SYLLABUS

M.Sc MATHEMATICS
KUCBSS Scheme

KANNUR UNIVERSITY

2014 ADMISSION

KANNUR UNIVERSITY
M.SC DEGREE PROGRAMME IN MATHEMATICS (KUCBSS)
SCHEME AND SYLLABUS (2014 ADMISSION)

COURSE STRUCTURE:

Course Code	Course Title	Lecture Hours/Week	Duration of Examination (Hours)	Credits	Marks
FIRST SEMESTER					
MAT1C01	Basic Abstract Algebra	5	3	4	75
MAT1C02	Linear Algebra	5	3	4	75
MAT1C03	Real Analysis	5	3	4	75
MAT1C04	Basic Topology	5	3	4	75
MAT1C05	Differential Equations	5	3	4	75
			Total	20	375
SECOND SEMESTER					
MAT2C06	Advanced Abstract Algebra	5	3	4	75
MAT2C 07	Measure and Integration	5	3	4	75
MAT2C08	Topology	5	3	4	75
MAT2C09	Complex Analysis	5	3	4	75
MAT2C10	Partial Differential Equations& integral equations	5	3	4	75
			Total	20	375
THIRD SEMESTER					
MAT3C11	Number Theory	5	3	4	75
MAT3C12	Functional Analysis	5	3	4	75
MAT3C13	Complex Function Theory	5	3	4	75
MAT3C14..	Advanced Real Analysis	5	3	4	75
MAT3E..	Elective-1	5	3	4	75
			Total	20	375
FOURTH SEMESTER					
MAT4C15	Operator Theory	5	3	4	75
MAT4C16	Differential Geometry	5	3	4	75
MAT4E..	Elctive-2	5	3	4	75
MAT4E..	Elective-3	5	3	4	75
MAT4D01	Project Work	5	-	2	35
MAT4V01	Viva-Voce	-	-	2	40
			Total	20	375

Total Marks: 1500

Total Credits: 80

Elective Course for Third Semester

1. Graph Theory
2. Probability Theory

Elective Course for Fourth Semester

1. Calculus of Variations
2. Commutative Algebra
3. Fourier and Wavelet Analysis
4. Operations Research

CONTINUOUS ASSESSMENT (CA)

This assessment shall be based on predetermined transparent system involving periodic written tests, assignments, seminars and attendance in respect of theory course and based on tests, lab skill, records/viva and attendance in respect of practical course.

The percentage of marks assigned to various components for internal evaluation is as follows.

THEORY

	Components	% of internal marks
i	Two test papers	40
ii	Assignments and Viva	20
iii	Seminars/Presentation of course study	20
iv	Attendance	20

To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal marks.

The course teacher shall maintain the academic record of each student registered for the course, which shall be forwarded to the University, through the college Principle, after endorsed by the HoD,

TESTS

For each course there shall be at least two class tests during a semester. The probable dates of the tests shall be announced at the beginning of each semester. Marks should be displayed on the notice board. Valued answer scripts shall be made available to the students for perusal within 10 working days form the date of the tests.

ASSIGNMENTS

Each student shall be required to do 2 assignments for each course. Assignments after valuation must be returned to the students.

SEMINAR

Each student shall deliver one seminar as an internal component for every course and must be evaluated by the respective teacher in terms of structure,

QUESTION PAPER PATTERN

Each question paper all semesters will have Two Parts, Part A and Part B, Part A will have six short answer questions out of which four are to be answered. The questions are to be evenly distributed over the entire syllabus. Each question carries 3 marks. Part B will have there units, each unit consists of three questions from the respective three units of the syllabus. Four questions are to be answered form B without omitting any unit. Each question carries 12 marks.

Project Work:

At the end of the Fourth Semester every student is required to submit three copies of neatly typed dissertation based on the project work carries out under the guidance of teacher. The topic of the project work must be chosen from any area in Mathematics, which is a not already covered in the syllabus prescribed for MSc Programme of Kannur University. The project work has to be evaluated by two external examiners, followings the guidelines given below:

Components of Evaluation of Project Work:

	Components	Weightage
a	Content	1
b	Methodology	1
c	Presentation	2
d	Viva-Voce	1

Project:-

i) <u>Arrangement of contents</u>

The project should be arranged as follows-

1. Cover page and title page
2. Bonafide certificate/s
3. Declaration by the student
4. Acknowledgement
5. Table of contents
6. List of tables
7. List of figures
8. List of symbols, Abbreviations and Nomenclature
9. Chapter
10. Appendices
11. Reference:

ii) <u>Page dimension and typing instruction</u>

The dimension of the Project report should be in A4 size. The project report should be printed in bond paper and bound using flexible cover of the thick white art paper or spiral binding. The general text of the report should be typed with 1.5 line spacing. Paragraph should be arranged in justified alignment with margin 1.25" each on top. Left and right of the page with portrait orientation. The content of the report shall be around 40 pages.

iii) <u>A typical specimen of Bonafide Certificate</u>

KANNUR UNIVERSITY

<Font style Times New Roman-size 18>

BONAFIDE CERTIFICATE

<Font style Times New Roman-Size 16>

<Font Style Times New Roman-size 14>

Certificate that this project report "…….TITLE OF THE PROJECT……" is the bonafide work of "……NAME OF THE CANDIDATE……" who carried out the project work under my supervision.

<<signature of HoD>> <<signature of Supervisor/Co-supervisor>>

SIGNATURE SIGNATURE

<<Name>> <<Name>>

HEAD FO THE DEPARTMENT SUPERVISOR

<<Academic Designation>> <<Academic Designation>>

<<Department>> <<Department>>

<<Seal with full address of the Dept.& college>> <<Seal with full address>>

iv)Declaration by the student

DECLARATION

I,…….., hereby declare that the Project work entitled……..(Title of the Project), ……has been prepared by me and submitted to Kannur University in partial fulfillment of requirement for the award of Bachelor of ……..is a record of original work done by me under the supervision of Dr./Prof……..of Department of …….college/(Name of Institute).

