DEPARTMENT OF MATHEMATICS: **ACHARYA NAGARJUNA UNIVERSITY**

Titles of the papers for M.Sc., mathematics, from the batch admitted during 2011-12

I SEMESTER

M 101 – ALGEBRA (New)
M 102 - ANALYSIS - 1
M 103 - DIFFERENTIAL EQUATIONS
M 104 - TOPOLOGY
M 105 – ADVANCED DISCRETE MATHEMATICS

II SEMESTER

M 201 - GALOIS THEORY
M 202 - ANALYSIS - II
M 203 - MEASURE AND INTEGRATION
M 204 - COMPUTER ORIENTED AND NUMERICAL METHODS
M 205 - GRAPH THEORY
M 206 – DISCRETE MATHEMATICS (Non-Core)

III SEMESTER

M 301 - RINGS AND MODULES

M 302 - COMPLEX ANALYSIS

M 303 - FUNCTIONAL ANALYSIS

M-304 (A) - FUZZYSETS AND THEIR APPLICATIONS

M 304 (B) - SEMI GROUPS
M 304 (C) – NUMBER THEORY
M 305 - LINEAR PROGRAMMING
M306 - MATHEMATICAL METHODS (Non-Core)

IV SEMESTER

M 401 - NON-COMMUTATIVE RINGS

M 402 – PARTIAL DIFFERENTIAL EQUATIONS

M 403 - NEAR-RINGS

M 404(A) – ALGEBRAIC CODING THEORY
M-404 (B)-LATTICE THEORY
M 404 C - OPERATOR THEORY

M 405 (B) - OPERATIONS REASEARCH

DEPARTMENT OF MATHEMATICS M 101 (NR)
ACHARVA NAGARJUNA UNIVERSITY

M.Sc., Maths, I Year, I Semester

SYLLABUS (w.e.f. Batch 2011-2013)

(With effect from the batch of students admitted during 2011-2012)

M 101: ALGEBRA

Unit-I:

Group theory: Definition of a Group - Some Examples of Groups - Some Preliminary Lemmas - Subgroups - A Counting Principle - Normal Subgroups and Quotient Groups - Homomorphisms - Automorphisms - Cayley's theorem - Permutation groups.
(2.1 to 2.10 of the prescribed book [1])

Unit-II

Group Theory Continued: Another counting principle - Sylow's theorem – direct products - finite abelian groups (2.11 to 2.14 of the prescribed book [1])

Unit-III

Ring Theory: Definitions and Examples of Rings - some special classes of rings - Homomorphisms - Ideals and quotient Rings - More Ideals and quotient Rings - The field of quotients of an Integral domain - Euclidean rings - A particular Euclidean ring.
(3.1 to 3.8 of the prescribed book [l])

Unit-IV

Ring Theory Continued: Polynomial Rings - Polynomials over the rational field - Polynomial Rings over Commutative Rings (3.9 to 3.11 of the Prescribed book [l]). Vector Spaces: Elementary Basic Concepts - Linear Independence and Bases - Dual spaces (4.1 to 4.3 of the prescribed book [1]).

PRESCRIBED BOOK: |1| Author: I.N. Herstein, Title: Topics in Algebra. Wiley Eastern Limited. New Delhi, 1988.

REFERENCE BOOK: Bhattacharya P.B., Jain S.K., Nagpaul S.R. "Basic Abstract Algebra", Cambridge Press, Second Edition.

M 102-ANALYSIS-I

UNIT-I

Continuity: Limits of functions, continuous functions, Continuity and Compactness, continuity and connectedness. Discontinuities, Monotone functions, Infinite limitsand limits at infinity(4.1 to 4.34 of chapter 4)

UNIT-II

Differentiation: Derivative of a 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. (5.1to 5.19 of chapter5)

UNIT-III

Riemann Stieltjes Integral: Definition and Existence of the Integral , Properties of the Integral , Integration and diffentiation, Integration of vector valued functions. Rectifiable curves. (6.1 to 6.27 of chapter 6)

UNIT-IV

Sequences and series of functions: Discussion of main problem, Uniform convergence, Uniform convergence and Continuity, Uniform convergence and Integration, Uniform Convergence and Differentiation. (7.1 to 7.18 of chapter7)

TEXT BOOK:

Principles of Mathematical analysis by Walter Rudin 3 rd edition.

M 103 (NR) :: DIFFERENTIAL EQUATIONS
(with effect from the batch of students admitted during 2014-2015)

UNIT-I

Linear equations of the first order: Linear equations of the first order – The equation $y^1+ay = 0$ – The equation $y^1 + ay =$ b(x) - The general linear equation of the first order. (Chapter 1 of Coddington).

Linear Equations with constant co-efficients: Introduction - The second order. homogeneous equation – Initial value problems for the second order equations – Linear dependence and independence – A formula for the Wronskian – The non-homogeneous equation of order two – The homogeneous equation of order n – Initial value problems for n-th order equations. (Sections 1 to 8 in Chapter 2 of Coddington).

UNIT – II

Linear Equations with Variable Co-efficients: Introduction – Initial value problems for the homogeneous equation – Solutions of the homogeneous equation – The Wronskian and linear independence – Reduction of the order of a homogeneous equation – The non-homogeneous equation – Homogeneous equations with analytic coefficients. (Sections 1 to 7 in Chapter 3 of Coddington).

UNIT – III

Linear Equations with Regular Singular Points: Introduction – The Euler equation – Second ordre equations with regular singular points –Second order equations with regular singular points – A convergence proof - The exceptional cases – The Bessel equation. (Sections 1 to 7 in Chapter 4 of Coddington).

UNIT- IV

Existence and Uniqueness of Solutions to First Order Equations: Introduction – Equation with variables separated – Exact equations – The method of successive approximations – The Lipschitz condition – Convergence of the successive approximations – Non-local existence of soltutions.(Sections 1 to 7 in Chapter 5 of Coddington).

Book : An introduction to Ordinary Differential Equations by Earl A. Coddington, Prentice-hall of Indial Private Limited, NEW DELHI, 1974.

