MA/CSI41

USN

Fourth Semester B.E Degree Examination, January/February 2004

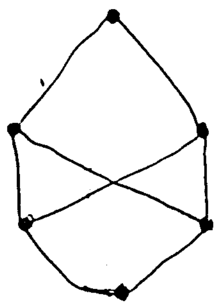
Computer Science / Information Science and Engineering

Applied Mathematics - II

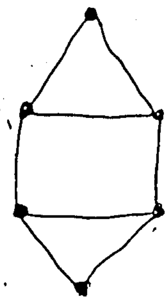
Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. All question carry equal marks.

1. (a) Determine whether the following graphs are isomorphic? (6 Marks)



and



(b) Show that a graph G is Eulerian if and only if G can be decomposed into circuits. (8 Marks)

(c) Define the following and give an example for each.

i) Universal graph;

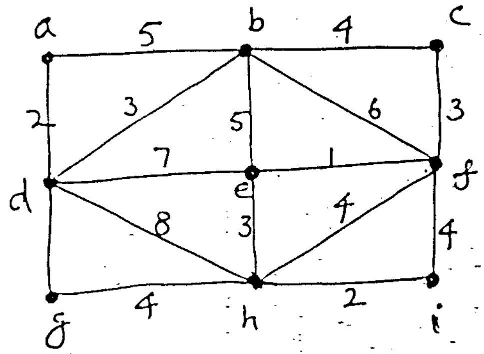
ii) Euler graph and

iii) Hamilton graph (6 Marks)

2. (a) Prove that a tree with n vertices has exactly n-1 edges. (7 Marks)

(b) Prove that a pendant edge in a connected graph is contained in every spanning tree of the graph. (6 Marks)

(c) Use Prim's algorithm to obtain a minimal spanning tree of the graph. (7 Marks)



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3. (a) Prove that an edge e in a connected graph G is a cut edge if and only if e is not included in any circuit of G. **(8 Marks)**

   (b) Show that the edge connectivity of a graph G can never exceed the vertex connectivity of G. **(6 Marks)**

   (c) Explain:

   i) In a tree, every vertex of degree greater than one is a cut vertex.

   ii) An Euler graph cannot have a cut set with an odd number of edges. **(6 Marks)**

4. (a) Prove that a connected planar graph with n vertices, e edges has $e - n + 2$ regions. **(7 Marks)**

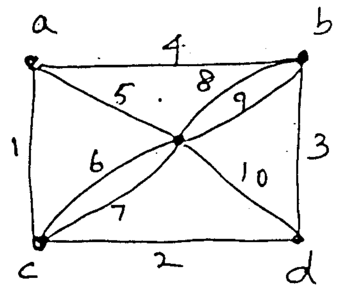
   (b) If G is a connected planar graph with n vertices and e edges ($e \geq 3$), show that $e \leq 3n - 6$. **(7 Marks)**

   (c) Show that K_4 is a self dual graph. **(6 Marks)**

5. (a) Define a cutset matrix with an example and list the properties of cut-set matrix. **(6 Marks)**

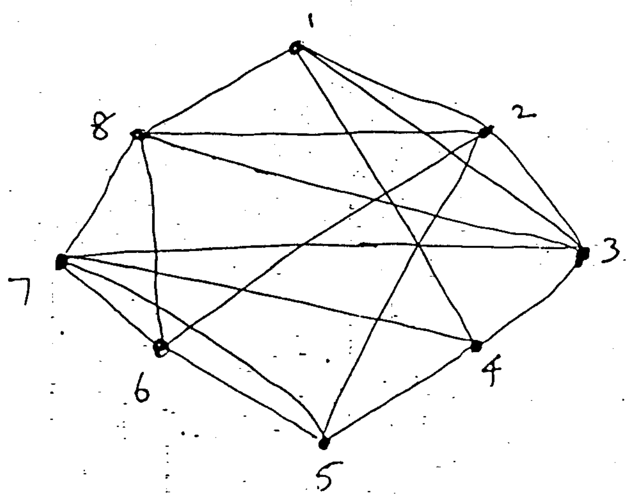
   (b) Prove that rank of a circuit matrix is $e - n + 1$ **(7 Marks)**

   (c) Write the incidence matrix A for the graph given below. Also, list any three observations that can be made about A.



(7 Marks)

6. (a) Define the proper colouring and chromatic number of a graph. Also, find the chromatic number of the graph shown below: **(6 Marks)**



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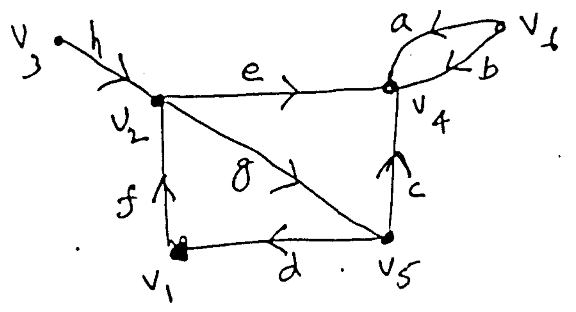
(b) Show that a graph G is bipartite if and only if it is 2-chromatic. (6 Marks)

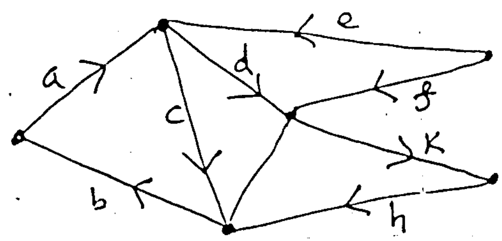
(c) Prove that vertices of every planar graph can be coloured with 5 colours. (8 Marks)

7. (a) Define simple digraph, asymmetric digraph and symmetric digraph with an example on each. (6 Marks)

(b) Obtain the circuit matrix of the digraph shown. (7 Marks)



(c) For the graph given below, determine all the fundamental circuits with respect to the spanning tree $T = \{a, d, f, h, k\}$ (7 Marks)



8. (a) Draw a flow chart and describe an algorithm for finding the shortest path between every pair of vertices. (10 Marks)

(b) Give the Kruskal's algorithm to find the minimal spanning tree of a connected graph by using the flow chart. (10 Marks)

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(Pages : 3)

MATCSI—41

FOURTH SEMESTER B.E. (INFORMATION SCIENCE AND ENGINEERING) DEGREE EXAMINATION

APPLIED MATHEMATICS—II

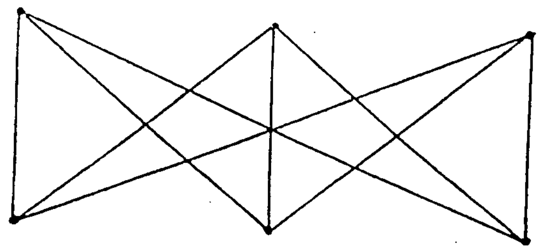
Time : Three Hours

Maximum : 100 Marks

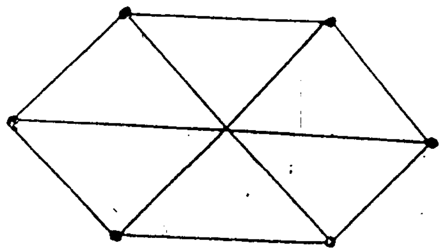
Answer any **five** *full questions.*
All questions carry equal marks.

