SYLLABUS

M. Sc. MATHEMATICS

KUCBSS Scheme

KANNUR UNIVERSITY

2017 ADMISSION

KANNUR UNIVERSITY

M.SC DEGREE PROGRAMME IN MATHEMATICS (KUCBSS)

SCHEME AND SYLLABUS (2017 ADMISSION)

1. COURSE STRUCTURE:

Course Code	Course Title	Lecture Hours/ Week	Duration of Examination (Hours)	Credits	Marks

FIRST SEMESTER

MAT1C01	Basic Abstract Algebra	5	3	4	100
MAT1C02	Linear Algebra	5	3	4	100
MAT1C03	Real Analysis	5	3	4	100
MAT1C04	Basic Topology	5	3	4	100
MAT1C05	Differential Equations	5	3	4	100
			Total	20	500

SECOND SEMESTER

MAT2C06	Advanced Abstract Algebra	5	3	4	100
MAT2C 07	Measure and Integration	5	3	4	100
MAT2C08	Topology	5	3	4	100
MAT2C09	Complex Analysis	5	3	4	100
MAT2C10	Partial Differential Equations& integral equations	5	3	4	100
			Total	20	500

THIRD SEMESTER

MAT3C11	Number Theory	5	3	4	100
MAT3C12	Functional Analysis	5	3	4	100
MAT3C13	Complex Function Theory	5	3	4	100
MAT3C14	Advanced Real Analysis	5	3	4	100
MAT3E...	Elective-1	5	3	4	100
			Total	20	500

FOURTH SEMESTER

MAT4C15	Operator Theory	5	3	4	100
MAT4C16	Differential Geometry	5	3	4	100
MAT4E...	Elctive-2	5	3	4	100
MAT4D01	Project Work	10	-	4	100
MAT4V01	Viva-Voce	-	-	4	100
			Total	20	500

Total Marks: 2000

Total Credits: 80

Elective Course for Third Semester :

1. MAT3E01 Graph Theory
2. MAT3E02 Probability Theory
3. MAT3E03 Calculus of Variations

Elective Course for Fourth Semester :

1. MAT4E04 Commutative Algebra
2. MAT4E05 Fourier and Wavelet Analysis
3. MAT4E06 Operations Research

2. 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.

	Components	% of internal marks
i	Two test papers	40
ii	Assignments	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 Head of the Department.

- **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 **two** 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.

- **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 Condonation 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

3. END SEMESTER EVALUATION (ESE)

3.1 UNIVERSITY 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 4 marks.
- **Part B** will have **three units,** each unit consists of three questions from the respective three units of the syllabus. Four questions are to be answered from Part B without omitting any unit. Each question carries 16 marks.

3.2 Comprehensive Viva-Voce

A comprehensive viva-voce at the end of IV semester shall be conducted for each student to assess the overall mathematical ideas assimilated by the student during their post graduate programme. A team comprising of two teachers shall be appointed for conducting the viva-voce. The modus operandi of conducting viva-voce shall be decided by convening a meeting of Board of Examiners from time to time.

3.3 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 carried out under the guidance of a teacher at the institution concerned. The topic of the project work must be chosen from any area in Mathematics, which is not already covered in the syllabus prescribed for MSc Programme of Kannur University.

3.3.1 Arrangement of Contents in Project Dissertation

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:

3.3.2 Page Dimension and Typing Instructions

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 at least 40 pages.

3.3.3 A typical Specimen of Bonafide Certificate

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>

Certified 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 OF THE DEPARTMENT	SUPERVISOR
<<Academic Designation>>	<<Academic Designation>>
<<Department>>	<<Department>>
<<Seal with full address of the Dept.& college>>	<<Seal with full address>>

3.3.4 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 fulfilment of requirement for the award of Master of Science in Mathematics is a record of original work done by me under the supervision of Dr./Mr./Ms…….. of Department of Mathematics, …….. 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 *Signature of the student*

Date *Name and Reg. No.*

3.3.5 Evaluation of Project Work

The project work has to be evaluated by two external examiners, followings the guidelines given below:

Components of Evaluation of Project Work:

	Components	Weightage
i.	Content	1
ii.	Methodology	1
iii.	Presentation	2
	Viva-Voce	1

4. 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**.