I also declare that this Project work has not been submitted by me fully or partly for the award of any Degree, Diploma, Title or recognition before any authority.

Place

Date Signature of the student

(Reg. No)

ATTENDANCE

The students admitted in the P.G programme shall be required to attend at least 75% percent of the total number of classes (theory/practical) held during each semester. The students having less than prescribed percentage of attendance shall not be allowed to appear for the University examination.

Condonation of shortage of attendance to a maximum of 10% of the working days in a semester subject to maximum of two times during the whole period of post graduate programme may be granted by the Vice-Chancellor of the University. Benefit of Cnndonation of attendance will be granted to the students on health grounds, for participating in University Union activities, meeting of the University bodies and participation in other extracurricular activities on production of genuine supporting documents with the recommendation of the Head of the Department concerned. A student who is not eligible for such Condonation shall repeat the course along with the subsequent batch.

Student who complete the course and secure the minimum required attendance for all the course of a semester and register for the University examinations at the end of the semester alone will be promoted to higher semester.

The students who have attendance within the limit prescribed, but could not register for the examination have to apply for the ***token registration***, within two weeks of the commencement of the next semester.

Attendance of each course will be evaluated (internally) as below:-

Attendance	**% of marks for attendance**
Above 90% attendance	100
85 to <90%	80
80 to <85%	60
76 to <80%	40
75%	20
<75	Nil

EVALUATION AND GRADING

The evaluation scheme for each course (including projects) shall contain two parts; (a) Continuous Assessment(CA) and (b) End Semester Evaluation (ESE). **20%** marks shall be given to CA and the remaining **80%** to ESE. The ratio of marks between **internal and external is 1:4.** Both internal and external evaluation shall be carried out using marks with corresponding grades and grade points in **7-point indirect relative grading system**.

Viva-Voce:

A viva-voce examination, covering the entire programme, must be conducted by two external at the end of the Fourth Semester.

MAT1C01: BASIC ABSTRACT ALGEBRA

Text Book: John. B. Fraleigh – A First Course in Abstract Algebra (7th Edition), Narosa (2003)

Unit I

Direct Products and finitely generated Abelian Groups, Group Action on a Set, Applications of Sylow Theorems.
(Chapter-2: Section 11; Chapter-3: Section 16; Chapter-7: Sections 36, 37)

Unit II

Field of Quotients of the Integral Domain, Isomorphism Theorems, Series of Groups, Free Abelian Groups, Field of Quotients of the Integral Domain
(Chapter-4: Section 21, Chapter-7: Section 34, 35, 38).

Unit III

Ring of Polynomials, Factorization of Polynomials over a Field, Homomorphisms and Factor Rings, Prime and Maximal Ideals
(Chapter-4: Section 22, 23; Chapter-5: Section 26, 27).

Reference:

1. N. Herstein: Topics in Algebra.Wiley India Pvt. Ltd, 2006
2. D. S. Malik, John. N. Merdson, M. K. Sen: Fundamentals of Abstract Algebra Mc Graw-hill Publishing Co., 1996
3. Clark, Allen: Elements of Abstract Algebra. Dover Publications, 1984
4. David M. Burton: A First course in Rings and Ideals.Addison-Wesley Educational Publishers Inc., 1970
5. Joseph. A. Gallian: Contemporary Abstract Algebra. Narosa, 1999
6. M. Artin: Algebra Addison Wesley; 2nd edition, 2010

MAT1C02: LINEAR ALGEBRA

Text Book: Kenneth Hoffman & Ray Kunze; Linear Algebra; Second Edition, Prentice-Hall of India Pvt. Ltd

Unit I

Linear Transformations: Liner Transformations, The Algebra of Linear Transformations, Isomorphism, Representation of Transformation by Matrices, Linear Functional, The Double Dual The Transpose of a Linear Transformation.

(Chapter-3; Sections 3.1, 3.2,3.3, 3.4, 3.5, 3.6, 3.7)

Unit II

Elementary Canonical Forms: Introductions, Characteristic Values, Annihilating Polynomials Invariant Subspace, Simultaneous Triangulations& Simultaneous Diagonalisation.

(Chapter-6: Section 6.1, 6.2,6.3, 6.4, 6.5, 6.6)

Unit III

Elementary Canonical Forms: Invariant Direct Sums, The Primary Decomposition Theorem.

The Rational and Jordan Forms: Cyclic Subspaces and Annihilators, Cyclic Decomposition and the Rational Forms, The Jordan Forms.

Inner Product Spaces: Inner Products, Inner Product Spaces.
(Chapter-6: Sections 6.7, 6.8; Chapter-7: Sections: 7.1, 7.2, 7.3 (Omit Proof of the theorems in this (7.3) section); Chapter-8: Sections 8.1, 8.2)

Reference:

1. Stephen H. Friedberg, Arnold J Insel and Lawrence E. Spence: Linear Algebra: 4th Edition 2002: Prentice Hall.
2. Serge A Land: Linear Algebra; Springer
3. Paul R Halmos Finite-Dimensional Vector Space; Springer 1974.
4. McLane & Garrell Birkhoff; Algebra; American Mathematical Society 1999.
5. Thomas W. Hungerford: Algebra; Springer 1980
6. Neal H.McCoy & Thomas R.Berger: Algebra-Groups, Rings & Other Topics: Allyn & Bacon.
7. S Kumaresan; Linear Algebra A Geometric Approach; Prentice-Hall of India 2003.