(a) Define Isomorphism of two graphs. Show that the graphs given below are isomorphic :

G1 :



G2 :



(6 marks)

(b) Define a Simple graph. Prove that a simple graph G with n vertices and k-components. Can have atmost $(n-k)(n-k+1)/2$ edges ?

(7 marks)

(c) Define an Euler graph and Hamiltonian graph with an example on each. Explain Konigsberg bridge problem and discuss the solution of the problem.

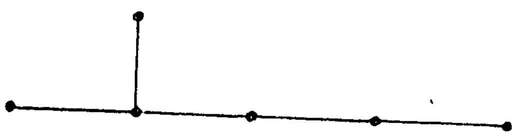
(7 marks)

(a) Define a Tree. Prove that there is one and only one path between a pair of vertices in a tree.

(5 marks)

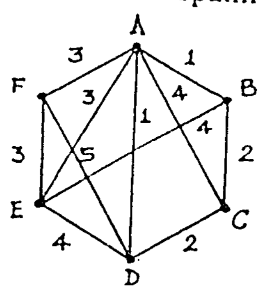
(b) Prove that every tree has either one or two centres. For the graph given below, find centre, radius and diameter.

G :



(6 marks)

(c) Write the prism algorithm to find the minimal spanning tree of a weighted graph. Using the algorithm, find the minimal spanning tree of the weighted graph.



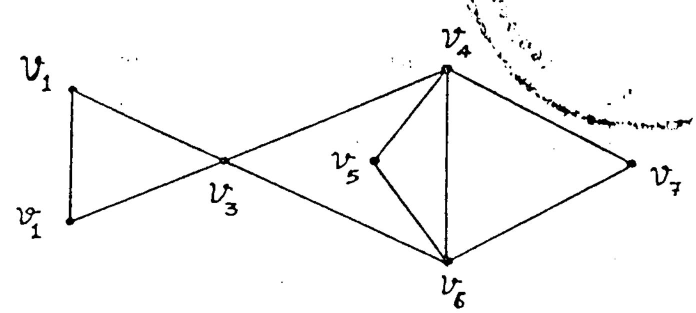
(9 marks)

Turn over

3. (a) Prove that every circuit has even number of edges in common with any cut-set.

(6 marks)

(b) Define (i) Edge connectivity ; (ii) Vertex connectivity ; and (iii) Separable graph. Is the graph given below a separable graph ? Explain.



(7 marks

(c) Prove that the maximum flow possible between vertices a and b in a network is equa to the minimum of the capacities of all cutsets with respect to a and b.

(7 marks)

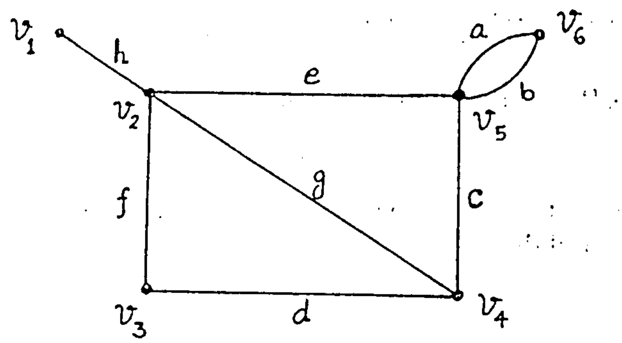
4. (a) Prove that a complete graph of five vertices is non-planar. (6 marks

(b) Explain the steps leading to the detection of planarity of a connected graph.

(7 marks

(c) Define a dual graph G^*. Explain the relations between G and G^*. (7 marks

5. (a) Define a cut-set matrix. Write the cut-set matrix for the graph given below. List som of the observations of the matrix :



(7 mark:

(b) Let B and A be respectively circuit matrix and incidence matrix whose columns ar arranged using the same order of edges. Then prove that every row of B is orthogon: to every row of A. ie., $A \cdot B^T = B \cdot A^T = 0$.

(6 mark

(c) If B is a circuit matrix of a connected graph G with e edges and n vertices, prove th: rank of $B = e - n + 1$.

(7 mark

6. (a) What is a coloring problem ? Define (i) proper coloring ; and (ii) chromatic number of graph.

(5 mark

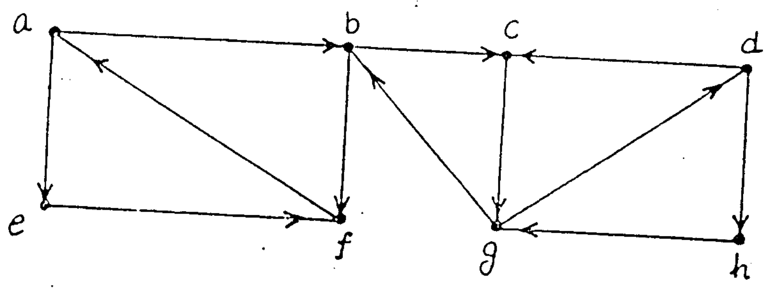
(b) Explain 4-color problem. Prove that every tree with 2 or more vertices is 2-chromat

(8 mark

(c) Prove that the vertices of every planar graph can be properly colored with 5 colors.

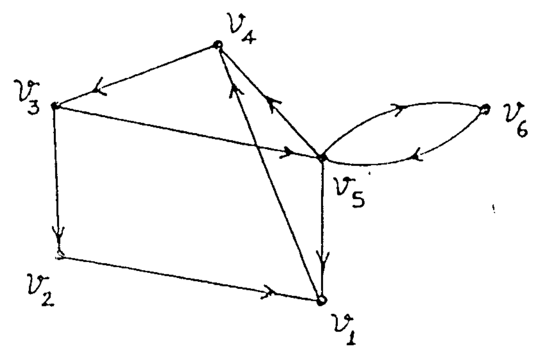
(7 mark

7. (a) Define a directed graph. Let D be the digraph as shown below : (i) Find the directed walk in D of length 8. Is the walk a directed path ? (ii) Find the directed trial of longest length. (iii) Find a directed path of longest length.



(7 marks)

(b) Define a strongly connected digraph. Is the graph given below strongly connected ? Explain.



