

B.Sc. MATHEMATICS

SYLLABUS

(with effect from June 2015)



DEPARTMENT OF MATHEMATICS

The Gandhigram Rural Institute – Deemed University
Gandhigram – 624 302 Tamil Nadu

Gandhigram Rural Institute (Deemed University), Gandhigram - 624302

(Fully Funded by Ministry of Human Resource Development, Govt. of India)

Department of Mathematics

B.Sc. Degree (Mathematics)

Revised Syllabus with effect from 2015 – 2016 onwards

Category	Course Code	Course Title	Number of Credits	Lecture Hours per week	Exam Duration (Hrs)	Marks		
						C.F.A	E.S.E	Total
Semester-I								
Language	15TAMU0101/ 15MALU0101/ 15HIDU0101/ 15FREU0101	Language I (Tamil/Hindi/Malayalam/French)	3	3	3	40	60	100
	15ENGU01X1	Language II English	3	3	3	40	60	100
Core Course	15MATU0101	Classical Algebra	4	4	3	40	60	100
	15MATU0102	Theory of Equations & Trigonometry	3	3	3	40	60	100
Allied Course	15PHYU01A1	Allied Physics –I (theory)	3	3	3	30	45	75
	@	Allied Physics –I (practical)		3	--	--	--	--
Foundation Course	15NSSU0001/ 15SHSU0001/ 15FATU0001/ 15SPOU0001	NSS/SS/FA/Sports	1	1	-	50	-	50
	15YOGU0002	Yoga	1	1	-	50	-	50
	15EVSU0001	Environmental Studies	3+1	3+2	-	100	-	100
TOTAL			22					
Semester-II								
Language	15TAMU0202/ 15MALU0202/ 15HIDU0202/ 15FREU0202	Language I (Tamil/Hindi/Malayalam/French)	3	3	3	40	60	100
	15ENGU02X2	Language II English	3	3	3	40	60	100
	15CTAU0001/ 15CHIU0001	Core Hindi/Core Tamil	2	2	2	20	30	50

Core Course	15MATU0203	Calculus	4	4	3	40	60	100
Allied Course	15PHYU02A2	Allied Physics – II (theory)	3	3	3	30	45	75
	15PHYU02A3	Allied Physics – II (practical)	2	3	3	30	20	50
Foundation Course	15GTPU0001	Gandhi's Life, Thought and Work	2	2	2	20	30	50
	15EXNU0001	Extension Education	2	2	--	20	30	50
Soft Skill	15ENGU00C1	Communication and Soft Skills	2	2	--	20	30	50
TOTAL			23					
Semester-III								
Language	15TAMU0303/ 15MALU0303/ 15HIDU0303/ 15FREU0303	Language I (Tamil/Hindi/Malayalam/French)	3	3	3	40	60	100
	15ENGU03X3	Language II English	3	3	3	40	60	100
	15CTAU0002 / 15CHIU0002	Core Hindi/ Core Tamil	2	2	2	20	30	50
Core Course	15MATU0304	Sequences, Series & Vector Calculus	3	3	3	40	60	100
	15MATU0305	Analytical Geometry	4	4	3	40	60	100
Allied Course	15MATU03A1	Object Oriented Programming with C++ Theory	3	3	3	30	45	75
	15MATU03A2	Object Oriented Programming with C++ Practical	1	2	3	15	10	25
Computer Skill	15MATU0306	Introduction to Computers and Office Automation (theory)	3	3	3	30	45	75
	15MATU0307	Introduction to Computers and Office Automation (practical)	1	2	3	15	10	25
Extension	15EXNU03V1	Village Placement Programme	2	--	--	50	--	50

Compulsory Non Credit Course	15MATU00F1	Compulsory Non Credit Course (Extension / Field Visit)	--	2	-	50	-	--
TOTAL			25					--
Semester – IV								
Core Course	15MATU0408	Abstract Algebra	4	4	3	40	60	100
	15MATU0409	Mathematical Statistics	4	4	3	40	60	100
	15MATU0410	Mechanics	4	4	3	40	60	100
Allied Course	15MATU04A3	Programming with Java Theory	3	3	3	30	45	75
	15MATU04A4	Programming with Java Practical	1	2	3	15	10	25
Electives	15MATU04EX	Major Elective	3	3	3	40	60	100
		Non Major Elective	3	3	3	40	60	100
Compulsory Non Credit Course	15MATU00F2	Compulsory Non Credit Course Extension / Field Visit	--	2	--	--	--	--
TOTAL			22					--
Semester – V								
Core Course	15MATU0511	Modern Analysis	4	4	3	40	60	100
	15MATU0512	Linear Algebra	4	4	3	40	60	100
	15MATU0513	Linear Programming	4	4	3	40	60	100
Electives	15MATU05EX	Major Elective	3	3	3	40	60	100
		Non Major Elective	3	3	3	40	60	100
Skill Based Elective	15MATU05S1	Quantitative Skills	2	2	--	20	30	50
TOTAL			20					
Semester – VI								
Core Course	15MATU0614	Operations Research	4	4	3	40	60	100
	15MATU0615	Differential Equations	4	4	3	40	60	100
	15MATU0616	Complex Analysis	4	4	3	40	60	100
	15MATU0617	Graph Theory	3	3	3	40	60	100
Modular Course	15MATU06MX	Modular Course	2	2	--	50	--	50
	15MATU06MX	Modular Course	2	2	--	50	--	50
Project	15MATU0618	Project	4	8	--	40	40+20	100
TOTAL			23					
GRAND TOTAL			136					

MAJOR ELECTIVES:

(15MATU04EX/ 15MATU05EX)

Semester -IV

1. 15MATU04E1 Numerical Methods
2. 15MATU04E2 Financial Mathematics

MODULAR COURSES: (15MATU06MX)

Semester -V

1. Fuzzy Set Theory
2. Mathematical Skills
3. Advanced Statistics

Semester -V

1. 15MATU05E1 Discrete Mathematics
2. 15MATU05E2 Introduction to Actuarial Science

Core Course
15MATU0101

Semester I
CLASSICAL ALGEBRA

Credits: 4

Objective: To impart skills in the various applications of algebraic methods.

Specific outcome of learning:

- The learner will become proficient in expansion and summation of function
- The learner will acquire knowledge of solving problems in matrices
- The learner will acquire skills of basic concepts of set theory
- The learner will become proficient in various types of functions
- The learner will acquire knowledge of basic concepts of number theory

Unit 1: Binomial theorem for any rational index - Exponential and Logarithmic Series - Summations and Approximations related to these series.

Unit 2: Matrices: Definition - Properties - Elementary transformations - Diagonalisation of matrices- Characteristic Equation - Cayley Hamilton Theorem - Evaluation of Eigen values and Eigen vectors.

Unit 3: Concept of a set- Finite and Infinite set – Axiom of extension – Set Algebra – Cartesian product of sets.

Unit 4: Relations and their types – Functions and their types-Countable and Uncountable sets.

Unit 5: Number Theory: Prime Numbers and Composite Numbers - Euler's function - Divisibility and Congruence relations - Fermat's theorem - Wilson's theorem.