MAT1C03: REAL ANALYSIS

Text Book I: Walter Rudin: Principles of Mathematical Analysis; 3rd Edition McGraw-Hill International

Text Book 2: T.M Apostol: Mathematical Analysis 2nd Edition; Narosa Publications (1973)

Unit-I

Basic Topology: Finite, Countable and Uncountable Sets, Metric Spaces, Compact Sets Perfect Sets, Connected Sets, Continuity: Limits of Functions, Continuous Functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotonic Functions, Infinite limits and Limits at Infinity.

(Text Book1; Chapter-2, All sections: Chapter-4, All sections)

Unit-II

Differentiation: The derivative of Real Function, Mean Value Theorems, The Continuity of Derivatives, L 'Hospital' s Rule, Derivatives of Higher Order Taylor's Theorem, Differentiation of Vector-Valued Functions. The Riemann-Stieltjes Integral: Definition and Existence of the Integral, Properties of the Integral.

(Text Book 1: Chapter-5; All sections; Chapter-6; sections 6.1 to 6.19)

Unit-III

The Riemann-Stieltjes Integral (Continued); Integration and Differentiation, Integration of Vector-Valued Functions,

(Text Book 1: Chapter-6; Sections 6.20 to 6.25;)

Functions of Bounded Variations and Rectifiable Curves.

(Text Book2; Chapter-6; Sections 6.1 to 6.12)

Reference:

1. R.G Bartle and D.R Sherbert; Introduction to Real Analysis; John Wiley Bros. 1982
2. L.M Graves; The Theory of functions of real variable; Tata McGraw-Hill Book Co.
3. M.H Porter and C.B Moraray; A first Course in Real Analysis; Springer Verlag UTM 1977.
4. S.C Sexena and S.M Shah: Introduction to Real Variable Theory, Intext Educational Publishers, San Francisco
5. S.R Ghopade and B.V Limaye; A Course in Calculus and Real Analysis, Springer.
6. N.L Carothers- Real Analysis Cambridge University Press.

MAT1C04: BASIC TOPOLOGY

Text: C. Wayne Patty, *Foundations of Topology*, Second Edition – Jones & Bartlett India Pvt. Ltd., New Delhi, 2012.

Unit – I

Topological Spaces: The Definition and Examples, Basis for a Topology, Closed Sets, Closures and Interiors of Sets, Metric spaces, Convergence, Continuous functions and Homeomorphisms.
[Chapter 1 Sections 1.2 to 1.7]

Unit – II

New spaces from old ones: Subspaces, The Product Topology on X x Y, The Product Topology, The Weak Topology and the Product Topology, The Uniform Metric, Quotient Spaces.
[Chapter 2 all sections]

Unit – III

Connectedness and Compactness: Connected spaces, Pathwise and local connectedness, Totally disconnected space, Compactness in metric spaces, Compact spaces,
[Chapter 3 all sections, Chapter 4 Sections 4.1 and 4.2]

References:

1. K. D. Joshi, *Introduction to General Topology*, New Age International (P) Ltd., Publishers.
2. Dugundji, *Topology*, Prentice Hall of India.
3. G. F. Simmons, *Introduction to Topology and Modern Analysis*, Mc Graw Hill.
4. S. Willard, *General Topology* , Addison Wesley Publishing Company.
5. J. R. Munkres, *Topology: A First Course*, Prentice Hall of India.
6. Murdeshwar M. G., *General Topology*, second edition, Wiley Eastern.
7. Kelley, *General Topology*, van Nostrand, Eastern Economy Edition.

MAT1C05: DIFFERENTIAL EQUATIONS

Text Book: G.F Simmons: Differential Equations with Historical Notes; Tata McGraw Hill.

Unit I

Power Series Solutions and Special Functions

Introduction. A Review of Power Series
Series Solutions of First Order Equations
Second Order Linear Equations. Ordinary Points
Regular Singular Points
Regular Singular Points (Continued)
Gauss's Hyper geometric Equation
The Point at Infinity
(Chapter-5; Sections 26 to 31)

Unit II

Legendre Functions, Bessel Functions and System of first order equations

Legendre Polynomials
Properties of Legendre Polynomials
Bessel Functions. The Gamma Function
Properties of Bessel functions
General Remarks on Systems
Linear Systems
Homogeneous Linear Systems with Constant Coefficients
Nonlinear Systems. Volterra's Prey-Predator Equations

(Chapter-8; Sections 44 to 47; Chapter-10; Sections 54 to 57)

Unit III

Non Linear Equations, The Existence and Uniqueness of Solutions

Autonomous Systems. The Phase Plane and Its Phenomena
Types of Critical Points. Stability
Critical Points and Stability for Linear Systems
Stability b y Liapunov's Direct Method
The Method of Successive Approximations 538
Picard's Theorem 543
Systems. The Second Order Linear Equation

(Chapter-11; Sections 58 to 61; Chapter-13; Sections 68 to 70)

Reference:

1. G.Birkoff and G.C Rota: Ordinary Differential Equations; Wiley and Sons; 3rd Edition (1978)
2. E.A Coddington; An Introduction to Ordinary Differential Equations; Prentice Hall of India, New Delhi (1974)
3. P.Hartmon; Ordinary Differential Equations; John Wiley and Sons
4. Chakraborti; Elements of Ordinary Differential Equations and Special Functions; Wiley Eastern Ltd New Delhi (1990)
5. L.S Poutrigardian: A Course in Ordinary Differential Equations; Hindustan Publishing Corporation Delhi (1967)
6. S.G Deo & V.Raghavendra; Ordinary Differential Equations and Stability Theory; Tata McGraw Hill New Delhi (1967)
7. V.I Arnold; Ordinary Differential Equations; MIT Press, Cambridge 1981.

MAT2C06: ADVANCED ABSTRACT ALGEBRA

Text Book: John. B. Fraleigh, A First Course in Abstract Algebra (7th Edition), Narosa (2003)

Unit I

Unique Factorization Domains, Euclidean Domains, Gaussian Integers and Multiplicative Norms, Introduction to Extension Fields (Chapter-9: Section - 45, 46, 47 and Chapter-6: Section - 29).