5. SYLLABUS

First 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. 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.
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)*

References:

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, *excluding* Theorem 1.46 and Theorem 1.51]

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.

[Chapter 2: Sections 2.1 to 2.4]

Unit – III

Connectedness in metric spaces: Connected spaces, Pathwise and Local connectedness, Totally disconnected space,

[Chapter 3: Sections 3.1 to 3.3 *excluding* Theorem 3. 29 and Theorem 3.30]

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; Third Edition-CRC Press, Taylor and Francis Group.

Unit I

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 32)

Unit II

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.

(Chapter-8; Sections 44 to 47; Chapter-10; Sections 54 to 56)

Unit III

Oscillations and the Sturm Separation Theorem, The Sturm Comparison Theorem, The Method of Successive Approximations, Picard's Theorem, Systems. The Second Order Linear Equation

(Chapter-4; Sections 24 and 25; Chapter-13; Sections 68 to 70)

Reference:

1. G.Birkoff and G.C Rota: Ordinary Differential Equations; Wiley and Sons; (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

Second Semester

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).

References:

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.
6. 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 : ADVANCED TOPOLOGY

Text:

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

Unit –1

Compactness: Compactness in metric spaces, Compact spaces. Local compactness and the relation between various forms of compactness.

[Chapter 4: Sections 4.1 to 4.3 *excluding* Corollary 4.22]

Unit – Il

The Separation and Countability Axioms: T_0, T_1 & T_2 spaces, Regular and completely regular spaces, Normal and completely normal spaces, The countability axioms.

[Chapter 5: Sections 5.1 to 5.4 excluding Examples 3, 5 and 6 and Theorem 5.10. Also exclude *the proof that the Moore Plane is Completely Regular*.]

Unit – III

Urysohn's Lemma and Tietze Extension Theorem, Special Topics: Urysohn's Lemma and Tietze Extension Theorem, The Alexander Subbase and Tychonoff Theorems, Urysohn's Metrization Theorem, Homotopy of Paths.

[Chapter 5: Section 5.5, Chapter 6: Section 6.7 *excluding* Example 20; Chapter 7: Section 7.1; Chapter 8: Section 8.1]

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

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 IV Sections **2 to 8 . (2.1 to 3.6 proof omitted)**

Unit II

Singularities

Classification of singularities, Residues, The Argument Principle

The Maximum Modulus Theorem

The Maximum Principle, Schwarz's Lemma

Chapter V Sections **1 to 3** , **Chapter VI** Sections **1 and 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.

Chapter VII Section **1 to 2;** and **4 to 5**

References:

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.
5. Lars V.Ahlfors-Complex Analysis (3rd Edition), Mc Graw-Hall international edition.

MAT2C10: PARTIAL DIFFERENTIALEQUATIONS AND INTEGRAL EQUATIONS

Text Book:

1.*Amarnath M:* Partial Differential Equations, Narosa, New Delhi(1997)

2.*Hildebran F. B.:* Methods of Applied Mathematics (2ndEdition), 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.

[Sections 1.1 – 1.10. from the Text 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 Dirichlet Problem for the Upper Half Plane, The Neumann Problem for the Upper Half Plane.

Heat Conduction Problem: Heat Conduction - Infinite Rod Case, Heat Conduction – Finite Rod Case.

Duhamel's Principle: Wave Equation, Heat Conduction Equation.

[Sections 2.1 – 2.6. from the Text 1. *Omit* sections 2.4.6 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.

[Sections 3.1 – 3.3, 3.6 – 3.9 from the Text 2]

REFERENCES

1. E.A. Coddington : An Introduction to Ordinary Differential Equations , Prentice 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. R. Courant and D.Hilbert : Methods of Mathematical Physics , Vol I , Wiley Eastern Reprint (1975)
5. W.E. Boyce & R.C. Deprima : Elementary Differential Equations and Boundary Value Problems , John Wiley & Sons, NY, 9th Edition
6. Ian Sneddon : Elements of Partial Differential Equations, McGraw-Hill International Edn., (1957)

Third Semester

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. *Ian Stewart and David Tall:* Algebraic Number Theory and Fermat's last theorem (Third Edition) A K Peters Natick Massachusetts

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)

References:

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 (Third Edition); New Age International Publishers.

