Semester I

Subject 1

ME010101 Abstract Algebra

Text book : John B. Fraleigh, A first course in abstract algebra, 7th edition, Pearson Education, 2003

Topic 1 Fundamental Theorem for Abelian Groups

- Session 1 Introduction to Abstract Algebra.
- Session 2 Direct product of Groups.
- Session 3 Finitely generated Abelian Groups.

Topic 2 Fundamental Homomorphism Theorem for Groups

- Session 1 Cosets and Homomorphism.
- Session 2 Factor Groups.
- Session 3 Fundamental Homomorphism & Automorphism.
- Session 4 Simple Groups.

Topic 3 Group Action

- Session 1 Group Action.
- Session 2 Isotropy Subgroups.
- Session 3 Burnside's forumula.

Topic 4 Nonabelian Groups : Isomorphism Theorems

- Session 1 First Isomorphism Theorem.
- Session 2 Second Isomorphism Theorem.
- Session 3 Third Isomorphism Theorem.

Topic 5 Nonabelian Groups : Sylow Theorems

- Session 1 Cauchy's Theorem.
- Session 2 First Sylow's Theorem.
- Session 3 Second Sylow's Theorem.

Subject 2

ME010102 Linear Algebra

Topic 1 Vector Spaces.

- Session 1 Introduction to Linear Algebra.
- Session 2 Vector Spaces.
- Session 3 Subspaces.

Topic 2 Basis of a Vector Space.

- Session 1 Basis and Dimension.
- Session 2 Co-ordinates and Change of Basis.
- Session 3 Row-equivalence.
- Session 4 Subspace Computations.

Topic 3 Linear Transformations.

- Session 1 Introduction to Linear Transformations.
- Session 2 Rank-Nullity Theorem.

Topic 4 The Algebra of Linear Transformations.

- Session 1 The Algebra of Linear Transformations.
- Session 2 The Group of Invertible Linear Transformations.

Topic 5 Matrix Representation of Linear Transformations.

- Session 1 Isomorphism and Matrix Representation.
- Session 2 Linear Functional and Double Dual Space.
- Session 3 Transpose of a Linear Transformation.

Topic 6 Determinants.

- Session 1 Commutative Rings.
- Session 2 Determinant Functions.
- Session 3 Properties of Determinants.
- Session 4 Uniqueness of Determinants.

Subject 3

ME010103 Basic Topology

Topic 1 Introduction to Topology.

- Session 1 Metric Spaces and Metric.
- Session 2 Topological Spaces.
- Session 3 Examples of Topological Spaces.

Topic 2 Bases and Subbases.

- Session 1 Bases and Subbases.
- Session 2 Subspaces.

Topic 3 Closure Operator.

- Session 1 Closed Set and Closure.
- Session 2 Closure characterisation.

Topic 4 Interior Operator.

- Session 1 Neighbourhood and Interior.
- Session 2 Interior Characterisation.

Topic 5 Characterisation of Closed Set.

- Session 1 Accumulation Points.

Topic 6 Continuous Functions.

- Session 1 Making Functions continuous.
- Session 2 Quotient Spaces.

Topic 7 Small Spaces.

- Session 1 Absolute vs Relative Properties.
- Session 2 Separable Spaces.

Topic 8 Topological Properites.

- Session 1 Functions on a compact space.

Subject 4

ME010103 Real Analysis

Topic 1 Bounded Variation.

Session 1 Properties of Monotonic Functions.

Session 2 Functions of Bounded Variation.

Subject 5

Graph Theory

Week 1

Semester II

Subject 6

ME010201 Advanced Abstract Algebra

Text book : John B. Fraleigh, A first course in abstract algebra, 7th edition, Pearson Education, 2003

Week 1 June 14-18, 2021

Day 1 Reading : §29.1-12
Introduction to Extension Fields
Algebraic and Transcendental Elements

Day 2 Reading : §29.13-19
The Irreducible Polynomial for α over F
Simple Extensions

Day 3 Reading Assignment : §31.1-11
Finite Extensions

Day 4 Reading : §31.12-18
Algebraically Closed Fields and Algebraic Closures

Day 5 Reading : §32.1-11
Constructible Numbers
The Impossibility of Certain Constructions