Text Books:

1. S. Narayanan& T. K. ManickavasagamPillai, **Algebra**, vol. 1, S. Viswanathan Pvt. Ltd., Chennai, 2004. Unit 1: Chapter 3, 4, 5.
2. S. Narayanan& T. K. ManickavasagamPillai, **Algebra**, Vol. 2, S. Viswanathan Pvt. Ltd. Chennai, 2004. Unit 2: Chapter 2. Unit 5: Chapter 5.
3. S. Narayanan & T. K. ManickavasagamPillai, **Modern Algebra**, Vol. 1, S. Viswanathan Pvt. Ltd. Chennai, 1999. Unit 3, 4: chapter: 2.

References:

1. Seymour Lipschutz, **Set theory & Related Topics**, Schaum's outlines, 2nd Edition, Tata McGraw Hill, New Delhi, 2005.
2. Arumugam&Issac, **Classical Algebra**, New gamma Publishing house, Tirunelveli, 2003.

Core Course
15MATU0102

Semester I
THEORY OF EQUATIONS AND TRIGONOMETRY

Credits: 3

Objective: To learn techniques of solving algebraic and trigonometric equations.

Specific outcome of learning:

- The learner will acquire basic concepts of roots and coefficients of equation
- The learner will acquire skills of solving problems in transformation of equations
- The learner will gain knowledge of trigonometric functions and related problems
- The learner will become proficient in various types of hyperbolic functions
- The learner will acquire skills of solving problems in summations of trigonometric series

Unit 1: Theory of Equations: Fundamental Theorem of Algebra - Relations between roots and coefficients - Symmetric functions of roots.

Unit 2: Transformation of Equations - Reciprocal Equations - Newton's Method of Divisors - Descartes' rule of signs – Horner's Method.

Unit 3: Trigonometry: Expansion of functions, $\sin nx$, $\cos nx$, $\tan nx$ - Series for $\sin x$, $\cos x$, $\tan x$, $\sin^n x$ and $\cos^n x$ - Properties and their related problems.

Unit 4: Hyperbolic functions -Inverse hyperbolic functions- Logarithm of Complex Numbers.

Unit 5: Summations of trigonometric series- Properties and their related problems.

Text Books:

1. S. Narayanan & T. K. Manickavasagam Pillai, **Algebra**, Vol. 2, S. Viswanathan Pvt. Ltd., Chennai, 2004. Unit 1: Chapter 6, Secs 6.1-6.14, Unit 2 : Chapter 6, Secs 6.15-6.30.
2. S. Narayanan & T. K. Manickavasagam Pillai, **Trigonometry**, S. Viswanathan Pvt. Ltd., Chennai, 2001. Unit 3: Chapter 3, Unit 4: Chapter 4, 5, Unit 5: Chapter 6.

Reference:

1. Arumugam & Issac, **Theory of Equations, Theory of Numbers and Trigonometry**, New gamma Publishing house, Tirunelveli, 2011.

Core Course
15MATU0203

Semester II
CALCULUS

Credits: 4

Objective: To learn the different concepts of differential and integral calculus.

Specific outcome of learning:

- The learner will gain knowledge of differentiation and its applications
- The learner will acquire basic knowledge of integration
- The learner will become proficient in multiple integrals
- The learner will acquire skills of applications of multiple integrals
- The learner will gain concepts of change of variables

Unit 1: Differential Calculus: Successive Differentiation - Leibnitz theorem and its applications - Curvature - Radius of Curvature and Centre of Curvature - Evolutes and Involutives.

Unit 2: Integral Calculus: Properties of definite integrals - Integration by parts - Reduction formulae - Bernoulli's formula.

Unit 3: Integration as limit of an infinite sum. Multiple Integrals: Definition of double integral - Evaluation of double integral - double integral in polar coordinates.

Unit 4: Triple integrals. Improper Integrals: Beta and Gamma integrals and their relations.

Unit 5: Change of Variables: Jacobian - Change of variable in the case of two variables and three variables - Transformation from Cartesian to polar coordinates - Transformation from Cartesian to spherical polar coordinates.

Text Books:

1. S. Narayanan & T. K. Manickavasagam Pillai, **Calculus**, Vol.1. S. Viswanathan Pvt. Ltd., Chennai, 2004. Unit 1: Chapter III, Chapter X Secs 10.2.1-10.3.1
2. S. Narayanan & T. K. Manickavasagam Pillai, **Calculus**, Vol.2. S. Viswanathan Pvt. Ltd., Chennai, 2004. Unit 2: Chapter 1 Secs 1.1.1-1.15.1, Unit 3: Chapter I Secs 1.15.2, Chapter 5 Secs 5.1-5.3.2, Unit 4: Chapter 5 Secs 5.4-5.5.4 Chapter 7 Secs 7.1.1-7.5, Unit 5: Chapter 6

References:

1. George B. Thomas, JR & Ross L. Finney, **Calculus and Analytic Geometry**, Sixth edition, Narosa Publishing House, New Delhi, 1986.
2. Arumugam & Isaac, **Calculus**, Vol.1&2, New Gamma Publishing House, 1999.

Core Course
15MATU0304**Semester III**
SEQUENCES, SERIES AND VECTOR CALCULUS**Credits: 3**

Objective: To enhance basic skills in the areas of sequences and vectors.

Specific outcome of learning: The learner will become proficient in

- Types of sets, inequalities and sequences
- Behavior of sequences and its subsequences
- Infinite series and various tests for finding its convergence
- Vectors and its product
- Multiple vector integration

Unit 1: Sequences: Sets and functions-Intervals in \mathbb{R} -Bounded sets-Least upper bound and Greatest lower bound-Countable sets-uncountable sets-Inequalities of Holder's and Minkowski's-Bounded functions-Sequences-Bounded sequences-Monotonic sequences-Convergent sequences-Divergent and oscillating sequences- The algebra of limits.

Unit 2: Behaviour of monotonic sequences-Some theorems on limits-Subsequences-Limit points-Cauchy sequences-The upper and lower limit of a sequence.

Unit 3: Series of positive terms: Infinite series-Comparison test-Kummer's test -Root test and condensation test-Integral test-Series of arbitrary terms: Alternating series-Absolute convergence.

Unit 4: Vector Differentiation: Introductory Ideas-Vector Products-Gradient-Divergence - Curl.

Unit 5: Vector Integration: Line integral-Volume integral-Surface integral –Gauss divergence theorem(without proof) -Stoke's theorem (without proof) – Green's theorem (without proof).

Text Books:

1. S. Arumugam & A. Thangapandi Isaac, **Sequences and series**, New Gamma Publishing House, Palayamkottai, 1999. Unit 1-Secs 1.1-1.5, 3.1-3.6, Unit 2-Secs 3.7-3.12, Unit 3-Secs 4.1-4.5, 5.1-5.2.
2. S. Arumugam & A. Thangapandi Isaac, **Modern Analysis**, New Gamma Publishing House, Palayamkottai, 2002. Unit 1-Secs 1.2-1.4
3. S. Narayanan & T. K. Manicavachagom Pillai, **Vector Algebra and Analysis**, S. Viswanathan Pvt. Ltd., Chennai, 1995. Unit 4- Chapters 1, 2, 4, Unit 5- Chapter 6.