Unit II

Algebraic Extensions, Geometric Constructions, Finite Fields, Automorphisms of Fields. (Chapter-6: Section - 31, 32, 33 and Chapter-10 : Section- 48).

Unit III

The Isomorphism Extension Theorem, Splitting Fields, Separable Extensions. Galois Theory (Chapter-10: Section – 49, 50, 51, 53).

Reference:

1. I. N. Herstein: Topics in Algebra. Wiley India Pvt. Ltd, 2006
2. D. S. Malik, John. N. Merdson, M. K. Sen: Fundamentals of Abstract Algebra Mc Graw-hill Publishing Co., 1996
3. Clark, Allen: Elements of Abstract Algebra. Dover Publications, 1984
4. David M. Burton: A First course in Rings and Ideals. Addison-Wesley Educational Publishers Inc., 1970
5. Joseph. A. Gallian: Contemporary Abstract Algebra. Narosa, 1999

M. Artin: Algebra Addison Wesley; 2nd edition, 2010

MAT2C07: MEASURE AND INTEGRATION

Text Book; G de Barra, Measure Theory and Integration. New age International Publishers, New Delhi (First Edition, 1981)

Unit I

Measure on the real line; Lebesgue Outer measure, Measurable sets, Ragularity, Measurable Functions, Borel and Lebesgue Measurability (Including Theorem 17),
Integration of functions of a Real Variable; Integration of Non-negative Functions.

(Chapter-2; Section 2.1-2.5, Chapter-3-Section 3.1)

Unit II

Integration of functions of a Real Variable; The general Integral, Riemann and Lebesgue Integrals
Abstract Measure Space; Measures and Outer measures, extension of measure, Uniqueness of the extension.

(Chapter-3, Section 3.2 and 3.4; Chapter-5; Section 5.1 –5.3)

Unit III

Abstract Measure Spaces; Measure Spaces, Integration with respect to a Measure
Inequalities and the L^P Spaces; The L^P Spaces, The inequalities of Holder and Minkowski, Completeness of $L^P(\mu)$

(Chapter-5, Section 5.5 –5.6; Chapter-6-section 6.1, 6.4 and 6.5)

Reference:

1. Walter Rudin; Real and Complex Analysis; 3rd Edition, Tata McGraw Hill
2. P.R Halmos; Measure Theory; D.Van Nostrand Co.
3. A.E Taylor; General Theory of Functions and Integrations; Blaisadel Publishing Company, New York
4. Inder k Rana; An Introduction to Measure and Integration; Narosa Publishing House, New Delhi. 1997.
5. Royden H.L Real Analysis Macmillan & Co
6. N.L Carothers-Real Analysis Cambridge Press.

MAT2C08 : TOPOLOGY

Text: C. Wayne Patty, Foundations of Topology, Second Edition – Jones & Bartlett India Pvt. Ltd., New Delhi, 2012.

Unit – I

The Separation and Countability Axioms: T0, T1 & T2 spaces, Regular and completely regular spaces, Normal and completely normal spaces, The countability axioms, Urysohn's Lemma and Tietze Extension Theorem, Embeddings.
[Chapter 5 all sections]

Unit – II

Compactness: Local Compactness and the Relation Between Various Forms of Compactness, The weak topology on a topological space, Equicontinuity.
Special Topics: Compactifications, The Alexander Subbase and the Tychonoff Theorems.
Metrizability and Paracompactness: Urysohn's Metrization Theorem.
[Chapter 4 Sections 4.3 to 4.5; Chapter 6 Sections 6.6 and 6.7; Chapter 7 Section 7.1]

Unit – III

The Fundamental Group and Covering Spaces: Homotopy of paths, The Fundamental Group, The Fundamental Group of the Circle, Covering Spaces.
[Chapter 8 Sections 8.1 to 8.4]

References:

1. K. D. Joshi, Introduction to General Topology, New Age International (P) Ltd., Publishers.
2. Dugundji, Topology, Prentice Hall of India.
3. G. F. Simmons, Introduction to Topology and Modern Analysis, Mc Graw Hill.
4. S. Willard, General Topology , Addison Wesley Publishing Company.
5. J. R. Munkres, Topology: A First Course, Prentice Hall of India.
6. Murdeshwar M. G., General Topology, second edition, Wiley Eastern.
7. Kelley, General Topology, van Nostrand, Eastern Economy Edition.

MAT2C09: COMPLEX ANALYSIS

Text Book: John B Conway- Functions of One Complex Variable, 2nd Edition, Springer International Student Edition

Unit I

Analytic Functions

Complex Integration

Power Series representation of Analytic Functions
Zeroes of an analytic function
The index of a closed curve
Cauchy's Theorem and Integral Formula
The homotopic version of Cauchy's Theorem and simple connectivity
Counting zeros the Open Mapping Theorem
Goursat's Theorem

Chapter III Section 2
IV Section 2 to 8

Unit II

Singularities

Classification of singularities
Residues
The Argument Principle

The Maximum Modulus Theorem

The Maximum Principle
Schwarz's Lemna

Chapter V Sections 1,2,3
VI Sections 1,2

Unit III

Compactness and Convergence in the Space of Analytic Functions

The Spaces of continuous functions C(G, Ω)
Spaces of analytic functions
The Riemann Mapping Theorem
Weierstrass Factorization Theorem
Factorization of the sine function
The gamma function

Chapter VII Section 1 to 7 (except 3)

Reference:

1. Louis Pennise: Elements of Complex Variable Half, Richart & Winston 1976
2. Silverman.H: Complex Variable, Haughton Miffin Complex, Boston 1975.
3. Rudin.W: Real and Complex Analysis (3rd Edition) McGraw Hill International Edition 1967.
4. E.T Copson: An Introduction to the Theory of a Complex Variables, Oxford University Press 1974.
5. Lars V.Ahlfors-Complex Analysis (3rd Edition), Mc Graw-Hall international edition

MAT2C10: PARTIAL DIFFERENTIAL EQUATIONS AND INTEGRAL EQUATIONS

Text Book: 1. Amarnath M: Partial Differential Equations, Narosa, New Delhi(1997)
2. Hildebrand F.B: Methods of Applied Mathematics, (2nd Edition) Prentice- Hall of India, New Delhi(1972)

UNIT I

First Order P.D.E.

