Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Science College
Semester-3 (M.Sc.)

Subject: Combinatorial Analysis (MSCMA13515)

Type of course: Major

Prerequisite: Basic knowledge of Multivariable Calculus and Linear Algebra.

Rationale: Combinatorial Analysis is a branch of mathematics that focuses on counting and organizing discrete structures. Its rationale lies in understanding and solving problems related to arrangements, selections, and patterns within finite sets. By studying combinatorial structures, students gain insights into diverse fields such as computer science, cryptography, and optimization.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
4	0	0	4	60	30	10	-	50	150

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Unit No.	Course content	Hrs	% Weightage
1	**CHAPTER 1:** Sets and samples, Unordered selections, Binomial coefficients.	15	25
2	**CHAPTER 2:** The Inclusion Exclusion principle with weights attached to the elements, The Sieve formula, The Euler's totient function (n).	15	25
3	**CHAPTER 3:** Permanents, Menage numbers.	15	25
4	**CHAPTER 4:** Rook Polynomials, Recurrence relations , Ramsey's theorem.	15	25

Continuous Assessment:

Sr. No.	Active Learning Activities	Marks
1.	**Pascal's Triangle and Beyond:** Students 'Investigate binomial coefficients (n choose k), Use Pascal's Triangle to find coefficients in the binomial expansion and Discuss applications in probability, algebra, and discrete mathematics and document uploaded on to the GMIU web portal.	10
2.	**The Inclusion-Exclusion Principle with Weights:** Students 'Use the inclusion-exclusion principle to compute the total "weight" of artists performing on any stage' and upload it to the GMIU web portal.	10
3.	**The Sieve Formula (Sieving Prime Numbers):** Students Explore the Sieve of Eratosthenes, Generate prime numbers up to a given limit (e.g., 100), Discuss how the sieve formula efficiently identifies prime numbers and prepare a chart and upload to the GMIU web portal.	10
4.	**Ménage Numbers:** Students will do activity 'Seating Arrangements at the Round Table' and Explore the significance of ménage numbers and prepare a report and upload it to the GMIU web portal.	10
5.	**Rook Placements on a Chessboard:** Students 'Imagine a chessboard with rooks (chess pieces) placed on it, Define the concept of rook polynomials and Discuss how rook polynomials relate to counting non-attacking rook placements.' will prepare short report and upload it to the GMIU web portal.	10
Total		**50**

Course Outcome:

After learning the course the students should be able to:	
CO1	Understand and Solve problems involving counting, probability, and combinatorial designs.
CO2	Solve complex combinatorial problems, including those involving permutations, combinations, and number theory.
CO3	Analyze and solve problems involving arrangements, permutations, and circular permutations.
CO4	Apply these concepts to solve problems in these areas, demonstrating the interdisciplinary nature of combinatorics.

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	10%	40%	30%	10%	10%	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MCQ etc.
From the content 10% topics are suggested for flipped mode instruction.
Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

Reference Books:

1. H. J. Ryser: Combinatorial Mathematics, The Mathematical Association of America. (Carns Mathematical Monographs number(4), USA)
2. V. Krishnamurthy: Combinatorics, Theory and applications, Affilicated East-West press Ltd., 1985, New Delhi, Madras.
3. Ian Anderson, A First Course in Combinatorial Mathematics, Clarendon Press. (Oxford Applied Mathematics and Computing Science Series)
4. Chen Chuan-Chong, Koh Khee-Meng, Principles and Techniques in Combinatorics, World Scientific Publishing Co. Pte. Ltd.
5. J. E. Graver, M. E. Watkins: Combinatorics with emphasis on Theory of graphs, Graduate texts in Mathematics no. 54, Springer Verlag, 1977.