References:

1. N. P. Bali, **Real Analysis**, An imprint of Laxmi Publications Pvt. Ltd., New Delhi, 2005.
2. Sterling K. Berberian, **A First Course in Real Analysis**, Springer, New York, 2004.
3. Robert G. Bartle, Donald R. Sherbert, **Introduction to Real Analysis**, John Wiley and Sons, New Delhi, 1982.

Core Course
15MATU0305**Semester III**
ANALYTICAL GEOMETRY**Credits: 4**

Objective: To study the various properties of geometrical figures in two dimension and three dimension.

Specific outcome of learning: The learner will

- understand the basic concepts of circles, parabola, ellipse and hyperbola as a 2 dimensional objects.
- acquire knowledge of representing conics in polar co-ordinates.
- acquire knowledge of planes and its properties as a 3 dimensional objects.
- understand the concepts skew lines and spheres.
- solving problems related to geometry of two dimension and three dimension.

Unit 1: System of circles: orthogonal circles - coaxal systems- properties and related problems. Parabola: properties and related problems.

Unit 2: Ellipse – Hyperbola – Properties-and their related problems.

Unit 3: Polar Equations: Representation of basic curves in polar coordinates. General equation of Conic: Tracing the Conic - Properties and its applications.

Unit 4: Basic Properties – Direction Ratios and Direction Cosines – General equations of Plane – normal form- plane through the line of intersection of two planes.

Unit 5: Equation of the straight line – coplanar lines – skew lines – intersection of three planes. Sphere – Standard equation – properties and related problems.

Text Books:

1. S. Narayanan & T. K. Manickavasagam Pillai, **Analytical Geometry 2D**, S. Viswanathan Pvt. Ltd., Chennai, 2001. Unit 1: Chapter V, VI, Unit 2: Chapter VII, VIII, Unit 3 : Chapter IX (up to section 9), X (up to section 8)
2. S. Narayanan & T. K. Manickavasagam Pillai, **Analytical Geometry 3D**, S. Viswanathan Pvt. Ltd., Chennai, 2001. Unit 4: Chapter I, II, Unit 5: Chapter III, IV

References:

1. George B. Thomas, JR & Ross L. Finney, **Calculus and Analytic Geometry**, Sixth edition, Narosa Publishing House, New Delhi, 1986.
2. S. Arumugam & Issac, **Analytical Geometry 3D and Vector Calculus**, New Gamma Publications – Palayamkottai, 1997.

Allied Course -Theory
15MATU03A1

Semester III
OBJECT ORIENTED PROGRAMMING WITH C++

Credits: 3

Objective: To develop programming skills in C++ and its object oriented concepts.

Specific outcome of learning:

- The learner will become proficient in object oriented programming concept and proficient in C++ tokens
- Proficient in C++ operators
- Proficient in C++ class declaration and definition and its objects
- Proficient in constructors, destructors and operator overloading
- Proficient in the concept inheritance

Unit 1: What is C++ - Applications of C++ - A simple C++ program - An example with class - tokens - keywords - Identifiers and constants - basic, user defined, derived data types- symbolic constants - type compatibility - declaration of variables - dynamic initialization of variables.

Unit 2: Operator in C++ - scope resolution, member differencing, memory management operators - manipulators - type cast operator - the main function - function prototyping - call by reference - return by reference - inline functions - default, constant arguments - function overloading - math library functions.

Unit 3: C structure - specifying a class - defining member function - a C++ program with class making an outside function inline - nesting of member function - private member function - array within class - static data members - static member functions - array of objects -objects as function arguments - friendly functions

Unit 4: Constructors – parameterized constructors - multiple constructors in a class - constructors with default arguments - dynamic initialization of objects - copy constructor - dynamic constructors – destructors - defining operator overloading - overloading unary, binary operators.

Unit 5: Defining derived classes - single inheritance - multilevel inheritance - multiple inheritance-hierarchical inheritance -hybrid inheritance - virtual base class - abstract classes - constructors in derived classes.

Text Book:

1. E. Balagurusamy, **Object Oriented Programming with C++**, Third edition, Tata McGraw-Hill publication, New Delhi, 2006.

Unit 1: Chapters: 2.1 - 2.5, 3.1- 3.11,

Unit 2: 3.13-3.18, 4.1-4.9 & 4.11.

Unit 3: 5.1- 5.9, 5.11-5.15.

Unit 4: 6.1-6.8, 6.11, 7.2-7.5.

Unit 5: 8.1-8.11.

References:

1. V. Ravichandran, **Programming with C++**, Second Edition Tata McGraw - Hill, New Delhi, 2006.
2. H. Schildt, **The complete Reference of C++**, Tata-McGraw-Hill publishing Company Ltd. New Delhi, 2003.

Allied Course -Practical
15MATU03A2Semester III
OBJECT ORIENTED PROGRAMMING WITH C++

Credit: 1

Practical related to Object Oriented Programming with C++

1. List the prime numbers in a given range
2. Display Fibonacci series
3. Sorting given list of names in alphabetical order
4. Sorting given list of numbers in ascending order
5. Read and display for a given matrix of any order
6. Compute simple and compound interest values
7. Computer biggest among three numbers
8. Compute biggest among N integers
9. Compute factorial of a given number using recursive function
10. Write a program to swap the values using functions
11. Print perfect squares in a given range
12. Write a program to solve a quadratic equation and test with three types of roots.
13. Write a program to calculate the following functions to 0.0001% accuracy
 - a) $\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots$
 - b) $SUM = 1 + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{3}\right)^3 + \left(\frac{1}{4}\right)^4 + \dots$
 - c) $\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \dots$
14. Write a program to calculate variance and SD of N numbers
15. Write a program to read two matrices and compute matrix multiplication using functions
16. Prepare employee details using class with array of objects
17. Program to illustrate objects as function arguments
18. Program to illustrate parameterized constructors
19. Program to illustrate multiple constructors in a class
20. Show by a suitable program: how the unary minus operator is overloaded?
21. Show by a suitable program: how the binary operator is overloaded?
22. Prepare student mark list by using multilevel inheritance
23. Program to illustrate multiple inheritance
24. Prepare student mark list by using hybrid inheritance
25. Prepare student mark list by using the concept of virtual base class

Core Course- Theory

Semester III

15MATU0306

INTRODUCTION TO COMPUTERS AND OFFICE AUTOMATION

Credits: 3

Objective: To gain basic knowledge about computer peripherals, MS Office, Internet and E-commerce.

Specific outcome of learning:

- The learner will become proficient in MS windows software
- The learner will become proficient in MS word
- Proficient in data representation in diagram via MS Excel
- Proficient in preparation of power points
- Proficient in creation of E-mail and uses of web browser

Unit 1: Introduction to Computer: Block diagram, Memories, Devices, Operating System, Devices. Introduction to Windows: Starting Windows - Desktop - closing Windows - Start button - icons - Task bar - shortcut icons. Windows properties - Menu options, Minimize, Maximize, Close Active & Inactive Windows - Personal tools. Word pad: Creating & Saving a file, opening the saved file, word processing. Paint: creating & editing bitmaps - Multimedia tools - file system. Hard disk: Drive - folders - file - Exploring the files. My Computer - Explorer - moving files, deleting, cut, copy, paste - Exploring web.

