ANNAMALAI UNIVERSITY
FACULTY OF SCIENCE
DEPARTMENT OF MATHEMATICS
M.Sc. MATHEMATICS
(CHOICE BASED CREDIT SYSTEM)
(2014 – 2015)
Regulations

MASTER'S PROGRAMME

A Master's Programme consists of a set of Core Courses and Optional Courses.

Core courses are basic courses required for each programme. The number and distribution of credits for core courses will be decided by the respective faculties.

Optional courses will be suggested by the respective Departments, and they may be distributed in all four semesters.

A course is divided into five units to enable the students to achieve modular and progressive learning.

SEMESTERS

An academic year is divided into two semesters, Odd semester and Even semester. The normal semester periods are:

Odd Semester: July to November (90 Working days)
Even Semester: December to April (90 Working days)

CREDITS

The term credit is used to describe the quantum of syllabus for various programmes in terms and hours of study. It indicates differential weightage given according to the contents and duration of the courses in the curriculum design.

The minimum credit requirement for a two year Master's Programme shall be 90.

The core courses shall carry 71 credits and the optional courses shall carry 19 credits.

COURSES

Each course may consist of lectures / tutorials / laboratory work / seminar / project work / practical training / report / viva voce etc.

COURSE WEIGHT

Core and optional courses may carry different weights. For example, a course carrying one credit for lectures, will have instruction of one period per week during the semester, if three hours of lecture is necessary in each week for that course then 3 credits will be the weightage. Thus normally, in each of the courses, credits will be assigned on the basis of the lectures / tutorials / laboratory work and other form of learning in a 15 week schedule:

i. One credit for each lecture period per week.
ii. One credit for each tutorial period per week.
iii. One credit for every three periods of laboratory or practical work per week.
iv. One credit for 3 contact hours of project work in a week.
v. One credit for every two periods of seminar.

GRADING SYSTEM

The term Grading System indicates a 10 point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class.

DURATION

The duration for completion of a two year Master's Programme in any subject is four semesters.

STRUCTURE OF THE PROGRAMME

The Master's Programme will consist of:

(i) Core courses which are compulsory for all students.
(ii) Optional courses which students can choose from amongst the courses offered by the other Department of a faculty as well as by the Departments of other faculties (Arts, Science, Education and Indian Language).
(iii) The optional subjects will be allotted by counseling by a committee of the respective Heads of the Departments under the Chairmanship of the Dean of the Faculty.
(iv) Dissertation / Project work / Practical training / Field work, which can be done in an organization (Government, Industry, Firm, Public Enterprise etc.) approved by the concerned Department.

ATTENDANCE

Every teaching faculty handling a course shall be responsible for the maintenance of attendance register for candidates who have registered for the course.

The teacher of the course must intimate the Head of the Department at least Seven Calendar days before the last instruction day in the semester about the attendance particulars of all students.

Each student should earn 80% attendance in the courses of the particular semester failing which he or she will not be permitted to sit for the end-semester examination.

However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 80% attendance for valid reasons on payment of a condonation fee and such exemptions should not under any circumstance be granted for attendance below 70%.

EXAMINATIONS

The internal assessment for each course carries 25% marks and is based on two sessional tests and a variety of assessment tools such as seminar and assignment. The pattern of question paper will be decided by the respective faculty. The tests are compulsory.

There will be one End Semester Examination (75% marks) of 3 hours duration for each course. The pattern of question paper will be decided by the respective faculty.

EVALUATION

The performance of a student in each course is evaluated in terms of Percentage of Marks (PM) with a provision for conversion to Grade Point (GP). The sum total performance in each semester will be rated by GPA while the continuous performance from the 2nd Semester onwards will be marked by (OGPA).

MARKS AND GRADING

A student cannot repeat the assessment of Sessional Test I and Sessional Test II. However, if for any compulsive reason, the student could not attend the test, the prerogative of arranging a special test lies with the teacher in consultation with the Head of the Department.

A student has to secure 50% minimum in the End Semester Examination.

The student who has not secured a minimum of 50% of marks (sessional plus end semester examination) in a paper shall be deemed to have failed in that paper.

A candidate who has secured a minimum of 50% of marks in all the papers prescribed in the programme and earned a minimum of 90 credits will be considered to have passed the Master's Programme.

GRADING

A ten point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme.

Marks	Grade point	Letter grade	Class
90 +	10	S	Exemplary
85-89	9.0	D++	Distinction
80-84	8.5	D+	Distinction
75-79	8.0	D	Distinction
70-74	7.5	A++	First Class
65-69	7.0	A+	First Class
60-64	6.5	A	First Class
55-59	6.0	B	Second Class
50-54	5.5	C	Second Class
49 or Less	-	F	Fail

The successful candidates are classified as follows:

I Class - 60% Marks and above in overall percentage of Marks (OPM).

II Class - 50-59% Marks in overall percentage of marks.

Candidates who obtain 75% and above but below 90% of marks (OPM) shall be deemed to have passed the examination in FIRST CLASS (Distinction) provided he / she passes all the papers prescribed for the programme at the first appearance.

For the Internal Assessment Evaluation, the break up marks shall be as follows:

Test (Two)	- 15 Marks
Assignment	- 5 Marks
Case Study/Seminar/Viva Voce	- 5 Marks
Total	- 25 Marks

For the Internal Assessment Evaluation for the Practical papers, the break up marks shall be as follows:

Test (Two)	- 30 Marks
Record	- 10 Marks
Total	- 40 Marks

COURSE-WISE LETTER GRADES

The percentage of marks obtained by a candidate in a course will be indicated in a letter grade.

A student is considered to have completed a course successfully and earned the credits if he / she secures an overall letter grade other than F. A letter grade F in any course implies a failure in that course. A course successfully completed cannot be repeated for the purpose of improving the Grade point.

The F grade once awarded says in the grade card of the student and is not deleted even when he / she completes the course successfully later. The grade acquired later by the student will be indicated in the grade sheet of the odd / even semester in which the candidate has appeared for clearance of the arrears.

A student who secures F grade in any course which is listed as a core course has to repeat it compulsorily when the examination is held next. If it is an optional course, the student has the option to repeat it when it is offered next or to choose a new optional if he / she so desires in order to get a successful grade. When new optional is chosen in the place of failed optional, the failed optional will be indicated as dropped in the subsequent grade card.

If a student secures F grade in the Project Work / Field Work / Practical Work / Dissertation, he / she shall improve it and resubmit it if it involves only rewriting incorporating the clarifications of the evaluators or he / she can re-register and carry out the same in the subsequent semesters for evaluation.

M.Sc. MATHEMATICS
(Choice Based Credit System)
Revised Scheme of Examinations and Syllabus
(For the Student admitted During the Year 2014 – 2015)

I Semester		**Credits**	**IA + E**	**Total**
MAMC 101	Abstract Algebra	5	25 + 75	100
MAMC 102	Advanced Real Analysis	5	25 + 75	100
MAMC 103	Advanced Differential Equations	5	25 + 75	100
MAMC 104	Programming Language C++	4	25 + 75	100
Optional – 1				
MPHO 115	Classical Mechanics and Special Theory of Relativity	4	25 + 75	100
		23		

II Semester

MAMC 201	Advanced Algebra	5	25 + 75	100
MAMC 202	Measure Theory and Integration	5	25 + 75	100
MAMC 203	Advanced Complex Analysis	5	25 + 75	100
MAMC 204	Soft skills (Computer Applications / English /Tamil)	4	25 + 75	100
MATP 205	Computer Practical – I (Based on C++)	2	40 + 60	100
Optional – 2				
MAMO 206	Mathematical Statistics	4	25 + 75	100
		25		

III Semester

MAMC 301	Topology	5	25 + 75	100
MAMC 302	Graph Theory	5	25 + 75	100
MAMC 303	Differential Geometry	5	25 + 75	100
MAMC 304	Probability Theory	5	25 + 75	100
MATP 305	Computer Practical – II (Based on C++)	2	40 + 60	100
Optional -3				
MPYO 316	Comparative Religion	4	25 + 75	100
		26		

IV Semester

MAMC 401	Functional Analysis	4	25 + 75	100
MAMC 402	Stochastic Processes	4	25 + 75	100
MAMC 403	Algebraic Number Theory	4	25 + 75	100
Optional – 4				
Students to choose one from the following:				
1.	MAMO 404A Fluid Dynamics	4	25 + 75	100
2.	MAMO 404B Fuzzy sets and their Applications			
		16		
	Total	**90**		**2100**

One paper per semester from the following to be offered for other Department students

I Semester

OMAM 116A	Programming Language C	4	25 + 75	100
OMAM 116B	Numerical Methods			

II Semester

OMAM 215A	Discrete Mathematics	4	25 + 75	100
OMAM 215B	Programming Language C++			

MAMC- Core Course; MATP - Practical;
OMAM - Optional (For other Department Students);
IA – Internal Assessment Evaluation Marks;
E - End Semester examination marks;

MAMC 101 ABSTRACT ALGEBRA

Objectives: Some advanced concepts in group theory are introduced. The algebraic structures rings, vector spaces, inner product spaces and modules are introduced and their properties are studied.