Week 2 June 21-25, 2021

Day 1 Reading : §33.1-7
The Structure of Finite Field

Day 2 Reading : §33.8-12
The Existence of $GF(p^n)$

Day 3 Reading : §45.1-7
Unique Factorization Domains

Day 4 Reading : §45.8-18
Every PID is a UFD

Day 5 Reading : §45.19-31
If D is a UFD, then $D[x]$ is a UFD

Week 3 June 28-July 2, 2021

Day 1 Reading : §46.1-5
Euclidean Domains

Day 2 Reading : §46.6-11
Arithmetic in Euclidean Domains

Day 3 Reading : §47.1-5
Gaussian Integers

Day 4 Reading : §47.6-10
Multiplicative Norms

Day 5 First Internal Examination
Module 1 & 2

Week 4 July 5-9, 2021

Day 1 Reading : §48.1-7
Automorphism of Fields

Day 2 Reading : §48.8-19
Automorphism and Fixed Fields, Frobenius Automorphism

Day 3 Reading : §49.1-5
The Extension Theorem

Day 4 Reading : §49.6-11
The index of a Field Extension

Day 5 Reading : §50.1-9
Splitting Fields

Week 5 July 12-16, 2021

Day 1 Reading : §51.1-6
Multiplicity of zeros of a polynominal

Day 2 Reading : §51.7-10
Separable Extensions

Day 3 Reading : §51.11-16
Perfect Fields
The Primitive Element Theorem

Day 4 Reading : §53.1-2
Galois Theory
Normal Extension

Day 5 Reading : §53.3-6
The Main Theorem

Week 6 July 19-23, 2021

Day 1 Reading : §53.7-8
Galois Groups over Finite Fields
Proof of the Main Theorem Completed

Day 2 Reading : §54.1-7
Illustrations of Galois Theory
Examples

Day 3 Reading : §55.1-6
Cyclotomic Extensions

Day 4 Second Internal Examination
Module 3 & 4

Day 5 Survey : §56.1-6
Insolvability of the Quintic

Subject 7

ME010202 Advanced Topology

Week 1

Subject 8

Numerical Analysis with Python3

Revision Plan

Day 1 Gauss elimination - Elimination phase('Pivot Equation', n^3 operations), Back substitution phase. §2.2(Kiusalaas pages 37-44) **Oct 8, 2020**

Day 2 Doolittle LU decomposition - ('LU' factorisation, Comparison), Modifications to Gauss Elimination, combined matrix, Forward + Back substitution §2.3(Kiusalaas pages 44-47) **Oct 9, 2020**

Day 3 Numerical Integration - Lagrange's interpolant, Newton-Cotes formula **Oct 12, 2020**

Subject 9

ME010204 Complex Analysis

Week 1 Jun 02-03, 2022

- Day 1 §1.1 *The Algebra of Complex Numbers : Arithmetic Operations, Square Roots, Justificaiton, Conjugation, Absolute Value, Inequalities*
- Day 2 §1.2 *The Geometric Representation of Complex Numbers : Geometric Addition and Multiplication, The Binomial equation, Analytic Geometry*

Week 2 Jun 06-10, 2022

- Day 1 §1.2.4 The Sperical Representation
- Day 2 §2.1 *Introduction to the Concept of Analytic Function : Limits and Continuity, Analytic Functions, Polynomials, Rational Functions*
- Day 3 §2.2 Elementary Theory Power Series : Sequences, Series, Uniform Convergence, Power Series
- Day 4 §2.2.5 Abel's Limit Theorem
- Day 5 §3.2 Conformality

Week 3 Jun 13-17, 2022

- Day 1 §3.3 Linear Transformations : Linear Group, Cross Ratio,
- Day 2 §3.3.3 Symmetry
- Day 3 §3.3.4-5 Oriented Circles, Families of Circles
- Day 4 §4.1 Fundamental Theorems : Line Integrals, Rectifiable Arcs, Line integrals as funtions of arcs
- Day 5 §4.1.4 Cauchy's theorem for a Rectangle

Week 4 Jun 20-June 24, 2022

- Day 1 §4.1.5 Cauchy's theorem in a Disk
- Day 2 §4.2 Cauchy's Integral Formula : The index of a point with respect to a closed curve

Day 3 §4.2.2 The integral formula

Day 4

Day 5 First Internal Examination
Module 1 & 2

Week 5 June 27-July 01, 2022

Day 1 §4.2.3 Higher Derivatives

Day 2 §4.3 Local Properties of Analytic Functions : Removable Singularities, Zeros and Poles