Unit I

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

(Chapter-2, Sections 5, 6, 7 and 8 [***omitting*** Banach Limits from Section 7])

Unit II

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

(Chapter-3, Sections 9, 10 and 11, ***Omitting*** Divergence of Fourier Series of Continuous Functions, 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, Sections 21, 22, 23 and 24 [*Omit* 23.2, 23.6 from section 23 and Weak Convergence and Weak Boundedness from Section 24]

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-Hill Education

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.

(Chapter X, Sections 1,2,3 ; Chapter XI, Sections 1 of Text 2)

References:

Louis Pennise: Elements of Complex Variable, Holt, Rinehart and Winston; 2nd edition (July 1976)

Silverman: Complex Variable, Haughton Miffin Boston 1975.

Rudin.W: Real and Complex Analysis (3rd Edition) McGraw Hill International Edition 1967.

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, Equicontinuous 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.

Electives (Third Semester)

MAT3E01 Graph Theory

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.

MAT3E02: Elective PROBABILITY THEORY

Text Book: B.R Bhat: Modern Probability Theory (2nd Edition.); New Age international PVT. Ltd.New Delhi 1999)

Unit I

Sets and Classes of Events, Random Variables, Probability Spaces
(Chapter -1: Sections 1.1 to 1.4; Chapter -2: Sections 2.1 to 2.3; Chapter -3: Sections 3.1 to 3.5)

Unit II

Distribution Functions, Expectation and Moments, Convergence of Random Variables
(Chapter- 4: Sections 4.1 to 4.4; Chapter -5: Sections 5.1 to 5.3; Chapter -6: Sections 6.1 to 6.6)

Unit III

Characteristic Functions, Convergence of Distribution Functions.
(Chapter -7: Sections 7.1 to 7.5, Chapter -8: Sections 8.1 to 8.3)

References:

1. P. Billingsley: Probability and Measure, John Wiley & Sons NY (1979)
2. K.I Chung : Elementary Probability Theory with Stochastic Process Narosa Publishing House New Delhi (1980)
3. W. Feller : An Introduction to Probability Theory and its Applications Vol 1 & 2, John Wiley & Sons NY (1968, 1971)
4. E. Parzen : Modern Probability Theory and its Applications, Wiley Eastern Ltd, New Delhi (1972)
5. H.G Tucker: A Graduate Course in Probability, Academic Press NY (1967)

MAT3E03: 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)

Fourth Semester

MAT4C15: OPERATOR THEORY

Text Book: Balmohan V Limaye; Functional Analysis (Third 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 16.1 to 16.7 [*Omitting* Theorem 16.3]; 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(*omitting* Fourier Plancherel Transform) and 27; Section 28: 28.1 to 28.5 (*Proof of 28.5 is omitted)*

References:

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

Arc 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)

Electives (Fourth Semester)

MAT4E04: 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)

References:

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).

MAT4E05: 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)

MAT4E06: 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)

References:

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

Pattern of University Question Paper

…….. **SEMESTER M.Sc DEGREE EXAMINATION**
MAT……: …….

Time: Three Hours Maximum : 80 Marks

Part A

Answer **four** *questions from this part.*
Each question carries **4** *marks.*

1. …
2. …
3. …
4. …
5. ….
6. …

Part B

Answer **four** *questions from this part without omitting any Unit.*
Each question carries **16** *marks.*

UNIT I

7. (*a*) …
   (*b*) …
8. *(a)* …
   (*b*) …
9. (*a*) …
   (*b*) …

UNIT II

10. (*a*) …
    (*b*) …
11. (*a*) …
    (*b*) …
12. (a) …
    (b) …

UNIT III

13. (a) …
    (b) …
14. (a) …
    (b) …
15. (a) …
    (b) …