UNIT - I

Permutation groups, Another Counting Principles and Sylow's Theorem.

UNIT - II

Rings, Homomorphisms, Ideals and quotient rings, Field of quotients of an integral domain, and Euclidean rings.

UNIT - III

A particular Euclidean ring – the ruing of Gaussian integrals, Polynomial rings, Polynomials over the rational field, Polynomial rings over commutative rings.

UNIT - IV

Elementary basic concepts of vector spaces and Linear independence and bases.

UNIT - V

Dual spaces, Inner product spaces and Modules.

TEXT BOOKS

Content and treatment as in the book "Topics in Algebra" by I.N. Herstein, John Wiley & Sons (Second Edition), New Delhi, 1975.

Unit – I	Chapter 2 Sections 2.10 to 2.12
Unit – II	Chapter 3 Sections 3.1 to 3.7
Unit – III	Chapter 3 Sections 3.8 to 11
Unit – IV	Chapter 4 Sections 4.1 and 4.2
Unit – V	Chapter 4 Sections 4.3 to 4.5

REFERENCE BOOKS

1. Lectures in Abstract Algebra Vol. I by N. Jacobson, D. Van Nostrand Co., New York, 1976.
2. Modern Algebra Vol. I by B.L. Van der Waerden, Frederic Ungar Publishing Company, 1970.
3. Modern Algebra by Surjeet Singh and Qasi Zameeruddin, Vikas Publishing House (Second Edition), New Delh**i,** 1975.
4. Algebra by Michael Artin, Prentice - Hall of India, New Delhi.

MAMC 102 ADVANCED REAL ANALYSIS

Objectives: The concept of derivatives of real valued functions and their properties are studied. Properties of monotonic functions, functions of bounded variations are also introduced. The concept of Riemann-Stieltjes integral and its properties are studied. The notion of convergence and uniform convergence of real valued functions and infinite series of functions are also studied.

UNIT - I:

Derivatives: Definition of derivative, Derivatives and continuity, Algebra of derivatives, The chain rule, One-sided derivatives and infinite derivatives, Functions with nonzero derivative, Zero derivatives and local extrema, Rolle's theorem, The mean-value theorem for derivatives, Intermediate-value theorem for derivatives, Taylor's formula with remainder, Derivatives of vector-valued functions, Partial derivatives.

UNIT - II:

Functions of Bounded Variation: Properties of monotonic functions, Functions of bounded variation, Total variation, Additive property of total variation, Total variation on [a, x] as a function of x, Functions of bounded variation expressed as the difference of increasing functions, Continuous functions of bounded variation.

UNIT – III:

Riemann-Stieltjes Integral: The definition of the Riemann-Stieltjes integral, Linear properties, Integration by parts, Change of variable in a Riemann-Stieltjes integral, Reduction to a Riemann integral, Step functions as integrators, Reduction to a Riemann-Stieltjes integral, Step functions as integrators, Reduction of a Riemann-Stieljes integral to a finite sum, Euler's summation formula, Monotonically increasing integrators, Upper and lower integrals, Additive and linearity properties of upper and lower integrals, Reimann's condition, Comparison theorems.

UNIT – IV:

Riemann-Stieltjes Integral (Continued): Integrators of bounded variation, Sufficient conditions for existence of Riemann-Stieltjes integrals, Necessary conditions for existence of Riemann-Stieltjes integrals, Mean value theorems for Riemann-Stieltjes integrals, The integral as a function of the interval, Second fundamental theorem of integral calculus, Change of variable in a Riemann integral, Second mean-value theorem for Riemann integrals, Riemann-Stieltjes integrals depending on a parameter, Differentiation under the integral sign, Interchanging the order of integration.

UNIT – V:

Sequences of Functions: Pointwise convergence of sequences of functions, Examples of sequences of real-valued functions, Definition of uniform convergence, Uniform convergence and continuity, The Cauchy condition for uniform convergence, Uniform convergence of infinite series of functions, Uniform convergence and Riemann-Stieltjes integration.

TEXT BOOK

Contents and treatment as in the book "Mathematical Analysis" by Tom. M. Apostol, Narosa Publishing House, (Second Edition), New Delhi, 1974.

Unit – I Chapter 5 Sections 5.1 to 5.14
Unit – II Chapter 6 Sections 6.1 to 6.8
Unit – III Chapter 7 Sections 7.1 to 7.14
Unit – IV Chapter 7 Sections 7.15 to 7.25
Unit – V Chapter 9 Sections 9.1 to 9.6 and 9.8.

REFERENCE BOOKS

1. Principles of Mathematical Analysis by Walter Rudin, McGraw-Hill International Book Company, (Third Edition), New Delhi, 1976.
2. Mathematical Analysis by S.C. Malik and S. Arora, Wiley Eastern Ltd., New Delhi, 1991.

MAMC 103 ADVANCED DIFFERENTIAL EQUATIONS

Objectives: This Course aims to provide problem solving techniques in ordinary differential equations with variable coefficients and some special partial differential equations of Mathematical Physics such as Elliptic and Parabolic equations.

UNIT-I: Linear Equation with Variable Coefficients

Initial value problems - Existence and uniqueness theorems - Solutions to solve a non-homogeneous equation - Wronskian and linear dependence - reduction of the order of a homogeneous equation - homogeneous equation with analytic coefficients -The Legendre equation.

UNIT-II: Linear Equation with Regular Singular Points

Euler equation - Second order equations with regular singular points -Exceptional cases - Bessel Function.

UNIT-III: Existence and Uniqueness of Solution to First Order Equations

Equation with variable separated - Exact equation - method of successive approximations - the Lipschitz condition - convergence of the successive approximations and the existence theorem.

UNIT-IV : Elliptic Differential Equations

Derivation of Laplace and Poisson equation - BVP - Separation of Variables - Dirichlet's Problem and Newmann Problem for a rectangle - Interior and Exterior Dirichlets's problems for a circle - Interior Newmann problem for a circle - Solution of Laplace equation in Cylindrical and spherical coordinates - Examples.

UNIT-V : Parabolic Differential Equations

Formation and solution of Diffusion equation - Dirac-Delta function - Separation of variables method - Solution of Diffusion Equation in Cylindrical and spherical coordinates - Examples.

TEXT BOOKS

Contents and treatment as in the following books:

1. "An Introduction to Ordinary Differential Equations" by E.A. Coddington, Prentice Hall of India, 1987.

   Unit-I Chapter - 3 Sections I to 8 [Omit section 9]
   Unit-II Chapter 4 : Sections 1 to 4 and 6 to 8 [Omit sections 5 and 9]
   Unit-III Chapter 5: Sections 1to 6 [Omit Sections 7 to 9]

2. "Introduction to Partial Differential Equations" by S, Sankar Rao, 2nd Edition, Prentice Hall of India, New Delhi. 2005

   Unit-IV Chapter 2: 2.1, 2 2 ,2.5 to 2.13 (omit 2.3 and 2.4)
   Unit-V Chapter 3: 3.1 to 3.7 and 3.9 (omit 3.8)

REFERENCE BOOKS

1. "Differential equations with applications and historical notes" by George F. Simmons, Tata McGraw Hill Publishing Company, (second edition), 2004, New Delhi.
2. Advanced calculus for applications by F.B. Hildebrand, Prentice - Hall. Inc, 1976.
3. I.N.Sneddon, Elements of Partial Differential Equations, McGraw Hill, New Delhi, 1983.
4. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd., New Delhi, 2001.

MAMC 104 PROGRAMMING LANGUAGE C++

Objectives: After having a course on the language C, the much sought after language is C++. The language C++ is a Object Oriented Programming Language. First the syntax of the language C++ is introduced. This is followed by Control statement, Arrays, Functions, Pointers, Structures and Classes. Many problems are solved after writing algorithms and programs in C++.

UNIT - I: Using Turbo C++:

Setting Up Turbo C++, Memory Models, The Demonstration Tour, Borland Program Examples, Borland C++ Options, Take the Tour. Your First Program: Invoking

Turbo C++, Naming Your Program, Using the Editor, Saving Your Program, Compiling and Linking, Running the program. Errors: Compiler Errors, Linker Errors, Run-time Errors. Other IDE features: Compiling and Linking Shortcut, Exiting from the IDE, Examining Files, Opening an Existing File, DOS Shell.