Day 3 §4.3.3 The Local Mapping

Day 4 §4.3.4 The maximum principle

Day 5 §4.4 The general form of Cauchy's theorem : Chains and Cycles, Simple Connectivity, Homology, The general statement of Cauchy's theorem, Proof of Cauchy's theorem, Locally exact differentials, Multiply Connected Regions

Week 6 July 04-08, 2022

Day 1 §4.5 The Calculus of Residues : The Residue theorem, The Argument Principle

Day 2 §4.5.3 Evaluation of Definite integrals

Day 3

Day 4

Day 5

Week 7 July 11-15, 2022

Day 1

Day 2

Day 3

Day 4

Day 5 Second Internal Examination
Module 3 & 4

Week 8 July 18-22, 2022

Day 1

Day 2

Day 3

Day 4

Day 5

Week 9 July 25-29, 2022

Day 1

Day 2

Day 3

Day 4

Day 5

Subject 10

ME010205 Measure & Integration

Week 1 Jun 02-03, 2022

- Day 1 Evolution of Integral
- Day 2 §1 *The Real Numbers : Sets, Sequences, and Functions*

Week 2 Jun 06-10, 2022

- Day 1 §2.1 Introduction
- Day 2 §2.2 Lebesgue Outer Measure
- Day 3 §2.3 The σ-algebra of Lebesgue Measurable Sets
- Day 4 §2.4 Outer and Inner Approximation of Lebesgue Measuareable Sets
- Day 5 §2.5 Countable Additivity, Continuity and Borel-Cantelli Lemma

Week 3 Jun 13-17, 2022

- Day 1 §2.6 Non measurable Sets
- Day 2 §2.7 The Cantor Set and Cantor Lebesgue Function
- Day 3 §3 Lebesgue Measurable Functions : Sums, Products and Compositions
- Day 4 §3.2 Sequential Pointwise Limits and Simple Approximation
- Day 5 §4 Lebesgue Integral : The Riemann Integral

Week 4 Jun 20-June 24, 2022

- Day 1 §4.2 The Lebesgue Integral of a bounded measurable function over a set of finite measure
- Day 2 §4.3 The Lebesgue Integral of a measurable non-negative function
- Day 3 §4.4 The General Lebesgue Integral
- Day 4
- Day 5 First Internal Examination
  Module 1 & 2

Week 5 June 27-July 01, 2022

- Day 1 §17 General Measure Spaces : Their Properties and Construction
- Day 2 §17.1 Measures and Measurable Sets
- Day 3 §17.2 Signed Measures : The Hanh and Jordan decompositions
- Day 4 §17.3 The Caratheodory Measure induced by an outer measure
- Day 5 §18 Integration over general Measure Spaces : Measurable Functions

Week 6 July 04-08, 2022

- Day 1 §18.2 Integration of non-negative measurable functions
- Day 2 §18.3 Integration of General Measurable Functions
- Day 3 §18.4 The Radon Nikodym Theorem
- Day 4 §20.1 Product Measures : The Theorems of Fubini and Tonelli
- Day 5

Week 7 July 11-15, 2022

- Day 1
- Day 2
- Day 3
- Day 4
- Day 5 Second Internal Examination
  Module 3 & 4

Week 8 July 18-22, 2022

- Day 1
- Day 2
- Day 3
- Day 4
- Day 5

Week 9 July 25-29, 2022

- Day 1
- Day 2
- Day 3
- Day 4
- Day 5

Semester III

Subject 11

ME010301 Advanced Complex Analysis

Week 1

Subject 12

ME010302 Partial Differential Equations

Week 1

Subject 13

ME010303 Multivariate Calculus & Integral Transforms

Textbooks : Tom M. Apostol, Mathematical Analysis, 2nd Edition, Addison-Wesley, 1974
Walter Rudin, Principles of mathematical analysis, 3rd Edition

Week 1 Weierstrass approximation theorem, other forms of Fourier series, Fourier integral theorem, exponential form of Fourier integral theorem, integral transforms. Reading : §11.15-20

Week 2 Directional derivatives, Total Derivative, Complex valued functions, matrix of linear functions, Jacobian matrix. Reading: §12.1-8

Week 3 chain rule, matrix form of chain rule, mean-value theorem. Reading : §12.9-11[1]

Week 4 Reading : §12.12-13

- Day 1 Sufficient condition for differentiability. Reading : §12.12
- Day 2 Sufficient condition for equality of partial derivatives. Reading : §12.13