Unit 2: Word Processing using MS WORD: Word processing - Advantages - MS WORD - Definition. Document: Create - save - Printing - Resave - Close- Exiting word. Editing: Opening document - cursor movement - selecting text - deleting - undo redo - Moving text - Copying text. Formatting text: Font - paragraph formatting - bullets & numbering - getting help - find and replace text - spell checking and correction - grammar checking - auto correct - auto text - using thesaurus - using tabs - defining & changing page setup - page print options. Tables: creating & formatting, multiple columns. Math equations and type setting in MS Word.

Unit 3: MS-EXCEL: Introduction to worksheet and Excel - Definitions - Advantages - Organization of worksheet area - entering information - number - Formula - save - data alignment - editing - range - definition - specifying - changing column width - row height - centering cell across column, hiding columns and rows - moving and copying data - inserting and deleting rows and columns - getting help.

Unit 4: MS-EXCEL: Formatting the worksheet - printing - setting up page and margin-defining header and footer - print options. Chart: creation - changing type - resize and move – controlling the appearance - modifying - deleting - printing - naming ranges - using statistical, Mathematical and financial functions - using drawing tool bar.

Unit 5: MS-POWER POINT: Introduction - Menus - Toolbar - Navigating Power Point– Creating Slides, Presentation, Animation, etc - working with Power Point. Internet: Internet Browsing, creating mail ID, Using search engines etc. – To know important govt. webpage’s for various forms, formats, exams etc, National/International University/Institute websites.

Text Book:

1. Sanjay Saxena, **MS-Office -2000 for every one**, Vikas Publishing House Pvt. Ltd., New Delhi, 2000.

Unit 1: Part I, Unit 2: Part II, III, Unit 3, 4: Part IV, Unit 5: Part V.

Reference:

1. R.X. Taxali, **P.C. Software for Windows 98 Made simple**, TATA McGraw-Hill Publishing Company Ltd., New Delhi, 2001.

Core Course-Practical

Semester III

15MATU0307 INTRODUCTION TO COMPUTERS AND OFFICE AUTOMATION

Credit: 1

Practical related to Computer Skill

1. Note pad Applications
2. Control Panel Setup
3. Designing Advertisement and Document creation with special features like header, footer, tables, etc.
4. Typing practices on Algebraic & Transcendental Equations, System of Equations, Matrices, Integral Equations, Differential Equations, etc. in MS Word
5. Table creation and Table editing, Table to Text / Text to Table conversion in MS Word
6. Electricity Bill creation, Mark sheet creation and Charts in Work Sheet
7. Power Point presentation on various concepts
8. Regression Equation Worksheet

Core Course
15MATU0408

Semester IV
ABSTRACT ALGEBRA

Credits: 4

Objective: To provide some knowledge about various algebraic structures.

Specific outcome of learning: The learner will be able to

- recognize the basic properties of groups and subgroups.
- understand the types of homomorphism and use them to classify groups.
- apply the theorems to study the structure of groups.
- recognize the basic properties of rings, fields and integral domains.
- apply the algebraic methods for solving problems.

Unit 1: Groups: Definition and Examples - Elementary Properties of a group – Quaternion group – Groups of symmetries – Order of an element – Sub groups.

Unit 2: Homomorphism and their types – Cayley’s theorem – Groups of permutations-Cyclic groups.

Unit 3: Automorphisms – Cosets and Lagrange’s theorem – Normal subgroups and Quotient groups – Fundamental theorem of Homomorphism.

Unit 4: Rings: Definition and Examples – Elementary Properties of rings –Division rings and Fields – Ordered Integral Domain – Sub rings and sub fields.

Unit 5: Homomorphism of rings and their types – Ideals – Quotient Structure and Isomorphism theorems – Fundamental theorem of ring Homomorphism – Prime and Maximal Ideals.

Text Book:

1. S. Narayanan & T. K. Manickavasagam Pillai, **Modern Algebra**, Vol. II, S. Viswanathan Pvt. Ltd., Chennai, 1997.

Unit 1: Chapter 1: Sections 1.1, 1.2, 1.3

Unit 2: Chapter 1: Sections 1.4, 1.5, 1.6

Unit 3: Chapter 1: Sections 1.7, 1.8, 1.9, 1.10 (up to Theorem 1.10.3)

Unit 4: Chapter 2: Sections 2.1, 2.2, 2.3, 2.4

Unit 5: Chapter 2: Sections 2.5, 2.6, 2.7, 2.8

References:

1. S. Arumugam & A. T. Isaac, **Modern Algebra**, SciTech Publications, India Pvt. Ltd., 2003.
2. John. B. Fraleigh, **A first course in abstract algebra**, 7th edition, Addison-Wesley Publications, US, 2003.

Core Course
15MATU0409**Semester IV**
MATHEMATICAL STATISTICS**Credits: 4**

Objective: To impart skills in various applications of statistical methods.

Specific outcome of learning: The learner will be able to

- analyze the given data by using statistical methods.
- understand the basic concepts of probability and related results.
- use different probabilistic methods to solve problems arise in different situations.
- construct and evaluate hypothesis tests.
- apply sampling techniques to real life situations.

Unit 1: Measures of Central Tendency – Measures of Dispersion – Moments, Skewness and Kurtosis – Theory of Probability: Definition – Axioms – Addition and Multiplication Theorems – Baye’s Theorem on conditional probability and its applications.

Unit 2: Random variables – Discrete and Continuous – Definition of Probability Mass Function and Density Function – Distribution Functions – Properties – Mathematical Expectations – Mean, Variance and Moments – Moment Generating Functions – Simple properties .

Unit 3: Theoretical distributions – Discrete: Binomial Distribution and Poisson distribution – Continuous: Normal Distribution Properties and Applications.

Unit 4: Curve Fitting by the Method of Least Squares – Correlation – Properties – Regression – Equations of Regression Lines – Angle between Regression Lines – Properties and Applications.

Unit 5: Sampling: Introduction – Types of Sampling – Parameters and Statistical Tests of Significance – Null Hypothesis – Large Sample Tests – Sampling Distributions: t, Chi – Square and F distributions.

Text Book:

1. S. Arumugam & A. Thangapandi Isaac, **Statistics**, New Gamma Publishing House, 2006.
Unit 1: Chapter 1: Sections 1.0 -1.4; Chapter 2: Section 2.0-2.5; Chapter 3: Sections: 3.0 -3.2; Chapter 4: Sections: 4.0 -4.2; Chapter 11: Sections: 11.0 -11.2.
Unit 2: Chapter 12: Sections 12.0 -12.5.
Unit 3: Chapter 13: Sections 13.0-13.3.
Unit 4: Chapter 5: Section 5.0, 5.1; Chapter 6: Section 6.0-6.3
Unit 5: Chapter 14: Sections 14.0-14.5.

References:

1. J.N. Kapoor & H.C. Saxena, **Mathematical Statistics**, S. Chand & Co Pvt. Ltd., New Delhi, 1994.
- S. C. Gupta & V. K. Kapoor, **Fundamentals of Mathematical Statistics**, S. Chand & Sons Pvt. Ltd., New Delhi, 1994.