C++ Programming Basics:

Basic Program Construction: Functions, Program Statements, White Space. Output Using Cout: String Constants. Preprocessor Directives: The # include Directive, Header Files. Comments: Comments Syntax, When to Use Comments, Alternative Comment Syntax. Integer variables: Defining Integer Variables, Declarations and Definitions, Variable Names, Assignment Statement, Integer Constants, Output variations. Character Variables: Character Constants, Initialization, Escape Sequences. Input with Cin: Variables Defined at Point of Use, Cascading, Expressions, Precedence. Type float: Floating-Point Constants, The Const Qualifier, The # define Directive. Manipulators: The end L Manipulator, The set W Manipulator, Type Long, Cascading the Insertion Operator, Multiple definitions, The IOMANIP.H Header File. Variable Type Summary: Unsigned data types. Type Conversion: Automatic Conversions, Casts. Arithmetic operators: The Remainder Operator, Arithmetic Assignment operators, Increment Operators. Library Functions: Header Files, Library Files, Header Files and Library Files, Two Ways to Use # include.

UNIT - II: Loops and Decisions:

Relational operators. Loops: The for Loop, Using Turbo C++ Debugging Features, for Loop Variations, The while Loop, Precedence: Arithmetic and Relational Operators, The do loop, When to Use Which Loop. Decisions: The if Statement, The if...else Statement, The else...if Construction, The Switch Statement. The Conditional Operator. Logical Operators: Logical OR Operator, Logical AND Operator, The Logical NOT Operator, Precedence Summary, Other Control Statements, The break Statement, The continue Statement, The GOTO Statement.

UNIT - III: Functions:

Simple Functions: The Function Declaration, Calling the Function, The Function Definition, Comparison with Library Functions, Eliminating the Declaration. Passing Arguments to Functions: Passing Constants, Passing Variables, Passing by Value, Passing Structure Variables, Names in the Declaration. Returning Values from Functions: The return Statement, Returning structure Variables. Reference Arguments: Passing Simple Data Types by Reference. Overloaded Functions: Different Numbers of Arguments, Different Kinds of Arguments. Inline Functions: Default Arguments, Variables and Storage Classes: Automatic Variables, External Variables, Static Variables, Storage, Returning by Reference.

UNIT - IV: Arrays:

Array Fundamentals. Defining Arrays, Array Elements, Accessing Array Elements, Averaging Array Elements, Initializing Arrays, Multidimensional Arrays, Passing Arrays to Functions, Arrays of Structures. Arrays as Class Member Data: Arrays of Objects, Arrays of English Distances, Arrays of Cards, String: Variables, Avoiding Buffer Overflow, String Constants, Reading Embedded Blanks, Reading Multiple Lines,

Copying a String the Hard Way, Copying a String the Easy Way, Arrays of Strings, Strings as Class Members, A User-Defined String Type.

UNIT - V: Pointers:

Addresses and Pointers, The Address of Operator & Pointer Variables, Accessing the Variable Pointed To, Pointer to void. Pointers and Arrays: Pointer Constants and Pointer Variables. Pointers and Functions: Passing Simple Variables, Passing arrays, Sorting Array Elements. Pointers and Strings: Pointers to String Constants, Strings as Function Arguments, Copying a String Using Pointers, Library String Functions, Arrays of Pointers to Strings.

TEXT BOOK

Content and treatment as in the book "Object-Oriented Programming in TURBO C++" by Robert Lafore, Galgotia Publications Pvt. Ltd., New Delhi, 1996.

Unit-I	Chapters 2 & 3
Unit-II	Chapter 4
Unit-III	Chapter 6
Unit-IV	Chapter 8
Unit-V	Chapter 12

REFERENCE BOOK

Programming in ANSI C by E. Balagurusamy, Tata McGraw Hill Publishing Ltd.,(Second Edition), New Delhi, 1992.

Optional – 1
MPHO 115 - CLASSICAL MECHANICS AND SPECIAL THEORY OF RELATIVITY

Objective: The contents emphasize the advantage of energy representation in dynamics and the macroscopic properties in terms of microscope manifestations..

Unit – I

Principle of Newtonian Mechanics – particle mechanics – conservation laws of linear momentum, Angular momentum and energy of a particle and body – Constraints and classification with examples – particle motion under a constant force – Motion of a system with variable mass.

Unit – II

Principle of virtual work – D'Alembert's principle – generalized coordinates – Lagrange equations – Cyclic or ignorable coordinates – remarks about the Lagrangian – Generalized moments and energy – Hamilton's principle – Hamilton's equations of motion.

Unit – III

Motion of a rigid body – the inertia tensor – Euler's equation of motion – Euler's angles – motion of a symmetric top – Poisson brackets and their properties – conservation theorems in Poisson brackets – small oscillations – normal modes – free vibrations of linear triatomic molecules – Harmonic oscillator – as an example of Hamilton-Jacobi method.

Unit – IV

Newtonian relativity- Michelson Morley experiment- Lorentz transformation and Consequences- relativity of simultaneity- the Lorenz-Fitz Gerald length contraction, Time dilation- Addition velocities.

Unit – V

Variation of moss with velocity, Moss energy relation, Minkowski four dimensional contiumum- Four vectors Compton scattering.

Text Books and References:

1. R.G.Takwale and P.S.Purani, Introduction to classical mechanics - Tata Macgraw Hill Publishing co Ltd., New Delhi.
2. B.D.Gupta and Sathyaprakash.-Classical Mecanics-Kedaernath Ramnath and CO .
3. Sathyaprakash and J.P.Agarwal- Statistical Mechanics- Kedar Nath Ram nath and Co.Publishers, MEERUT. 2003.
4. M.C Guptha -Statistical Thermo Dynamics -Weiley Eastern Limeted,New Delhi.
5. Herbert Gold Stein, - Classical Mechanics – Narosa Publishing House, Chennai .
6. V.B.Bhatia., - Classical Mechanics, Narosa Publishing House, Chennai – 6 ,1997
7. B.K.Agarwal and Melvin Eisner, - Statistical Mechanics- New age international (p) Ltd. Chennai, 1994.
8. S.C.Garg, R.M.Bansal and C.K.Ghosh , - Thermal Physics. Tata McGrew Hill Publishing co Ltd. Delhi,1993.

MAMC 201 ADVANCED ALGEBRA

Objectives: Finite extensions of fields and algebraic elements are introduced. Galois gave the connection between normal subgroups and normal extensions. This concept is given as fundamental theorem of Galois. The properties of Linear transformations are given and their canonical forms like, triangular form, rational form are studied.

UNIT - I

Extension Fields, Roots of Polynomials, More about roots.

UNIT – II

The elements of Galois theory, Solvability by radicals, Finite fields.

UNIT - III

The algebra of linear transformations, Characteristic roots, Matrices, Canonical forms: Triangular form.

UNIT - IV

Nilpotent transformations and their canonical forms, Jordan Form, Rational canonical form.

UNIT - V

Hermitian, Unitary and Normal transformations, Real quadratic forms.

TEXT BOOK

Content and treatment as in the book "Topics in algebra" by I.N. Herstein, John Wiley & Sons (Second Edition) New Delhi, 1975.

Unit-I	Chapter 5: Sections 5.1, 5.3 and 5.5
Unit-II	Chapter 5: Sections 5.6 and 5.7 and Chapter 7: Section 7.1
Unit-III	Chapter 6: Sections 6.1 to 6.4
Unit-IV	Chapter 6: Sections 6.5 to 6.7
Unit-V	Chapter 6: Sections 6.10 and 6.11

REFERENCE BOOKS

1. Lectures in abstract algebra Vol. II and Vol. III by N. Jacobson, D. Van Nostrand Co., New York.
2. Modern Algebra Vol. I by B.L. Van der Waerden, Frederic Ungar Publishing Company, 1970.
3. Modern Algebra Vol. I by Surjeet Singh and Qasi Zammeruddin, Vikas Publishing House (Second Edition), New Delhi, 1975.
4. Algebra by M. Artin, Prentice-Hall of India, New Delhi, 1994.

MAMC 202 MEASURE THEORY AND INTEGRATION

Objectives: The concept of Lebesgue measure is introduced. Measure space and integration with respect to a measure are introduced.

UNIT - I

Lebesgue Outer measure, Measurable sets, Regularity, Measurable functions, Borel and Lebesgue measurability.

UNIT - II

Integration of nonnegative functions, General integral, Integration of series, Riemann and Lebesgue integrals.

UNIT - III

Continuous non-differentiable functions, Lebesgue differential theorem (statement only), Differentiation and Integration, Lebesgue set, Convergence in measure, Almost uniform convergence.

UNIT – IV

Measures and outer measures, Extension of a measure, Uniqueness of the extension completion of a measure, Measure spaces, Integration with respect to a measure.

UNIT - V

L^p spaces, Convex functions, Jensen's inequality, The inequalities of Holder and Minkowski completeness of $L^p(\mu)$.

TEXT BOOK

Contents and treatment as in the book "Measure Theory and Integration" by G. de Barra, New Age International Publishers, 2005.

