QP CODE: D2BAM2402	**(Pages: 3)**	**Reg. No**	**:**	**...............................**
		Name	**:**	**...............................**

SECOND SEMESTER FYUGP EXAMINATION, APRIL 2025

MINOR COURSE

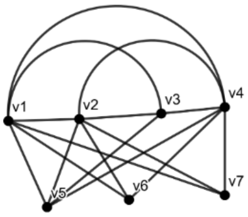
AMA2MN104 : Graph Theory and Automata

(Credits: 4)

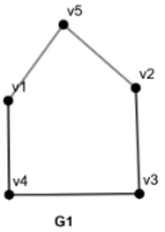
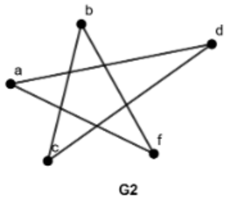
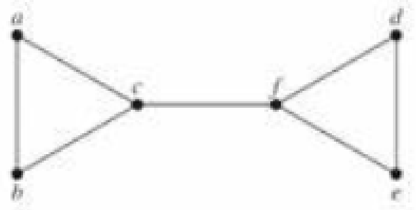
Time: 2 Hours	**Maximum Marks: 70**

Section A

Answer the following questions. Each carries 3 marks (Ceiling: 24 marks)

1.	Find the number of vertices and edges of the graph given below. Also find the degree of each vertex. 	BL2	CO1
2.	Define the following. i. Path ii Cycle iii. Circuit	BL2	CO1
3.	A connected, planar graph contains 10 vertices and divides the plane into seven regions. compute the number of edges in the graph. A connected planar graph contains 24 edges. It divides the plane into 13 regions. compute the number of vertices in the graph.	BL2	CO1
4.	Define the length of word. Write the properties of length.	BL1	CO3
5.	Draw the graph with adjacency matrix. $\begin{bmatrix} 1 & 1 & 1 & 0 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & 1 \end{bmatrix}$	BL2	CO1
6.	Define bipartite and complete bipartite graph. Give example for each.	BL2	CO1
7.	Distinguish between cycle and circuit. Give example for each. **(PTO)**	BL1	CO1, CO2

<table>
<tr><td>8.</td><td>Draw the graph with given adjacency matrix and write its properties.
$\begin{bmatrix} 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix}$</td><td>BL2</td><td>CO1</td></tr>
<tr><td>9.</td><td>Define Kleene Closure of a Language.</td><td>BL1</td><td>CO3</td></tr>
<tr><td>10.</td><td>Draw the transition diagram of the FSA, M = (S,A,I,F,s_0) where I = {a,b},
and S = {s_0,s_1,s_2}, A={s_2}.</td><td>BL2</td><td>CO3</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Section B</td></tr>
<tr><td colspan="4">Answer the following questions. Each carries 6 marks (Ceiling: 36 Marks)</td></tr>
<tr><td>11.</td><td>Among a group of 5 people, is it possible for everyone to be friends with exactly 2 of the people in the group? What about 3 of the people in the group? Explain using the conecpt of graph theory.</td><td>BL3</td><td>CO1</td></tr>
<tr><td>12.</td><td>Give an example for a graph which is:
i. Eulerian but not Hamiltonian.
ii. Hamiltonian but not Eulerian and give justification for each.</td><td>BL2</td><td>CO1, CO2</td></tr>
<tr><td>13.</td><td>The table given below lists the students taking the various courses at Konigsberg College. The registrar would like to develop a conflict-free final exam schedule using as few time slots as possible. How can you help her using the concept of graph theory?
<table>
<tr><th>Course A</th><th>Course B</th><th>Course C</th><th>Course D</th><th>Course E</th><th>Course F</th><th>Course G</th></tr>
<tr><td>Boole</td><td>Cantor</td><td>Clinton</td><td>Boole</td><td>Boole</td><td>Abel</td><td>Abel</td></tr>
<tr><td>Bourbaki</td><td>Euler</td><td>Euler</td><td>Ford</td><td>Cantor</td><td>Ford</td><td>Boole</td></tr>
<tr><td>Cantor</td><td>Newton</td><td>Gauss</td><td>Hamilton</td><td>Cauchy</td><td>Gauss</td><td>Cauchy</td></tr>
<tr><td>Ford</td><td>Pascal</td><td>Newton</td><td>Hardy</td><td>Fibonacci</td><td>Nobel</td><td>Cayley</td></tr>
<tr><td>Hamilton</td><td>Russel</td><td>Nobel</td><td>Pascal</td><td>Newton</td><td>Russel</td><td>Hardy</td></tr>
</table></td><td>BL4</td><td>CO1</td></tr>
<tr><td>14.</td><td>Let N={A,B,σ}, T={a,b} and P=$\{\sigma \to aA, A \to bA, A \to a\}$. Then G={N, T, P, σ} is a grammar. Draw a derivation tree for each word in L(G).
a) ab b) a^4b</td><td>BL2</td><td>CO3</td></tr>
<tr><td>15.</td><td>Let A, B, C and D be any language over Σ. Then prove or disprove the following with an example.
i. A(B$\cap$ C) $\subseteq$ AB $\cap$ BC
ii. If A $\subseteq$ B and C $\subseteq$ D, then AC $\subseteq$ BD</td><td>BL2</td><td>CO3</td></tr>
</table>

16.	Are the graphs G1 and G2 given below are isomorphic ? Show details of work.   	BL1	CO1
17.	Use Dirac's theorem and Ore's theorem to determine whether the graph is Hamiltionian. Construct a circuit if it exists.If not, is it possible to construct a Hamitonian path.  	BL2	CO1, CO2
18.	For each description given, either draw a planar graph that meets the description or prove that no planar graph can meet the description given. (a) A simple graph with 5 vertices and 8 edges. (b) A simple graph with 6 vertices and 13 edges. (c) A simple bipartite graph with 7 vertices and 10 edges. (d) A simple bipartite graph with 7 vertices and 11 edges.	BL3	CO1
Section C			
Answer any one question. Each carries 10 marks (1 x 10 = 10 Marks)			
19.	Let G be a simple graph with n vertices $v_1, v_2, ..., v_n$ and adjacency matrix $A=[a_{ij}]_{nxn}$. Let $B=[b_{ij}]_{nxn}$, where $b_{ij} = -a_{ij}$ if i not equal to j $b_{ij} = deg(v_i)$ if i equal to j Let C be the (n-1)x(n-1) matrix obtained by deleting row 1 and column 1 of B. Then thenumber of nonisomorphic sapnning trees of G is the determinant, |C|. Using this fact find the number of nonisomorphic spanning trees of K_5.	BL3	CO1
20.	a) Find the language L(G) generated by the grammar G=(N,T,P, σ) where N = {σ, A,B} T={a,b}, P={$\sigma \to aA, A \to Bb, A \to a, B \to b$} b) Draw a derivation tree for the production rule P where N={σ, A, B}, T={a,b}, P={$\sigma \to aAa, A \to bBb, \sigma \to \lambda, A \to a, B \to a, B \to b$}.	BL2	CO3
	CO : Course Outcome		
	BL : Bloom's Taxonomy Levels (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)		