M103 – DEFFERENTIAL EQUATIONS (OR)
(Continued upto 2014-15, 2015-16, 2016-17)

UNIT-I

Second order linear equations: Introduction, The general solution of the homogeneous equation, The use of a known solution to find another, The homogeneous equation with constant coefficients ,The method of undetermined coefficients, The method of variation of parameters. (Sections 14 to 19 of Chapter 3)

UNIT-II

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. (Sections 25 to 30 of Chapter 5)

UNIT-III

Some special functions of Mathematical Physics: Legendre polynomials, Bessels functions, The Gamma function, Properties of Bessel functions , Linear systems, Homogeneous linear systems with constant coefficients. (Sections 32 to 35chapter 6 & Sections 37 and 38 of chapter 7)

UNIT-IV

Laplace Transforms: Introduction, a few remarks on theory Applications to differential equations, Derivatives and integrals of laplace transforms, Convolutions, The method of successive approximations, Picards theorem. (Sections 50 to 54 of chapter 10 & Sections 55 and 56 of chapter11)

TEXT BOOK:

"Differential equations" with applications and Historical Notes by G.F. Simmons. Published by Tata Mc Graw Hill 25th reprint 2001.

M 104 – TOPOLOGY

UNIT-I

Metric Spaces: Definition and some examples, Open sets, Closed sets, Covergence, completencess and Baire's theorem, Continuous mappings. (Sections 9 to 13 of chapter 2)

UNIT-II

Topological spaces : The Definition and some examples , Elementary Concepts, Open bases and open subbases, Weak topologies. (Sections 16 to 19 of chapter 3)

UNIT-III

Compactness: Compact spaces, Products of spaces, Tychonoff's theorem and locally compact spaces, Compactness for metric spaces, Ascolli's theorem. (Sections 21 to 25 of chapter 4)

UNIT-IV

Separation: T_1 –spaces and Hausdorff spaces , Completely regular spaces, and normal spaces,Urysohn'sLemma and the Tietze extension theorem,The Urysohn imbedding theorem, Connected spaces, The components of a space (Sections 26 to 29 of chapter 5 and sections 31 and 32 of chapter6)

TEXT BOOK:

Introduction to Topology and Modern Analysis by G.F. Simmons , Mc. Graw Hill Book Company , New York International student edition.

M 105 – ADVANCED DISCRETE MATHEMATICS.
(With effect from 2017-19 admitted batch)

UNIT –I

Propositional Calculus: Statements and Notations-Connectives and Truth Tables-Tautology and Contradiction-Equivalence of Statements/Formulas-Duality Law and Tautological Implication-Normal Forms-The Theory of Inference for Statement Calculus-Consistency of Premises and Indirect Method of Proof.(Chapter-1 of the reference [3]).

Predicate Calculus:Predicate Logic-Statement Functions,Variables and Quantifiers-Free and Bound Variable-Inference Theory for the Predicate Calculus.(Chapter-2 of the reference [3]).

UNIT –II

Finite machines : Introduction , state tables and diagrams, simple properties ,Dynamics and behavior (refer Chapter 5 of the reference book[1])

UNIT – III

Properties and Examples of lattices, Distributive lattices , Boolean polynomials. (Sections 1 to 4 of Chapter 1 of [2]).

UNIT –IV

Ideals , filters and equations, Minimal forms of Boolean polynomials ,application of lattices applications of switching circuits.(Sections 5,6 of Chapter -1 and Sections 7 and 8 of Chapter -2 of [2]).

Note: For units –III and IV, the material of pages 1 to 66 of [2] is to be covered)

Reference Books:

[1] James L Fisher "Application oriented Algebra" IEP, Dun-Downplay pub.1977.
[2] R.Lidl and G. Pilz "Applied abstract algebra" (Second edit) UTM springer, 1998.

[3]Bhavanari Satyanarayana,Tumurukota Venkata Pradeep Kumar and Shaik Mohnddin Shaw,"Mathematical Foundation of Computer Science" BS Publications(A unit of BSP Books Pvt Ltd), Hyderabad, India,2016.(ISBN:978-93-83635-81-8).

[4] Rm. Somasundaram "Discrete Mathematical Structures" Prentice Hall of India, 2003

[5] Bhavanari Satyanarayana& Kuncham Syam Prasad,"Discrete Mathematics and Graph theory"(For B.Tech/M.Tech/B.Sc./M.Sc.(Maths)),Printice Hall of India,New Delhi,April 2014(ISBN: 978-81-203-4948-3)

M 105 – ADVANCED DISCRETE MATHEMATICS.
(Continued upto 2017-18, 2018-19, 2019-20)

UNIT –I

Logic : Computer Representation of Sets, Mathematical inductor Matrices, Logic, Tautology , Normal Forms, Logical Inferences , Predicate Logic, Universal Quantifiers, Rules of Inference (reference Chapter 1 of the reference book[3])

UNIT –II

Finite machines : Introduction , state tables and diagrams, simple properties ,Dynamics and behavior (refer Chapter 5 of the reference book[1])

UNIT – III

Properties and Examples of lattices, Distributive lattices , Boolean polynomials. (Sections 1 to 4 of Chapter 1 of [2]).

UNIT –IV

Ideals , filters and equations, Minimal forms of Boolean polynomials ,application of lattices applications of switching circuits.(Sections 5,6 of Chapter -1 and Sections 7 and 8 of Chapter -2 of [2]).

Note: For units –III and IV, the material of pages 1 to 66 of [2] is to be covered)

Reference Books:

[1] James L Fisher "Application oriented Algebra" IEP, Dun-Downplay pub.1977.
[2] R.Lidl and G. Pilz "Applied abstract algebra" (Second edit) UTM springer, 1998.
[3] Rm. Somasundaram "Discrete Mathematical Structures" Prentice Hall of India, 2003

SEMESTER – II

M201-GALOIS THEORY

UNIT-I

Algebraic extensions of fields; Irreducible polynomials and Eisenstein's criterion Adjunction of roots. Algebraic extensions.Algebraically closed fields. (Chapter15 of the orescribed text book)

UNIT-II

Normal and separable extensions; Splitting fields, Normal extensions, multiple roots, Finite fields, Separable extensions
(Chapter16of the prescribed text book)

UNIT-III

Galois Theory : Automorphism groups and fixed fields. Fundamental theorem of Galois theory , Fundamental theorem of Algebra (Chapter 17 of the prescribed
text book)

UNIT-IV

Applications of Galois theory to classical problems: Roots of unity and cyclotomic polynomials, Cyclic extensions, Polynomials solvable by radicals,
Symmetric (Chapter 18 of the prescribed text book)

TEXT BOOK:

Basic Abstract Algebra , by P.B.Bhattacharya, S.K. Jain and S.R. Nagpaul, Second Edition Published by Cambridge University Press, 2001.