Unit – I Chapter 2 Sections 2.1 to 2.5
Unit – II Chapter 3 Sections 3.1 to 3.4
Unit – III Chapter 4 Sections 4.2, 4.4 to 4.6 and Chapter 7 Sections 7.1 and 7.2
Unit – IV Chapter 5 Sections 5.1 to 5.6
Unit – V Chapter 6 Sections 6.1 to 6.6

REFERENCE BOOKS

1. Real Analysis by Royden, MacMillan Publishing Company, New York, 1968.
2. Mathematical Analysis by V. Ganapathy Iyer, Tata McGraw Hill Publication Co. Ltd., New Delhi.
3. Measure Theory by P.R. Halmos, Van Nostrand Princeton, New Jersey, 1950.

MAMC 203 ADVANCED COMPLEX ANALYSIS

Objectives: This course aims to train the students to get essential knowledge in functions of a complex variable. Analytic functions and their properties, Residue theorem and its applications, Riemann mapping theorem and Elliptic functions and their properties are discussed in detail.

UNIT - I

Complex integration:

Line integrals, Rectifiable arcs, Line integrals as functions of arcs, Cauchy's theorem for a rectangle, Cauchy's theorem in a Disc.

Cauchy's integral Formula:

The index of a point with respect to a closed curve, The integral formula, Higher derivatives.

UNIT - II

Local Properties of Analytic Functions:

Removable Singularities, Taylor's theorem, Zeros and poles, The Local Mapping and The Maximum Principle.

The General Form of Cauchy's Theorem:

Chains and cycles, Simple connectivity, Locally exact differentials, Multiply connected regions.

UNIT - III

Harmonic Functions:

Definition and basic properties, The mean-value property, Poisson's Formula, Schwarz's theorem, The Reflection principle.

Power Series Expansions:

Weierstrass's Theorem, The Taylor series, The Laurent Series.

Partial Fractions and Factorization:

Partial fractions, Infinite products and Canonical products.

UNIT - IV

Normal Families:

Equicontinuity, Normality and Compactness, Arzela's Theorem, Families of Analytic Functions, The classical definition.

The Riemann Mapping Theorem:

Statement and Proof

Conformal mapping of Polygons:

The behavior at an angle, The Schwarz-Christoffel formula, Mapping on a rectangle, The triangle functions of Schwarz.

UNIT - V

Elliptic Functions:

Doubly periodic functions - The period module, Unimodular transformations, The canonical basis, General properties of Elliptic functions.

Weierstras theory - The Weierstras $\mathcal{P}$ -function, The Functions $\zeta(z)$ and $\sigma(z)$, The associated Differential equation.

TEXT BOOK

Content and treatment as in the book "Complex Analysis" by L.V. Ahlfors, (Third edition), McGraw Hill Inc., New Delhi, 1979.

Unit-I	Chapter 4 Sections 1 & 2.
Unit-II	Chapter 4 Sections 3, 4(4.1, 4.2, 4.6 and 4.7 only)
Unit-III	Chapter 4 Section 6; Chapter 5 Sections 1,2 (2.1,2.2 & 2.3 only)
Unit-IV	Chapter 5 Section 5, Chapter 6 Sections 1 and 2.
Unit-V	Chapter 7 Sections 2 and 3 (3.1, 3.2, and 3.3 only)

REFERENCE BOOKS

1. Functions of One Complex Variable by J.B. Conway, Springer-Verlag, 1973.
2. Notes on Complex Function Theory by Donald Sarason, Hindustan Book Agency, 1994.
3. Complex Variables by H. Silverman, Hughton Miffin Company.
4. Foundations of Complex Analysis by S. Ponnusamy, (Second edition), Narosa, 2005.

MAMC 204 SOFT SKILLS

Objective: To train the students in soft skills such as personality development, effective listening, interpersonal communication, public speaking, and writing skills which are essential for their employability.

Unit-I: Personality Development

Personal effectiveness skills – Managerial and supervisory skills – Leadership skills – Creativity skills – Problem solving skills – Team spirit – culture building

Unit-II: Effective Listening

Registration of ideas – Crystallization – Listening – What does listening mean? – Why are people inherently poor listeners? – Poor listening habits – Types of listening – Effective and ineffective listening skills – Pay-offs of effective listening – Barriers to listening – Active and passive listening

Unit- III: Interpersonal Communication

Characteristics of interpersonal relationships – Intimacy in interpersonal relationship – Relationship development and maintenance – Self disclosure in interpersonal relational relationships

Unit-IV: Public Speaking

What is public speaking – The art of public speaking – Language and proficiency in public speaking – Spoken English-Fluency – Awareness of different accents – Interviews – Group discussion – Seminars – Telephone Skills?

Unit-V: Writing Skills

Business writing of sorts – Common components of business letters – strategies for writing the body of a letter – Writings of other sorts like memos, notes etc. – Business report – Business proposal

Text Books:

1. Namrata Palta. The Art of Effective Communication.New Delhi: Lotus Press, 2007.
2. Edgar Thorpe, Showick Thorpe. Winning at Interviews.Dorling Kindersley (India) Pvt. Ltd, 2006.
3. S.K. Mandal. Effective Communication and Public Speaking. Mumbai:Jaico Publishing House, 2005.
4. Lani Arredondo. Communicating Effectively.Tata McGraw-Hill edition, 2003.

Reference Books:

1. Robert Bolton. People Skills.Simon& Schuster, 1986.
2. Ronald B. Adler, George Rooman. Understanding Human Communication.Oxford University Press, 2006.
3. Meenakshi Raman, Prakash Singh. Business Communication. Oxford University Press, 2006.
4. V. Sasikumar, P. KiranmaiDutt, GeethaRajeevan. A Course in Listening and Speaking II.Cambridge University Press, 2007
5. Dale Carnegie. The Leader in You.New York: Pocket Books, 1993.

MATP 205: COMPUTER PRACTICAL – I
(Using C++ language)

Objectives: This Paper is divided into four parts viz solution of transcendental and polynomial equations in one variable, solution of linear equations, solution of ordinary differential equations and numerical integration. This paper gives practical applicability of C programming to some of the problems in numerical mathematics.

1. Solution of transcendental and polynomial equations in one variable:
    i. Newton's Method
    ii. Method of Bisection
    iii. Method of Regula Falsi
2. Solution of Linear Equations:
    i. Jacobi's Iterative Method
    ii. Gauss-Seidal Iterative Method
3. Numerical Solution of Ordinary Differential Equations:
    i. Euler's Method.
    ii. Modified Euler's Method
    iii. Runge-Kutta Method of order four
4. Numerical Integration:
    i. Simpson's one third rule
    ii. Simpson's three eighth rule
    iii. Weddle's rule.

TEXT BOOK

Content and treatment as in relevant sections of "Numerical Algorithms" by E.V. Krishnamoorthy and S.K. Sen, Affiliated East West Press Pvt., Ltd., (Second Edition), 1996.

Optional – 2
MAMO 206 MATHEMATICAL STATISTICS

Objectives: The objective is to train students in some concepts in mathematical statistics. The notion of random variables, distribution function and characteristic functions are introduced. Some examples of discrete and continuous random variables are introduced and their properties are studied.

UNIT-I Random Variables:

The concept of a random variable, The distribution function, Random variables of the discrete type and the continuous type, functions of random variables, Multi dimensional random variables, Marginal distributions, Conditional distributions, Independent random variables, Functions of multi dimensional random variables.

UNIT-II Parameters of the distribution of a random variable:

Expected values, Moments, The Chebyshev inequality, Absolute moments, Order parameters, Moments of random vectors, Regression of first type, Regression of the second type.

UNIT-III Characteristic Functions:

Properties of characteristic functions, The characteristic functions and moments, Emi invariants, The characteristic function of the sum of independent random variables, Determination of the distribution function by the characteristic function, The characteristic function of multidimensional random vectors, Probability generating functions.

UNIT-IV Some Probability Distributions:

One point and two point distributions, The Bernoulli scheme, The binomial distribution, The Poisson scheme, The generalized binomial distribution, The Polya and hypergeometric distributions, The Poisson distribution.

UNIT-V Some Probability Distributions (Continued):

The uniform distribution, The normal distribution, The gamma distribution, The beta distribution, The Cauchy and Laplace distributions, The multidimensional normal distribution, The multinomial distribution.

TEXT BOOK

Content and treatment as in the book "Probability Theory and Mathematical Statistics" by Marek Fiszs, John Wiley, New York, (Third edition), 1963.

Unit – I Chapter 2: Sections 2.1 to 2.9.
Unit - II Chapter 3: Sections 3.1 to 3.8.
Unit - III Chapter 4: Sections 4.1 to 4.7.
Unit - IV Chapter 5: Sections 5.1 to 5.5.
Unit - V Chapter 5: Sections 5.6 to 5.12.