Core Course
15MATU0410**Semester IV**
MECHANICS**Credits: 4**

Objective: To learn the application of geometric and trigonometric properties in equilibrium and motion of particles.

Specific outcome of learning:

- The learner will be able to apply geometrical concepts in parallel forces, moments and couples
- Proficient in static equilibrium of three forces acting on a rigid body and friction
- Proficient in Newton's laws of motion and projectiles
- Proficient in collision of elastic bodies
- Proficient in motion under action of central forces

Unit 1: Basic Concepts and Principles - Forces acting at a Point - Lami's Theorem and Applications - Parallel Forces - Like and Unlike Parallel Forces - Moment of a force - Couples - Related problems.

Unit 2: Equilibrium of Three Forces acting on a rigid body - Friction - Laws of Friction - Angle of Friction - Cone of Friction - Properties and related problems.

Unit 3: Motion in a Straight line under uniform acceleration - Newton's Laws of motion. Projectiles: Definition - Path of Projectile - Range on an Inclined Plane - Properties and Problems.

Unit 4: Impulse and Impact: Collision of Elastic Bodies - Direct and Oblique Impact - Loss of Kinetic Energy - Related Properties and Simple Problems.

Unit 5: Central Orbits: Motion under the action of Central Forces - Properties and Related Problems - Differential Equation of Central Orbit - Pedal Equation of Central Orbit - Velocities in a Central Orbit - Law of Forces - Properties and Related Problems.

Text Books:

1. M. K. Venkataraman, **Statics**, Agasthiar Publications, Trichy, 2004.
Unit 1: Chapters 2, 3, 4
Unit 2: Chapters 5, 7
2. M. K. Venkataraman, **Dynamics**, Agasthiar Publications, Trichy, 2004.
Unit 3: Chapters 3: section 3.22, Chapter 4: Section 4.3, Chapter 6
Unit 4: Chapter 8
Unit 5: Chapter 11

References:

1. T. K. Manickavasagam Pillai, **Statics**, S. Viswanathan & Co., Chennai, 1980.
2. S. Narayanan, **Dynamics**, S. Chand & Co., New Delhi, 1980.

Allied Course -Theory
15MATU04A3

Semester IV
PROGRAMMING WITH JAVA

Credits: 3

Objective: To develop object oriented programming skills in JAVA and its applications in webpage designing.

Specific outcome of learning:

- The learner will become proficient in the creation and implementation of java programs and Java tokens
- Proficient in operators and expressions
- Proficient in decision making and looping
- Proficient in interfaces
- Proficient in applet programming

Unit 1: Overview of java language: Introduction - Simple java program - An application with two classes - Java program structure - Java tokens - Java statements - implementing a java program - Java virtual machine - Command line arguments: Constants, Variables and Data types - declaration of variables giving values to variables - Scope of variables - Symbolic constants - Type casting - Getting values of variables - Standard default values.

Unit 2: Operators and Expressions: Arithmetic operators - Relational operators - Logical operators - Assignment operators - Increment and decrement operators- Conditional operators - Bitwise operators - Special operators- - Arithmetic expressions -Evaluation of expressions - Precedence of Arithmetic operators - Type conversion in expressions - Operator precedence and associativity. 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 - Switch statement -The?: operator.

Unit 3: Decision making and Looping: The while statement - The do statement - the for statement - Jumps in loops - Labeled loops. Classes, Objects and Methods Defining a Class - Adding variables -.Adding methods - Creating Objects - Accessing Class members - Constructors -Methods. Overloading - Static members- Nesting of methods - Inheritance: Extending a class - Overriding methods - Final variables and methods - final classes - finalizer methods - Abstract methods and, classes - visibility control - Arrays - One dimensional. Arrays - Crating an array -Two dimensional array - Strings - Vectors - wrapper Classes.

Unit 4: Interfaces: Defining interfaces - Extending interfaces - Implementing interfaces - Accessing interface variables - Packages: Java API Packages - Using system packages - Naming conventions - Creating packages - Accessing a package -Using a package - adding a class to a package - Hiding classes.

Unit 5: Applet Programming: Introduction - How applets differ from applications - Preparing to write applet - Building applet code - Applet life cycle - Creating an executable applet - Designing a web page - Applet tag - Adding applet to HTML File - Running The Applet - More about applet tag - Displaying numerical values- Getting input from the user. **Graphics Programming:** Introduction - The Graphics class - Lines and Rectangles - Circles and Ellipses - Drawing arcs - Drawing polygons -. Line graphs - Using control loops in applets - Drawing bar charts.

Text Book:

1. E.Balagurusamy, **Programming with Java**, McGraw - Hill Publishing Company Ltd., New Delhi, 2005.
 - Unit 1: Chapters 3, 4
 - Unit 2: Chapters 5, 6
 - Unit 3: Chapters 7, 8, 9
 - Unit 4: Chapters 10, 11
 - Unit 5: Chapters 14, 15.

References:

1. H. Schildt, **JAVA2: The Complete Reference**, Fourth Edition, TMH Publishing Company, New Delhi, 2001.
2. C. Xavier, **Programming with JAVA 2**, SciTech Publications, Chennai, 2000.

Allied Course -Practical
15MATU04A4**Semester IV**
PROGRAMMING WITH JAVA**Credit: 1****Practical related to Programming with Java**

1. Write a program to determine the sum of harmonic series
2. Write a program to convert the given temperature in Fahrenheit to Celsius
3. Write a program to perform any 5 math functions
4. Write a program to solve two linear equations with two unknowns
5. Prepare your house EB bill according to unit price of reading range by TNEB
6. Display Floyd's triangle
7. Compute power of 2 using for loop
8. Reverse the digits using while loop
9. Write a program that computes and prints a table of factorials for any given m.
10. Write a program to compute sum of digits of a given integer
11. Write a program using do...while loop to calculate and print first m Fibonacci numbers
12. Program to illustrate Class
13. Program to illustrate Constructors
14. Program to illustrate method overloading
15. Program to illustrate static members
16. Program to illustrate inheritance concept
17. Write a program to sort a list of numbers
18. Write a program to perform matrix multiplication
19. Write a program for alphabetical ordering of strings
20. Write a program to calculate compound interest value by using wrapper class methods
21. Prepare student mark list by implementing multiple inheritance using interfaces
22. Program to illustrate packages
23. Develop an applet that receives three numeric values as input from the user and then displays the largest value on the screen. Write a HTML page and test the applet.
24. Applet program to display bar chart for the following data:

Year	:	2010	2011	2012	2013	2014	2015
Turnover	:	110	150	100	170	190	120

(Rs. Crores)
25. Write applets to draw the following shapes:
 - a) Cone
 - b) Cylinder
 - c) Cube
 - d) Square inside a circle
 - e) Circle inside a square

Core Course
15MATU0511

Semester V
MODERN ANALYSIS

Credits: 4

Objective: To impart concepts about sets with metric and related properties.

Specific outcome of learning: The learner will become proficient in

- Sets with various metric functions
- Open sets and closed sets and its properties
- Completeness of a metric space
- Continuous and discontinuous functions on metric spaces
- Connected metric spaces and properties of continuous functions on it

Unit 1: Metric Spaces: Definitions and examples-Bounded sets in a metric space-Open ball in a metric space-Open sets-equivalent metrics.