M 202 –ANALYSIS-II

UNIT-I

Equicontinuous family of functions, Weierstrass theorem and stone's generalization, power series (7.19 to 7.33 of Chapter 7& 8.1 to 8.5 of Chapter8)

UNIT-II

Exponential & logarithmic functions, Trigonometric functions , Linear Transformations , Differentiation ,Contraction principle .(8.6, 8.7 of Chapter8
And 9.1 to 9.23 of Chapter 9)

UNIT-III

Inverse function theorem, Implicit function theorem, determinants, derivatives of higher order and differentiation of integrals.
(9.24 to 9.29 and 9.33 to 9.43 of Chapter 9)

UNIT-IV

Integration of differential forms: Integration, Primitive mappings, partitions of unity change of variables, differential forms (10.1 to 10.25 of Chapter10).

TEXT BOOK:

Principles of Mathematical Analysis by Water Rudin, Third Edition.

M 203- MEASURE AND INTEGRATION
From the batch of students admitted during 2017-2018.

UNIT-I

Lebesgue Measure: Introduction, outer measure, Measurable sets and Lebesgue measure, A nonmeasurable sets, Measurable functions, Littlewoods's three principles **(Chapter 3)**

UNIT-II

The Lebesgue integral: The Riemann Integral, The Lebesgue integral of a Bounded function over a set of finite measure, the integral of a non- negative function. The general Lebesgue Integral, Convergence in measure. **(Chapter 4)**

UNIT-III

Differentiation and Integration: Differentiation of monotone functions, functions of bounded variation, differentiation of an integral, absolute continuity, Convex functions**.(Chapter 5)**

UNIT-IV

The Classical Banach Spaces: The L^P spaces, The Minkowski and Holder inequalities, convergence and completeness, Approximation in L^P, Bounded linear functional on the L^P spaces. **(Chapter 6)**

TEXT BOOK:

Real Analysis by H.L. Royden.

M 203- MEASURE AND INTEGRATION
(Continued upto 2017-18, 2018-19, 2019-2020)

UNIT-I

Lebesgue Measure: Introduction, outer measure , Measurable sets and Lebesgue measure, A nonmeasurable sets, Measurable functions , Littlewoods's three principles (Chapter 3)

UNIT-II

The Lebesgue integral: The Riemann Integral, The Lebesgue integral of a Bounded function over a set of finite measure, the integral of a non- negative function. The general Lebesgue Integral, Differentiation of monotone functions, functions of bounded variation, differentiation of an integral, absolute continuity.
(4.1 to 4.4 of Chapter 4 & 5.1 to 5.4 of Chapter 5).

UNIT-III

Measure and Integration: Measure spaces, Measurable functions, Integration, General Convergence theorems, Signed Measures, The Radon- Nikodym theorem. (11.1 to 11.6 of Chapter 11)

UNIT-IV

Measure and outer measure: Outer Measure and Measurability, The Extension theorem, product measures (12.1, 12.2 & 12.4 of Chapter12).

TEXT BOOK:
Real Analysis by H.L. Royden.

PAPER - M.204: COMPUTER ORIENTED NUMERICAL METHODS (NR)

(With effect from the batch of students admitted during 2014-2015)

M 204 (NR)

UNIT-I

C Programming

C Charcter set, Identifiers and key words, declaration statement date types, variables and constants, structure of C program.
(1.4, 1.5, 1.6, 1.7, 1.11 &1.12 of Ajay Mittal).
Expressions, simple expressions and compound expressions, classification of operations.
(2.2, 2.3 &2.4 of Ajay Mittal).
Statements, classification of statements.
(3.2& 3.3 of Ajay Mittal)
Single dimensional arrays, Multidimensional arrays
(4.3 & 4.6.1 of Ajay Mittal)
Functions, classification of functions
(5.2 &5.3 of Ajay Mittal)

UNIT-II

Interpolation and Approximation: Introduction, Lagrange and Newton Interpolations, Finite difference Operators, Interpolating polynomials using finite differences, Hermite interpolations.
(Section 4.1 to 4.5 of [2]).

UNIT-III

Numerical Differentiation and Integration: Introduction, Numerical Integration, Methods based on interpolation, Methods based On Undetermined Coefficients, Composite Integration Methods
(Sections 5.1, 5.6, 5.7, 5.8 &5.9 of [2])

UNIT – IV

Ordinary Differential Equations: Introduction Numerical methods, Single step Methods, Multi step methods
(Sections 6.1 to 6.4 of [2]).

TEXT BOOKS:

[1] C Programming A Practical approach by Ajay Mittal, Pearson Edition
[2] Numerical Methods for Scientific and Engineering Computation by M.K.Jain, S.R.K. Iyangar and R.K. Jain, Third edition, New Age International (p) Limited, New Delhi ,1997.

COMPUTER ORIENTED NUMERICAL METHODS

M.204 (OR)

(W.e.f.batch2011-2013) **M.2.4 (OR)**

(Continued upto 2014-15, 2015-16, 2016-17)

UNIT – I

C – Basics

C – Character set
Data types
Variables
Constants
Expressions
Structure of C program
Operators and their precedence and Associatively
Basic input and output statements
Control structures
Simple programs in c using all the operators and control structures

Functions

Concept of a function
Parameters and how they are passed
Automatic Variables
Recursion
Scope and extent of variables
Writing programs using recursive and non – recursive functions

(1.4,1.7,1.11,1.12 of Chapter 1, 2.2,2.3,2.4 of Chapter 2 , 3.1,3.2,3.3 of Chapter 3 & 5.1, 5.2,5.3 of Chapter 5 of [1])

UNIT – II

Arrays and Strings

Single and multidimensional Arrays
Character array as a string
Functions on strings, Writing C Programs using arrays and for string manipulation.

