NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech. / CSE		
Course Title	Combinatorics and Graph Theory		
Course Code	CSPE32	**No. of Credits**	3
Course Code of Pre-requisite subject(s)	CSPC11	**Semester**	III
Session	July 2023	**Section (if, applicable)**	B
Name of Faculty	Dr. J. Pavan Kumar	**Department**	CSE
Official Email	pavan@nitt.edu	**Telephone No.**	
Name of Course Coordinator(s)	NIL		
Official E-mail	NIL	**Telephone No.**	
Course Type	Program Elective Course		

Syllabus (approved in BoS)

UNIT-I
Introduction to combinatorics, permutation of multisets. Combinations of Multisets, distribution of distinct objects into distinct cells, distribution of non-distinct objects into distinct cells, Shamire secret sharing. Catalan number. Principle of inclusion and exclusion, Derangement.

UNIT-II
Generating functions, Partitions of integer, Ferrer graph. Solving recurrence relations using generating functions, Generating permutations and combinations. Pigeonhole principle: simple and strong Form, a theorem of ramsey.

UNIT-III
Graph, simple graph, graph isomorphism, incidence and adjacency matrices, Haveli-Hakimi criterion. Subgraphs Tree, minimum spanning tree, Kruskal, Prims algorithm, Caleys' formula, Kirchoff-Matrix- tree Theorem, Fundamental circuits, Algorithms for fundamental circuits , Cut-sets and Cut-vertices, fundamental cut-sets.

UNIT-IV
Eular graph, Fleury's algorithm Hamiltonian graph, Planar and Dual Graphs, Kuratowski's graphs. Coloring, Greedy coloring algorithm, chromatic polynomial.

UNIT-V
Mycielski's theorem, Matching, halls marriage problem. Independent set, Dominating set, Vertex cover, clique, approximation algorithms

TEXT BOOKS

1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", 5th Edition, PHI/Pearson Education,2004.
2. G. Chartrand and P. Zhang, "Introduction to Graph Theory", McGraw-Hill, 2006.

REFERENCE BOOKS

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7th edition, McGraw- Hill, 2012.
2. John Harris, Jeffry L. Hirst, Michael Mossinghoff, "Combinatorics and Graph Theory", 2nd edition, Springer Science & Business Media, 2008.
3. J. H. Van Lint and R. M. Wilson, "A course in Combinatorics", 2nd edition, Cambridge Univ. Press, 2001.
4. Dr. D.S. Chandrasekharaiah, "Graph Theory and Combinatorics", Prism,2005.

COURSE OBJECTIVES

1. To introduce basic concepts of combinatorics and graph theory.
2. To study graphs, trees and networks.
3. To discuss Euler formula, Hamilton paths, planar graphs and coloring problem.
4. To practice useful algorithms on networks such as shortest path algorithm, minimal spanning tree algorithm and min-flow max-cut algorithm

MAPPING OF COs with POs

Course Outcomes	Program Outcomes (PO)
1. Comprehend the fundamentals of combinatorics and apply combinatorial ideas in mathematical arguments in analysis of algorithms, queuing theory,etc.	**1, 2, 3, 6**
2. Comprehend graph theory fundamentals and tackle problems in dynamic programming, network flows,etc.	**1, 3, 5, 6, 11**
3. Design and develop real time application using graph theory	**1, 3, 5, 6, 11, 12**
4. Construct and communicate proofs of theorems	**2, 8, 10, 11**

COURSE PLAN – PART II

COURSE OVERVIEW

This course covers basic concepts of combinatorics and graph theory, focusing on ways to handle graphs, trees and networks efficiently for developing real time application using graph theory. It provides the application of theoretical concepts in various scenarios and its analysis by discussing several examples.

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week/Contact Hours	Topic	Mode of Delivery
1	Week 1/ 3hrs	**UNIT-I :** Introduction to combinatorics, Induction and Recurrences	Chalk and Talk
2	Week 2/ 3 hrs	Permutation of multisets, Combinations of Multisets,	Chalk and Talk
3	Week 3/ 3 hrs	distribution of distinct objects into distinct cells, distribution of non-distinct objects into distinct cells, Catalan number	Chalk and Talk

4	Week 4/ 3 hrs	Principle of inclusion and exclusion, Derangement, Shamire secret sharing	Chalk and Talk
5	Week 5/ 3 hrs	**UNIT-II :** Generating functions, Partitions of integer, Ferrer graph	Chalk and Talk
6	Week 6/ 1 hr	**Cycle Test 1**	Written
7	Week 7 / 3 hrs	Solving recurrence relations using generating functions, Generating permutations and combinations	Chalk and Talk
8	Week 8/ 3 hrs	Pigeonhole principle: simple and strong Form, A theorem Of ramsey	Chalk and Talk
9	Week 9/ 1 hr	**UNIT-III :** Graph, simple graph	Chalk and Talk
10	Week 10/ 2 hours	graph isomorphism, Incidence and adjacency matrices, Haveli-Hakimi criterion, Subgraphs	Chalk and Talk
11	Week 11/ 3 hours	Tree, minimum spanning tree, Kruskal, Prims algorithm, Caleys' formula, Kirchoff-Matrix- tree Theorem	Chalk and Talk
12	Week 12/ 3 hours	Fundamental circuits, Algorithms for fundamental circuits, Cut-sets and Cut-vertices, fundamental cut-sets	Chalk and Talk
13	Week 13/ 2 hours	**UNIT-IV:** Euler graph, Fleury's algorithm, Hamiltonian graph, Planar and Dual Graphs, Kuratowski's graphs	Chalk and Talk
14	Week 14/ 1 hr	**Cycle Test 2**	**Written**
15	Week 15/ 3 hours	Coloring, Greedy coloring algorithm, Chromatic polynomial, **UNIT-V :** Mycielski's theorem,	Chalk and Talk

16	Week 16 3 hours	Matching, Halls marriage problem, Independent set, Dominating set, Vertex cover, clique, Approximation algorithms	Chalk and Talk

COURSE ASSESSMENT METHODS (shall range from 4 to 6**)**

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Cycle Test 1	04/09/2023 to 08/09/2023	1 hour	20
2	Cycle Test 2	30/10/2023 to 03/11/2023	1 hour	20
3	Quiz	16/10/2023 to 20/10/2023	--	10
CPA	Compensation Assessment*	As per academic schedule	1 hour	20
4	Final Assessment *	As per academic schedule	3 hours	50

***mandatory; refer to guidelines on page 4**

COURSE EXIT SURVEY

1. Students' feedback through class committee meetings
2. Feedbacks are collected before final examination through MIS or any other standard format followed by the institute
3. Students, through their Class Representatives, may give their feedback at any time to the course faculty which will be duly addressed.

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

MODE OF CORRESPONDENCE (email/ phone etc)

Email/ Phone, in-person – after 4.00 pm.

COMPENSATION ASSESSMENT POLICY

1. One compensation assessment will be given after completion of Cycle Test 1 and 2 for the students those who are absent for any assessment due to genuine reason.
2. Compensatory assessments would cover the syllabus of Cycle tests 1 & 2.
3. Prior permission and required documents must be submitted for absence.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.

Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

The above policy against academic dishonesty shall be applicable for all the programs.

ADDITIONAL INFORMATION, IF ANY

1. The Course Coordinator is available for consultation during the time intimated to the students then and there.
2. Relative grading adhering to the instructions from the office of the Dean (Academic) will be adopted for the course.

FOR APPROVAL

Course Faculty: 4-8-2023 **CC- Chairperson:** **HOD:**