Curves and Surfaces, Genesis of first order Partial Differential Equations, Classification of integrals, Linear equations of first order, Pfaffian differential equations, Compatible systems, Charpit's method, Jacobi's method, Integral surfaces passing through a given curve, Quasi linear equations, Non-linear First order Partial Differential Equations
[Sections 1.1 – 1.11. from the Text 1]
Omit the Proof of Theorem 1.11.1

UNIT II

Second Order P.D.E.

Genesis of second order Partial Differential Equations.
Classification of second order Partial Differential Equations.
One dimensional Wave Equation.
Vibrations of an infinite String , Vibrations of semi-infinite String, Vibrations of a String of Finite Length, Riemann's Method, Vibrations of a String of Finite Length (Method of Separation of Variables).
Laplace's Equation.
Boundary Value Problems, Maximum and Minimum Principles, The Cauchy Problem, The Dirchlet Problem for the Upper Half Plane, The Neumann Problem for the Upper Half Plane, , Laplace's Equation - Green's Function, The Dirchlet Problem for a Half Plane , The Dirchlet Problem for a Circle .
Heat Conduction Problem.
Heat Conduction - Infinite Rod Case, Heat Conduction – Finite Rod Case,
[Sections 2.1 – 2.8. from the Text 1. Omit sections 2.4.5 to 2.4.13]

UNIT III

Integral Equations.

Introduction ,Relation Between differential and Integral Equation, The Green's Function, Frdholm Equation With Separable Kernels, Illustrative Examples, Hilbert Schmidt Theory, Iterative Methods for Solving Equations of the Second Kind, The Neumann Series , Fredholm Theory.
[Sections 3.1 – 3.3, 3.6 – 3.11 from the Text 2]

Reference:

1. E.A. Coddington : An Introduction to Ordinary Differential Equations
   Printice Hall of India ,New Delhi (1974)
2. F. John : Partial Differential Equations
   Narosa Pub. House New Delhi (1986)
3. Phoolan Prasad & Renuka Ravindran: Partial Differential Equations
   Wiley Eastern Ltd New Delhi (1985)
4. J.N Sharma and Kehar Sing, Partial Differential Equations for engineering scientists
   Narosa Pub. House New Delhi.

MAT3C11: NUMBER THEORY

Text Book:

1. Tom M Apostol: Introduction to Analytic Number Theory; Springer International Student Edtion
2. D.M Burton: Elementary Number Theory (6^{th} Edition) Mc Graw Hill
3. lan Stewart and David Tall: Algebraic Number Theory and Fermal's last theorem (Third Edition) A K Peters Natick Massachussets

Unit I

The Fundamental theorem of Arithmetic: Introduction-Divisibility-Greatest common divisor-prime numbers- The fundamental theorem of arithmetic-The series of reciprocals of primes-The Euclidean algorithm-The greatest common divisor of more than two numbers.
(Text 1, Sectons1.1-1.8)

Arithmetical Functions and Dirichlet multiplication: Introduction- The Mobius function $\mu(n)$ –The Euler totient function φ (n) –The relation connecting μ and φ -the product formula for φ (n) –The Dirichlet product of arithmetical functions- Dirichlet inverses and Mobius inversion formula- The Mangolt function $\Lambda(n)$ –Multiplicative functions- Multiplicative functions and Dirichlet multiplication- The inverse of a completely multiplicative function-Liouville's function $\lambda(n)$- The divisor function $\sigma_\alpha(n)$.

(Text 1, Section 2.1-2.13)

Congruences: Definition and basic properties of congruences- Residue classes and complete residue system- Liner Congruences-Reduced residue system and the Euler- Fermat theorem-Polynomial congruences modulo $_P$ and Langrange's theorem- Applications of Langrange's theorem- Simultaneous linear congruences and Chinese Remainder theorem- Applications of Chinese remainder theorem- Polynomial congruences with prime power moduli.

(Text 1, Section 5.1-5.9)

Unit II

Quadratic Residues and Quadratic Reciprocity Law: Quadratic residues- Legendre's symbol and its properties- Evaluation of $(-1|p)$ and $(2|p)$ Gauss lemma-The quadratic reciprocity law –Applications of the reciprocity law – The Jacobi symbol- Applications to Diophantine equations.

(Text 1, Sections 9.1 –9.8)

Primitive Roots: The exponent of number mod *m* and primitive roots- Primitive roots and reduced residu; system- The nonexistence of primitive roots mod 2a for $\alpha \geq 3$- The existence of primitive roots mod *p* for odd primes *p*- Primitive roots and quadratic residues – The existence of primitive roots and P^a- The existence of primitive roots mod 2 P^a –The nonexistence of Primitive roots in the remaining cases- The number of primitive roots mod *m*.

(Text 1, Sections 10.1-10.9)

Introduction to Cryptography; From Caesar Cipher to Public Key Cryptography-The Knapsack Crypto system- An application of primitive roots to Cryptography.

(Text 2, Sections 10.1-10.3)

Unit III

Algebraic Backgrounds: Symmetric polynomials- modules- free abelian groups
(Text 3, Section 1.4-1.6)

Algebraic Numbers: Algebraic numbers- Conjugates and Discriminants- Algebraic integers- Integral bases- Norms and Traces- Rings of integers.
(Text 3, Section 2.1-2.6)

Quadratic and Cyclotomic fields: Quadratic fields-Cyclotomic fields.