Pointers

Pointers declarations
Pointers expressions
Pointers as parameters to functions
Pointers and Arrays
Pointer arithmetic

Structures & Unions

Declaring and using structures
Operations on structures
Arrays of structures
User defined data types
Pointers to Structures

Files
Introduction
File structure
File handling functions
File types
File error handling
C programming examples for using files
(4.1 to 4.6 of Chapter 4, 6.1 to 6.8 of Chapter 6 , Chapter 9 & Chapter 10 of [1])

UNIT-III

Interpolation and Approximation: Lagrange and Newton Interpolations,
Finite difference Operators, Interpolating polynomials using finite differences, Hermite interpolations.

(Section 4.1 to 4.5 of [2]).

UNIT-IV

Numerical Differentiation and Integration: Methods based on interpolation, Methods based On Undetermined Coefficients, Composite Integration Methods,
Ordinary Differential Equations: Introduction, Difference Equations,
Numerical Methods, Single step Methods.
(Sections 5.7, 5.8, 5.9 of [2]) & (Sections 6.1 to 6.4 of [2]).

TEXT BOOKS:

[1] C Programming A Practical approach
By Ajay Mittal, Publishers – Pearson Edition.
[2] Numerical Methods for Scientific and Engineering Computation
by
M.K.Jain S.R.K. Iyangar and R.K. Jain, Third edition,
New Age International (p) Limited, New Delhi, 1997.

M 205- GRAPH THEORY

UNIT-I

Paths and circuits: Isomorphism, Subgraphs , a puzzle with multi colored cubes. walks , Paths and Circuits, connected graphs , Disconnected graphs, Components, Euler graphs , Operations on graphs, More on Euler graphs ,Hamiltonian paths and circuits, Travelling – Salesman Problem (Chapter 2 of the reference book).

UNIT-II

Trees and Fundamental Circuits: Trees , some properties of trees , pendant Vertices in a tree, distances and centers in a tree, rooted and binary trees, on Counting trees, spanning trees, fundamental circuits, finding all spanning trees of a graph , spanning trees in a weighted Graphs. (Chapter 3 of the reference book.)

UNIT-III

Cut sets and Cut –vertices: Cut sets, All cut sets in a graph , Fundamental circuits and cut sets, connectivity and separability, network flows, one-isomorphism, two- isomorphism's. (Chapter 4 of the reference book.)

UNIT-IV

Planar and dual graphs: Combinatorial Vs Geometric graphs , Planer graphs, Kuratowski's two graphs , Different representations of a planar graph , Detection of planarity, Geometric dual .[Sections 1 to 6 of Chapter 5)

Vector spaces of a graph: Sets with one operation , Sets with two operations, Modular arithmetic and Galois field, Vectors and Vector spaces, Vector space associated with a graph , Basis vectors of graph . (Sections 1 to 6 of Chapter 6)

TEXT BOOK:

Narsingh Deo "Graph theory with applications to Engineering and Computer Science," Prentice Hall of India Pvt., New Delhi, 1993.

Non-core Paper-I
Second Semester M 206
M. 2.6 DISCRETE MATHEMATICS

Unit –I

Mathematical Logic: Statements-Truth value of a Statement- Truth Tables –Conditional and Bi-conditional Statements-Propositional Functions-Tautologies and contradictions-Arguments.

Unit-II

Sets and Relations : Sets-Operations on Sets-Cartesian product of sets-Binary operations –Binary relations-Properties of relations on a set-Equivalence relations.

Unit-III

Partially ordered sets-Hasse diagrams-Minimal and maximal elements in a poset-Least and greatest elements-upper bounds and least upper bound-Lower bounds and greatest lower bound.

Unit-IV

Graph Theory: Introduction-Subgrphs-Puzzle with multi colored cubes-walk, paths and circuits-connected Graphs-Euler Graphs-Operations on Graphs.

Prescribed Book: Satyanarayana and Syam Prasad, Discrete Mathematics and Graph Theory, Prentice Hall of India, 2009.

Books for Reference:

1. M.K.Gupta - Discrete Mathematics, Krishna Prakashan Media(P) Ltd., Meerut, 2011.
2. N. Deo – Graph theory with applications to Engineering and Computer Science, Prentice Hall of India, 1987.
3. P.C.Biswal, Discrete Mathematics and Graph Theory, Prentice Hall of India, 2005.

SEMESTER-III
M 301 –RINGS AND MODULES

UNIT-I

Rings and related algebraic systems, subrings, homomorphisms, ideals. (Sections1.1,1.2 of chapter -1)

UNIT-II

Modules, direct products and directsums, classical isomorphism theorems. (Sections 1.3,1.4 of chapter-1)

UNIT-III

Prime ideals in commutative rings , prime ideals in special commutative rings. (Sections 2.1,2.2 of Chapter 2)

UNIT-IV

The complete ring of quotients of a commutative ring, Ring of quotients of Commutative semi prime rings , prime ideal spaces. (Sections 2.3,2.4,2.5 of Chapter2)

TEXT BOOK:

J.Lambek "Lectures on rings and modules" A Blasidell Book in Pure and Applied Mathematics.

M.Sc. MATHEMATICS, III Semester, Paper – II, (Paper Code: M. 302 (NR)
(With effect from the batch of students admitted during 2014-2015)
M-302- COMPLEX ANALYSIS - (NR)

UNIT-I

Sums and products, basic algebraic properties, further properties, vectors and moduli, complex conjugates, exponential form, products and powers in exponential form, arguments of products and quotients - Roots of complex numbers- examples - Regions in the complex plane.

(Sections 1 to 11 of Text Book) (Questions not to be given in Sections 1 to 11)

Functions of complex variable, mappings, mappings by the exponential function, limits, Theorems on limits – limits involving the point at infinity continuity, derivatives, Differentiation formulas - Cauchy-Riemann equations, sufficient conditions for differentiability, polar co-ordinates. Analytic functions, Harmonic functions,Uniquely determined Analytical functions,Reflection principle.