Jan 08, 2020 Internal Examination Module 2

Week 5 Reading : §13.1-4

- Day 1 Implicit function, Jacobian determinant $J_f(\overline{x})$, Jacobian determinant of complex-valued functions §13.1
- Day 2 Continuity of f with $J_f(\overline{x}) \neq 0$. Reading : §13.2 Theorem 13.2
- Day 3 Function f with $J_f(\overline{x}) \neq 0$ is an open mapping. §13.2 Theorem 13.3
- Day 4 Inverse function therorem. Reading : §13.3
- Day 5 Implicit function theorem. Reading : §13.4

[1]Semester 2, University Examinations

Jan 15, 2020

Week 6 Reading : §13:5-6

Day 1 Extrema of function on one variable. Reading : §13.5

Day 2 Extrema of functions on several variables. Reading : §13.6

Jan 22, 2020

Week 7 Convolution theorem for Fourier transforms. Reading : §11.21 (pending)

Jan 29, 2020

Week 8 Reading : §10.1-9

Day 1 k-cell I_k, integration over k-cell, support, primitive mappings, flip, local represenation as composition of primitives and flips, partitions of unity, change of variables on continuous functions with compact support.

Feb 05, 2020

Week 9 Reading : §10.10-14

Day 1 k-surface, k-form (differential form of order k), properties of k-forms, basic k-forms.

Feb 12, 2020

Subject 14

ME010304 Functional Analysis

Week 1

Subject 15

ME010305 Optimization Technique

Week 1

Semester IV

Subject 16

ME010401 Spectral Theory

Week 1 Jun 02-03, 2022

- Day 1
- Day 2

Week 2 Jun 06-10, 2022

- Day 1 §4.6 Reflexive Spaces
- Day 2 §4.7 Category Theory, Uniform Boundedness Theorem
- Day 3 §4.8 Strong and Weak Convergence
- Day 4 §4.9 Convergence of Seqeunce of Operators and Functionals
- Day 5 §4.12 Open Mapping Theorem

Week 3 Jun 13-17, 2022

- Day 1 §4.13 Closed Linear Operator, Closed Graph Theorem
- Day 2 §5.1 Banach Fixed Point Theorem
- Day 3 §7.1 Spectral Theory in Finite dimensional Normed Spaces
- Day 4 §7.2 Basic Concepts
- Day 5

Week 4 Jun 20-June 24, 2022

- Day 1 §7.3 Spectral Properties of Bounded Linear Operator
- Day 2 §7.4 Futher Properties of Resolvent and Spectrum
- Day 3 §7.5 Use of Complex Analysis in Spectral Theory
- Day 4
- Day 5 First Internal Examination
  Module 1 & 2

Week 5 June 27-July 01, 2022

- Day 1 §7.6 Banach Algebras
- Day 2 §7.7 Further Properties of Banach Algebras

Day 3 §8.1 Compact Linear Operators on Normed Spaces

Day 4 §8.2 Further Properties of Compact Linear Operators

Day 5 §8.3 Spectral Properties of Compact Linear Operators

Week 6 July 04-08, 2022

Day 1 §8.4 Further Spectral Properties of Compact Linear Operators

Day 2 §9.1 Spectral Properties of Bounded Self-Adjoint Linear Operators

Day 3 §9.2 Further Spectral Properties of Bounded Self-Adjoint Linear Operators

Day 4 §9.3 Positive Operators

Day 5 §9.5 Projection Operators

Week 7 July 11-15, 2022

Day 1 §9.6 Further Properties of Projections

Day 2

Day 3

Day 4

Day 5 Second Internal Examination
Module 3 & 4

Week 8 July 18-22, 2022

Day 1

Day 2

Day 3

Day 4

Day 5

Week 9 July 25-29, 2022

Day 1

Day 2

Day 3

Day 4

Day 5

Subject 17

ME010402 Analytic Number Theory

Week 1

Subject 18

ME800401 Differential Geometry

Text book : J. A. Thorpe, Elementary topics in Differential Geometry, Springer, 1979

Week 1 Reading : Chapter 1, 2, and 3

- Day 1 Graphs and Level Sets. Reading : Chapter 1
- Day 2 Vector Fields. Reading : Chapter 2
- Day 3 Maximal Integral Curve. Reading : Chapter 2
- Day 4 Tangent Space. Reading : Chapter 3

