

# SYLLABUS

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI-12

## PG - COURSES – AFFILIATED COLLEGES

Course Structure for

### M.Sc Mathematics

( Choice Based Credit System)

( with effect from the academic year 2017- 2018 onwards)

Semester-IV				
Part	Subject Status	Subject Title	Subject Code	Credit
	Core - 16	Functional Analysis	PMAM41	4
	Core - 17	Complex Analysis	PMAM42	4
	Core - 18	Advanced Algebra – II	PMAM43	4
	Core - 19	Topology - II	PMAM44	4
	Core - 20	Project	PMAM41	8

## FUNCTIONAL ANALYSIS

### Objective:

- To gain knowledge about Banach Spaces, Hilbert Spaces and Banach Algebra.
- To use algebraic structure in Analysis.

### Prerequisite:

Basic knowledge of Metric Spaces, Topology and Sequences.

### Outcome:

Graduates will have a strong foundations and in depth understanding of the current topics related with functional Analysis, Spectral Theory, Approximation Theory.

### UNIT 1:

**Banach Spaces:** Banach Spaces- The definition and some examples-Continuous linear transformations- The Hahn Banach Theorem

**Chapter 9** Sections 46, 47, 48 .

**Problems:** Section 46 (1-4), 47 (1-3) 48 (1).

### UNIT 2:



### **Imbedding :**

The Natural Imbedding of  $N$  in  $N^{**}$ - The open mapping theorem

**Chapter 9** Sections 49, 50

**Problems:** Section 49 (1-3), 50 (2,3)

### **UNIT 3:**

#### **Hilbert Spaces:**

Conjugate of an operator -Hilbert Spaces-The Definition and some simple properties- Orthogonal compliments

**Chapter 9**Section 51, Chapter 10 Sections 52, 53

**Problems:** Section 51 (1-3) 52 (4,6), 53 (1-4).

### **UNIT 4:**

#### **The Conjugate space and adjoint:**

Orthonormal sets-The conjugate space  $H^*$ - The Adjoint of an operator- Self adjoint operators

**Chapter 10** Sections 54, 55, 56, 57

**Problems:** Section 54 (1,5) 55 (1-3), 56 (1-4), 57 (1,2)

### **UNIT 5:**

#### **Spectral Theory:**

Normal and Unitary operators- projections, Finite dimensional spectral theory- Determinants and the spectrum of an operator- The spectral theorem

**Chapter 10** Sections 58, 59, Chapter 11 Sections 61, 62

**Problems:** Section 58, 59, 61, 62 (1-5) .

### **Text Book:**

Introduction to Topology and Modern Analysis- G.F. SIMMONS-McGraw-Hill International Editions

### **Books for Reference:**

1. Functional Analysis - Second edition (2011), Tata MC Graw Hill Education Private Ltd. (New Delhi) – Walter Rudin.
2. Functional Analysis – K.ChandrasekaraRao, Narosa Publishing House (2009) New Delhi.



# COMPLEX ANALYSIS

## **Objectives:**

- To gain advanced knowledge about Complex functions and Analytic functions as mappings.
- To understand the concept of Analyticity Conformality, Linear Transformation and Complex Integration.

## **Prerequisite:**

Basic knowledge of concepts of Differentiation and Integration for functions of real variables further in UG level they level the fundamental Ideas and theorems about Complex plane power series residues.

## **Outcome:**

- Acquisition of solving problems in Complex Integration and boundary value problems.

## **Unit I:**

### **Analytic functions :**

Analytic functions – Polynomials – Power series- Abel's limit theorem.

**Chapter 2:** Sec 1.1 – 1.4, Sec 2.4 & 2.5 .

**Problems:** Chapter 2: 1.2 (1,4,5,7) 2.4 (2- 6) .

## **Unit II:**

### **Conformal mappings :**

Conformal mappings - Linear transformations –the linear group – the cross ratio- Symmetry – line integrable – line integrable as functions of arc.

**Chapter 3:** Sec 2.3, 3.1 – 3.3, Chapter 4 : Sec 1.1 – 1.3(1,3,4,5).

**Problems:** Chapter 3: 3.1 (4); 3.2 (1,4) 3.3 (1,2,4);

## **Unit III:**

### **Cauchy's theorem for Rectangle :**

Cauchy's theorem for Rectangle – Cauchy's theorem in a disc, Cauchy's Integral formula, Index of a point – The integral formula.

**Chapter 4:** Sec 1.4 & 1.5, 2.1 & 2.2

**Problems:** Chapter 4 : 2.2 (1-3)

## **Unit IV:**

### **Higher derivatives -Taylor's Theorem :**

Higher derivatives -Taylor's Theorem – Zeros and Poles – The local mapping – The maximum principle and the general statement of Cauchy's Theorem ( Statement only ) .