REFERENCE BOOKS

1. Random variables and probability distributions by H. Cramer, University Press, Cambridge, 1937.
2. Mathematical methods in Statistics Topology by H. Cramer, Princeton University Press, Princeton, 1946.
3. Mathematical Statistics by Samuel S. Wilks, John Wiley & sons, New York, 1962.

MAMC 301 TOPOLOGY

Objectives: The ideas and methods of topology have transformed large parts of geometry and analysis. This subject is of interest in its own right, and it also serves to lay the foundations for future studies in analysis and geometry. In this course we teach the basics of topology including connectedness, compactness, countability, separation axioms, Tychonoff theorem and complete metric spaces.

UNIT-I

Topological spaces, Basis for a topology, The order topology, The product topology on $X \times Y$.

UNIT-II

The subspace topology, Closed sets and limit points, Continuous function, The product topology.

The metric topology, Connected spaces, Connected subspaces of the real line, Components and Local connectedness.

UNIT-III

Compact spaces, Compact subspaces of the real line, Limit point compactness, Local compactness.

UNIT-IV

Countability axioms, The separation axioms, Normal spaces, Urysohn Lemma, Urysohn metrization theorem, The Tietze extension theorem.

UNIT-V

The Tychonoff Theorem, Stone-Cech compactification, Complete metric spaces, Compactness in metric spaces.

TEXT BOOK

Content and treatment as in the book "Topology" by James R. Munkres, Prentice Hall of India, (Second edition), New Delhi, 2000.

Unit – I	Chapter 2: Sections 12 to 15.
Unit - II	Chapter 2: Sections 16 to 21 and Chapter 3: Sections 23 to 25.
Unit - III	Chapter 3: Sections 26 to 29.
Unit - IV	Chapter 4: Sections 30 to 35.
Unit - V	Chapter 5: Sections 37 and 38; Chapter 7: Sections 43 and 45 only.

REFERENCE BOOKS

1. Elements of General topology by S.T. Hu, Holden-Day Inc, San Francisco, 1964.
2. Topology by J.G. Hocking and G.S. Young, Addison-Wesley Pub. Com, 1961.
3. Introduction to Topology and Modern analysis by G.F. Simmons, McGraw Hill International Edition, Singapore, 1963.
4. Topology of Metric Spaces by S. Kumaresan, Narosa Publishing house, 2005.

MAMC 302 GRAPH THEORY

Objectives: Graph Theory is an integral part of Discrete Mathematics. It has applications to many fields, including computer science, physics, chemistry, psychology and sociology. In this course we teach basic topics in graph theory such as Trees, Directed graphs, Connectivity, Euler tours, Hamilton cycles, Matchings, Colourings, Planar graphs.

UNIT-I: Graphs and Subgraphs:

Graphs and Simple Graphs, Graph Isomorphism, The Incidence and Adjacency Matrices, Subgraphs, Vertex Degrees, Paths and Connection and Cycles.

Trees:

Trees, Cut Edges and Bonds, Cut Vertices and Cayley's Formula.

UNIT-II: Connectivity and Hamilton Cycles:

Connectivity, Blocks, Euler Tours and Hamilton Cycles.

UNIT-III: Matchings:

Matchings, Matchings and Coverings in Bipartite Graphs and Perfect Matchings.

UNIT-IV: Edge Colourings:

Edge Chromatic Number, Vizing's Theorem.

Vertex Colourings:

Chromatic Number, Brooks' Theorem, Hajos' Conjecture - Dirac's Theorem, Chromatic Polynomials, Girth and Chromatic Number.

UNIT-V: Planar Graphs:

Plane and Planar Graphs, Dual Graphs, Euler's Formula, The Five - Colour Theorem, Nonhamiltonian Planar Graphs.

TEXT BOOK

Contents and treatment as in the book 'Graph Theory with Applications' by J.A. Bondy and U.S.R. Murty, Macmillan Company, 1976.

Unit – I	Chapter 1: Sections 1 to 7;
	Chapter 2: Sections 1 to 4.
Unit - II	Chapter 3: Sections 1, 2; and
	Chapter 4: Sections 1 and 2.
Unit – III	Chapter 5: Sections 1 to 3.
Unit - IV	Chapter 6: Sections 1, 2; and Chapter 8: Sections 1 to 5.
Unit - V	Chapter 9: Sections 1 to 3 and 6, 7

REFERENCE BOOKS

1. Graph Theory by R. Gould, The Benjamin/Cummings Publishing Company, Inc., California, 1988.
2. Pearls in Graph Theory by N. Hartsfield and G. Ringel, Academic Press, 1990.
3. Graph Theory by F. Harary, Addison-Wesley, (Second Printing) 1971.
4. Basic Graph Theory by K.R. Parthasarathy, Tata McGraw Hill Publishing Company Limited, New Delhi, 1994.
5. A Text book of Graph Theory by R. Balakrishnan and K. Ranganathan, Springer-Verlag, New York, Inc., 2000.
6. Introduction to Graph Theory by D.B. West, Pearson Education (Second Edition), 2001.

MAMC 303 DIFFERENTIAL GEOMETRY

Objectives: To introduce space curves surfaces, curves on surfaces and study some of their properties. To study the notion of geodesic and its properties. To understand some type of special surfaces such as developables and minimal surfaces.

UNIT - I

Space curves, Arc length, Tangent, normal and binormal, Curvature and torsion of a curve given as the intersection of two surfaces.

UNIT - II

Contact between curves and surfaces, Tangent surface, involutes and evolutes, Intrinsic equations, Fundamental existence theorem for space curves, Helices.

UNIT - III

Surface, Curves on a surface, Metric, Direction coefficients, Geodesics, Canonical geodesic equations, Normal property of geodesics, Geodesic curvature.

UNIT - IV

Gauss-Bonnet theorem, Gaussian curvature, Surfaces of constant curvature, Conformal mapping, Only statements of Dini's theorem and Tissot's theorem.

UNIT - V

Second fundamental form, Developables, Developables associated with space curves, Developables associated with curves on surfaces, Minimal surfaces.

TEXT BOOK

Content and treatment as in the book "An Introduction to Differential Geometry" by T.J. Willmore, Oxford University Press, New Delhi, 1959.

Unit-I	Chapter 1 Sections 1 to 5
Unit-II	Chapter 1 Sections 6 to 9
Unit-III	Chapter 2 Sections 1and 2, 5,6,10,11,12 and 15
Unit-IV	Chapter 2 Sections 16 to 20
Unit-V	Chapter 3 Sections 1 and 4 to 7

Reference Book

Lectures on Classical Differential Geometry by D.T. Struik, Addison-Wesley Press, 1950.

MAMC 304 PROBABILITY THEORY

Objectives: The objective is to train students in some rigorous concepts in probability theory through measure theoretic approach. Different types of convergence concepts are discussed. The weak and strong laws of large numbers are studied. The concept of characteristic function and different versions of central limit theorems are also taught.

UNIT-I: Distribution Function:

Monotone functions, Distribution functions, Absolutely continuous and Singular distributions.

Measure Theory:

Classes of sets, Probability measures and their distribution functions.

Random variable, Expectation, Independence:

General definitions, Properties of mathematical expectation, Independence.

UNIT-II: Convergence Concepts:

Various modes of convergence, Almost sure Convergence; Borel-Cantelli lemma, Vague Convergence, Continuation.

UNIT-III: Law of Large Numbers. Random series:

Simple limit theorems, Weak law of large numbers, Convergence of series, Strong law of large numbers.

UNIT-IV: Characteristic Function:

General properties; Convolutions, Uniqueness and inversion, Convergence theorems, Simple applications.

UNIT-V: Central limit theorem and its Ramifications:

Liapounov's theorem, Lindeberg-Feller theorem, Ramification of the central limit theorem.

TEXT BOOK

Content and treatment as in the book "A Course in Probability Theory" by K.L. Chung, Academic Press, Second Edition, 1974.

Unit - I	Chapter 1(Sections 1 to 3).
	Chapter 2 (Sections 1 and 2).
	Chapter 3 (Sections 1 to 3).
Unit – II	Chapter 4 (Sections 1 to 4).
Unit - III	Chapter 5 (Sections 1 to 4).
Unit – IV	Chapter 6 (Sections 1 to 4).
Unit - V	Chapter 7 (Sections 1 to 3).

REFERENCE BOOKS

1. Modern Probability Theory, B.R. Bhat, Wiley Eastern, New Delhi.
2. Measure, Integration and Probability, C.W. Burril, McGraw Hill.

MATP 305 COMPUTER PRACTICAL – II

Objectives: This paper is divided into four parts namely solution of Linear Programming problems, solution of Inventory models, problems in Number Theory and problems

involving Matrices. This paper gives a practical knowledge to solve problems including the fields of optimization, number theory and matrix theory.