(Text 3, Sections 3.1-3.2)

Reference:

1. G.H Hardy and E.M Wright: An introduction to the theory of numbers, Oxford University Press.
2. I Niven, H.S Zuckerman, H.L Montgomery; An Introduction to the theory of numbers, Wiley India
3. Emil Grosswald: Introduction to number theory.
4. P.Samuel; Theory of Algebraic Numbers, Herman Paris Haughton Mifflin
5. S.Lang Algebraic Number Theory Addison Wesley Pub. Co Reading.

MAT3C12: FUNCTIONAL ANALYSIS

Text Book; Balmohan V Limaye; Functional Analysis (2^{nd} Edition); New Age International Publishers.

Unit I

Fundamentals of Normed Spaces; Normed Spaces, Banach spaces, Continuity of Linear Maps, Hahn-Banach Theorems.

(Chapter-2, Sections 5,6,7,8)

Unit II

Bounded Linear Maps on Banach Spaces; Uniform Boundedness Principle, Closed Graph and Open Mapping Theorems, Bounded Inverse Theorem

(Chapter-3, Section 9, 10, 11, Omit Quadrature Formula and Matrix Transformation and Summability Methods of Section 9)

Unit III

Geometry of Hilbert Spaces; Inner Product Spaces, Orthonormal Sets. Approximation and Optimization, Projection and Riesz Representation Theorems.

(Chapter-6, Section 21,22, 23, 24 (Omit 23.2, 23.6, 24.7, 24.8))

Reference:

1. E.Kreyszig; Introductory Functional Analysis with Applications, John Wiley
2. Walter Rudin; Functional Analysis, TMH Edtions 1978
3. M.T Nair; Functional Analysis A First Course; Prentice Hall of India.
4. Chaudhary and Sudarsan Nanda; Functional Analysis with Applications, Wiley Eastern Ltd.
5. Walter Rudin; Introduction to Real and Complex Analysis, McGraw Hill International Edition
6. J.B Conway; Functional Analysis, Narosa Publishing Company
7. Bachman and Narici; Functional Analysis

MAT3C13: COMPLEX FUNCTION THEORY

Text Book 1: Lars V.Ahlfors-Complex Analysis (3rd Edition), Mc Graw-Hall international edition

Text Book 2: John B Conway- Functions of One Complex Variable, 2nd Edition, Springer International Student Edition

Unit I

Elliptic Functions
- Simple periodic functions
- Doubly periodic functions

The Weierstrass Theory
- Chapter 7, Sections 1,2,3 of Text 1

The Riemann Zeta function
- Chapter 7, Sections 8 of Text 2

Unit II

Runge's Theorem
- Runge's Theorem
- Simple Connectedness
- Mittag Lefler's Theorem

Analytic Continuation and Riemann Surfaces
- Schwarz Reflection Principle
- Analytic Continuation along a path
- Mondromy Theorem
- (Chapter VIII, Section 1,2,3, of text 2
  IX Section 1,2,3 of text 2)

Unit III

Harmonic Functions
- Basic Properties of harmonic functions
- Harmonic functions on a disk
- Sub harmonic and super harmonic functions

Entire Functions
- Jensen's formula
- The genus and order of entire function
- Hadamard Factorization Theorem
- (Chapter X, Sections 1,2,3 of Text 2)
- (Chapter XI, Sections 1,2,3 of Text 2)

Reference:

1. Louis Pennise: Elements of Complex Variable Half, Richart & Winston 1976
2. Silverman.H: Complex Variable, Haughton Miffin Complex, Boston 1975.
3. Rudin.W: Real and Complex Analysis (3rd Edition) McGraw Hill International Edition 1967.
4. E.T Copson: An Introduction to the Theory of a Complex Variables, Oxford University Press 1974.

MAT3C14: ADVANCED REAL ANALYSIS

Text Book: Walter Rudin: Principles of Mathematical Analysis; (3rd Edition) Mc. Graw Hill, 1986.

Unit I

Sequence and series of Functions: Discussion of Main Problem, Uniform Convergence, Uniform Convergence Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Equicontinous Family of Functions, The Stone-Weierstrass Theorem,

(Chapter-7; Sections 7.1 to 7.33 and Theorem 7.33)

Unit II

Some Special Functions; Power Series, The Exponential and Logarithmic Functions, The Trigonometric Functions, The Algebraic Completeness of the Complex Field, Fourier Series. The Gamma Function

(Chapter-8: Sections 8.1 to 8.22)

Unit III

Functions of Several Variables: Liner Transformations, Differentiation The Contraction Principle, The Inverse Function Theorem, The Implicit Function Theorem,

(Chater-9; Sections 9.1 to 9.29)

Reference:

1. R.G Bartle and D.R Sherbert; Introduction to Real Analysis; John Wiley Bros. 1982
2. L.M Graves; The Theory of Functions of a Real Variable; Tata McGraw-Hill Book Co 1978
3. M.H Protter and C.B Moray; A First course in Real Analysis; Springer Verlag UTM 1977
4. T.M Apostol; Mathematical Analysis; 2nd Edition; Narosa Publications 1973.

MAT4C15: OPERATOR THEORY

Text Book: Balmohan V Limaye; Functional Analysis(2^{nd} Edition); New Age International Publishers

Unit I

Spectrum of a Bounded Operator-Spaces of Bounded Linear Functionals; Duals and Transposes Weak and Weak* Convergence

(Chapter-3 Section-12; Chapter-4 Sections 13; 13.1 to 13.6 and Sections 15; 15.1 to 15.4)

Unit II

Spaces of Bounded Linear Functionals; Reflexivity, Compact Operators on Normed Spaces: Compact Linear Maps, Spectrum of a Compact Operator.