Week 2 Reading : Chapters 4, and 5

- Day 1 Surface. Reading : Chapter 4
- Day 2 Vector Fields on Surfaces. Reading : Chapter 5
- Day 3 Maximal Integral Curve. Reading : Chapter 5
- Day 4 Orientation. Reading : Chapter 5
- Day 5

Week 3 Reading : §6, §7

- Day 1 Gauss Map. Reading : §6
- Day 2 Gauss map is onto. Reading : §6
- Day 3 Geodesics. Reading : §7
- Day 4 Maximal Geodesic. Reading : §7
- Day 5

Week 4 Reading : §8

- Day 1 Covariant Differentiation. Reading : §8
- Day 2 Levi-Civita Parallel. Reading : §8
- Day 3 Parallel Transport. Reading : §8

Day 4 Properties of Parallel Transport. Reading : §8

Day 5

Week 5 Reading : §9,§10

Day 1 Directional Derivatives. Reading : §9

Day 2 Weingarten map. Reading : §9

Day 3 Properties of Weingarten Map. Reading : §9

Day 4 Curvature of Plan Curves. Reading : §10

Day 5

Week 6 Reading : §11

Day 1 Length of parameterised Curve. Reading : §11

Day 2 Existence of global parameterisation. Reading : §11

Day 3 Unit speed global parameterisation. Reading : §11

Day 4 Differential Forms. Reading : §11

Day 5

Week 7 Reading : §12

Day 1 Normal Curvature of Surfaces. Reading : §12

Day 2

Day 3

Day 4

Day 5

Week 8 Reading : §14

Day 1

Day 2

Day 3

Day 4

Day 5

Subject 19

ME800402 Algorithmic Graph Theory

Week 1 Reading §1.1-1.9

- Day 1 Graph, Degree of Vertex, Graph Isomorphism, Subgraph, Degree Sequence
  Graphic Degree Sequence : **Havel-Hakini**
  Reading : §1.1-1.5
- Day 2 Connected Graph, Cut-vertex, Bridge, Block, Special Graphs: Complete, n -partite, and HyperCube, Digraph, Indegree & Outdegree (id,od), Semiwalk, Weakly connected, Symmetric, Tournament, Multidigraph, Pseudodigraph.
  Every $u - v$ walk contains a $u - v$ path.
  Bridge Characterisation : bridge won't belong to any cycle
  Bipartite Characterisation : No odd cycles
  If there is a Cut-vertex, then thereare two end-blocks.
  Reading : §1.6-1.9
- Day 3
- Day 4
- Day 5

Week 2 Reading

- Day 1
- Day 2
- Day 3
- Day 4
- Day 5

Week 3 Reading

- Day 1
- Day 2

Day 3

Day 4

Day 5

Week 4 Reading

Day 1

Day 2

Day 3

Day 4

Day 5

Week 5 Reading

Day 1

Day 2

Day 3

Day 4

Day 5

Subject 20

ME800403 Combinatorics

Week 1 Reading §1.1-1.3

- Day 1 Two basic counting principles, Reading: §1.1
- Day 2 Permutation, Reading : §1.2, Assignment : Q
- Day 3 Circular Permutation, Reading : §1.3
- Day 4 Exercises

Week 2 Reading §1.4-1.6

- Day 1 Combination Reading, : §1.4
- Day 2 Injection & Bijection principles, Reading : §1.5
- Day 3 Arrangements & Selection with Repeation, Reading : §1.6
- Day 4 Distribution Problems, Reading : §1.7
- Day 5 Exercises Q 1.1-115

Week 3 Reading §3.1-3.5

- Day 1 Pigeonhole Principle, Reading: §3.1-2
- Day 2 More Examples, Reading : §3.3
- Day 3 Ramsey Numbers, Reading : §3.4
- Day 4 Bounds for Ramsey Numbers, Reading : §3.5
- Day 5 Exercise Q 3.1-46

Week 4 Reading

- Day 1
- Day 2
- Day 3
- Day 4
- Day 5

Week 5 Reading

Day 1

Day 2

Day 3

Day 4

Day 5

Week 6 Reading

Day 1

Day 2

Day 3

Day 4

Day 5

Subject 21

Probability Theory

Week 1

Subject 22

Operational Research

Week 1

Subject 23

Operational Research

Week 1

Subject 24

Commutative Algebra

Week 1

Subject 25

Ordinary Differential Equations

Week 1

Subject 26

Classical Mechanics

Week 1

Bibliography