1. Solution of Linear Programming Problem.
2. Deterministic Inventory Models.
    i. Single-item Static Model.
    ii. Single-item Static Model with Price Breaks.
    iii. Multi-item Static Model with Storage Limitation.
3. Number Theory:
    i. Reversing of an integer series.
    ii. Generating Fibonocci series.
    iii. Average and Standard Deviation of numbers.
    iv. Identification of Prime, Even and Odd integers.
4. Matrix Theory
    i. Determinant of a matrix.
    ii. Rank of a matrix.
    iii. Inverse of a matrix.
    iv. Product of matrices.

TEXT BOOK

Content and treatment as in relevant sections of the following books:

1. 'Optimization Methods' by K.V. Mital and C. Mohan, Third Edition, New Age International Publishers, New Delhi.
2. 'Operations Research - An Introduction' by Hamdy A. TAHA, Macmillan Publishing Company, New York, (Fourth Edition) 1987.

OPTIONAL -3
MPYO 316 COMPARATIVE RELIGION

Objectives: To make the students aware of the Principles of major religions. To make the students aware of the techniques of comparing religions.

UNIT-I: Hinduism

God World – Man – Evil and suffering - Life after death – Human destiny – Hindu Ethics, prayer and rituals.

UNIT-II: Christianity

God World – Man – Evil and suffering - Life after death – Human destiny – Hindu Ethics and prayer.

UNIT-III: Islam

God - World – Man – Evil and suffering - Life after death – Human destiny – Ethics and prayer.

UNIT-IV: Buddhism

God-hood – World – Man – Evil and suffering – Life after death – Ultimate destiny – Buddhist discipline.

UNIT-V: Jainism and Comparison of Religions

God-hood – World – Man – Evil and suffering Life after death – Ultimate destiny – Jain discipline – Comparison between Hinduism, Christianity, Islam, Buddhism and Jainism.

Text Books:

1. Kedar Nath Tiwari, Comparative Religion, Motilal Banarsidas, Delhi, 1990.
2. Ram Shankar Srivastava, Comparative Religion, Munshiram Manoharlal Publishers Pvt. Ltd., New Delhi 1974.
3. Suda J.P, Religion in India, Sterling Publishers Pvt. Ltd., New Delhi, 1978.

Reference Books:

1. Widgoery, A.C, The Comparative Study of Religions, Munshi Ram Manoharlal, Delhi, 1922.
2. Max Mullar, F, Natural Religion, collected works Asian Educational Service, Delhi, 1979.
3. Rajendra Verma, Comparative Religion: concepts and Experience, Intellectual Publishing House, Delhi, 1984.
4. Ward J.Follows. Religions East and West. Holt Rinehart and Winston, New York, 1979.
5. Brodov, V. Indian Philosophy in Modern Times, Progress Publishers, Moscow,1984.

MAMC 401 FUNCTIONAL ANALYSIS

Objectives: There are many domains in the broad field of topology. The following are the few viz, the theory of Banach and Hilbert Spaces and their operators and Banach algebras. In this course we teach some results on Banach spaces, Hilbert spaces, operator theory and Banach algebras. Each of these subjects starts from the fundamental knowledge and develops its own methods of dealing with its own characteristic problems.

UNIT - I

Linear transformations, Banach spaces, Continuous linear transformations, The Hahn-Banach theorem.

UNIT - II

The natural embedding of N into N^{**}, The open mapping theorem, The conjugate of an operator.

UNIT - III

Hilbert space, Orthogonal complements, Orthonormal sets, The Conjugate space H, The adjoint of an operator, Self adjoint operators, Normal and Unitary operators.

UNIT - IV

Finite dimensional Spectral theory, Matrices, Determinants and Spectrum of an operator, The spectral theorem.

UNIT - V

Banach algebras - Definition and some examples, Regular and singular elements, Topological divisors of zero, The spectrum, The formula for the spectral radius.

TEXT BOOK

Content and treatment as in the book "Introduction to Topology and Modern Analysis" by G.F. Simmons, McGraw Hill Book Company, 1963.

Unit-I	Chapter 8: Section 44 only and
	Chapter 9: Sections 46, 47 and 48.
Unit-II	Chapter 9: Sections 49, 50 and 51.
Unit-III	Chapter 10: Sections 52 to 58.
Unit-IV	Chapter 11: Sections 60, 61 and 62.
Unit-V	Chapter 12: Sections 64 to 68.

REFERENCE BOOKS

1. Functional Analysis by B.V. Limaye, Prentice - Hall of India, New Delhi, 1981.
2. Functional Analysis by Bachmann and Narishi, Academic Press.
3. Beginning Functional Analysis by Karen Saxe, Springer, 2002
4. A First Course in Functional Analysis by C. Goffman and G. Padrick, Chelsea Pub.

MAMC 402 STOCHASTIC PROCESSES

Objectives: Advanced level of Mathematical Sophistication and enhancing the horizons of knowledge are the major objectives of this paper. This paper deals with the theory of Markov and renewal processes. Because of the simplicity and applicability, more theoretical discussion is devoted to Markov processes. Nevertheless, some simple concepts of renewal theory and stationary processes have also been included. The aim is to familiarize the student with the use of stochastic models in different areas.

UNIT - I: Stochastic Processes:

Introduction, Specification of Stochastic Processes, Stationary Process, Martingales.

Markov Chains:

Definition and Examples, Higher Transition Probabilities, Generalization of independent Bernoulli Trials: Sequence of Chain Dependent Trials, Classification of States and Chains.

UNIT - II: More on Markov Chains:

Determination of Higher Transition Probabilities, Stability of a Markov System, Markov Chain with Denumerable Number of States, Reducible Chains.

UNIT - III: Markov Processes with Discrete State Space: Poisson Process and its Extensions:

Poisson Process, Poisson Process and Related Distributions, Generalization of Poisson Process, Birth and Death Process, Markov Process with Discrete State Space (Continuous Time Markov Chains).

UNIT - IV: Markov Chains and Markov Processes with Continuous State Space:

Markov Chains with Continuous State Space, Introduction, Brownian Motion, Wiener Process, Differential Equations for a Wiener Process, Kolmogorov Equations, First Passage Time Distribution for Wiener Process.

UNIT - V: Renewal Processes and Theory:

Renewal Process, Renewal Processes in Continuous Time, Renewal Equation, Stopping time: Wald's Equation, Renewal Theorems, Delayed and Equilibrium Renewal Processes.

TEXT BOOK

Content and treatment as in the book "Stochastic Processes" by J. Medhi, New Age International (P) Limited, Publishers, New Delhi, (Second Edition), 1994.

Unit-I	Chapter 2: Sections 1 to 4 and Chapter 3: Sections 1 to 4.
Unit-II	Chapter 3: Sections 5,6,8 and 9.
Unit-III	Chapter 4: Sections 1 to 5.
Unit-IV	Chapter 3: Section 11
	Chapter 5: Sections 1 to 5.
Unit-V	Chapter 6: Sections 1 to 6.

REFERENCE BOOKS

1. Stochastic Processes by J.L. Doob, Wiley, New York, 1953.
2. A First Course in Stochastic Processes, by S. Karlin and H.M. Taylor, Academic Press (second edition), New York, 1975.
3. Stochastic Processes by S.M. Ross, Wiley, New York, 1983.

MAMC 403 ALGEBRAIC NUMBER THEORY

Objectives: The prime aim of this paper is to enrich the knowledge of Number Theory. The concepts of primes, congruences, prime power moduli, power residues, quadratic residues, greatest integer function, Moebius inversion formula are introduced. Diophantine equations and their positive solutions are discussed. Algebraic numbers, algebraic integers, primes in quadratic fields and unique factorization property are also considered.

UNIT - I: Divisibility and Congruences:

Divisibility, Primes, Congruences, Solutions of Congruences, Congruences of degree 1, The function φ (n), Congruences of higher degree.

UNIT - II: Quadratic Reciprocity:

Prime power moduli, Prime modulus, Congruences of degree two, Power Residues, Quadratic residues, Quadratic reciprocity, The Jacobi symbol.

UNIT - III: Some functions of number theory:

Greatest integer function, Arithmetic functions, The Moebius inversion formula, The Multiplication of Arithmetic functions.

UNIT - IV: Some Diophantine Equations:

Diophantine equations, The equation $ax+by=c$, Positive solutions, The equation $x^2+y^2=z^2$. Sums of four and five squares, Sum of two squares.

UNIT - V: Algebraic numbers:

Polynomials, Algebraic numbers, Algebraic integers, Quadratic fields, Units in Quadratic fields, Primes in quadratic fields, Unique Factorization in the fields $Q(\sqrt{m})$.

TEXT BOOK

Contents and treatment as in the book "An Introduction to the Theory of Numbers", Ivan Niven and H.S. Zuckerman, Wiley Eastern Limited, New Delhi, 1994.