(7 marks)

(c) Prove that in any digraph the sum of the in degree of all vertices is equal to the sum of their out degrees.

(6 marks)

8. (a) Define an Algorithm. Using flowchart, write Kruskal's algorithm to find the shortest spanning tree.

(10 marks)

(b) Write the flowchart to describe Dijkstra's algorithm to find the shortest path between two given vertices.

(10 marks)

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MATCSI41

Reg. No.

Fourth Semester B.E Degree Examination, January/February 2003

Computer Science / Information Science and Engineering

Applied Mathematics - II

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*
All question carry equal marks.

1. (a) Define isolated vertex, pendant vertex and null graph with an example each. (6 Marks)

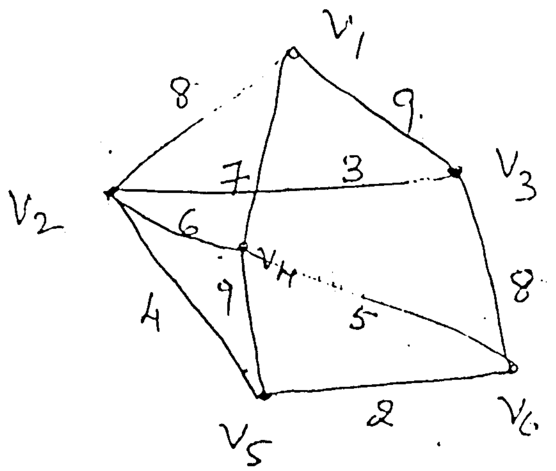
   (b) Show that a simple graph with n vertices and k-components can have atmost $(n-k)(n-k+1)/2$ edges. (7 Marks)

   (c) Show that a connected graph G is an Euler graph if and only if it can be decomposed into circuits. (7 Marks)

2. (a) Show that a graph is a tree if and only if it is minimally connected. (6 Marks)

   (b) Define complementary graph. Give examples for
      i) G & $\overline{G}$ both connected
      ii) G disconnected & $\overline{G}$ connected. (7 Marks)

   (c) Explain Krushkal algorithm to find shortest spanning tree and hence find a shortest sp. tree. .



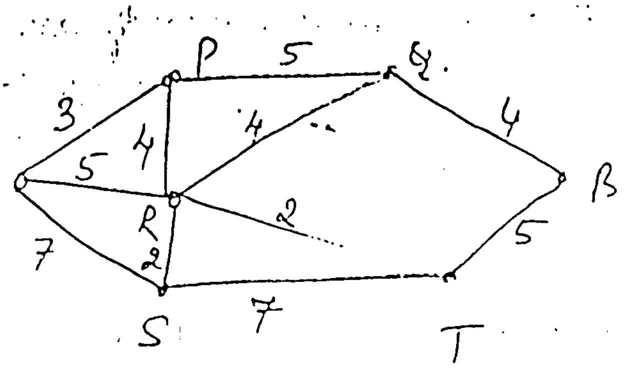
(7 Marks)

3. (a) Show that the minimum set of edges which contains at least one branch of every spanning tree of G is a cutset. (6 Marks)

   (b) Show that a vertex v in a connected graph G is a cut-vertex if and only if there exists vertices x and y in G such that every path between x and y passes through v. (7 Marks)

Contd.... 2

(c) Find maximum flow from A to B. .

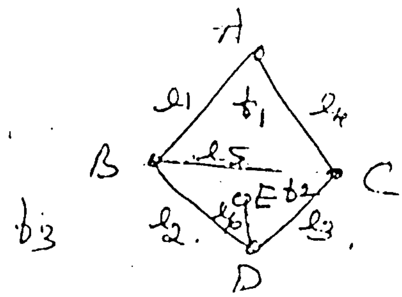


(7 Marks)

4. (a) If G is a connected planar graph with n vertices and l edges ($l \geq 3$). Show that $c \leq (3n - 6)$ (6 Marks)

(b) If G is a finite connected planar graph with atleast 3 vertices ($n \geq 3$). Show that G has atleast one vertex with degree 5 or less. (7 Marks)

(c) Define dual of a graph. Find the dual of .



(7 Marks)

5. (a) Define a cutset matrix with an example and list the properties of cut set matrix. (6 Marks)

(b) Show that the reduced incidence matrix is non singular if and only if the graph is a tree. (7 Marks)

(c) Show that rank of a circuit matrix of a connected graph is $l - n + 1$ (7 Marks)

6. (a) Define chromatic number and maximal independent set with an example each. (6 Marks)

(b) Show that every planar graph is five colourable. (7 Marks)

(c) Show that a covering g of a graph is minimal if and only if g contains no paths of length 3 or more. (7 Marks)

7. (a) Define simple digraphs, asymmetric digraph and symmetric digraph with an example each. (6 Marks)

(b) Define an arboresence. Show that an arboresence is a tree in which every vertex other than the root has an in-degree of exactly one. (7 Marks)

(c) Show that the determinant of every sub-matrix of A, the incidence matrix of a digraph is 1, -1 or 0. (7 Marks)

8. (a) Explain the algorithm to find a sp. tree with a flow chart. (10 Marks)

(b) With a flow chart for an algorithm to find shortest paths between all pairs of vertices. (10 Marks)

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MATCSI41

USN | | | | | | | | | | |

Fourth Semester B.E Degree Examination, July/August 2003

Computer Science / Information Science and Engineering

Applied Mathematics - II

Time: 3 hrs.] [Max.Marks : 100

Note: ***1. Answer any FIVE full questions.***
2. All question carry equal marks.

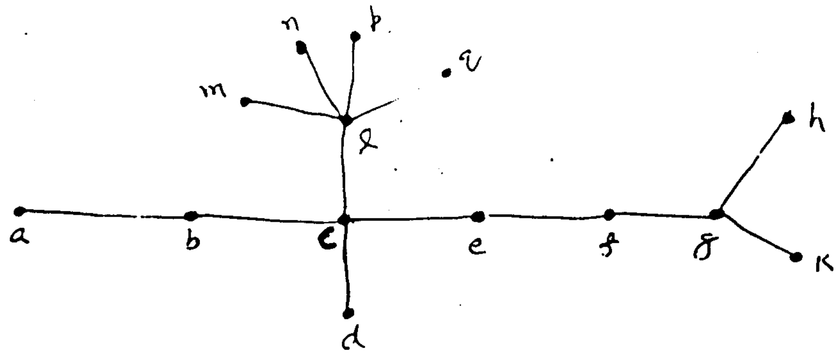
1. (a) Explain Königsberg bridge problem. **(6 Marks)**

