Shyam Lal College, University of Delhi

Tentative Teaching Plan

Academic Year: 2024-25
Teacher Name: Dr. Vinod Kumar
Course Name: B.Sc. (Hons.) Mathematics
Paper Name -> DSC-1: Algebra
Semester: I (From August 29, 2024 to December 24, 2024)

Weeks 1 to 4: Polynomials, The remainder and factor theorem, Synthetic division, Factored form of a polynomial, Multiple roots, Fundamental theorem of algebra, Relations between the roots and the coefficients of polynomial equations, Upper bounds for the real roots, Results on imaginary, integral and rational roots, Newton's method for integral roots, Descartes' rule of signs.
[2] Chapter II, and Chapter VI (Section 67).

Weeks 5 and 6: Polar representation of complex numbers, De-Moivre's theorem for integer and rational indices and their applications, The nth roots of unity, Cardan's solution of the cubic, Descartes' solution of the quartic equation.
[1] Chapter 2 [Sections 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2 (up to Figure 2.8, page 48), and 2.2.3)]
[2] Chapter IV (Sections 42, 43, and 51).

Weeks 7 and 8: Statement of well ordering principle, The division algorithm in $\mathbb{Z}$, Divisibility and the Euclidean algorithm.
[4] Chapter 4 [Sections 4.1 (4.1.1 to 4.1.6), and 4.2 (4.2.1 to 4.2.11)].

Weeks 9 and 10: Fundamental theorem of arithmetic, Modular arithmetic and basic properties of congruences.
[4] Chapter 4 [Sections 4.3 (4.3.7 to 4.3.9), and 4.4].

Weeks 11 to 13: Groups, Basic properties, Symmetries of a square, Dihedral group, Order of a group, Order of an element, Subgroups, Center of a group, Centralizer of an element.
[3] Chapters 1, 2 and 3.

Weeks 14 and 15: Cyclic groups and properties, Generators of a cyclic group, Classification of subgroups of cyclic groups.
[3] Chapter 4.

References:
1. Andreescu, Titu & Andrica, D. (2014). *Complex numbers from A to...Z.* (2nd ed.). Birkhäuser.
2. Dickson, Leonard Eugene (2009). *First Course in the Theory of Equations.* John Wiley & Sons, Inc. The Project Gutenberg eBook: http://www.gutenberg.org/ebooks/29785
3. Gallian, Joseph. A. (2017). *Contemporary Abstract Algebra* (9th ed.). Cengage Learning India Private Limited, Delhi. Indian Reprint 2021.
4. Goodaire, Edgar G., & Parmenter, Michael M. (2006). *Discrete Mathematics with Graph Theory* (3rd ed.). Pearson Education Pvt. Ltd. Indian Reprint 2018.

Assessment Activity Schedule:

The assessment will be conducted during the course, preferably after completion of each unit. Week 1 – 4, Week 5 – 9 and Week 10 – 15 contain three units of the syllabus. Besides tests/assignments, students are encouraged to give blackboard presentation or power point presentation on the topic of their choices covering the content of the syllabi and applications of the theory.

Signature of the Teacher

Name of the Teacher: Dr. Vinod Kumar

Designation: Assistant Professor in Mathematics

Shyam Lal College, University of Delhi

Tentative Teaching Plan

Academic Year: 2024-25
Teacher Name: Dr. Vinod Kumar
Course Name: B.Sc. (Hons.) Mathematics
Paper Name -> DSE-1(iii): Number Theory
Semester: III (August 1, 2024 to November 28, 2024)

Teaching Plan (DSE-1(iii): Number Theory): B.Sc. (Hons.) Mathematics, Semester-3

Week 1: The Euclidean Algorithm and linear Diophantine equation.
[1]: Chapter 2 (Section 2.4 up to page 28, and Section 2.5).

Weeks 2 and 3: Least non-negative residues and complete set of residues modulo n; Linear congruences, The Chinese remainder theorem, and system of linear congruences in two variables.
[1]: Chapter 4 (Section 4.2 page 64, and Section 4.4).

Week 4: Fermat's little theorem, Wilson's theorem and its converse, Application to solve quadratic congruence equation modulo odd prime p.
[1]: Chapter 5 (Section 5.2 up to before pseudo-prime at page 90, and Section 5.3).

Weeks 5 and 6: Number-theoretic functions for the sum and number of divisors, Multiplicative function, Möbius inversion formula and its properties; Greatest integer function with an application to the calendar.
[1]: Chapter 6 (Sections 6.1, 6.2, 6.3 up to page 118, and 6.4).