Unit 2: Subspaces- Interior of a set- Closed sets –Closure- Limit point-Dense sets.

Unit 3: Complete metric space: Completeness- Cantor's intersection theorem-Baire's Category theorem.

Unit 4: Continuity: Continuity – Homeomorphism-Uniform continuity-Discontinuous functions on \mathbb{R} .

Unit 5: Connectedness: Definition and examples, Connected subsets of \mathbb{R} - Connectedness and continuity; Compact space: Compact subsets of \mathbb{R} -Equivalent characterization for compactness- Compactness and continuity.

Text Book:

1. S. Arumugam & A. Thangapandi Isaac, **Modern Analysis**, New Gamma Publishing House, Palayamkottai, 2002. Unit 1-Secs 2.1-2.4. Unit 2-Secs 2.5-2.10. Unit 3-Secs 3.1-3.2. Unit 4-Secs 4.1-4.4. Unit 5-Secs 5.1-5.3, 6.1-6.4.

References:

1. N. P. Bali, **Real Analysis**, An imprint of Laxmi Publications Pvt. Ltd., New Delhi, 2005.
2. Sterling K. Berberian, **A First Course In Real Analysis**, Springer, New York, 2004.
3. Robert G. Bartle and Donald R. Sherbert, **Introduction to Real Analysis**, John Wiley and Sons, New Delhi, 1982.
4. Richard R. Goldberg, **Methods of Real Analysis**, Oxford & IBH Publishing CO. PVT. LTD., New Delhi, 1970.
5. S. C. Malik & Savita Arora, **Mathematical Analysis**, New Age International LTD., New Delhi, 1992

Core Course
15MATU0512**Semester V**
LINEAR ALGEBRA**Credits: 4**

Objective: To introduce the fundamentals of Vector spaces.

Specific outcome of learning: The learner will be able to

- recognize the basic properties of vector spaces
- understand the concepts of linear algebra in geometric point of view
- visualize linear transformations as a matrix form
- apply the tools of linear algebra to solve the system of equations
- formulate the importance and applications of linear algebra in many branches of mathematics

Unit 1: Vector Spaces: Definition and Examples –Properties of vector space - Linear combination-Linear span.

Unit 2: Linear Dependence and Independence–Basis- Dimension- Quotient space.

Unit 3: Isomorphism of vector spaces – Direct sums- Matrix of a linear transformation-Rank and Nullity of a linear transformation.

Unit 4: Characteristic equation of a matrix- Matrix Polynomial – Elementary matrices and Transformations- Row rank, column rank and rank of a matrix- Row space and column space.

Unit 5: Inner product spaces: Definition and Examples –Orthogonality – Orthogonalization- Orthogonal Complement.

Text Book:

1. S. Narayanan & T. K. Manickavasagam Pillai, **Modern Algebra**, Vol III, S. Viswanathan Pvt. Ltd., Chennai, 1997.
 - Unit 1: Chapter 1: Sections 1.1, 1.2, 1.3, 1.4.
 - Unit 2: Chapter 1: Sections 1.5, 1.6, 1.7, 1.8.
 - Unit 3: Chapter 1: Sections 1.9, 1.10; Chapter 2: Sections 2.1, 2.2.
 - Unit 4: Chapter 2: Sections 2.5, 2.6, 2.7.
 - Unit 5: Chapter 3: Sections 3.1, 3.2, 3.3, 3.4

References:

1. S. Arumugam & A. T. Isaac, **Modern Algebra**, SciTech Publications, India Pvt. Ltd., 2003.
2. S. Kumaresan, **Linear Algebra: A Geometric approach**, Prentice Hall of India, 2006.
3. Vivek Sahai & Vikas Bist, **Linear Algebra**, Narosa Publishing House, 2002.

Core Course
15MATU0513**Semester V**
LINEAR PROGRAMMING**Credits: 4**

Objective: To impart the basic concepts and applications of linear programming.

Specific outcome of learning:

- The learner will formulate a linear programming problem and solve them graphically and simplex method
- The learner will be able to understand the concepts of duality programming
- The learner will analyze the different aspects of transportation problems and also assignment problems
- The learner will develop, organize, evaluate short, long term processes and solve problems
- The learner will acquire the knowledge of basics in game theory

Unit 1: Introduction to convex sets - Mathematical Formulation of LPP - Graphical Solution - Simplex Method – Big M Method - Two Phase Method.

Unit 2: Duality in Linear Programming: Formulation of Primal - Dual Pairs - Duality and Simplex Method - Dual Simplex Method.

Unit 3: Transportation Problems: Mathematical formulation of the problem - finding initial basic feasible solution using North West Corner Rule and Vogel's approximation method - Moving towards Optimality - Unbalanced Transportation Problems. Assignment Problems: Mathematical formulation of Assignment Problems - Assignment algorithm - Routing Problems.

Unit 4: Sequencing Problems: Problems with 'n' jobs and 'k' machines - Problems with 'n' jobs and 2 machines- Problems with 2 jobs and k machines - Problems with 2 jobs and 3 machines.

Unit 5: Game Theory: Two persons Zero sum games - maximin and minimax principle - Games without saddle points - Mixed strategies - Graphical method - Dominance property.

Text Book:

1. KantiSwarup, P. K. Gupta & Man Mohan, **Operations Research**, Sultan Chand & Sons, New Delhi, Twelfth Revised Edition, 2005.
Unit 1: chapter 2: 2.1,2.2, chapter 3: 3.2, chapter 4: 4.1, 4.4.
Unit 2: chapter 5: 5.2, 5.3, 5.7, 5.9.
Unit 3: Chapter 10: 10.2,10.9, 10.14, Chapter 11: 11.2, 11.3.
Unit 4: Chapter 12: 12.1 – 12.6.
Unit 5: Chapter 17: 17.1 – 17.7.

References:

1. P. K. Gupta & D. S. Hira, **Operations Research**, S. Chand & Company Ltd., New Delhi, 2002.
2. J. K. Sharma, **Operations Research theory and its applications**, 2nd Edition, Macmillan, New Delhi, 2006.
3. R. Panneerselvam, **Operations Research**, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.

Skill Based Elective 15MATU05S1	Semester V QUANTITATIVE SKILLS	Credits: 2
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Objective: To impart skills in numerical and quantitative techniques.

Specific outcome of learning: The learner will be

- able to critically evaluate various real life situations by resorting to Analysis of key issues and factors.
- proficient in applying graphs, charts and probability techniques on various problems.
- proficient in the problems on relations, coding and decoding.
- able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
- able to face interviews.

Unit 1: H.C.F and L.C.M of Numbers- decimal fractions- simplifications- square roots and cube roots- average- Problems on Numbers- Problems on Ages Surds and Indices.

Unit 2: Tabulation- Bar graphs- Pie charts- Line graphs- Permutation and combinations- Probability- true discount- Banker's discount- Heights and distances.

Unit 3: Percentages- Profit and Loss- Ratio-Proportion- Partnership- Chain rule- Time and work- Pipes and cistern-Time and Distances.

Unit 4: Problems on Trains- Boats and Streams- Coding and decoding- Blood Relations- Logical Venn Diagram.