(Sections 12 to 28 of Text Book)

UNIT-II

The exponential function, the logarithmic functions, branches and derivatives of logarithms, contours, contour integrals, Some examples – Examples with branch cuts - upper bounds for moduli of contour integrals, anti-derivatives, Proof of the theorem (45), Cauchy-Goursat theorem,proof of the theorem(47), simply connected domains, multiply connected domains.Cauchy integral formula, An extension of the Cauchy integral formula – Some consequences of the extension.

(Sections 29 to 31 & 39 to 52 of Text Book)

UNIT-III

Liouvelli's theorem and the fundamental theorem of Algebra, maximum modulus principle.Convergence of sequences, convergence of series, Taylor series, Laurent series, absolute and uniform convergence of power series, continuity of sums of power series, integration and differentiation of power series, uniqueness of series representations,

(**Sections 53—66 of text book)**

UNIT-IV

Isolated singular points , Residues, Cauchy residue theorem, Residue at infinity -The three types of isolated singular points, Residues at poles , Examples,zeros of analytic functions, zeros and poles, behavior of a function near isolated singular points.Evaluation of improper integrals, Example – Improper integrals from Fourier analysis , Jordan's Lemma , definite integrals involving Sines and Cosines, Argument Principle, Rouche's Theorem.

(Sections 68 to 81 and 85 to 87 of text book)

Text Book:

Complex Variables and Applications , James Ward Brown, Ruel V. Churchill, Mc Graw Hill, Eighth Edition, 2009.

Reference Books:

Complex Variables, H. Silvermen
Complex Variables by H.S.Kasana,Prentice Hall of India
Complex Variables by Murrey Rspiegel, Scheam's Outline series.

M-302- COMPLEX ANALYSIS (Paper M.302(OR)
(Continued upto 2014-15, 2015-16, 2016-17)

UNIT-I

The Field of Complex Numbers, Complex planes representation and roots of Complex numbers ,Lines and Half lines in the Complex plane, The extended plane and it's spherical representation, power series, Analytic functions and Moboius transformations. (Chapters I and III).

UNIT-II

Power series representation of Analytic functions, zeros of analytic Functions , 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. (Chapter IV)

UNIT-III

Classification of Singularities Residues, The Argument Principle. (Chapter –V)

UNIT-IV

The Maximum Principle, Schwartz Lemma, Convex function and Hadamard's three circle Theorem pharagman-Lindeloff theorem, Weierstrass factorization Theorem. (Chapter VI and Chapter VII).

TEXT BOOK:

Functions of one Complex Variable, john B. Conway, Second Edition, Springer, International student edition , Narosa publishing House.

M 303 – FUNCTIONAL ANALYSIS

UNIT-I

Review of properties of Metric spaces (Chapter-1) Normed spaces Examples, Basic properties-Finite dimensional normed spaces- compactness and finite Dimensions. (2.1 to 2.5 of Chapter 2)

UNIT-II

Linear operators –Bounded Linear functional Finite dimensional case – Duality Banach's fixed point theorem – Applications to linear equations and differential Equations (2.6 to 2.10 of Chapter 2 and 5.1 to 5.3 of Chapter5)

UNIT-III

Hann Banach theorem – Applications to bounded linear functonals of C [a, b] Adjoint reflexivity –(4.1 to 4.6 of Chapter 4)

UNIT- IV

Uniform boundedness principles – Convergence of sequences of operators and functionals – open mapping theorem – closed graph theorem (Sections 4.7,4.8,4.9,4.12 and 4.13 of Chapter 4).

TEXT BOOK:

Introductory Functional analysis with applications by Erwin Kryszing, John Willy and sons.

M 304 (A) - FUZZYSETS AND THEIR APPLICATIONS

UNIT-1

From Classical (Crisp) sets to fuzzy sets:- Introduction - Crispsets: An overview - Fuzzyset: Basic types - Fuzzy sets. Basic Concepts - Characteristics and significance of the paradign shift (CH-1 of (l)). Fuzzysets versus Crisp sets - Additional Properties of a-cuts-Representations of Fuzzysets - Extension principle for Fuzzysets (CH-2 of (l)).

UNIT – II

Operations on Fuzzysets - Types of Operations - Fuzzy Compliments - Fuzzy Inter sections: t-norms - Fuzzy unions: t-Conorms - Combinations of operations -Agreegation Operations (CH-3 of (l)).

UNIT- III

Fuzzy Arithmetic - Fuzzy Numbers - Linguistic Variables - Arithmetic Operations on Intervals - Arithmetic Operations on Fuzzy numbers - Lattice of fuzzy numbers -Fuzzy equations (CH-4 of (l)).

UNIT-IV

Fuzzy Relations - Crisp versus fuzzy relations - Projections and Cylindric Extensions - Binary Fuzzy Relations - Binary Relations and Singleset - Fuzzy Equivalence Relations - Binary Relations on a single set - Fuzzy Equivalence Relations - Fuzzy Compatibility Relations - Fuzzy Ordering Relations - Fuzzy Morphisoms - Sup-Compositions of Fuzzy Relations - Inf- ω i Compositions of fuzzy Relations, (CH-5 of (I)).

TEXTBOOK:

G.J.KLIR & BOYUAN "Fuzzy sets and Fuzzy Logic, Theory and Applications" Prentice - Hall of India Pvt. Ltd., New Delhi., 2001.

M 304 (B) – SEMI GROUPS

UNIT – I

Basic definitions – Homogenic Semigroups – Ordered sets – Semi lattices and lattices – Binary relations – Equivalences – Congruences.

UNIT – II

Free Semi groups – Ideals and – Rees Congruences, Lattices of equivalences and congruences – Green's equivalences. The structure of D.Classes – regular Semigroups.

UNIT - III

Simple and Q – Simple semi groups , Principle factors, Rees's Theorem, Primitive idempotents.

UNIT –IV

Congruences on completely O – Simple semi groups. The Lattice of Congruences on a completely O – Simple Semi groups. Finite Congruences, free semi groups.

