Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2020-2021
COURSE HANDOUT (PART-II)

09-01-2024

In addition to Part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No. : **MATH F421**
Course Title : **COMBINATORIAL MATHEMATICS**
Instructor-in-Charge : **Debopam Chakraborty**
Instructor : Debopam Chakraborty

1. Scope and Objective of the Course: Combinatorics is a fascinating subject with applications in different branches of Mathematics as well as other subjects. This makes it hard to classify, but a common theme is that it deals with structures that are, in some sense, finite or discrete. The thing that sets combinatorics apart from other branches of mathematics is that it focuses on techniques rather than results. The way you prove a theorem is of bigger importance than the statement of the theorem itself. Combinatorics is also characterized by what seems to be less deep than other fields. Combinatorial reasoning underlies all analysis of computer systems. It plays a similar role in discrete operation research problems and in finite probability. It is very much useful in the analysis of the speed and logical structure of operations research algorithms to optimize efficient manufacturing or garbage collections.

2. Textbooks:

Richard A. Brualdi, Introductory Combinatorics, Pearson Prentice Hall, 4th Edition, 2008.

3. Reference books

R1. Alan Tucker, Applied Combinatorics, John Wiley & Sons, 6th Edition, 2012.
R2. V. Krishnamurthy, Combinatorics Theory and Applications, East-West Press Pvt. Ltd. 1985.

4. Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Textbook
1	Motivation of the Course	Introduction to Combinatorics	1
2 - 4	Learning Ramsey Theorem	Pigeonhole principle, Ramsey Theorem	2.1 – 2.3
5 - 12	Learning advanced Permutation and Combinations	Counting Principles, Permutations and combinations of Multiset, Generating Permutations, Generating Combinations, Inversion in Permutation, Generating r-combinations	3.1 – 3.5, 4.1 – 4.5
13 - 15	The Binomial Coefficients	Pascal's formula, Unimodality of Binomial coefficients, The multinomial theorem, Newton's Binomial Theorem	5.1 – 5.7
16 - 18	Learning the Inclusion	The inclusion-exclusion principle,	6.1 – 6.6

	– Exclusion Principle	permutation with forbidden positions, Mobius inversion	
19-22	To learn recurrence relation models and solution of recurrence relations. Introducing generating functions as a model to solve counting problems.	Linear homogeneous and non-homogeneous recurrence relations. Generating functions, recurrences and generating functions, exponential generating functions	7.1 – 7.7
23 – 26	To understand different counting principles, to learn theory of partitions	Catalan numbers, Difference sequence, Stirling numbers, Partition Numbers, Lattice Paths, Schroder Numbers	8.1 – 8.5
27 – 32	Introducing Graph Theory	Eulerian trails, Hamiltonian Paths and cycles, Bipartite graphs, trees	11.1 – 11.7
33 - 37	Enumeration problems on graph theory	Chromatic number, Independence number, Clique number, Connectivity	13.1 – 13.5
38 – 40	To learn Permutation Group and Polya's Counting	Permutation and Symmetry Groups, Burnside's Theorem, Polya's counting formula	14.1 – 14.3

5. Evaluation Scheme:

Component	**Duration**	**Weightage (%)**	**Date & Time**	**Nature of Component**
Quiz 1	30 minutes	10	Will be announced in class	Closed Book
Mid-Semester Examination	90 Minutes	35	14/03 - 2.00 - 3.30PM	Open Book
Assignment	-	5		Closed Book
Quiz 2	30 minutes	10	Will be announced in class	Closed Book
Comprehensive Exam	180 minutes	40	15/05 FN	Closed Book

Total Marks: 100

6. Chamber consultation Hour: To be announced in the class.

7. Notice: Notice, if any, concerning this course will be displayed only in CMS.

8. Make up: Prior permission is needed for make up; make up will only be given if enough evidence is there for not being able to take regular test.

9. **Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge
MATH F421