**Chapter 4:** Sec 2.3, 3.1 – 3.4 and 4.4.

**Problems:** Chapter 4 : 2.3 (1) , 3.2(2 – 4)

## **Unit V:**



**Calculus of Residues:**

Calculus of Residues –The Residue theorem - The Argument Principle –  
Evaluation of definite integrals.

**Chapter 4:** Sec 5.1 – 5.3

**Problems:**Chapter 4: 5.2( 1-3) ,5.3 ( 1, 3( a- g) )

**Text :**

Complex Analysis – Lars V.Ahlfors – Tata McGraw Hill (Third Edition)

**Book for Reference:**

Foundations of Complex Analysis – S.Ponnusamy – Narosa Publishing House  
2015 (Second Edition).



## ADVANCED ALGEBRA II

### **Objectives:**

Gain knowledge in fields in the theory of numbers, the theory of equations and Galois theory .

### **Prerequisite:**

Knowledge of Groups , Rings and Elementary properties of fields.

### **Outcome:**

Understand the application of Galois theory in theory of equations and Geometry.

### **Unit I:**

#### **Extension fields.:**

Extension fields.

**Sections: 5.1**

**Problems: 5.1(1-5, 8)**

### **Unit II:**

#### **Roots of polynomials :**

Roots of polynomials – More about roots.

**Sections: 5.3, 5.5**

**Problems: 5.5(1-3)**

### **Unit III:**

#### **Elements of Galois theory.:**

Elements of Galois theory.

**Sections: 5.6**

### **Unit IV:**

#### **Finite fields :**

Finite fields – Wedderburn's theorem(First proof only)

**Sections: 7.1, 7.2(Theorem 7.2.1-First proof only)**

### **Unit V:**

#### **Some special theorems:**

A theorem of Frobenius – Integral quaternions and the four square theorem.

**Sections: 7.3, 7.4.**

### **Text Book:**

Topics in Algebra(Second edition) Wiley Eastern Limited – I.N. Herstein



**Book for Reference:**

1. A course in Abstract algebra (3rd edition)-Vijay.K.Khanna,S.K.Bhambri – Vikas Publishing House –Newdelhi.
2. Modern Algebra –Surjeetsingha and Qazizameerudin- Vikas Publishing House –Newdelhi.
3. Fields and Rings –Kaplemsky ,Irving (Second edition)-University of Chicago-Chicago -(1972).



# TOPOLOGY II

## **Objective:**

- Gain knowledge in separation axioms in Topological Spaces.
- Understanding the concepts of Normal and Regular Spaces.

## **Prerequisite:**

- Basic Knowledge in Set theory and Analysis at Undergraduate level.
- Knowledge in first course topology and functions in Topological Spaces.

## **Outcome:**

- Improves the standard of understanding Set theory, Analysis and Topology and pave the way to do Research in these areas.

## **Unit I:**

### **Separation axioms.:**

The countability axioms – Separation axioms.

**Chapter 4:** Sections 30, 31.

**Problems:** Section 30: 2,3 and Section 31: 1-3.

## **Unit II:**

### **The Urysohn lemma :**

Normal spaces – The Urysohn lemma.

**Chapter 4:** Sections 32, 33.

**Problems:** Section 32: 1, 3, 4 and Section 33: 1-2.

## **Unit III:**

### **Urysohn and Tietz extension theorem :**

The Urysohn metrization theorem – The Tietz extension theorem.

**Chapter 4:** Sections 34, 35.

**Problems:** Section 34: 1, 3 and Section 35: 1, 3.

## **Unit IV:**

### **The Tychonoff theorem :**

The Tychonoff theorem – Local finiteness.

**Chapter 5:** Sections 37 and Chapter 6: Section 39

**Problems:** Section 37: 1,2 and Section 39: 3,5.

## **Unit V:**

### **Baire Spaces.:**

Baire Spaces.

**Chapter 8:** Sections 48.

**Problems:** Section 48: 1, 3, 4, 6.

## **Text Book:**



Topology (Second edition), James R. Munkres, Printice – Hall of India

**Books for reference:**

Introduction to General Topology – K.D. Joshi Wiley Eastern Limited (1986)

Topology – K.ChandrasekaraRaoNarosa Publishing House 2009 ( New Delhi)





# PROJECT

## **Objective:**

- To provide training in scientific skills.
- To prepare students for professional training programme or entry level jobs in any area of Mathematics.

## **Prerequisite:**

- Students should be able to understand and interpret the literature in their areas of research.

## **Outcome:**

At the end of the project the students should have increased

- Their capacity to think critically
- Their ability to design analyse and execute an experiment.
- Their confidence and ability in communication skills(in writing and oral)
- To acquiring the literature collection methods and interpreting the date of their scientific equipment etc.