TEXT BOOKS:

An Introduction to Semi group Theory by J.M. Howie (1976), Academic Press,
(Content of the Syllabus, Chapter – I, II and III)

M 304(C) - NUMBER THEORY

UNIT-1: ARITHMETICAL FUNCTIONS AND DIRICHLET MULTIPLICATION

Introduction, The Mobius function u(n), The Euler totient function φ(n), A relation connecting φ and μ. A product formula for φ (n),The Dirichlet product of arithmetical functions, Dirichlet inverses and Mobius Inversions formula. The Mangoldt function π(n), Multiplicative functions. Multiplicative functions and Dirichlet multiplication, The inverse of a completely multiplicative function, Liouville's function (n), The divisor function (n). Generalised convolutions.

UNIT-11: AVERAGES OF ARITHMETICAL FUNCTIONS

Introduction, The big oh notation Asymptotic equality of functions, Euler's summation formula, some elementary asymptotic formulas, the average order of d(n), the average order of divisor functions (n), the average order of φ(n), An application to the distribution of lattice points visible from the origin. The average order of μ(n) and π(n), The partial sums of a Dirichlet product, Applications to μ(n) and π(n), Another identity for the partial sums of a Dirichlet product.

UNIT-III: SOME ELEMENTARY THEOREMS ON THE DISTRIBUTION OF PRIME NUMBERS

Introduction, Chebyshev's functions Ψ(x)and v(x). Relations connecting Ψ (x)and v(x), some equivalent forms of the prime number theorem, Inequlities of π(n) and Pn Shapiro's Tauberian theorem. Application of Shapiro's theorem. An asymptotic formulae for the partial sums $\sum_{p \le x} (1/p)$

UN1T-1V: CONGRUENCES

Definition and basic properties of congruences. Residue classes and complete residue **systems.** Linear congruences. Reduced residue systems and Euler - Format theorem, Polynomial congruences modulo p, Lagrange's theorem. Simultaneous linear congruences, the Chinese remainder theorem. Applications of the Chinese remainder theorem. Polynomial congruences with prime power moduli.

Sections: 2.2 to 2.14 3.1 to 3.12 4.1 to 4.9 5.1 to 5.9

TEXTBOOK:

Introduction to analytic number theory - by Tom M-Apostol, Narosa Publishing House, New Delhi.

M 305 LINEAR PROGRAMMING

UNIT – I

Mathematical Back ground : Lines and hyper planes: Convex sets, convex sets and Hyper planes , convex cones. [Sections 2.19 to 2.22 of Chapter 2of [1]].

Theory of the simplex method : restatement of the problem, slack and surplus Variables , reduction of any feasible solution to a basic feasible solution , some definitions and notations ,improving a basic feasible solution, unbounded solutions, optimality conditions alternative optima , Extreme points and basic feasible solutions. [Sections 3.1,3.2,3.4 to 3.10 of Chapter 3 of [1]]

UNIT –II

Detailed development and Computational aspects of the simplex method, The Simplex method , selection of the vector to enter the basis ,degeneracy and breaking ties further development of the transportation formulas , the initial basic feasible solution –artificial variables, Tableau format for simplex computations ,use of the tableau format, conversion of a minimization problem to a maximization problem,Review of the simplex method , illustrative examples. [Sections 4.1 to 4.5 ,4.7 to 4.11 of Chapter 4 of [1]].

UNIT –III

Transportation problems: Introduction ,properties of the matrix A: the simplex Method and transportation problems , simplifications resulting from all Yijαβ = ± 1or0, Stone algorithm, determination of an initial basic feasible solution, alternative procedure for computing z ij –c ij; duality. [Sections 9.1 to 9.7 ;9.10 to 9.11 of Chapter 9of [1]].

UNIT –IV

The assignment problem : Introduction ;description and mathematical statement of the problem ;Solution using the Hungarian method ;the relationship between transportation and assignment problems; further treatment of the assignment problem ;the bottle neck assignment problem. [Sections 6.1 to6.6 of Chapter-6of [2]

TEXT BOOK:

[1] G.Hadley “Linear Programming” Addison-Wesley Publishing Company.

[2] Benjamin Lev and Howard J.Weiss “Introduction to Mathematical Programming” Edward Arnold Pub, London, 1982.

Non-core paper-2
Third Semester M. 306
Mathematical Methods M. 3.6

Unit-I

The Laplace Transform: Piece wise continuity-Functions of exponential order-function of class A-The transform concept-Laplace transform-Some standard results.

Unit-II

The Inverse Laplace Transform: Definition-Uniqueness of inverse Laplace Transform-Partial Fractions-Heaviside's expansion formula-The complex inversion formula-Simple applications to Differential equations.

Unit-III

The Fourier Transform: The Infinite Fourier Transform-The finite Fourier Transform.

Unit-IV

Groups-Subgroups-Normal subgroup-Homomorphisms (Definitions, simple results, examples only).

Prescribed BooKs:

1. A.R.Vasistha, Modern Algebra, Krishna Prakashan, Meerut
2. Vasistha and Gupta - Integral Transforms, Krishna Prakashan, Meerut, 2000.

Books for References:

1. J.K.Goyal and K.P.Gupta - Laplace and Fourier Transforms, Pragati Prakashan, Meerut, 2003.
2. I.N.Herstien, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1988.

SEMESTER- IV
M 401 – NON COMMUTATIVE RINGS

UNIT -I

Primitive Rings, radicals completely reducible modules. [Sections 3.1,3.2 ,3.3 of Chapter 3]

UNIT – II

Completely reducible rings, Artinian and Noetherian rings, on lifting idempotents, local and semi perfect rings. [Sections 3.4, 3.5, 3.6, 3.7 of Chapter 3]

UNIT – III

Projective modules , Injective modules , the complete ring of quotients, rings of endomorphism's of injective modules.[Sections 4.1,4.2,4.3,4.4of Chapter 4]

UNIT –IV

Tensor products of modules, Hom and functors exact sequences. [Sections 5.1,5.2,5.3 of Chapter 5]

TEXT BOOK:

J. Lambek "Lectures on Rings and Modules" A Blasidell book in Pure and Applied Mathematics.

M 402 – PARTIAL DIFFERENTIAL EQUATIONS

UNIT-I

First Order Partial Differential equations. Curver and Surfaces, Genesis of first order partial differential equations, Classification of integrals, linear equations of the first order, Partial Differential equations. Compatible systems. Charpit's method. Differntial equations. Integral surfaces through a given curve. (Sections 1.1 to 1.9 of Chapter 1 of [1]).