(b) Prove that, a simple graph with n vertices and k components can have at most, $\frac{(n-k)(n-k+1)}{2}$ edges. **(8 Marks)**

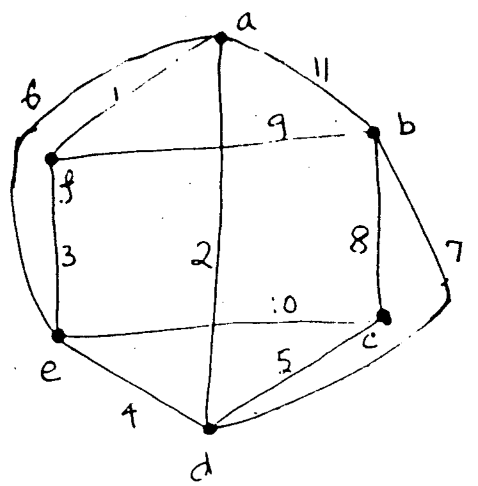
(c) Define i) Universal graph; ii) Unicursal graph and give one example each. **(6 Marks)**

2. (a) Prove that every tree has either one or two centres. **(6 Marks)**

(b) Determine the center of the tree. **(7 Marks)**



(c) Determine the minimal spanning tree of the graph. **(7 Marks)**



3. (a) Define a cut vertex and a cut edge. Give examples. **(6 Marks)**

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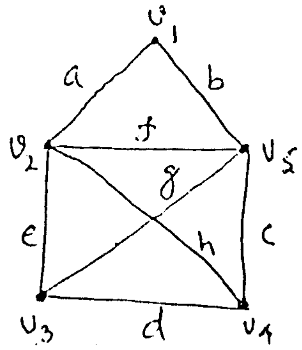
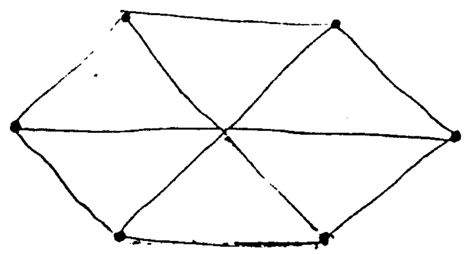
(b) List all the fundamental cut sets of the graph



with respect to the spanning tree whose edge sequence is a, e, d, f. **(8 Marks)**

(c) Show that the maximum flow possible between two vertices a and b in a network is equal to the minimum of the capacities of all cut-sets with respect to a and b. **(6 Marks)**

4. (a) Show that the graph G ia non-planar

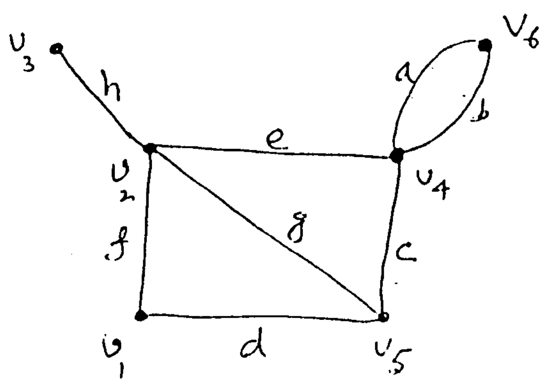


(6 Marks)

(b) If every region of a simple planar graph G (with n vertices and e edges) embedded in a plane is bounded by K edges, show that $e = \frac{k(n-2)}{k-2}$ **(6 Marks)**

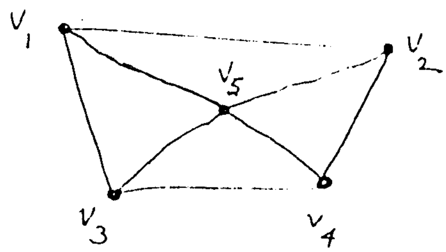
(c) Define the Geometric dual of a graph. List the relationship between a graph and its dual. **(8 Marks)**

5. (a) Obtain the circuit matrix of the graph.



and hence list any three observations that can be made about the graph. **(8 Marks)**

(b) Obtain the adjacency matrix of the graph G. Also list any three observations that can be made about G. **(6 Marks)**



(c) Define the path matrix of a graph. Give one example. List some of the observations one can make about the graph. **(6 Marks)**

6. (a) Define :

i) Proper colouring of a graph.

ii) Chromatic number of a graph.

Also, give the chromatic numbers of i) Null graph; ii) Tree; iii) Complete graph. **(6 Marks)**

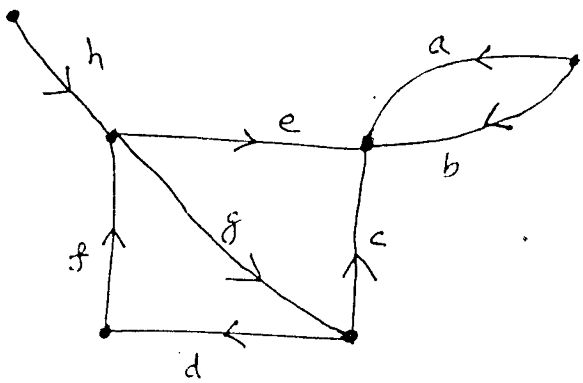
(b) Show that a graph is 2-chromatic if and only if it is bipartite. **(6 Marks)**

(c) Explain i) covering of a graph and ii) four colour problem. **(8 Marks)**

7. (a) Define the following and give an example each i) Directed walk; ii) Directed path and iii) Circuit. **(6 Marks)**

(b) Show that a digraph G is an Euler digraph if and only if $d^-(v) = d^+(v)$ for every vertex U in G. **(8 Marks)**

(c) Obtain the incidence matrix of the graph given below. **(6 Marks)**



8. (a) Write a flow chart and describe the algorithm for finding a spanning tree of a connected graph. **(10 Marks)**

(b) Give the description of Dijkslra's algorithm and a flow chart for finding the shortest distance between two specified vertices. **(10 Marks)**

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CS54

USN

NEW SCHEME

Fifth Semester B.E. Degree Examination, Dec.06 / Jan.07

CS / IS

Data Communications

Time: 3 hrs.] [Max. Marks:100

Note: ***1. Answer any FIVE full questions.***
2. Answer must be to the point.
3. Diagrams if any must be neatly drawn.