Unit 5: Logical deduction- Alphabet Test- Deriving conclusion from passages- Group discussion (on any current relevant topic).

Text Book:

1. R.S. Aggarwal, **Quantitative Aptitude**, 7th Revised Edition, S. Chand & Company Ltd., New Delhi, 2015.

Reference:

1. R.S. Aggarwal, **A Modern approach to verbal Reasoning**, (Fully solved), Chand & Company Ltd., New Delhi, 2012.

Core Course
15MATU0614**Semester VI**
OPERATIONS RESEARCH**Credits: 4**

Objective: To impart mathematical modeling skills through operations research techniques.

Specific outcome of learning: The learner will become proficient in modeling and decision making processes in mathematics and engineering.

- The student will be able to demonstrate knowledge of the major concepts of decision theory and decision making process.
- Students will be able to identify the basic analysis of queuing systems.
- Students will be able to identify the basic analysis of various inventory models.
- The students will acquire the knowledge of system reliability and specific types of simulation.
- The learner will become to understand the role and application of PERT/CPM for project scheduling.

Unit 1: Decision Theory: Introduction – Decision making problem – Decision making process – Decision making environment – Decision under uncertainty – Decision under risk – Decision tree analysis – Decision making with utilities.

Unit 2: Queuing Theory: Introduction – Queuing system – Characteristics of Queuing system – Probability Distributions in Queuing system – Classification of Queuing Models – Transient and Steady State. Definitions – Poisson Queuing system.

Unit 3: Inventory Control: The inventory decisions – Cost associated with inventories – Factors affecting inventory control – Economic Order Quantity (EOQ) – Deterministic Inventory Problems with no shortages – Deterministic Inventory Problems with shortages – EOQ Problems with Price Breaks.

Unit 4: Replacement Problems and System Reliability: Replacement of equipment – Replacement of equipment that fails suddenly – Reliability and system failure rates. Simulation: Methodology of simulation – simulation models – Event type simulation – Generation of Random Numbers – Monte-Carlo Simulation – Simulation of a Queuing System – Simulation of an inventory System.

Unit 5: Network Scheduling by PERT/CPM: Network and basic components – Logical sequencing – Rules for network construction – Critical Path Method – Probability considerations in PERT – Distinctions between PERT and CPM.

Text Book:

1. KantiSwarup, P. K. Gupta&Man Mohan, **Operations Research**,Twelfth Revised Edition, Sultan Chand & Sons New Delhi, 2005.

Unit 1: Chapter 16: 16.1-16.8.

Unit 2: Chapter 20: 20.1-20.8.

Unit 3: Chapter 19: 19.1-19.8.

Unit 4: Chapter 18: 18. 1-18.3, 18.6, Chapter 23: 23.1-23.9.

Unit 5: Chapter 21: 21.1-21.7.

References:

1. P. K. Gupta & D. S. Hira, **Operations Research**, S. Chand and Company Ltd., New Delhi, 2002.
2. J. K. Sharma, **Operations Research theory and its applications**, 2ndEdition, Macmillan India Limited, 2003.

Core Course
15MATU0615**Semester VI**
DIFFERENTIAL EQUATIONS**Credits: 4**

Objective: To introduce the basic concepts of differential equations and Fourier series.

Specific outcome of learning: The learner will

- Understand the basic concepts of first order differential equation and its applications.
- Determine solutions to second order linear homogeneous, non-homogeneous differential equations with constant coefficients.
- Find solutions by applying Laplace transform methods.
- Understand the elementary theory of partial differential equations, and solve it using various techniques.
- Familiar with Fourier series and their applications to partial differential equations.

Unit 1: Differential Equations: Introduction – First order O.D.E – Types of first order O.D.E – Applications of first order O.D.E – first order O.D.E of higher degree.

Unit 2: Linear Second Order Equations with constant coefficient and particular integral of the functions of the type X^m , $e^{ax}\cos bx$ and $e^{ax}\sin bx$ only. Homogeneous linear equations with variable coefficients - Variation of parameters - Simultaneous Equations - Linear equations of the second order with variable coefficients.

Unit 3: Laplace Transform of Elementary Functions - Laplace Transforms of Periodic Functions - Inverse Transforms - Solutions of Ordinary Second Order Differential Equations with Constant Coefficients.

Unit 4: Partial Differential Equations (PDE) Forming a PDE - Lagrange Method of solving Linear Equations - Standard forms of PDE - Charpits Method.

Unit 5: Fourier series: Expansion of a function - Dirichlet's Conditions - Determining the Fourier Coefficients- Odd and Even Functions - Half Range Sine Series - Half Range Cosine Series.

Text Books:

1. S. Narayanan & T.K. Manickavasagam Pillai, **Differential Equations**, S. Viswanathan Pvt. Ltd., Chennai, 1995.
Unit 1: Chapters I-IV
Unit 2: Chapter V (up to section 6), Chapter VI, Chapter VIII.
Unit 3: Chapter IX
Unit 4: Chapter XII
2. T. Veerarajan, **Transforms and Partial Differential Equations**, Tata McGraw Hill Education Private Ltd., New Delhi, 2012.
Unit 5: Chapter 1-Section 1.1 – 1.9

References:

1. Arumugam & Isaac, **Differential Equations and Applications**, New Gamma Publishing House, 2003.
2. M. D. Raisinghania, **Advanced Differential equations**, S. Chand Publications, New Delhi 2004.
3. K. Vairaamanickam, Nirmala P. Ratchagar & T. Tamilselvan, **Transforms and Partial Differential Equations**, SciTech Publications Pvt. Ltd., 2011.

Core Course
15MATU0616

Semester VI
COMPLEX ANALYSIS

Credits: 4

Objective: To introduce the concepts of complex numbers and analytic functions.

Specific outcome of learning:

- The learner will acquire basic concepts of analytic function and its properties
- The learner will acquire basic knowledge about conformal and bilinear transformation
- The learner will gain knowledge of integration of complex valued function
- The learner will become proficient in series of analytic function
- The learner will acquire skills of finding integral values of complex function using residues

Unit 1: Analytic function - Cauchy Riemann Equation in Cartesian and polar co-ordinates - Harmonic function Properties and applications.

Unit 2: Conformal mappings - Linear and Non-linear transformations - Bilinear transformations - Properties and applications.

Unit 3: Integration in the Complex plane - Cauchy's Integral theorem - Cauchy's Integral formula - Liouville's theorem - Maximum modulus theorem - Applications and simple problems.

Unit 4: Taylor's and Laurent's series - Expansion of functions in power series - Singular points - Types of singularities - Properties of singularities - Identification of singularities.

Unit 5: Calculus of Residues: Residue theorem - Integration of functions of the type involving $\cos x, \sin x$ - Applications and problems relating to residues.

Text Book:

1. S. Narayanan & T.K. Manickavasagam Pillai, **Complex Analysis**, S. Viswanathan Publishers, Chennai, 1997.
 - Unit 1: Chapter 1
 - Unit 2: Chapter 2
 - Unit 3: Chapter 3

Unit 4: Chapter 4

Unit 5: Chapter 5

References:

1. S. Arumugam, A. Thangapandi Isaac & A. Somasundaram, **Complex Analysis**, SciTech Publications, India, Pvt. Ltd., 2004.
2. S. Ponnusamy, **Foundations of Complex Analysis**, 2nd Edition, Narosa Publication, New Delhi, 2005.
3. R. V. Churchill & J. W. Brown, **Complex variables and applications**, 5th Edition, McGraw Hill, Singapore, 1990.

