5$ .
- 2) Define an Eulerian and a Hamiltonian graph and explain with example.
- 3) Show that the number of vertices with ODD degree in any connected graph  $G$  is always EVEN.

### Section E

(Attempt any two. All question carries equal marks)

2\*10= (20 marks)

1. Define a tree. Prove that a graph with a vertex,  $n-1$  edges, and no circuits is connected.
2. Define the following with one example.
  - a. Complete graph
  - b. Eulerian graph
  - c. Hamiltonian graph
  - d. Bi-partite graph
  - e. Cut points of a graph
3. Let  $v$  be a vertex in a connected graph  $G$  prove that there exists a spanning tree  $T$  in  $G$  such that the distance of every vertex from  $v$  is the same both in  $G$  and in  $T$ .