UNIT-II

Second order Partial differential Equations. Genesis of Second Order Partial Differential Equations. Classification of Second Order Partial differential equations. One Dimensional Waves equations. Vibrations of an infinite string.Vibrations of a semi infinite string. Vibrations of a string of Finite Length , Riemann's Method vibratons of a string of finite length (method of separation of variables.)
(Sections 2.1 to 2.3.5 of Chapter 2 of [1]).

UNIT-III

Laplaces Equations . Boundary value problems and minimum principles, The Cauchy problem. The Dirichlet problem for the upper Half plane. The Neumann problem for the upper Half plane, the Dirichlet Interior problem for a circle. The dirichlet exterior problem for a circle. The Dirichlet problem for a Rectangle Harnacks Theorem.(Sections 2.4.1 to 2.4.10 of Chapter 2 if [1]).

UNIT-IV

Laplaces Equation – Green's Function. The Dirichlet problem for a Half plane.The Dirichlet problem for a circle, Heat conduction- infinite rod case, Heat conduction –Finite rod case, Duhamel's principle , Wave equation,Heat conduction equation. (Sections 2.4.11 to 2.4.13 , 2.5.1,2.5.2,2.6.1,2.6.2 of Chapter 2 or [1]).

TEXT BOOK: An Elementary course in Partial Differential Equations by T. Amaranath , Published by Narosa Publishing House.

M 403 (NR)

PAPER - M 403 : NEAR-RINGS M 403(NR)
(With effect from the batch of students admitted during 2013-2014)

UNIT-I

The Elementary Theory of Near-Rings.

(a) Fundamental definitions and properties
   1. Near-rings.
   2. N-groups.
   3. Substructures,
   4. Homomorphisms and Ideal-like concepts
   5. Annihilators
   6. Generated objects. .

(b) Constructions:
   1. Products, direct sums and subdirect products.

(c) Embeddings
   1. Embedding in M (Γ)

UNIT-II

Ideal Theory:

(a) Sums
   1. Sums and direct sums
   2. Distributive sums.

(b) Chain conditions

(c) Decomposition theorems

(d) Prime ideals
   1. Products of subsets
   2. Prime ideals
   3. Semi prime ideals

(e) Nil and nilpotent.

UNIT-III

Structure Theory:
Elements of the structure theory

a) Types of N-groups
b) Change of the near-ring
c) Modularity
d) Quasi-regularity
e) Idempotents

UNIT-IV

Primitive Near-Rings

a) General.
   1. Definitions and elementary results
   2. The centralizer
   3. Independence and density

b) 0-Primitive near-rings

c) 1-Primitive near-rings
d) 2-Primitive near-rings
    1. 2-Primitive near-rings
    2. 2-primitive near-rings with identity.

Prescribed Book:

Near-Rings, The Theory and its Applications by Gunter Pilz, North-Holland Publishing Company, AMSTERDAM, Revised Edition 1983.

NEAR-RINGS M 403(OR)
(Continued upto 2014-15, 2015-16 and 2016-17)

M 403 (OR)

UNIT-I

The Elementary Theory of Near-Rings.

(a) Fundamental definitions and properties: Near-rings, N-groups, Substructures, Homomorphisms and Ideal-like concepts, Annihilators,' Generated objects. .

(b) Constructions: (1) Products, Directsums & Subdirect products.

(c) Embeddings: (l) Embedding in M (Γ) (2) More beds.

UNIT-II

Ideal Theory

(a) Sums: (1) Sums and direct sums (2) Distributive sums.

(b) Chain conditions

(c) Decomposition theorems

(d) Prime ideals (1) Products of subsets (2) Prime ideals (3) Semi prime ideals

(e) Nil and nil potent.

UNIT-III

Structure Theory

Elements of the structure theory

(a) Types of N-groups

(b) Change of the near-ring

(c) Modularity

(d) Quasi-regularity

(e) Idempotents

(f) More on Minimality.

UNIT-IV

Primitive Near-Rings

(a) General (I) Definitions and elementary results (2) The centralizer (3) Independence and density

(b) 0-Primitive near-rings

(c) 1-Primitive near-rings

(d) 2-Primitive near-rings

(1) 2-Primitive near-rings

(2) 2-primitive near-rings with identity.

Radical Theory: (a) Jacobson-type radicals: Common Theory,

(I) Definitions and Characterizations of radicals (2) Radicals of related near-rings

(3) Semi simplicity.

TEXT BOOK: Near-Rings, The Theory and its Applications by Gunter Pilz, Revised Edition 1983, North-Holland Publishing Company, AMSTERDAM.

M 404(A) – ALGEBRAIC CODING THEORY

UNIT –I

Introduction to Coding Theory: Introduction, Basic assumptions correcting and Detecting error patterns, Information Rate , The Effects of error Correction and Detection, finding the most likely codeword transmitted some basic algebra, Weight and Distance , Maximum likelihood decoding Reliability of MLD , error detecting Codes, error – correcting Codes. (Chapter 1)

UNIT – II

Linear Codes : Linear Codes , Two important subspaces , Independence, Basis, Dimension, Matrices, Bases for C= <S> and C , Generating Matrices and Encoding , Parity – Check Matrices, Equivalent Codes, Distance of a Linear Code , Cosets, MLD for Linear Codes, Reliability of IMLD for Linear Codes. (Chapter 2)

UNIT – III

Perfect and Related Codes: Some bounds for Code , Perfect Codes , Hamming Codes , Extended Codes , The extended Golay Code , Decoding of the extended Golay Code , the Golay code , Reed – Mullar Codes, Fast decoding for RM (1,m). (Chapter 3)

UNIT –IV

Cyclic Linear Codes : Polynomials and Words , Introduction to Cyclic codes, Polynomials encoding and decoding , Finding Cyclic Codes, Dual Cyclic Codes. (Chapter 4)

TEXT BOOK:

CODING THEORY BY D.G. Hoffman, D.A Lanonard , C.C. Lindner, K. T.Phelps, C. A. Rodger, J.R.Wall.

M -404(B) – LATICE THEORY

UNIT –I

Partially, ordered sets – Diagrams –Special subsets of a partially ordered set Length Lower and upper bounds – The Jordan –Dedekind chain condition –Dimension functions.