Unit - I	Chapter 1 Sections 1 to 3 and Chapter 2 Sections 1 to 5
Unit - II	Chapter 2 Sections 6 to 9 and Chapter 3 Sections 1 to 3
Unit – III	Chapter 4 Sections 1 to 4
Unit - IV	Chapter 5 Sections 1 to 3, 5,7 and 10
Unit - V	Chapter 9 Sections 1, 2 and 4 to 8

REFERENCE BOOKS

(1) Introduction to Analytical Number Theory, Tom M. Apostal, Narosa Pub. Company, New Delhi, 1980.

(2) Elementary Theory of Numbers, C.Y. Hsiung, World Scientific, Singapore, 1992.

(3) An Introduction to the Theory of Numbers, G.H. Hardy and E.M. Wright, Clarendon Press, (Third edition), 1954.

Optional -4
MAMO 404A Fluid Dynamics

Objective:

This course aims to discuss kinematics of fluids in motion, Equations of motion of a fluid, three dimensional flows, two dimensional flows and viscous flows.

Unit I:

Kinematics of Fluids in Motion: Real fluids and ideal fluids – Velocity of a fluid at a point stream lines – path lines – Steady and unsteady flows – Velocity potential – The velocity vector – Local and particle rates of changes – Equations of continuity– Examples.

Unit II:

Equation of Motion of a fluid: Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Condition at a boundary of two invicid immersible fluids. Euler's equation of motion – Discussion of the case of steady motion under conservative body forces.

Unit III:

Some three dimensional flows: Introduction – Sources – Sinks and doublets – Images in rigid infinite plane – Axis symmetric flows – Stokes stream function.

Unit IV:

Some two-dimensional flows: Two dimensional flows – Meaning of two dimensional flow – Use of cylindrical polar co-ordinates – The stream function – Complex potential for two dimensional – Irrational incompressible flow – Complex velocity potential for standard two dimensional flows – Examples.

Unit V:

Viscous flows: 21Viscous flows – Stress components in a real fluid – Relation between Cartesian components of stress – Translation motion of fluid elements – The rate of strain quadric and principle stresses – Further properties of the rate of strain quadric – Stress analysis in fluid motion – Relation between stress and rate of strain – The coefficients of viscosity and Laminar flow – The Navier – Stokes equations of motion of a viscous fluid.

Text Book:

Content and treatment as in the book "Fluid Dynamic", F. Chorlton, CBS Publication New Delhi, 1985.

Unit – I Chapter 2: Sections 2.1 to 2.8
Unit – II Chapter 3: Sections 3.1 to 3.7
Unit – III Chapter 4: Sections 4.1 to 4.3 and 4.5
Unit – IV Chapter 5: Sections 5.1 to 5.6
Unit – V Chapter 8: Sections 8.1 to 8.9.

References:

1. G.K. Batchaelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi,1994.
2. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Pvt.Ltd., New Delhi, 1976.
3. R.K. Rathy, An Introduction to Fluid Dynamics, IBH Publ. Comp. New Delhi, 1976.

MAMO 404B - Fuzzy Sets and Their Applications

Objective:

This course aims to offer fuzzy sets, fuzzy relations, fuzzy logic, fuzzy composition and applications.

Unit I:

Fuzzy sets: Fuzzy sets – Basic types – Basic concepts - Characteristics – Significance of the paradigm shift – Additional properties of α- Cuts.

Unit II:

Fuzzy Sets Versus CRISP Sets: Representation of Fuzzy sets – Extension principle of Fuzzy sets – Operation on Fuzzy Sets – Types of Operation – Fuzzy complements.

Unit III:

Operations on Fuzzy Sets: Fuzzy intersection – t-norms, Fuzzy unions – t conorms – Combinations of operations – Aggregation operations.

Unit IV:

Fuzzy Arithmetic: Fuzzy numbers – Linguistic variables – Arithmetic operation on intervals – Lattice of Fuzzy numbers.

Unit V:

Constructing Fuzzy Sets: Methods of construction: An overview – Direct methods with one expert – Direct method with multiple experts – indirect method with multiple experts and one expert – Construction from sample data.

Text Book:

Content and treatment as in the book "Fuzzy Sets and fuzzy Logic: Theory and Applications", G.J. Klir, and Bo Yuan, Prentice Hall of India Ltd., New Delhi, 2005.

Unit – I	Chapter 1: Sections 1.3 to 1.5 and Chapter 2: Sections 2.1
Unit – II	Chapter 2: Sections 2.2 to 2.3 and Chapter 3: Sections 3.1 to 3.2
Unit – III	Chapter 3: Sections 3.3 to 3.6
Unit – IV	Chapter 4: Sections 4.1 to 4.4
Unit – V	Chapter 10: Sections 10.1 to 10.7

References:

1. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, Chennai, 1996.
2. A. Kaufman, Introduction to the Theory of Fuzzy Subsets, Academic Press, New York, 1975.
3. V. Novak, Fuzzy Sets and Their Applications, Adam Hilger, Bristol, 1969.

OPTIONAL - 1

(To be choosen by other Department students)

OMAM 116A PROGRAMMING LANGUAGE C

Objectives: The high level language C is introduced. The variables, constants and their types, Algebraic operations available in the language C are studied. Syntax for IF, IF-

ELSE and other decision making statement are given. The switch statement which is an important decision making statement is discussed. Arrays and user-defined functions, available in other languages, are introduced. Pointer which is a special tool in the language C is explained.

UNIT-I

Overview of C:

Basic structure of C programs, Programming style.

Constants, Variables and Data Types:

Character set, C tokens, Keywords and identifiers, Constants, Variables, Data types, Declaration of variables, Assigning values to variables, Defining symbolic constants.

Operators and Expressions:

Arithmetic of Operators, Relational operators, Logical operators, Assignment operators, Increment and decrement operators, Conditional operator, Bitwise operators, Special operators, Arithmetic expressions, Evaluation of expressions, Precedence of arithmetic operators, Some computational problems, Type conversions in expressions, Operator precedence and associativity, Mathematical functions.

Managing Input and Output Operators:

Reading a character, Writing a character, Formatted input, Formatted output.

UNIT-II

Decision Making and Branching:

Decision making with IF statement, Simple IF statement, The IF-ELSE statement, Nesting of IF...ELSE statements, The ELSE IF ladder, The switch statement, The ?: Operator, The GOTO statement.

Decision Making and Looping:

The WHILE statement, The DO statement, The FOR statement, Jumps in loops.

UNIT-III

Arrays:

One-dimensional arrays, Two-dimensional arrays, Initializing two-dimensional arrays, Multidimensional arrays.

User-Defined Functions:

Need for user-defined functions, A multi-function program, The form of C functions, Return values and their types, Calling a function, Category of functions, No arguments and no return values, Arguments but no return values, Arguments with return values, Handling of non-integer functions, Nesting of functions, Recursion, Functions with arrays, The scope and lifetime of variables in functions, Ansi C functions, Points to remember.

UNIT-IV

Structures and Unions:

Structure definition, Giving values to members, Structure initialization, Comparison of structure variables, Arrays of Structures, Arrays within structures, Structures within structures, Structures and functions, Unions, Size of structures, Bit fields.

Pointers:

Understanding pointers, Accessing the address of a variable, Declaring and initializing pointers, Accessing a variable through its pointer, Pointer expressions, Pointer increments and scale factor, Pointers and arrays, Pointers and character strings, Pointers and functions, Pointers and structures, Points on pointers.

UNIT-V

Dynamic Memory Allocation and Linked Lists:

Dynamic memory allocation, Concepts of linked lists, Advantages of linked lists, Types of linked lists, Pointers revisited, Basic list operations, Application of linked lists.

The Preprocessor:

Macro substitution, File inclusion, Compiler control directives, ANSI additions.

TEXT BOOK

Content and treatment as in the book "Programming in ANSI C" by E. Balagurusamy, Tata McGraw Hill Pub. Co., Second Edition, 1989.

Unit I - Chapters 1 to 4.
Unit II - Chapters 5 and 6.
Unit III - Chapters 7 and 9.
Unit IV - Chapters 10 and 11.
Unit V - Chapters 13 and 14.

REFERENCE BOOK

"The Sprit of C An introduction to Modern Programming", by H. Mullish and L. Cooper, JAICO Pub., Mumbai, 1997.

OPTIONAL - 2

(To be choosen by other Department students)

OMAM 116B NUMERICAL METHODS
(For all M.Sc. students except Mathematics)

Objectives: The roll of numerical analysis is to develop and analyze the numerical techniques. In this paper, different methods for finding the roots of algebraic and transcendental equations, solutions of simultaneous equations, solutions of differential equations are concentrated. Numerical differentiation and integration are also evaluated.

UNIT - I: The solution of Numerical Algebraic and Transcendental Equations:

Introduction, The Bolzano's bisection method, Method of successive Approximations or the iteration method, The method of false position (Regula Falsi Method), Newton's iteration Method (Newton - Raphson method).

