DEPARTMENT OF MATHEMATICS				*CLASS: II B.Sc. Mathematics*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
III	Major	20U3MMC5	Graph Theory	3	4	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	
Skill oriented	✓		Entrepreneurship oriented	

Objectives:

Graph Theory is one of the most flourishing branches of Mathematics with wide applicability in a variety of areas ranging from Engineering to Molecular Biology. The objective of this course is to introduce basic concepts in the theory of graphs and to develop problem-solving ability and mathematical maturity in this area.

Course content:

Unit	Description	Hours	K–Level	CLO(s)
I	**BASICS:** Graphs – Pictorial representation – Subgroups – Isomorphism and degrees – Walks and connected graphs – Cycles in graphs – Cut-vertices and cut-edges.	9	K3	1
II	**EULERIAN AND HAMILTONIAN GRAPHS:** Eulerian graphs – Fleury's algorithm –Hamiltonian graphs – weighted graphs.	9	K4	2
III	**BIPARTITE GRAPHS AND MATRICES:** Bipartite graphs – Marriage problem – Trees –Connector problem – Matrix representations – Vector spaces associated with graphs – Cycle space – cut-set space.	9	K3	3
IV	**PLANAR GRAPHS:** Planar Graphs – Euler formula – Platonic solids – Dual of a plane graph – Characterization of planar graphs.	9	K3	4
V	**GRAPH COLOURINGS:** Vertex colouring – Edge colourings – An algorithm for vertex colouring.	9	K3	5

Book or study:

- S.A.Choudum– A First Course in Graph Theory, Macmillan India Limited, 1987.
  UNIT I – 1.1 to 1.7
  UNIT II – 2.1 to 2.4
  UNIT III – 3.1 to 3.4 and 4.1 to 4.4
  UNIT IV – 5.1 to 5.5
  UNIT V – 6.1 to 6.3

Books for Reference:

1. S. Arumugam and S. Ramachandran, - *Invitation to Graph Theory*, SCITECH publications (India) Pvt. Ltd, Chennai, 2006.
2. Gary Chartrand and Ping Zhang. *Introduction to Graph Theory*. New Delhi; New York : Tata McGraw-Hill Pub. Co. 2006.
3. Robin J.Wilson, Introduction *to Graph Theory*, Pearson publications, 5th Edition, 2010.

Web Resources

- https://d3gt.com
- https://www.brianheinold.net/graph_theory/graph_theory_book.html
- https://www.youtube.com/playlist?list=PLoJC20gNfC2gmT_5WgwYwGMvgCjYVsIQg

Rationale for Nature of the course:

This course namely Graph Theory has applications in various fields. Graph theory has been serving as an elegant tool to easily approach/solve several problems/concepts in other fields ranging from Science to Sociology. This course will enable the students to acquire skills by which they can model certain real-life problems as graph theoretical terms and can make inference.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Modeling certain real-life problems like Scheduling problem, Traffic signal problem, Marriage problem and so on.

Pedagogy: Chalk and Talk, PPT, Group Discussion, Quiz, Seminar, Problem solving, Tutorial, LMS (CANVAS, FLICKERS).

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO #	Description	K -Level
CLO1	Identify various types of sub graphs of a graph, to find degree sequence of a graph, to identify isomorphic graphs, to determine connectedness of a graph, to list out cut-vertices and cut-edges of the given graph	Up to K3
CL02	Determine whether graphs are Hamiltonian and/or Eulerian	Up to K4
CL03	Recognize bipartite graphs, to find various matrices representing a graph, to determine vector spaces associated with a given graph and also to solve problems involving Matchings and trees	Up toK3
CL04	Identify planar graphs, to find dual of a plane graph	Up to K3
CL05	Find minimum vertex and edge coloring of certain families of graphs	Up to K3

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences withevidences

Mapping with Programme Specific Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	1	1				2
CLO2	3	1				1	
CLO3	3	2	1		1	2	1
CLO4	3		2	1	1	2	
CLO5	3	2	2		1	2	1