(Chapter-4, Section 16; Chapter-5, Sections 17,18)

Unit III

Bounded Operators on Hilbert Spaces; Bounded Operators and Adjoints, Normal, Unitary and Self Adjoint Operators, Spectrum and Numerical Range, Compact Self Adjoint Operators.

(Chapter-7; Section 25, 26(omit 26.6) and 27and 28; 28.1 to 28.4 and 28.5 Statement only)

Reference:

1. E.Kreyszig; Introductory Functional Analysis with Applications, John Wiley
2. Walter Rudin; Functional Analysis, TMH Edtion 1978.
3. M.T Nair: Functional Analysis A First Course: Prentice Hall of India
4. Chaudhary and Sudarsan Nanda: Functional Analysis with Applications, Wiley Eastern Ltd.
5. Walter Rudin: Introduction to Real and Complex Analysis, McGraw Hill International Edition
6. J.B Conway: Functional Analysis, Narosa Publishing Company
7. Bachman and Narici; Functional Analysis.

MAT4C16: DIFFERENTIAL GEOMETRY

Text Book: John A Thorpe: Elementary Topics in Differential Geometry, Springer Verlag NY Heidelberg, Berlin

Unit I

Graphs and Levels Sets, Vector Fields, The Tangent Space, Surfaces, Vector fields on Surfaces, Orientation

(Chapter 1,2,3,4,5)

Unit II

The Gauss map, Geodesics, Parallel Transport, The Weingarten Map, Curvature of Plane Curves.

(Chapter 6,7,8,9,10)

Unit III

Are Length and Line Integrals, Curvature of Surfaces, Parameterized Surfaces, and Local Equivalence of Surfaces and Parameterized Surfaces.

(Chapter 11,12,14,15)

Reference:

1. W I Burko: Applied Differential Geometry, Cambridge University Press (1985)
2. M.De Carmo: Differential Geometry of Curves, Surfaces (Prentice Hall Inc. Englewood cliffs N.J (1976)
3. V. Grilleman and Pollack: Differential Topology, Prentice Hall, Inc Englewood cliffs N.J (1974)
4. Singer and J.A Thorp: Lecture notes on elementary Topology and Geometry CUTM Springer Verlag, New York (1967)
5. R. Millmen and Parker: Elements of Differential Geometry (Prenice Hall Inc. Englewood cliffs N.J (1977)
6. M Spivak: A Comprehensive Introduction to Differential Geometry, Vol 1 to 5, Perish Boston (1970-75)

MAT3E: Elective

Graph Theory (Elective)

Text 1 J.A Bondy and U.S Murty, Graph Theory with Applications, The MacMillan Press Ltd, 1976

Text 2 John Clark and Derek Allan Holtan, A First Look at Graph Theory, Allied Publishers, Ltd

Unit I

Independent Sets and Cliques; Independent Sets, Ramsey's Theorem, Turan's Theorem, Shur's Theorem

Vertex Colorings: Chromatic Number, Book's Theorem Hajo's Conjecture, Chromatic Polynomials, Girth and Chromatic Number.

(Chapter 7; Except Section 7.5, Chapter 8 Except Section 8.6, Text 1)

Unit II

Edge Colourings: Edge Chromatic Number, Vizing's Theorem, The Timetabling Problem

Planar Graphs; Plane and Planar Graphs, Dual Graphs, Euler's Formula Bridges, Kuratowski's Theorem. The Five Colour Theorem Non Hamiltonian Planar Graphs.

(Chapter 6, All sections; Chapter 9; Except section 9.8 of Text 1)

Unit III

Matchings: Matchings, Matchings and Coverings in bipartite Graphs, Perfect Matchings,The Personnel Assignment Problem, The Optimal Assignment Problem.
(Chapter 5, Sections 5.1, 5.2, 5.3, 5.4, 5.5 of text 1)

Networks; Flows and Cuts, Separating sets

(Chapter 8; Sections 8.1 & 8.3 of text 2

Reference:

1. F. Harraray, Graph Theory, Narosa Publishing House.
2. Narasingh Deo, Graph Theory with applications to Engineering and Computer Science, PHI.
3. O.Ore, Graph and Their uses, Random House Inc, NY (1963)
4. K.D Joshi, Foundations of Discrete Mathematics, Wiley Eastern Ltd.

MAT3E: Elective

PROBABILITY THEORY

Text Book: A.K. Basu: Measure and Probability, Prentice Hall of India 2003.

Unit I

Sets and Sequences of Sets, Sequence of Sets, Fields and σ- Fields, Monotone Class, Borel Sets in Real line, Fundamental Properties of Measure Different Example of Measure, Random Variables and Measurable Transformations, Discrete Sample Space, Combinatorial Aspects of Set Functions.

(Chapter-1; All sections; Chapter-2; Sections 1,2,3,4 and 5)

Unit II

Induced Measure and Distribution Function, Probability Generating Function and Discrete Convolution, Continuity Theorem for Additive Set Functions and Applications, Distribution Function (Univariate), Multivariate Distribution Function, Stieltjes Integral, Characteristic Functions, Moments and Applications, Inversion Theorem, Continuity Theorem and their Applications. Test for Characteristic Functions and Polya's Theorem, Necessary and Sufficient Condition for a Characteristic Function.

(Chapter-2, Sections 6,7 and 8; Chapter-3; Sections 1,2,3,4,5,6,7 and 8)

Unit III

Weak Convergence and Helly's Theorems Algebra of Measurable Functions, Almost Every Where Convergence, Convergence in Measure Definition and Properties of Integration and Expectation, Moments and Inequalities, Kolomogorov's Definition of Expectation.

(Chapter-3; Section 9, Chapter-4, Section 1,2 and 3; Chapter-5; Sections 1,2 and 3(Excluding Sub Section 5.3.2))

Reference:

1. B.R Bhat; Modern Probability Theory, 2nd Edition, Wiley Eastern, New Delhi.
2. A.N Kolmogrov; Foundations of Probability, Chelsea, NY (1950)
3. Loeve.M Probability Theory, Van-Nostrand, Princeton (1963)
4. Chows. Y.S and Tiecher H; Probability Theory, Springer Verlag (1988).