UNIT - II: Simultaneous Linear Algebraic Equations:

Gauss Elimination method, Computation of the inverse of a matrix using Gauss elimination method, Method of Triangularisation (Method of Factorization), Crout's method, Iterative methods, Jacobi method of iteration (Gauss-Jacobi Method), Gauss Seidal method of iteration.

UNIT - III: Interpolation:

Introduction, Linear interpolation, Gregory Newton Forward and Backward interpolation Formula, Equidistant terms with one or more missing values.

Interpolation with unequal intervals:

Divided Differences, Properties of Divided differences, Newton's interpolation formula for unequal intervals, Lagrange's interpolation formula, Inverse interpolation.

UNIT - IV: Numerical Differentiation and Integration:

Introduction, Newton's forward difference formula to compute the derivatives, Newton's backward difference formula to compute the derivatives, Derivatives using Stirling's formula.

Trapezoidal rule, Simpson's rule, Practical applications of Simpson's rule, Trapezoidal rules.

UNIT - V: Numerical Solution of Ordinary Differential Equations:

Euler's method, improved Euler method, modified Euler method, Runge-Kutta methods, Second order Runge-Kutta Method, Higher order Runge - Kutta method.

TEXT BOOK

Content and treatment as in the book "Numerical Methods in Science and Engineering" by M.K. Venkataraman, The National Publishing Company, Madras, 1991.

Chapters - III, IV, VI, IX, XI.

REFERENCE BOOKS

1. Introductory Methods of Numerical Analysis by S.S. Sastry, Prentice Hall of India (P) Ltd. 1994.
2. Numerical Methods for Scientific and Engineering Computation, M.K. Jain, S.R.K. Iyengar, and R.K. Jain, Wiley Eastern Ltd., Third Edition, 1993.

OPTIONAL - 3

(To be choosen by other Department students)

OMAM 215A DISCRETE MATHEMATICS

(For all M.Sc. students except Mathematics)

Objectives: Students must understand mathematical reasoning in order to read, comprehend and construct mathematical arguments. Mathematical logic, which serves as foundation for subsequent discussion is discussed. Discrete structures such as sets and permutations are studied. Discrete probability, recurrence relations, conquer relations and principles of inclusion and exclusion are studied.

UNIT I: Logic and Counting:

Propositions and logical operations, Conditional statements, Methods of Proof, Mathematical Induction. Permutations, Combinations, Pigeonhole Principle, Elements of Probability, Recurrence Relations.

UNIT II: Relations and Digraphs:

Product sets and partitions, Relations and Digraphs, Paths in Relations and Digraphs, Properties of relations, Equivalence Relations, Computer Representation of

Relations and Digraphs, Operations on Relations, Transitive Closure and Warshall's Algorithm.

UNIT III: Functions:

Functions, Functions for Computer Science, Growth of Functions, Permutation Functions.

UNIT IV: Order Relations and Structures:

Partially Ordered Sets, Extremal Elements of Partially Ordered Sets, Lattice, Finite Boolean Algebras, Functions on Boolean Algebra, Circuit Designs.

UNIT V: Semigroups and Groups:

Semigroups, Product and Quotient of Semigroups, Groups, Product and Quotient of Groups.

TEXT BOOK

Content and treatment as in the book "Discrete Mathematical Structures" by Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, Prentice - Hall of India, Private Limited, New Delhi, 2002.

Unit I	Chapter 2 Sections 1 to 4, Chapter 3 Sections 1 to 5.
Unit II	Chapter 4 Sections 1 to 8.
Unit III	Chapter 5 Sections 1 to 4.
Unit IV	Chapter 6 Sections 1 to 6.
Unit V	Chapter 9 Sections 1 to 4.

REFERENCE BOOKS

1. Discrete Mathematics with Graph Theory by E.G. Goodaire and M.M. Paramenter, Prentice Hall International Editions, New Jersey (1998).
2. Invitation to Discrete Mathematics by J. Matonsek and J. Nesetril, Clarendon Press, Oxford (1998).
3. Discrete Mathematical Structures with Applications to Computer Science by J.P. Tremblay and R. Manohar, Tata McGraw Hill Publication Company, 1997.

OPTIONAL – 4

(To be choosen by other Department students)
OMAM 215B PROGRAMMING LANGUAGE C++
(For all M.Sc. students except Mathematics)

Objectives: After having a course on the language C, the much sought after language is C++. The language C++ is a Object Oriented Programming Language. First the syntax of the language C++ is introduced. This is followed by Control statement, Arrays, Functions, Pointers, Structures and Classes. Many problems are solved after writing algorithms and programs in C++.

UNIT - I: Using Turbo C++:

Setting Up Turbo C++, Memory Models, The Demonstration Tour, Borland Program Examples, Borland C++ Options, Take the Tour. Your First Program: Invoking Turbo C++, Naming Your Program, Using the Editor, Saving Your Program, Compiling and Linking, Running the program. Errors: Compiler Errors, Linker Errors, Run-time Errors. Other IDE features: Compiling and Linking Shortcut, Exiting from the IDE, Examining Files, Opening an Existing File, DOS Shell.

C++ Programming Basics:

Basic Program Construction: Functions, Program Statements, White Space. Output Using Cout: String Constants. Preprocessor Directives: The # include Directive, Header Files. Comments: Comments Syntax, When to Use Comments, Alternative Comment Syntax. Integer variables: Defining Integer Variables, Declarations and Definitions, Variable Names, Assignment Statement, Integer Constants, Output variations. Character Variables: Character Constants, Initialization, Escape Sequences. Input with Cin: Variables Defined at Point of Use, Cascading, Expressions, Precedence. Type float: Floating-Point Constants, The Const Qualifier, The # define Directive. Manipulators: The end L Manipulator, The set W Manipulator, Type Long, Cascading the Insertion Operator, Multiple definitions, The IOMANIP.H Header File. Variable Type Summary: Unsigned data types. Type Conversion: Automatic Conversions, Casts. Arithmetic operators: The Remainder Operator, Arithmetic Assignment operators, Increment Operators. Library Functions: Header Files, Library Files, Header Files and Library Files, Two Ways to Use # include.

UNIT - II: Loops and Decisions:

Relational operators. Loops: The for Loop, Using Turbo C++ Debugging Features, for Loop Variations, The while Loop, Precedence: Arithmetic and Relational Operators, The do loop, When to Use Which Loop. Decisions: The if Statement, The if...else Statement, The else...if Construction, The Switch Statement. The Conditional Operator. Logical Operators: Logical OR Operator, Logical AND Operator, The Logical NOT Operator, Precedence Summary, Other Control Statements, The break Statement, The continue Statement, The GOTO Statement.

UNIT - III: Functions:

Simple Functions: The Function Declaration, Calling the Function, The Function Definition, Comparison with Library Functions, Eliminating the Declaration. Passing

Arguments to Functions: Passing Constants, Passing Variables, Passing by Value, Passing Structure Variables, Names in the Declaration. Returning Values from Functions: The return Statement, Returning structure Variables. Reference Arguments: Passing Simple Data Types by Reference. Overloaded Functions: Different Numbers of Arguments, Different Kinds of Arguments. Inline Functions: Default Arguments, Variables and Storage Classes: Automatic Variables, External Variables, Static Variables, Storage, Returning by Reference.

UNIT - IV: Arrays:

Array Fundamentals. Defining Arrays, Array Elements, Accessing Array Elements, Averaging Array Elements, Initializing Arrays, Multidimensional Arrays, Passing Arrays to Functions, Arrays of Structures. Arrays as Class Member Data: Arrays of Objects, Arrays of English Distances, Arrays of Cards, String: Variables, Avoiding Buffer Overflow, String Constants, Reading Embedded Blanks, Reading Multiple Lines, Copying a String the Hard Way, Copying a String the Easy Way, Arrays of Strings, Strings as Class Members, A User-Defined String Type.

UNIT - V: Pointers:

Addresses and Pointers, The Address of Operator & Pointer Variables, Accessing the Variable Pointed To, Pointer to void. Pointers and Arrays: Pointer Constants and Pointer Variables. Pointers and Functions: Passing Simple Variables, Passing arrays, Sorting Array Elements. Pointers and Strings: Pointers to String Constants, Strings as Function Arguments, Copying a String Using Pointers, Library String Functions, Arrays of Pointers to Strings.

TEXT BOOK

Content and treatment as in the book "Object-Oriented Programming in TURBO C++" by Robert Lafore, Galgotia Publications Pvt. Ltd., New Delhi, 1996.

Unit-I	Chapters 2 & 3
Unit-II	Chapter 4
Unit-III	Chapter 6
Unit-IV	Chapter 8
Unit-V	Chapter 12

REFERENCE BOOK

Programming in ANSI C by E. Balagurusamy, Tata McGraw Hill Publishing Ltd., (Second Edition), New Delhi, 1992.