Mapping with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CLO1	3				
CLO2	2		2		
CLO3	2	1	3		
CLO4	2				
CLO5	1		2		1

1- Basic Level 2- Intermediate Level 3- Advanced Applications

BLUE PRINT (for External Examinations)

Articulation Mapping –K Levels with Course Learning Outcomes (CLOs)

Sl.No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1/ K2	1	K1	2 (K2/K2)	1(K3)
2	CLO 2	Up to K4	2	K1/ K2	1	K1	2 (K4/K4)	1(K4)
3	CLO 3	Up to K3	2	K1/ K2	1	K2	2 (K3/ K3)	1(K3)
4	CLO 4	Up to K3	2	K1/ K2	1	K2	2 (K3 /K3)	1(K2)
5	CLO 5	Up to K3	2	K1/ K2	1	K2	2 (K1/ K1)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	**Section A (No choice)**	**Section B (No choice)**	**Section C (Either/ or)**	**Section D (Open choice)**	**Total marks**	**% of marks without choice**	**Consoli-dated**
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67
K4	-	-	10	10	20	16.67	16.67
Total marks	10	10	50	50	120	100	100%

Blue Print for CIA - I

Articulation Mapping –K Levels with Course Learning Outcomes (CLOs)

Sl.No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1/ K2	1	K2/K2	2 (K2/K2)	1(K3)
2	CLO 2	Up to K4	2	K1/ K2	2	K1	2 (K3/K3)	1(K3) 1(K4)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each section			4		6		10	20

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

Blue Print for CIA - II

Articulation Mapping –K Levels with Course Learning Outcomes (CLOs)

Sl.No	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 3	Up to K3	2	K1/ K2	2	K1/ K2	2 (K2/K2)	2(K3)
2	CLO 4	Up to K3	2	K1/ K2	1	K2	2 (K3 /K3)	1(K3)
No. of Questions to be asked			4		3		4	3
No. of Questions to be answered			4		3		2	2
Marks for each question			1		2		5	10
Total Marks for each section			4		6		10	20

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

COURSE PLAN

Unit	Description	Hours	Pedagogy
I	Graphs – Pictorial representation	1	Chalk and talk, D3 Graph Theory – ICT tool, Interaction, Group Discussion
	Subgroups	1	
	Degrees	1	
	Isomorphism	1	
	Walks and connected graphs	2	
	Cycles in graphs	1	
	Cut-vertices and cut-edges	1	
	Tutorial	1	
II	Introduction to Eulerian graphs	1	Chalk and talk, PPT, D3 Graph Theory – ICT tool, Interaction, Group Discussion and e - quiz
	Theorems on Eulerian graphs	2	
	Fleury's algorithm to find Eulerian trail	1	
	Hamiltonian graphs	2	
	weighted graphs	2	
	Tutorial	1	
III	Bipartite graphs	1	Chalk and talk, PPT, D3 Graph Theory – ICT tool, Interaction, Assignment and Seminar
	Marriage problem	1	
	Trees	2	
	Connector problem	1	
	Matrix representations	1	
	Vector spaces associated with graphs Cycle space – cut-set space.	2	
	Tutorial	1	
IV	Introduction to Planar Graphs – definition and example	1	Chalk and talk, PPT, D3 Graph Theory – ICT tool, Interaction and e-Quiz
	Properties of planar graphs	2	
	Euler formula for plane graphs and its	1	
	Platonic solids	1	
	Dual of a plane graph	1	
	Characterization of planar graphs	2	
	Tutorial	1	
V	Vertex colouring – definition and examples	1	Chalk and talk, D3 Graph Theory – ICT tool, Assignment and Interaction
	Theorems on vertex colouring	2	
	Algorithm to find a minimum vertex colouring	1	
	Introduction to Edge colouring	1	
	Results on edge colouring	3	
	Tutorial	1	

Course Designer :

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