1 a. Compare and contrast the working of telephony and computer networks with respect to services provided, addressing used, routing mechanism, and signaling. **(06 Marks)**

b. Why do computer networks use packet switching? What kind of addressing is used in internet and why? Why is that the reliability aspect is addressed by the hosts attached to the network and not by the routers in the network. What is the role of DNS in the internet? **(08 Marks)**

c. What is LAN? What is MAC protocol and why is it required? Is routing required in LAN? Justify your answer. What is framing? What kind of addressing is used? What is its length? **(06 Marks)**

2 a. What is an internetwork? What are the issues in internetworking? With a neat diagram explain the working of an internetwork. What is ARPANET? Discuss its salient features. **(10 Marks)**

b. Why there is a need for an overall network architecture? What do you understand by the term layering? How does it help simplify network design? **(04 Marks)**

c. What is SMTP? With a neat tabulation, explain the interaction between the client and the server, clearly indicating the important messages exchanged. **(06 Marks)**

3 a. With a neat schematic block diagram, explain the working of each layer of the OSI reference model. **(10 Marks)**

b. Why digital transmission of information is preferred over analog transmission? With a neat schematic block diagram explain how analog information is transformed into digital. **(05 Marks)**

c. Suppose an uncompressed text file is 1 Mega byte in size. How long does it take to download the file over a 32 kbps modem? If 1 : 6 compression is used what is the time required? **(05 Marks)**

4 a. Describe the process of sampling the analog signal. With a neat block diagram, explain the process of transmission of analog information by digital transmission system, clearly indicating the process of quantization and the resulting quantization error. **(06 Marks)**

b. With neat graphs, describe how do you characterize a communication channel using frequency domain characterization. **(06 Marks)**

c. What is Nyquist criteria? With appropriate equation describe the term channel capacity. **(03 Marks)**

d. A 10 kHz baseband channel is used by a digital transmission system. Ideal pulses are sent at Nyquist rate and pulses can take 16 levels. What is the bit rate of the system? **(05 Marks)**

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Reg. No. [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Fourth Semester B.E Degree Examination, February 2002

Computer Science / Information Science

Applied Mathematics

16

Time 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*
All question carry equal marks

1. (a) Define a simple graph. Prove that a simple graph G with n vertices and k - components can have at most (n-k) (n-k+1)/2 edges. (7 Marks)

   (b) Define

   i) A walk

   ii) Ring sum of two graphs

   iii) Hamiltonian path

   With an example each. (6 Marks)

   (c) Define Isomorphism of two graphs. Test whether the graphs given below are isomorphic or not.

(7 Marks)

2. (a) Define a Tree and show that a tree with n vertices has n-1 edges. (6 Marks)

   (b) Show that a Hamiltonian path is a spanning tree. (7 Marks)

   (c) Prove that every tree has either one or two centres. (7 Marks)

3. (a) Define a set of fundamental cut sets and fundamental circuits with examples. (7 Marks)

   (b) Prove that the maximum vertex connectivity that a graph G of n vertices and e edges can have is $[\frac{2e}{n}]$ provided $e \geq n-1$. (7 Marks)

   (c) Define connectivity and separable graph with an example for each. (6 Marks)

4. (a) Prove that a complete graph of five vertices is non-planar. (6 Marks)

   (b) Explain the steps leading to the detection of planarity of a connected graph (7 Marks)

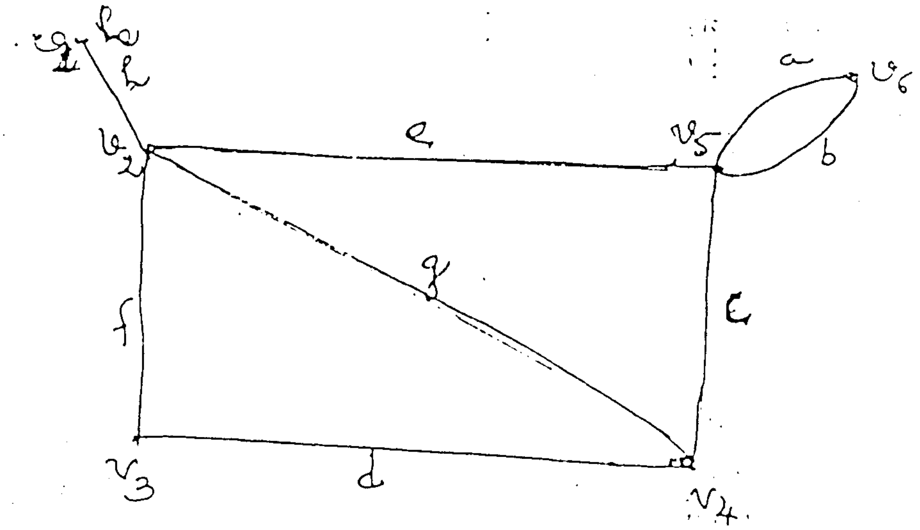
   (c) Define a dual graph G^*. Explain the relations between G and G^* (7 Marks)

Contd... 2

5.. (a) If B is a circuit matrix of a connected Graph G with e- edges and n-vertices. prove that rank of B = e-n+1. (7 Marks)

(b) Let B and A be respectively circuit matrix and incidence matrix whose columns are arranged using the same order of edges. Then prove that every row of B is orthogonal to every row of A. $A \bullet B^T = B \bullet A^T = 0$ (7 Marks)

(c) Define a cut-set matrix. Write the cut-set matrix for the graph given below (6 Marks)



6. (a) What is colouring problem? Define

i) proper colourings

ii) Chromatic number of a graph. (6 Marks)

(b) Explain 4-colour problem. Prove that every tree with 2 or more vertices is 2-chromatics. (7 Marks)

(c) Prove that the vertices of every graph can be properly coloured with 5 colours. (7 Marks)

7. (a) What is a digraph? List different types of digraphs with examples. (6 Marks)

(b) Prove that incidence matrix of a digraph G is 1, - 1 or 0. (7 Marks)

(c) Prove that every complete tournament has a directed Hamiltonian path. (7 Marks)

8. (a) Give the characteristics of an algorithm in a computer programme. (4 Marks)

(b) Explain Dijkstra's algorithm for finding the shortest path between two vertices in a graph. (8 Marks)

(c) Write the flow chart for an algorithm to find a set of fundamental circuits. (8 Marks)

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6. (a) Define Cromatic number of a graph. Prove that every tree with two or more vertices is 2-cromatic.

(6 marks)

(b) Define Covering of a graph. Prove that a covering g of a graph is minimal if and only if g contains no paths of length three or more.

(6 marks)

(c) What is four colour problem ? Show that the vertices of every planar graph in can be properly coloured with five colours.

