# **SYLLABUS**

# MANONMANIAM SUNDARANAR UNIVERISTY, TIRUNELVELI-12

### **PG COURSES – AFFILIATED COLLEGES**

# **M.Sc.** Mathematics

#### (Choice Based Credit System) (with effect from the academic year 2021-2022 onwards)

Semester-I				
Part	Subject Status	Subject Title	Subject Code	Credit
III	Core-6	Algebra-II		4
III	Core-7	Analysis-II		4
III	Core-8	Advanced Calculus		4
III	Core-9	Differential Geometry		4
III	Core-10	Research Methodology and Statistics		4
III	Elective-1 (Choose any one)	Classical Mechanics Partial Differential Equations Python Programming – Theory		4



# ALGEBRA – II

#### **Objective:**

The aim of the paper is the introduction of Rings and its properties.

#### **Prerequisite:**

Basic knowledge in Group and its properties.

#### **Outcome:**

Gained knowledge about varieties of Rings and their properties.

# Unit I:

Ring Homomorphisms – Ideals and Quotient Rings – More Ideals and Quotient Rings – The field of Quotients of an Integral Domain **Text 1:** Sections: 3.3 – 3.6

# Unit II:

Euclidean Rings – A Particular Euclidean Ring. **Text 1:** Sections: 3.7 and 3.8

# Unit III:

Polynomial Rings – Polynomials over Rational Field – Polynomial Rings over Commutative Rings **Text 1:** Sections: 3.9 – 3.11.

# Unit IV:

Certain Radicals of a Ring – Jacobson Radical of a Ring –Semi Simple Ring – Nil Radical – Primary Ring. **Text 2:** Chapter 8: Definition 8.1 –Theorem 8.15.

# Unit V:

Quasi regular – J-semi simple – Direct sum of rings Text 2: Chapter 8: Theorem 8.16–Theorem 8.18 and Chapter 10.

**Text book**: Topics in Algebra, I.N. Herstein, 2nd Edition, Wiley Student edition A First Course in Rings and Ideals, David M. Burton, Addison – Wesley Publishing Company



# **ANALYSIS-II**

#### **Objective**:

The aim of the paper is to introduce Integrations of Functions and convergence.

#### Prerequisite:

Basic knowledge in Functions and Integrations

#### Outcome:

Gained knowledge about the concepts of Convergence of Functions and Integrations of Functions.

#### Unit I:

Definition and Properties of Integral – Integration and Differentiation. **Chapter 6:** Section: 6.1 -6.22, Exercise Problems: 1,2,4,5,10,11.

#### Unit II:

Integration of vector valued functions – Rectifiable arcs, Sequence and Series of functions: Discussion of main problem – Uniform Convergence – Uniform convergence and Continuity.

**Chapter 6:** section 6.23-6.27 & Chapter 7: Section: 7.1 - 7.15. Exercise Problems: Chapter 7: 1,4,6 and 7.

#### Unit III:

Uniform Convergence and Integration –Uniform Convergence and Differentiation – Equicontinuous Families of Functions. **Chapter7**: Section7.16-7.25

#### Unit IV:

The Stone Weierstrass Theorem – Power series. Chapter 7: Section 7.26-7.33 and Chapter 8: Section 8.1 -8.5. Exercise Problems: Chapter 8: 1-5

#### Unit V:

The Algebraic Completeness of the Complex Field –Fourier Series –The Gamma function. **Chapter 8:** Section 8.8-8.22. Exercise Problems: Chapter 8:13,14,15.

**Text Book:** Principles of Mathematical Analysis, Third Edition, Walter Rudin – McGraw Hill International Book Company.

Nesamony Memorial Christian College, Marthandam



# **ADVANCED CALCULUS**

#### **Objective:**

The aim of the paper is to introduce Definite and Multiple Integrals. Prerequisites: Basic knowledge in Calculus.

# **Outcome:**

Gained knowledge about the concepts of Multiple Integrals and Vector Analysis.

### Unit I:

Integration: The Definite Integral – Evaluation of Definite Integrals **Chapter 4**: Sections 4.2, 4.3.

# Unit II:

Differentiation of Transformations: Transformations-Linear Functions and Transformations-Differentials of Transformations **Chapter 7:** Sections7.2 – 7.4

# Unit III:

Inverse of Transformations – The Implicit Function Theorems-Functional Dependence. **Chapter 7**:Sections 7.5, 7.6, 7.7

# Unit IV:

Applications to Geometry and Analysis: Set Functions-Transformations of Multiple Integrals – Curves and Arc Length **Chapter 8:** Sections8.2, 8.3, 8.4

# Unit V:

Differential Geometry and Vector Calculus: Vector Analysis -The Theorems of Green, Gauss and Stokes. **Chapter 9**: Sections9.3, 9.4

**Text Book**: Advanced Calculus, R. Creighton Buck, Third Edition, Tata McGraw Hill, International Student edition.

**Book for Reference:** Principles of Mathematical Analysis, Walter Rudin, Third Edition, McGraw Hill International Book Company.