Weeks 7 and 8: Euler's Phi-function, Euler's theorem and some properties of the Phi-function.
[1]: Chapter 7 (Section 7.2, Theorem 7.2 without proof, Section 7.3, and Section 7.4, Theorem 7.6 without proof).

Weeks 9 to 11: The order of an integer modulo n and primitive roots for primes, Primitive roots of composite numbers n: when n is of the form 2^k, and when n is a product of two coprime numbers.
[1]: Chapter 8 (Sections 8.1, 8.2, and 8.3 (up to page 159)).

Week 12: The quadratic residue and nonresidue of an odd prime and Euler's criterion.
[1]: Chapter 9 (Section 9.1).

Weeks 13 and 14: The Legendre symbol and its properties, Quadratic Reciprocity law and its application.
[1]: Chapter 9 (Section 9.2 up to page 181, Statement of Theorems 9.3 and 9.5, and Section 9.3).

Week 15. Introduction to cryptography, Hill's cipher, Public-key cryptography and RSA encryption and decryption technique.
[1]: Chapter 10 (Section 10.1).

Essential Reading

1. Burton, David M. (2011). Elementary Number Theory (7th ed.). McGraw-Hill Education Pvt. Ltd. Indian Reprint 2017.

Assessment Activity Schedule:

The assessment will be conducted during the course, preferably after completion of each unit. Week 1 – 4, Week 5 – 9 and Week 10 – 15 contain three units of the syllabus. Besides tests/assignments, students are encouraged to give blackboard presentation or power point presentation on the topic of their choices covering the content of the syllabi and applications of the theory.

Signature of the Teacher

Name of the Teacher: Dr. Vinod Kumar

Designation: Assistant Professor in Mathematics

Shyam Lal College, University of Delhi

Tentative Teaching Plan

Academic Year: 2024-25
Teacher Name: Dr. Vinod Kumar
Course Name: GE (Mathematics)
Paper Name -> GE-3(i): Differential Equations
Semester: III (August 1, 2024 to November 28, 2024)

Weeks 1 and 2: First order ordinary differential equations: Basic concepts and ideas, First order exact differential equations, Integrating factors and rules to find integrating factors.
[2]: Chapter 1 (Sections 1.1, and 1.2), Chapter 2 (Sections 2.1, 2.2, and 2.4 up to page 64).

Week 3: Linear equations and Bernoulli equations, Initial Value Problems, Applications of first order differential equations: Orthogonal trajectories and Rate Problems.
[2]: Chapter 2 (Sections 2.3), Chapter 3 (Section 3.1 up to page 74, and Section 3.3 up to page 94).

Weeks 4 and 5: Basic theory of higher order linear differential equations, Wronskian and its properties.
[2]: Chapter 4 (Sections 4.1 up to page 115).

Weeks 6 and 7: Linear homogeneous equations with constant coefficients, Linear non-homogeneous equations, Method of undetermined coefficients.
[2]: Chapter 4 (Section 4.1 from page 120 onwards, Sections 4.2, and 4.3).

Weeks 8 and 9: Method of variation of parameters (only second order), Two-point boundary value problems, Cauchy- Euler equations, Systems of linear differential equations.
[2]: Chapter 4 (Sections 4.4, and 4.5).
[2]: Chapter 1 (Section 1.3 up to page 16).
[2]: Chapter 7 (Sections 7.1, and 7.3).

Weeks 10 and 11: Partial differential equations: Basic concepts and definitions, Classification and construction of first-order partial differential equations, Method of characteristics and general solutions of first order partial differential equations.
[1]: Chapter 2 (Sections 2.1 to 2.3, and 2.5).

Weeks 12 and 13: Canonical forms and method of separation of variables for first-order partial differential equations.
[1]: Chapter 2 (Sections 2.6, and 2.7).

Weeks 14 and 15: Classification and reduction to canonical forms of second-order linear partial differential equations and their general solutions.
[1]: Chapter 4 (Sections 4.1 to 4.4).

Essential Readings

1. Myint-U, Tyn and Debnath, Lokenath (2007). Linear Partial Differential Equations for Scientist and Engineers (4th ed.). Birkhäuser. Indian Reprint.
2. Ross, Shepley L. (1984). Differential Equations (3rd ed.). John Wiley & Sons.

Assessment Activity Schedule:

The assessment will be conducted during the course, preferably after completion of each unit. Week 1 – 4, Week 5 – 9 and Week 10 – 15 contain three units of the syllabus. Besides tests/assignments, students are encouraged to give blackboard presentation or power point presentation on the topic of their choices covering the content of the syllabi and applications of the theory.

Signature of the Teacher

Name of the Teacher: Dr. Vinod Kumar

Designation: Assistant Professor in Mathematics