23U606 (Pages: 2) Name: ……………………

Reg. No……………………

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2026

(CBCSS-UG)

(Regular/Supplementary/Improvement)

CC19UMTS6E01 / CC20UMTS6E01 – GRAPH THEORY

(Mathematics – Elective Course)

(2019 Admission onwards)

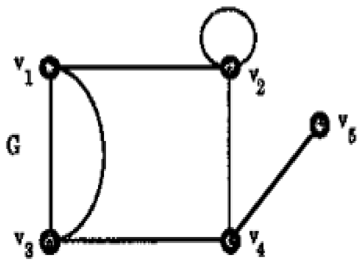
Time: 2 Hours Maximum: 60 Marks

Credit: 2

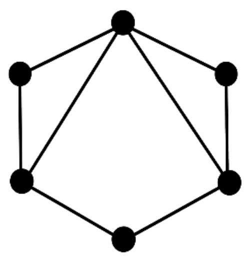
Section A

Answer ***all*** questions. Each question carries 2 marks.

1. Define the simple graph and give an example.
2. Define the graph isomorphism and give an example.
3. State the first theorem of graph theory and verify for the given graph



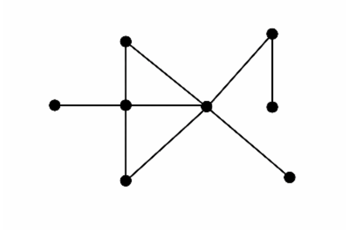
4. Prove that in any graph G, there is an even number of odd vertices.
5. Define the intersection of two graphs.
6. Let G be an acyclic graph with n vertices and k connected components. Then prove that G has $n - k$ edges.
7. Let G be a graph in which the degree of every vertex is at least two. Then prove that G contains a cycle.
8. Find the closure of the given graph



9. Define maximal non-Hamiltonian graph and give an example.
10. If G is a simple planar graph then prove that G has a verter v of degree less than 6, i.e., there is a v in $V(G)$ with $d(v) \leq 5$.

11. Show that K_5 is nonplanar.

12. Find connectivity, $K(G)$ for the given graph.



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(Ceiling: 20 Marks)

Section B

Answer ***all*** questions. Each question carries 5 marks.

13. Draw the graph corresponding to the matrix

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

14. Given any two vertices u and v of a graph G, prove that every $u - v$ walk contains a $u - v$ path.

15. Explain the Konigsberg bridge problem.

16. Let T be a tree with at least two vertices and let $P = u_0 u_1 ... u_n$ be a longest path in T (so that there is no path in T of length greater than n). Then both u_0 and u_n have degree 1.

17. If T is a tree with n vertices, then prove that it has precisely $n - 1$ edges.

18. Let G be a plane graph with n vertices, e edges, f faces and k connected components. Then $n - e + f = k + 1$.

19. Prove that an edge e of a graph G is a bridge if and only if e is not part of any cycle in G

(Ceiling: 30 Marks)

Section C

Answer any ***one*** question. The question carries 10 marks.

20. Let G be a nonempty graph with at least two vertices. Prove that G is bipartite if and only if it has no odd cycles.

21. a) Prove that graph G is connected if and only if it has a spanning tree.

    b) A simple graph G is Hamiltonian if and only if it closure $c(G)$ is Hamiltonian.

(1 × 10 = 10 Marks)

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