# **DIFFERENTIAL GEOMETRY**

#### **Objective:**

The aim of the paper is to introduce about Curve, Curvature, Evolute and Involute.

# **Prerequisite:**

Basic knowledge in Geometry.

# Outcome:

Gained knowledge about the concepts of Curvature and Geodesics.

# Unit I:

The Theory of Space Curves- Definitions, Arc length –Tangent –Normal and Binormal – Curvature and Torsion.

Chapter 1:Section 1.1 – 1.5Problems: Chapter 1:Miscellaneous Exercise I: 1 -

# 3.

# Unit II:

Contact between Curves and Surfaces – Tangent Surface – Involutes and Evolutes – Helices

**Chapter 1:** Section 1.6, 1.7 and 1.9 Problems: Chapter 1: Miscellaneous Exercise I: 8 - 12

# Unit III:

Definition of a Surface – Curves on a Surface – Helicoids –Metric – Direction Coefficients **Chapter 2:** Section: 2.1, 2.2, 2.4, 2.5, 2.6 Problems: Chapter 2: Miscellaneous Exercise II: 1 – 4.

# Unit IV:

Families of Curves – Geodesics, Canonical Geodesic Equation, Normal Property of Geodesics (Christoffel symbols not included).
Chapter 2: Section: 2.7, 2.10 – 2.12
Problems: Chapter 2: Miscellaneous Exercise II: 6,7,8.

# Unit V:

Geodesic Curvature, The Second Fundamental Form–Principal curvature– Lines of Curvature (Dupin's indicatrix not included). **Chapter 2**: Section 2.15, Chapter 3: Section: 3.1-3.3. Problems: Miscellaneous Exercise III: 1-5.

**Text book**: An Introduction to Differential Geometry, T.J. Willmore, Oxford University Press, (17th Impression), New Delhi,2002, (Indian Print).

Nesamony Memorial Christian College, Marthandam



# **RESEARCH METHODOLOGY AND STATISTICS**

#### **Objectives:**

- To understand the Basic aspects in Research
- To learn Mathematical and Statistical Technique for Research
- To acquire basic knowledge about various instruments and Techniques in Mathematical Research.

#### **Prerequisite:**

Basic knowledge in Statistics and related information to be useful for Research.

#### **Outcome:**

Training and participating in active Research activities for their Academic and Professional levels. Creation of novel ideas and simple technique useful to society R/D) Acquire background knowledge in Research Publication and Thesis writing.

#### Unit I:

Different components of a Research Project – Title page – Abstract-Acknowledgement - List of Contents – Introduction-Literature Review-Methodology – Style of Presentation –Conclusions – Bibliography – Appendices.

**Chapter 6:** Section 6.1 – 6.4, 6.6, 6.7, 6.8.1, 6.9.1, 6.11 – 6.13 in Text 1.

#### Unit II:

Multivariate Distributions: Distributions of Two Random Variables – Conditional Distributions and Expectations –Independent Random Variables – Extension to Several Random Variables.

Chapter 2: Sections 2.1, 2.2, 2.4, 2.5. in Text 2

#### Unit III:

Some Special Distributions: The Gamma and Chi – Square Distribution
The Normal Distribution.
Chapter 3: Sections 3.3, 3.4 in Text 2
Exercise Problems: Chapter 3: 3.28 – 3.33, 3.40 – 3.46.

#### Unit IV:

**Sampling Theory**: Transformation of Variables – t & F Distributions. **Chapter 4**: Sections 4.1 - 4.4 in Text 2



Exercise Problems: Chapter 4: 4.1–4.8, 4.14–4.17, 4.20–4.25, 4.34–4.41.

#### Unit V:

**Random Variables**: The MGF technique – Distributions of and  $ns2 - \sigma 2$ Expectations of Functions of Random Variables – The Central Limit Theorem. **Chapter4:** Section 4.7 – 4.9 & **Chapter 5**: Section 5.4 in **Text2** Exercise Problems: Chapter 4: 4.68 – 4.74, 4.83 – 4.93. Exercise Problems: Chapter 5:5.20 – 5.22, 5.25 – 5.27.

#### **Text Books:**

#### Writing up your University Assignments and Research Projects -

- 1. A Practical Handbook, Neil Murray and Geraldine Hughes, McGraw Hill Open University Press.
- 2. Introduction to Mathematical Statistics, Fourth Edition,Robert V, Hogg and Allen T. Craig, Pearson Education Asia.

#### **Books for Reference:**

- 1. **Research Methodology** (2ndRevised Methods and Techniques Edition) C.R. Kothari, New Age International Publications, New Delhi.
- 2. **Fundamentals of Mathematics Statistics** C. Gupta, V.K. Kapoor, Eleventh Edition 2002, Sultan Chand & Sons Publishers, New Delhi.



# **CLASSICAL MECHANICS**

#### **Objective:**

The aim of the paper is to introduce the Equation of Motion and to study about the Motion of Bodies

# Prerequisite:

Basic knowledge in velocity and acceleration of a particle.