(8 marks)

7. (a) Define Work and Path in a directed graph. Find sequence of vertices and edges of the longest walk in the digraph given in Fig. 7 below :

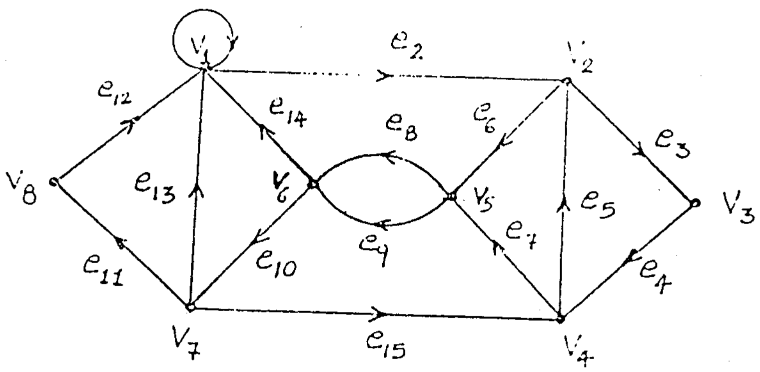


FIG. 7.

(8 marks)

(b) Define Arborescence directed graph. Show that an arborescence is a tree in which every vertex other than the root has an in-degree of exactly one.

(6 marks)

(c) Define Adjacency matrix of a digraph. Find adjacency matrix of the digraph given in Fig. 8 below :

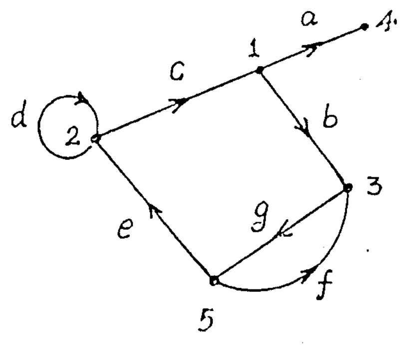


FIG. 8.

(6 marks)

8. (a) Make the flowchart to describe Paton's algorithm to find fundamental circuits.

(10 marks)

(b) Describe Dijkstra's algorithm to find the shortest path between two specified vertices.

(10 marks)

Reg. No. □□□□□□□□□□

Fourth Semester B.E Degree Examination, July/August 2002

Computer Science / Information Science Engineering

Applied Mathematics - II

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*
All question carry equal marks

1. (a) Distinguish between the following :
   i) A walk and a path
   ii) Regular and complete graph
   iii) Decomposition and Ring sum operations. (6 Marks)

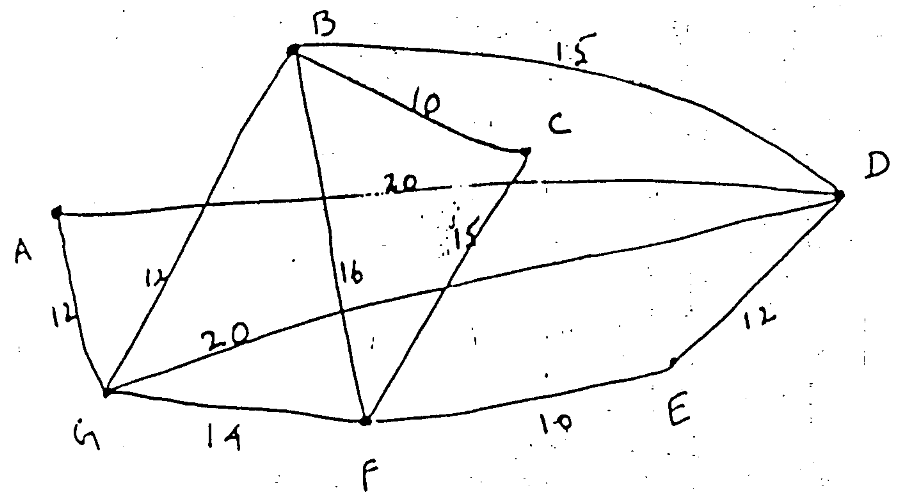
   (b) Prove that a connected graph G is an Euler graph if and only if all the vertices of G are of even degree. (8 Marks)

   (c) Define an infinite graph. Show that an infinite graph with a finite number of vertices and infinite number of edges will have at least one pair of vertices joined by an infinite number of parallel edges. (6 Marks)

2. (a) Prove that any connected graph G with n vertices and $n-1$ edges is a tree. (7 Marks)

   (b) Show a tree in which its diameter is not equal to twice the radius. Under what condition does this inequality hold ? (6 Marks)

   (c) Using the Kruskal's algorithm, find minimal spanning tree of.



(7 Marks)

3. (a) Show that with respect to a given spanning tree, a branch b_i that determines a fundamental cut - set is contained in every fundamental circuit associated with the chords in S and in no others. (7 Marks)

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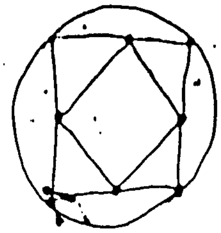
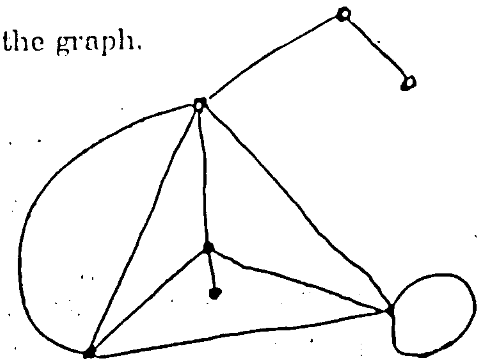
(b) Determine the edge connectivity and vertex connectivity of the graph. (6 Marks)



(c) Explain i) 1 - isomorphism and ii) 2 - isomorphism by means of an example. (7 Marks)

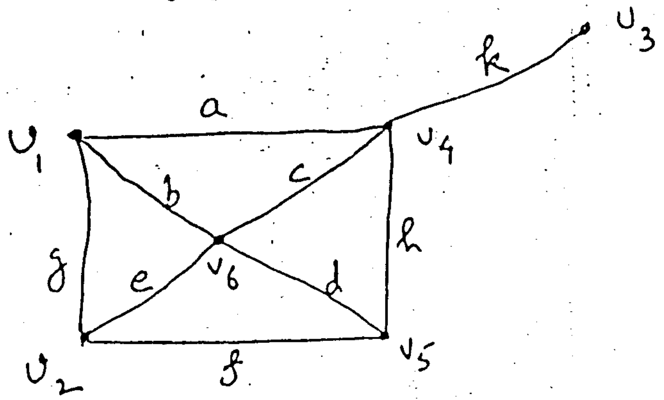
4. (a) Prove that a connected planar graph G with n ventrices and e edges has $e - n + 2$ regions. (7 Marks)

(b) Draw the geometric dual of the graph. (6 Marks)



(c) Define a self-dual graph. Show that K_4 is a self-dual graph. (7 Marks)

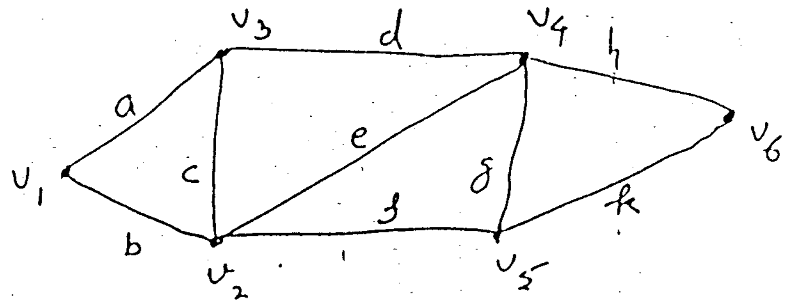
5. (a) Define the incidence matrix of a graph. Obtain the adjacency matrix of the graph.



