Kotebe University of Education
College of Natural and Computational Sciences
Department of Mathematics

Course Syllabus on 'Enumerative Combinatorics I'

Course Code: Math 642

Credit Hours/ ECTS: 3 / 7

Lecture hrs: 4

Collaborative Learning hrs: 2

Independent learning hrs: 5

Length of time to complete the course: 16 weeks

Total number of load hours the student will carry to complete the course: 189 hrs

Pre-requisite course: Math 601

Program: M.SC. in Mathematics (Combinatorics Specialization)

Learning Outcomes

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

- understand and use the basic counting principles: Addition and Multiplication principles.
- model problems using recurrence relations
- solve recurence relations: linear and non homogeneous
- understand general tools for counting more complex structures
- understand the concept of generating functions and the corresponding formal calculus
- use generating functions to solve application problems
- understand the concept of Equivalence and symmetric groups
- understand the Burnside's Theorem
- use cycle Index of the symmetric group in counting

- understand and use polya's Enumeration formula.
- demonstrate ability to think critically and analytically by using appropriate enumeration techniques to solve problems from diverse areas.

Mode of Delivery: This course will be offered in a semester based mode of delivery

Course Contents

1. **Basic Counting**
   - 1.1 Addition and Multiplication Principles
   - 1.2 Permutations and Combinations with repetition
2. **Recurrence Relations**
   - 2.1 Recurrence Relation Models
   - 2.2 Divide and Conquer Relations
   - 2.3 Solving Linear Recurrence Relations
   - 2.4 Non-homogeneous Recurrence Relations and their solutions
3. **The Principle of Inclusion-Exclusion**
   - 3.1 Counting with Venn Diagrams
   - 3.2 Inclusion-Exclusion Formula
   - 3.3 Derangements
   - 3.4 Restricted Positions and Rook Polynomials
4. **Generating Functions**
   - 4.1 Ordinary and Exponential Generating Functions
   - 4.2 The Calculus of Ordinary and Exponential Generating Functions
   - 4.3 Generating functions and their applications to counting graphs, paths, permutations and partitions.
5. **Polya's Enumeration Formula**
   - 5.1 Equivalence and Symmetric Groups
   - 5.2 Burnside's Theorem
   - 5.3 The Cycle Index of a Symmetric Group
   - 5.4 Polya's Formula

Teaching-Learning Strategy/Methods

Lectures, Tutorial, Group Assignments

Assessment Strategy/Methods

- Assignment: 20%
- Tests: 30%
- Semester Examination: 50%

Course Policy

A student has to

- Attend at least 80% of the classes
- Take all continuous assessments
- Take final examination
- Respect all rules and regulations of the University Reference

References

[1] Aigner, M., A course in Enumeration, Springer, 2000

[2] Bona, M., A Walk Through Combinatorics, 1st Edition, World Science Publishing Company, River Ridge, New Jersey, 2002.

[3] Graham, R.L., Kunth, D.E., and Patashnik, O., Concrete Mathematics, Addison-Wesley Publishing Company, 1989.

[4] Lando, K., Lectures on Generating Functions, American Mathematical Society-Student Mathematical Library Series, Providence, Rhode Island, 2003.

[5] Pemmaraju, S., Computational Discrete Mathematics Combinatorics and Graph Theory with Mathematica, Cambridge University Press, Cambridge, 2000

[6] Wilf, H., Generating functionology, 2nd edition, Academic press, San Diego, CA 1994

[7] Van Lint, J.H. and Wilson, R.M., A course in Combinatorics, Cambridge University Press, Cambridge, 1992