### **Outcome:**

Gained knowledge about the concepts of Equations of Motion Lagrange's Equation and Hamilton's Equations

### Unit I:

Mechanics of particle– Mechanics of a system of particles constraints. Chapter 1: Section 1-3, Problems: 2, 4 and 5.

# Unit II:

D'Alembert's Principle and Lagrange's Equation – Velocity dependent potentials and dissipation functions – Simple applications of Lagrangian formulation.

Chapter 1: Section 4, 5 and 6, Problems: 11, 13 and 17.

# Unit III:

Hamilton's Principle – Some techniques of Calculus of Variation – Derivation of Lagrange's equations from Hamilton's principle – Extension of Hamilton principle to non- holonomic systems. **Chapter 2:** Section 1 - 4, Problems: 1 - 3.

- Unit IV: Reduction to the equivalent one-body problem The equations of motion and first Integrals The equivalent one-dimensional problem and classification of orbits The virial theorem.
  Chapter 3: Section 1 4, Problems: 2 4.
- Unit V: The differential equation for the orbit and integrable power law potentials
  The Kepler problem: Inverse square law of force The motion in time in the Kepler problem The Laplace Runge Lenz vector.
  Chapter 3: Section 5, 7 9.

#### **Text Book:**

Classical Mechanics, H. Goldstein, Second Edition, Addison Wesley India Edition.



# PARTIAL DIFFERENTIAL EQUATIONS

#### **Objective:**

The aim of the paper is to introduce the concepts of solving different types of Partial Differential Equations.

#### **Prerequisite:**

Basic knowledge in Ordinary Differential Equations and its solutions.

#### **Outcome:**

Gained knowledge to solve Partial Differential Equations.

#### Unit I:

Methods of Solution of  $\frac{dx}{p} + \frac{dy}{q} + \frac{dz}{R}$  Pfaffian Differential Forms and Equations- Solution of Pfaffian Differential Equations in three variables. **Chapter 1**: Section: 3, 5 and 6 (all problems)

#### Unit II:

Partial Differential equations – Origins of first order Partial Differential equations – Linear equations of the first order –Integral surfaces passing through a given curve.

Chapter 2: Section: 1,2,4 and 5 (all problems)

# Unit III:

Cauchy's Method of Characteristics – Compatible systems of First order Equations –Charpit's Method. Chapter 2: Section: 8 – 10 (all problems)

# Unit IV:

Second order equations in Physics – Linear Partial Differential equations with Constant Coefficients. Chapter 3: Section: 2 and 4 (all problems)

#### Unit V:

Characteristics of Equations in three variables – Separation of variables. **Chapter 3:** Section: 7 and 9 (all problems)

# **Text Book: Elements of Partial Differential Equations**, IAN N.SNEDDON, McGraw Hill, New Delhi, 1983.



# **PYTHON PROGRAMMING – THEORY**

#### **Objective:**

The aim of the paper is to introduce Python programming.

#### **Prerequisite:**

Basic knowledge in C- Programming.

#### **Outcome:**

Gained knowledge in problem solving using Python programming.

#### Unit I:

### **PROBLEM SOLVING TECHNIQUES**

Problem solving Techniques – Algorithm, flowchart, pseudocode, programming; Algorithms: properties, quality (time, space); building blocks of algorithms - statements, state, control flow, functions, notation (pseudo code, flow chart, programming language)

#### Unit II:

#### ALGORITHMIC PROBLEM SOLVING

Algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion), pseudocode for some Mathematical Problems – greatest of two numbers, print n natural numbers, greatest common divisor, fibonacci sequence upto n terms. Practical applications of algorithms.

#### **Unit III:**

#### **INTRODUCTION TO PYTHON**

Introduction to Python, Python interpreter, Modes of Python Interpreter, Values and Data Types, Variables, Keywords, Identifiers, Statements and Expressions, Input and Output, Comments, Docstring, Lines and Indentation, Quotation, Tuple Assignment, Operators and Types of Operators, Operator Precedence.

#### Unit IV:

#### **PYTHON FUNCTIONS**

Functions, Types of function, Function definition (Sub program), Flow of Execution, Function Prototypes, Parameters and Arguments; Modules; Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained



conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion;

### Unit V:

# STRING, LISTS, TUPLES IN PYTHON

Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value.

### **Text Books:**

- 1. Allen B. Dowley, "Think Python: How to Think Like a Computer Scientist", 2nd Edition.
- 2. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython", O'Reilly, 2nd Edition, 2018.
- 3. Jake VanderPlas, "Python Data Science Hand Book: Essential Tools for working with Data", O'Reilly, 2017.

### **Reference Books:**

- 1. Wesley J. Chun, "Core Python Programming", Prentice Hall, 2006.
- 2. Mark Lutz, "Learning Python", O'Reilly, 4nd Edition, 2009.

#### **E-Books:**

- 1. http://www.programmer-books.com/introducing-data-science-pdf/
- 2. http://www.CS.uky.edu/~keen/115/haltermanpythonbook.pdf
- 3. http://math.ecnu.edu.cn/~Ifzhou/seminar/IJoel GeuslDatascience from Scratch First Princ.pdf

