

**GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR
(GIET UNIVERSITY)**

Ph. D. (Second Semester – Regular) Examinations, April – 2026

**23SPPEMT2011 – Advanced Graph Theory
(Mathematics)**

Time: 3 hrs

Maximum: 70 Marks

The figures in the right-hand margin indicate marks.

Answer ANY FIVE Questions

(14 x 5 = 70)

- 1.a. Prove that every graph at least one spanning tree. 6
- b. Find two spanning trees for the following graph in Fig.1. 8
- 2.a. Prove that the vector space of a graph, the circuit subspace and the cut-subspace are orthogonal to each other. 7
- b. Verify whether the cut-set vector and the circuit vector in the following graph (Fig.2.)are orthogonal 7
- 3.a. Identify two different subspaces of complete graph K_3 and check whether they are orthogonal complements. 7
- b. Find the number of simple graphs with $n(= 3,4,5)$ vertices and r edges (for all possible values of r) using Polya's counting theorem. 7
- 4.a. Prove that there are n^{n-2} labeled trees with n vertices ($n \geq 2$) 7
- b. Describe an algorithm to find all directed circuits of a digraph with suitable example. 7
- 5.a. Prove that every acyclic digraph has unique kernel. 7
- b. Explain uses of graphs in Coding theory. 7
- 6.a. Write the adjacency and incident matrices for the following graph. (Fig.3.) 6
- b. Describe DFS algorithm and illustrate how it is applied to the following graph (Fig. 4.) 8
- 7.a. Describe an algorithm to find critical path and hence project duration of an activity network and employ the same to find CPM in the following graph. (Fig. 5) 14
- 8.a. Find the minimal cost flow of the network from the vertex s to t . (Fig. 6.) 14

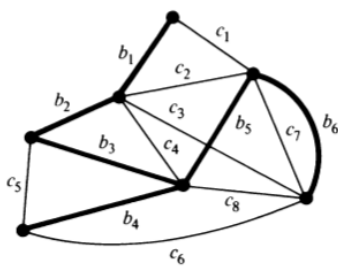


Fig. 1

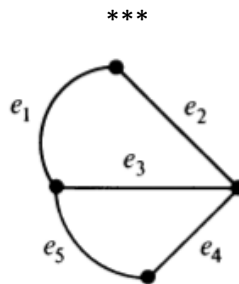


Fig. 2

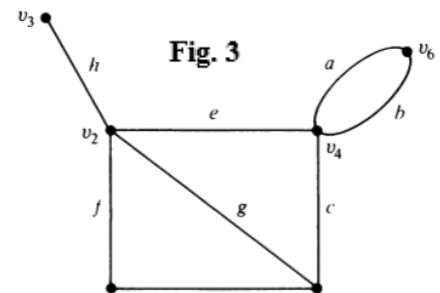


Fig. 3

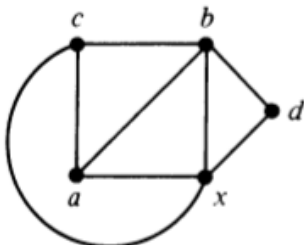


Fig. 4.

Fig. 5

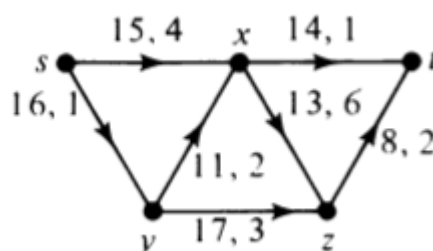
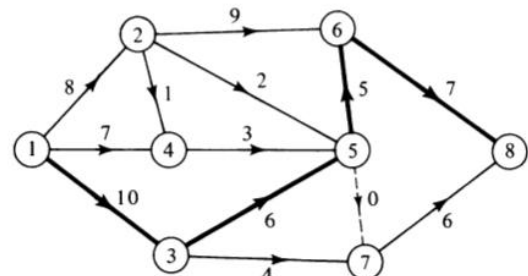


Fig. 6.