(7 Marks)

(b) Let G be a connected graph with n vertices. Show that the rank of incidence matrix of G is $n - 1$. (7 Marks)

(c) Write down the path matrix $P(V_1, V_6)$ of the graph.



(6 Marks)

6. (a) Define the chromatic polynomial of a graph. Show that the chromatic polynomial of an n - vertex tree is $\lambda(\lambda - 1)^{n-1}$ (6 Marks)

(b) Show that a covering g of a graph is minimal if and only if g contains no paths

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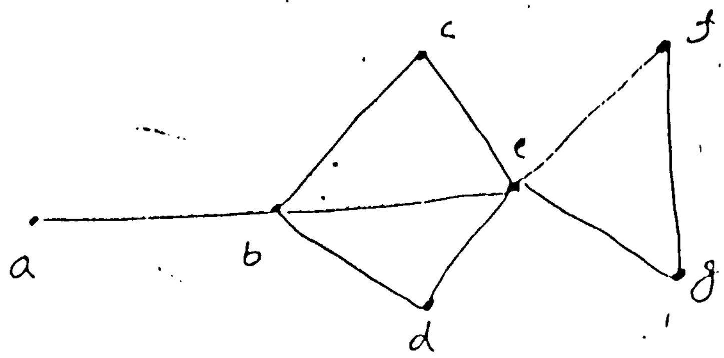
of length 3 or more.

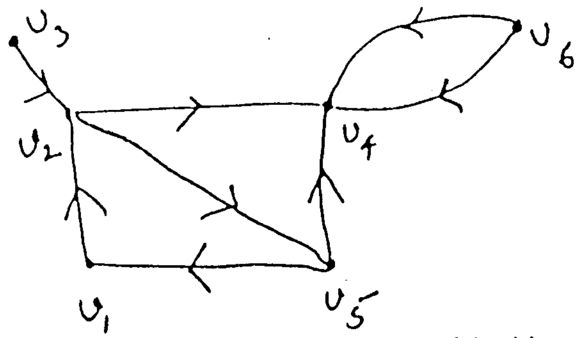
(c) Obtain the chromatic partitioning of the graph.



(6 Marks)

7. (a) Define the two types of connectedness in a digraph. Give one example for each. (6 Marks)

(b) Define the incidence matrix of a digraph. Obtain the incidence matrix of



(7 Marks)

(c) Let B and A be, respectively, the circuit matrix and incidence matrix of a self loop-free digraph such that the columns in B and A are arranged using the same order of edges. Show that $A.B^T = B.A.^T = 0$ (7 Marks)

8. (a) Make the flow chart to describe the algorithm for finding the minimal spanning tree. (10 Marks)

(b) Describe the algorithm for finding the shortest distance between all pairs of vertices. (10 Marks).

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MATCSI 41

Reg. No. [ ][ ][ ][ ][ ][ ][ ]

Fourth Semester B.E Degree Examination, August 2001

Computer Science / Information Science

Applied Mathematics

Time: 3 hrs.] [Max.Marks : 100

Note: *Answer any FIVE full questions.*
All question carry equal marks

1. (a) Define i) walks, paths, circuits ii) Connected graphs, disconnected graphs, components with an example for each

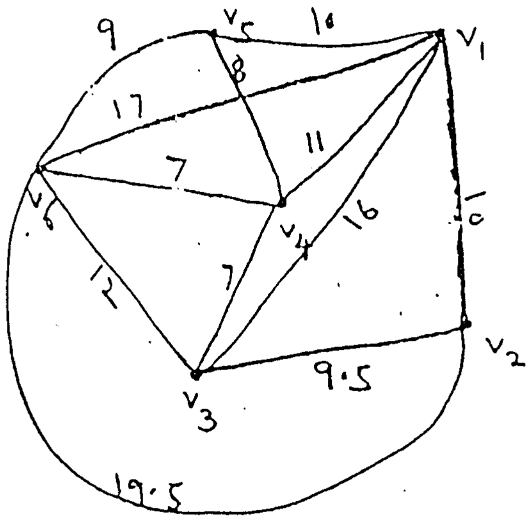
   (b) Define universal graph and Hamiltonian circuit, Euler's graph. Give example for universal graph.

   (c) Prove that sum of degrees of all the vertices in a graph is always even. Show that a graph always has an even number of odd degree vertices.

2. (a) Prove that a tree with n vertices has n-1 edges.

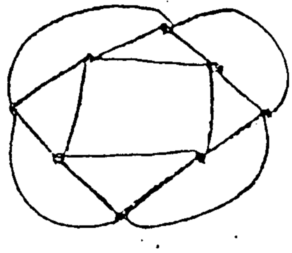
   (b) Define Distance, Centres and Eccentricity, Radius and Diameter in a tree. Give an example for eccentricity.

   (c) Write Kruskal algorithm to find minimal spanning tree of a weighted graph. Using algorithm find a minimal spanning tree of a weighted graph goven below.



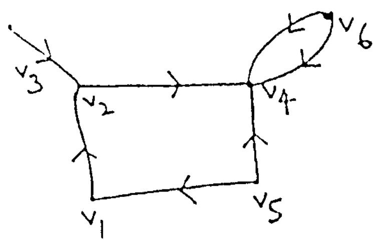
3. (a) Define fundamental circuits. Discuss that a connected graph G is a tree if adding an edge between any two vertices in G creates exactly one circuit.

   (b) Define connectivity and seperable graph with an example. Find the edge connectivity and vertex connectivity for the graph G given below

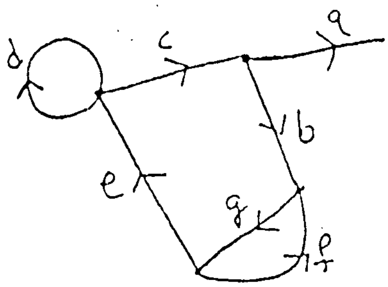


7. (a) Define a directed graph. Directed paths and Connectedness. Explain taking an example of a graph.

(b) Find incidence matrix for the graph



also find the adjaceny matrix for the graph



(c) Prove every complete tournament has a Hamiltonian path.