UNIT – II

Algebras – Lattices – The Lattices theoretical duality principle – Semi lattices – Lattices as partially ordered sets –Diagrams of lattices –Sub lattices –Ideals –Bounded elements of a lattice – atoms and dual atoms Complements ,relative complements , semi-complements –Irreducible and prime elements of a lattice- The homeomorphisms of a Lattice –Axiom systems of Lattices.

UNIT – III

Complete Lattices – Complete sub lattices of a complete lattice – Cardinality of a complete lattice – Compact elements and compactly generated Lattices – sub algebras Lattice of an algebra – Closure operations – Galois connections Dedekind cuts – partially ordered sets as topological spaces.

UNIT – IV

Distributive lattices –Infinitely distributive and completely distributive Lattices, Modular Lattices – Characterization of modular and distributive Lattices by their sub lattices-distributive sub-lattices of modular Lattices-the isomorphism theorem of modular Lattices-Covering conditions-Meet representation in modular and
distributive Lattices-Boolean algebras and DeMorgan Formulae-Complete Boolean algebras – Boolean algebras and Boolean rings.

TEXT BOOK:

Introduction to Lattice Theory, Gabor Szasz, academic press. Contents: Topics 1 to 36 and 42, 43 and 44 of the text book.

M 404 C – OPERATOR THEORY

UNIT –I

Hilbert Spaces, Othogonality Total orthonormal sets, Legendre, Hermite and Laguerres polynomials – Representation of functionals on Hilbert Spaces. (Sections: 3.1 to 3.9 of Chapter 3)

UNIT – II

Spectral theory in finite dimensional normed spaces, properties of resolvent and Spectrum. (Sections :7.1 to 7.4 of Chapter -7)

UNIT –III

Resolvent and spectrum of an element in Banach algebras, Compact linear operations on Normed spaces and their properties. (Sections: 7.6 to 7.7 of Chapter 7 and Sections 8.1 ,8.2 & 8.3 of Chapter -8)

UNIT –IV

Spectral properties of Compact linear operations on normed spaces, Fredholm type Operators, Fredholm alternative. (Sections: 8.4 to 8.7 of Chapter -8)

TEXT BOOK:

INTRODUCTORY FUNCTIONAL ANALYSIS WITH APPLICATIONS: Erwin Kreyszig, John Wiley & Sons.

M 405 (B) – OPERATIONS RESEARCH

UNIT –I

Further Discussion of the simplex method: Further discussion ; the two phase Method for artificial variables ; phase-I; Phase-II; Numerical examples of the two phase method. [Sections 5.1 to 5.4 of Chapter -5 of [1]]

UNIT –II

Duality theory and its Ramifications: Alternative formulations of linear programming problems; Dual linear programming problems ;Fundamental properties of dual problems; other formulations of dual problems; unbounded solution in the primal; the dual simplex algorithm –an example. Post optimality problems, changing the price vector, changing the requirements vector, adding variables or constraints
[Sections 8.1 to 8.7;8.10 of Chapter 8 and 11.2 to 11.5 Chapter 11 of [1]).

UNIT –III

The Revised simplex method: Introduction ;Revised simplex method-standard form I; computational procedure for standard form I; Revised simplex method- Standard form II; computational procedure for standard form II; Initial identity matrix for phase –I ; comparison of the simplex method and Revised simplex method.
[Sections 7.1 to 7.6 ;7.8 of Chapter 7 of[1]).

UNIT –IV

Game theory: Game theory and Linear programming ;Introduction ;reduction of a game to a linear programming problem; conversion of a linear programming problem to a game problem.

Integer programming: Introduction; Gomory's cut, Balas Implicit Enumeration technique. Goal programming [Sections 11.2 to 11.14 of Chapter 11 of [1] and Sections 7.1,7.2and 7.4 of Chapter 7 and Section 10.3 ofChapter10 of[2]).

TEXT BOOKS:

[1] G.Hadley " Linear programming" Addison Wesley Publishing Company.
[2] Benjamin Lev and Howard J. Weiss " Introduction to Mathematical Programming" Edward Arnold Pub, London, 1982.

Model Question Paper

M.Sc. DEGREE EXAMINATION

Second Semester

Mathematics

Paper III- MEASURE AND INTEGRATION

(w.e.f the batches admitted during 2017-18 onwards)

Time :Three hours Maximum:70 marks

Answer any SEVEN bits in question No.1 compulsory.
Answer ONE question from each unit
All questions carry equal marks.

1. (a) Define outer measure of a set
(b)Write Littlewood's three principles
(c) State Bounded convergence theorem
(d)If f is integrable over E then so is $|f|$.
(e)State Vitali lemma
(f)Define convex function
(g)Define norm of a function in L^P spaces
(h)State Riesz-Fischer theorem

UNIT I

2. Prove that the outer measure of an interval is its length.

Or

3. (a) Show that the interval (a,∞) is measurable.
(b) State and prove Egoroff's Theorem

UNIT II

4. (a) State and prove bounded convergence theorem.
(b) Let f be a nonnegative function which is integrable over a set E, then prove that given $\varepsilon > 0$ there is a $\delta > 0$ such that for every set $A \subset E$ with $m(A) < \delta$ we have $\int_A f < \varepsilon$.

Or

5. Let f and g be integrable over E.Then :
i.The function cf is integrable over E, and $\int_E cf = c\int_E f$
ii. The function f+g is integrable over E, and $\int_E f + g = \int_E f + \int_E g$
iii.If $f \le g$ a.e., then $\int_E f \le \int_E g$

UNIT III

6. State and prove Vitali lemma

Or

7.(a) Define function of bounded variation. If f is bounded variation on [a, b], then prove that $T_a^b = P_a^b + N_a^b$ and $f(b) - f(a) = P_a^b - N_a^b$.
(b) Prove that if f is absolutely continuous on [a, b] and $f'(x) = 0$ a.e. then prove that f is constant.

UNIT IV

8.(a) Prove that $||f+g||_1 \leq ||f||_1 + ||g||_1$

(b) State and prove Holder inequality

Or

9. State and prove Riesz Representation Theorem.