MAT4E: Elective

CALCULUS OF VARIATIONS

Text Book:I M. Gelfand and S.V Fomin; Calculus of Variations, Prentice Hall Inc, N.Y (1963)

Unit I

Elements of the Theory, Further Generalizations

(Chapter-1, all Sections ; Chapter-2 all Section)

Unit II

General Variations of a Functional, The Canonical Form of the Euler Equations and related topics

(Chapter-3 All sections; Chapter-4 All sections)

Unit III

The Second Variation, Sufficient condition for a Weak Extremum

(Chapter-5 All sections)

Reference:

1. Bliss G.A Calculus of Variations, Open Court Publishing Co. Chicago (1925)
2. Bolza O Lecture on Calculus of Variations, G.E Stinchar & Co. NY (1931)
3. Courant R and Hilbert D; Methods of Mathematical Physics, Vol. 1 Wiley Eastern Reprint (1975)
4. Elsgoltz I; Differential Equations and Calculus of Variations, Mr Publishers Moscow (1973)
5. Morse M. The Calculus of Variations, American Mathematical Society (1934)

. MAT4E: Elective

COMMUTATIVE ALGEBRA

Text Book: Atiyah M.F and Macdonald I.G; Introduction to communicative Algebra, Addison Wiley (1969)

Unit I

Rings and Ideals, Modules; Rings and Ring Homomorphism, Ideals, Quotient Rings, Zero Divisors, Nilpotent Elements, Unit, Prime Ideals and Maximal Ideals, Nilradical and Jocobson Redical, Operations on Ideals, Extension and Contraction, Modules and Module Homomorphism, Submodules and Quotient Modules, Operations on Submodules, Direct Sum and Product, Finitely Generated Modules, Exact Sequences.

(Chapter-1; All Sections; Chapter-2; Section 2.1 to 2.11)

Unit II

Rings and Modules of Fractions, Primary Decomposition: Local Properties, Extended and Contracted Ideals. Primary Decomposition.

(Chapter-3; All sections; Chapter-4; All Section)

Unit III

Integral dependence, Chain conditions, Noetherian Rings; Integral Dependence, The Going-Up Theorem, Integrally Closed Integral Domains. The Going-Down Theorem, Chain Conditions, Noetherian Rings.

(Chapter-5; All section, except 5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24; Chpater-6; All sections; Chapter-7; All sections, except 7.8, 7.9 and 7.10)

Reference:

1. N.Bourbaki: Commutative Algebra, Paris Herman (1961)
2. D.Burton; A first course introduction to Rings and Ideals, Wesley (1970)
3. N.S Gopalakrishnan; Commutative Algebra, Oxonian Press (1984)
4. T.W Hunger ford; Algebra, Springer Verlag (1974)
5. D.G North Cott; Ideal Theory, Cambridge University Press (1953)
6. O.Zarisiki and P. Samuel; Commutative Algebra, Vol I and II, Van Nostrand, Princeton (1960).

. MAT4E: Elective

FOURIER AND WAVELET ANALYSIS

Text Book: M.W. Frazier, An Introduction to Wavelets through Linear Algebra; Springer (1999)

Unit I

Construction of Wavelets on Z_n, The First Stage.
Construction of Wavelets on Z_n,The Iteration Step.
The Haar System, the Shannon wavelets and the Daubechies's D6 wavelets on Z_n.
(Chapter-3, Sections 3.1 , 3.2 and Examples 3.32, 3.33 and 3.35 of Section 3.3.)

Unit II

l^2 (Z), Complete Orthonormal sets in Hilbert Spaces l^2 (Z) and Fourier Series,
The Fourier transforms and convolution on l^2 (Z).
First Stage Wavelets on Z, The Iteration Step for Wavelets on Z.
(Chapter-4, Sections 4.1 to 4.6)

Unit III

L^2 (R) and Approximate Identities.
The Fourier Transform on R.
(Chapter-5, Section 5.1 to 5.2)

References:

1.G.Bachman, L.Narici, E. Beckenstein : Fourier and Wavelet Analysis, Springer (2000)
2. I.Daubechies : Ten Lectures on Wavelets, SIAM (1992)
3. C.Heil : A Basis Theory Primer, Birkhauser (2011)
4. D.F Walnut : An Introduction to Wavelet Analysis, Birkhauser (2002)

MAT4E: Elective

OPERATIONS RESEARCH

Text Book; Kanti Swarup, P.K Gupta, Man Mohan; Operations Research; Sultan Chand & Sons. New Delhi (2007)

Unit I

Markov Analysis, Decision Analysis, Simulation

(Chapter-15; All Sections; Chapter-16; All Sections; Chapter-22; Section 22.1 to 22.9)

Unit II

Reliability and System failure rates, Inventory Control

(Chapter-18; Section 18.6, Chpater-19; All Sections, expect 19.8 and 19.9)

Unit III

Information Theory (Chpater-30; Section 30.1 to 30.10)

Reference:

1. K.V Mittal; Optimization methods on Operations Research and System Analysis, New Age International (P) Ltd. New Delhi
2. J.K Sharma; Operations Research-Theory and Applications, Macmillan, New Delhi
3. R.K Gupta; Operations Research, Krishna Prakashan Mandir II, Shivaji Road, Meerat-2,
4. L.R Potti; Operations Research, Yamuna Publications, Sreekanteswaram, Thiruvananthapuram
5. Premkumar Gupta and D.S Hira; Operations Research, S.Chand & Company Ltd. Ram Nagar New Delhi 1995.
6. B.S Goel and S.K Mittal; Operations Research, Pragti Prakashan Meerat-2