Algebra & Calculus

Semester : I   Subject Code: BS11504   Lectures: 40

Objectives:

The syllabus aims in equipping students with

- Understanding and writing mathematical statements and proofs;
- stating and proving fundamental results in number theory;
- generalizing the notion of congruence to that of an equivalence relation and studying its usefulness;
- Proficiently using Euclid's algorithm and manipulating congruences, and understand the basic properties of prime numbers.

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Unit 1: **Relations and functions**	No. of lectures 12

- Revision of sets and notations mainly irrational(ex $\sqrt{2}$) and rational numbers.

- Ordered pairs, Cartesian product of sets

- Relations, types of relation, equivalence relation, Partial order relation.

- Equivalence Class, properties and partition of a set.

- Transitive closure of a relation and Warshall's Algorithm.

- Digraph of relation, matrix representation and composition of relations.

- Definition of function as a relation, types of functions(one-one,onto and bijective)

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Unit 2: Divisibility in Integers-I

- Well ordering principles

- Division Algorithm (without proof)

- Divisibility and its properties.

- Euclid's Lemma (Without proof).

- Definition of G.C.D and L.C.M, Expressing G.C.D of two integers as a linear combination of the two integers.

- Relatively prime integers, Euclid's Lemma and its generalization.

- Congruence relation and its properties , Residue Classes: Definition, Examples, addition and multiplication modulo n and composition tables.

- Euler's and Fermat's Theorems. (Without proof).Examples

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Unit 3: Continuity and Differentiability

- Introduction: Definition of limits: R.H.L and L.H.L with examples

- Continuity and properties of continuous functions. Differentiability.

- Left hand Differentiability and Right hand differentiability.

- Intermediate value Theorem (without proof).

- Rolle's theorem (with proof and geometric interpretation).

- Lagrange's Mean Value Theorem (with proof and geometric interpretation).

- Cauchy's Mean Value theorem (with proof) verification and Application.

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Unit 4 : Applications of differentiation

No. of Lectures 10

- Indeterminate forms.

- 'L' Hospital's Rule.

- Taylor's and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders (without proof).

- Taylor's and Maclaurin's Series.

Text Book:

1) David M. Burton *Elementary Number Theory* McGraw-Hill Science/Engineering/Math; 7 edition February 4, 2010.

2) Tom M. Apostol *Calculus, Vol. 1: One-Variable Calculus, with an Introduction to Linear Algebra* January 16, 1991.

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Reference Books:

1) Bernard Kolman, Robert Busby, Sharon Cutler Ross, Nadeem- ur-Rehman, *Discrete Mathematics Structure* Pearson Education, 5th Edition .

2) C.L.Liu (Tata McGraw Hill) *Elements of Discrete Mathematics* 3) Thomas Finny *Calculus and Analytical Geometry*

3) The Theory of Numbers by Zukerman.

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