8. (a) Explain algorithm. Give efficiencies of the algorithm.

(b) Draw flow chart by Krushkal's algorithm for the minimal spanning tree.

(c) Write the flow chart for an algorithm to find a set of fundamental circuits.

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MAT CSI—41

FOURTH SEMESTER B.E. DEGREE EXAMINATION, MARCH 20..

APPLIED MATHEMATICS—II

14

Time : Three Hours | Maximum : 100 Marks

Answer any five *full questions.*
All questions carry equal marks.

1 (a) Define Regular graph. Show that the number of vertices of odd degree in a graph is always even.

(6 marks)

(b) Define Isomorphism of two graphs. Show that the following graphs in Fig. 1 are isomorphic :—

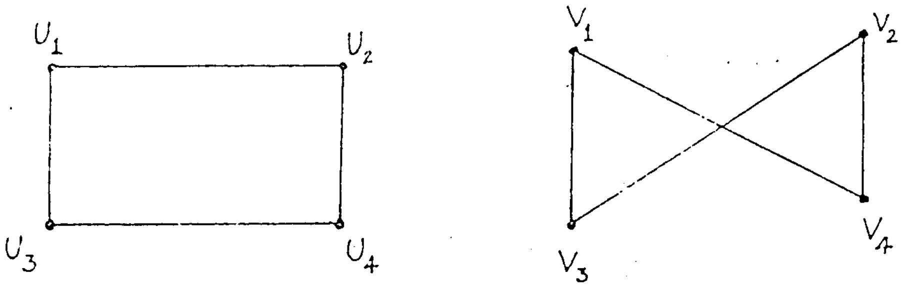

FIG. 1.

(6 marks)

(c) Define Hamiltonian circuit. Prove that in a complete graph with n vertices there are $(n-1)/2$ edge-disjoint Hamiltonian circuits, if n is an odd number ≥ 3.

(8 marks)

2 (a) Define a Tree. Prove that a graph is a tree if and only if it is minimally connected.

(6 marks)

(b) Define Binary tree. Find centre, radius and diameter of the graph in Fig. 2

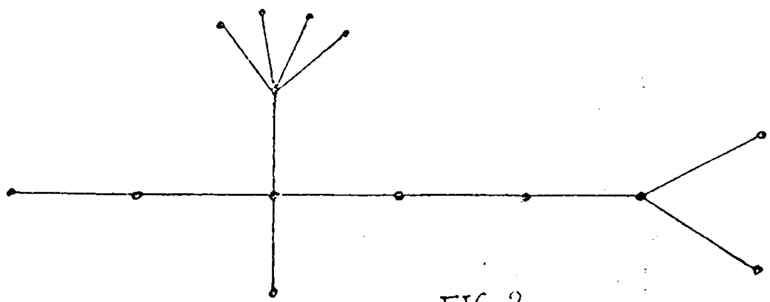

FIG. 2.

(6 marks)

(c) Define Spanning tree. Find minimal spanning tree of the weighted graph in Fig. 3

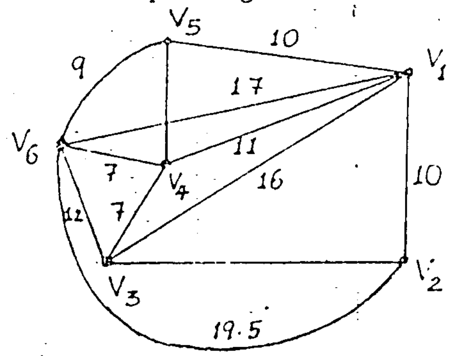

FIG. 3.

(8 marks)

Turn over

3. (a) Define Cut-set. Prove that in a connected graph G, any minimal set of edges containing at least one branch of every spanning tree of G is a cut set.

(8 marks)

(b) Define Fundamental cut set. Find all fundamental cut sets of the given graph in Fig. 4 with respect to the spanning tree $\{b, c, e, h, k\}$.

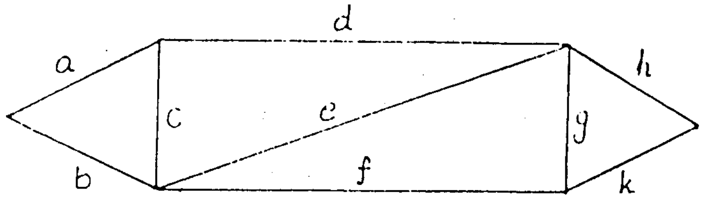

FIG. 4.

(6 marks)

(c) Prove that if G_1 and G_2 are two 1-isomorphic graph, the rank of G_1 equals the rank of G_2 and the nullity of G_1 equals the nullity of G_2.

(6 marks)

4. (a) Define Planar graph. Prove that the Kuratowski's second graph consisting of six vertices and nine edges is non-planar.

(8 marks)

(b) State criteria to detect the planarity of a connected graph and give an example also.

(6 marks)

(c) Prove that a graph has a dual if and only if it is planar. (6 marks)

5. (a) Define Circuit matrix. Find the circuit matrix of the graph given in Fig. 5 below :

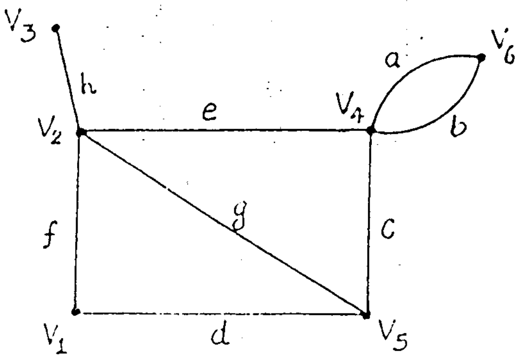

FIG. 5.

(7 marks)

(b) Define Fundamental circuit. Find a fundamental circuit matrix B_f with respect to a spanning tree $\{e_1, e_4, e_5, e_7\}$ for the graph in Fig. 6 given below :

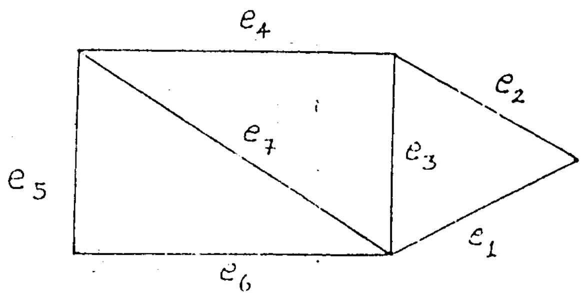

FIG. 6.

(7 marks)

(c) If B is a circuit matrix of a connected graph G with e edges and n vertices, rank of $B = e - n + 1$.

(6 marks)