

# **THIRUVALLUVAR UNIVERSITY**

**MASTER OF PHILOSOPHY**

**MATHEMATICS**

**(FT/PT)**

**(with effect from 2009-2010)**

**PART I**

**CORE COURSE I**

**ALGEBRA AND ANALYSIS**

## **UNIT-I: RINGS, IDEALS AND MODULES**

Rings and ring homomorphisms - Ideals, Quotient rings - Zero-divisors, Nilpotent elements, Units - Prime ideals and maximal ideals - Nilradical and Jacobson radical - Operations on ideals - Extension and contraction - Exercises - Modules and module homomorphisms - Submodules and quotient modules - Operations on submodules - Direct sum and product - Finitely generated modules - Exact sequences - Tensor product of modules - Restriction and extension of scalars - Exactness properties of the tensor product - Algebras - Tensor product of algebras - Exercises.

## **UNIT-II: RINGS, MODULES OF FRACTIONS AND PRIMARY DECOMPOSITION**

Local properties - Extended and contracted ideals in rings of fractions Exercises - Primary Decomposition - Exercises.

## **UNIT-III: CHAIN CONDITIONS, NOETHERIAN RINGS AND ARTIN RINGS**

Chain conditions - Exercises - Primary decomposition in Noetherian rings - Exercises - Artin Rings - Exercises.

## UNIT-IV: ABSTRACT INTEGRATION AND $L^p$ - SPACES

The concept of measurability - simple functions - Elementary properties of measures - Integration of positive functions - Integration of complex functions - The role played by sets of measure zero - Convex functions and inequalities -  $L^p$  - spaces

## UNIT-V: FOURIER TRANSFORMS AND HOLOMORPHIC FOURIER TRANSFORMS

Formal properties - The Invention Theorem - the Plancherel Theorem - The Banach algebra  $L^1$  - Introduction - Two Theorems of Paley and Wiener - Quasi - analytic classes - The Denjoy - Carleman theorem.

### TEXT BOOKS:

1. M.F. Atiyah, I.G. Macdonald, Introduction to Commutative Algebra, Addison - Wesley Publishing Company, 1969.

Unit - I	Chapter - 1	(pp 1 - 10),	Chapter - 2	(pp 17 - 31)
Unit - II	Chapter - 3	(pp 36 - 43),	Chapter - 4	(pp 50 - 55)
Unit - III	Chapter - 6	(pp 74 - 78),	Chapter - 7	(pp 80 - 84)
	Chapter - 8	(pp 89 - 91)		

2. Walter Rudin, Real and Complex Analysis, 3<sup>rd</sup> Edition, McGraw Hill International, 1986.

Unit - IV	Chapter - 1	(pp 5 - 31),	Chapter - 3	(pp 61 - 69),
Unit - V	Chapter - 9	(pp 178 - 193),	Chapter - 19	(pp 371 - 383)

**PART I**  
**CORE COURSE II**  
**TOPOLOGY AND DIFFERENTIAL EQUATIONS**

**UNIT-I: FUNDAMENTAL GROUP AND COVERING SPACES**

Homotopy - Fundamental group - Covering spaces.

**UNIT-II: SIMPLICIAL COMPLEXES**

Geometry of Simplicial Complexes - Bary Centric subdivisions - Simplicial approximation Theorem - Fundamental Group of a simplicial Complex.

**UNIT-III: LINEAR SYSTEMS**

Uncoupled Linear System - Diagonalization - Exponentials operators - The Fundamental Theorem for linear system - Linear System in  $\mathbb{R}^2$  - Complex Eigen Values - Multiple Eigen Values - Non Homogeneous Linear System.

**UNIT-IV: NON LINEAR SYSTEMS: LOCAL THEORY**

Some preliminary concepts & definitions - The Fundamental Existence - Uniqueness Theorem - Dependence on Initial Conditions and Parameters - The Maximum Interval of Existence - The Flow Defined by a Differential Equation.

**UNIT-V: NON LINEAR SYSTEMS**

Linearization - The Stable Manifold Theorem - Dynamical Systems and Global Existence Theorems - Limit Sets and Attractors

## TEXT BOOK(S):

1. **I.M. Singer, J.A. Thorpe**, Lecture Notes on Elementary Topology and Geometry, Springer - Verlag, New York, 1967.

Unit - I Chapter - 3 (pp 49 - 77)

Unit - II Chapter - 4 (pp 78 - 108)

2. **L. Perko**, Differential Equation and Dynamical System, Third Edition, Springer - Verlag, New York, 2006.

Unit - III Chapter - 1 (Sections 1.1 to 1.7 and 1.10) (pp 1 - 39, 60 - 63)

Unit - IV Chapter - 2 (Sections 2.1 to 2.5) (pp 65 - 101)

Unit - V Chapter - 2 (Sections 2.6 and 2.7) (pp 101 - 118)

Chapter - 3 (Sections 3.1 and 3.2) (pp 181 - 199)