Core Course
15MATU0617

Semester VI
GRAPH THEORY

Credits: 3

Objective: To acquire knowledge of different types of graphs.

Specific outcome of learning:

- To understand different Models of a graph
- Students can develop various algorithms related to graph parameters
- To understand how to solve different real life problems
- To understand many techniques to solve a particular problem
- To understand different colouring parameters.

Unit 1: The Definition of a graph - graphs as models - more definitions - vertex degrees, sub graphs - paths and cycles - Matrix representation of graphs - fusions. Trees and Connectivity - definitions and simple properties – bridges - spanning trees.

Unit 2: Connector problems - Kruskal's algorithm - Prim's algorithm - Shortest path problems- Cut vertices and connectivity.

Unit 3: Euler tours and Hamiltonian cycles - The Chinese postman problem - Fleury's Algorithm - Hamiltonian Graphs - The travelling salesman problems (Except closest insertion Algorithm).

Unit 4: Matching and Augmenting paths - The marriage problem - The Hall's marriage theorem - The Personnel Assignment Problem - The Optimal Assignment Problem.

Unit 5: Plane and Planar Graphs - Euler's Formula - Vertex colouring - Vertex colouring Algorithms - critical graphs.

Text Book:

J.Clark &D.A.Holton, **A first Look at Graph Theory**, Allied Publishers, New Delhi,1995. Chapters 1,2,3,4,5 and 6.

References:

1. J.A. Bondy & U.S.R.Murty, **Graph Theory with Applications**, Elsevier, New York,1976.
2. S.A.Choudam, **A first course in Graph Theory**, Macmillian, India Ltd., Delhi, 2007.

Modular Course
15MATU06M1

Semester VI
FUZZY SET THEORY

Credits: 2

Specific outcome of learning: The learner will be able to

- recognize the concept of fuzzy sets and its properties.
- distinguish fuzzy sets from crisp sets.
- perform various operations on fuzzy sets.
- understand the fuzzy graphs and fuzzy relations.

Unit 1: Fuzzy Sets: Sets- Definition of Fuzzy - Expanding Concepts of Fuzzy Set -Standard Operation of Fuzzy Set- Fuzzy Complement – Fuzzy Union– Fuzzy Intersection – Other Operations in Fuzzy Set – T-norms and T-conorms.

Unit 2: Fuzzy Relation and Composition: Fuzzy Relation– Extension of Fuzzy set - Fuzzy Graph and Relation: Fuzzy Graph – Characteristics of Fuzzy Relation- Classification of Fuzzy Relation- Other Fuzzy Relations.

Text Book:

1. Kwang H. Lee, **First Course on Fuzzy Theory and Applications**, Springer, New York, 2005.
Unit 1: Chapter 1: Sections 1.4 -1.6; Chapter 2: Sections 2.1 - 2.6
Unit 2: Chapter 3: Sections 3.3 - 3.4; Chapter 4: Sections 4.1 - 4.4

References:

1. G. J. Klir and B. Yuan, **Fuzzy Sets and Fuzzy Logic**, Prentice-Hall India, 1995.
2. H. J. Zimmermann, **Fuzzy Set Theory and Its Applications**, Springer, 2001.
3. Didier Dubois and Henri Prade, **Fuzzy Sets and Systems: Theory and Applications**, Academic Press, 1980.

Modular Course
15MATU 06M2

Semester VI
MATHEMATICAL SKILLS

Credits: 2

Objective: To impart Mathematical competitive skills.

Specific outcome of learning:

- The learner will acquire knowledge of interest calculation.
- The learner will become proficient in odd man out and series problems.

Unit 1: Allegation or mixture – Simple Interest – Compound Interest – Area

Unit 2: Volume and surface Areas - Calendar - Odd man out and series

Text Books:

1.R.S.Aggarwal, **Quantitative Aptitude**, 7th Revised Edition, S. Chand and Company Ltd, New Delhi, 2015

Unit 1: Section1, Topic 20,21,22,24

Unit 2: Section1, Topic 25, 27, 35

Reference:

1. Abhijit Guha, **Quantitative Aptitude for MBA Entrance Examinations**, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2006

Modular Course
15MATU 06M3

Semester VI
ADVANCED STATISTICS

Credits: 2

Objective: To import skills of various advanced statistical techniques.

Specific outcome of learning

- The learner will become proficient in consistency of data and index number.
- The learner will acquire knowledge of measuring trends and analysis of variance.

Unit 1: Theory Attributes: Attributes-Consistency of data- Independent and Association of data- Index Number: Types of index numbers- Conversion of chain base to fixed base and converse.

Unit 2: Analysis of Time series: Components of time series- Measurement of trends-Analysis of variance: One, Two, Three Criteria classification

Text Book:

S. Arumugam & A. Thangapandi Isaac, *Statistics*, New Gamma Publishing house, Tirunelveli, 2006.

Unit 1: Chapters 8, 9,

Unit 2: Chapters 10, 11

References:

1. J. N. Kapoor & V. C. Saxena, *Mathematics Statistics*, S. Chand & Co Pvt. Ltd, Newdelhi, 1994.
2. S. C. Gupta & V.K. Kapoor, *Fundamentals of Mathematical Statistics*, S.Chand & & Co Pvt. Ltd, Newdelhi, 1994.

Core Course
15MATU0618

PROJECT

Credits: 4

Major Elective
15MATU04E1**Semester IV**
NUMERICAL METHODS**Credits: 3**

Objective: To develop efficient algorithms for solving problems in Science, Engineering and Technology.

Specific outcome of learning:

- The learner will be capable of solving the interpolation problems.
- Students will be able to identify the basic concept of numerical differentiation and integration, principle of least squares.
- The learner will analyze the different aspects of numerical solution of algebraic and transcendental equations.
- The learner will become knowledgeable in solving solution to simultaneous linear equations.
- The learner will become to understand the role and application of numerical solution of ordinary differential equations.

Unit-1: Errors in Numerical Calculations: Errors and their computations - A general error formula - Error in a series. Approximation Solution of Algebraic and Transcendental equations: The Bisection method – The Method of False position - Iteration method - Newton - Raphson method.

Unit-2: Interpolation: Finite differences - Forward Differences – Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols. Newton's Formulae for Interpolation - Gauss's central difference formulae - Stirling's formula - Interpolation with unevenly spaced points: Lagrange's interpolation formula - Inverse Interpolation.

Unit-3: Numerical Differentiation: Derivatives using Newton's Forward Difference Formula – Derivatives using Newton's Backward Difference Formula - Derivatives using Stirling's Formula - Maxima and Minima of Tabulated Function. Numerical Integration: General Quadrature Formula - Trapezoidal Rule - Simpson's 1/3 Rule - Simpson's 3/8 Rule.

Unit-4: Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss - Jordan method - Jacobi's method - Gauss - Seidel method.

Unit -5: Numerical Solutions of Ordinary Differential Equations: Solution by Taylor's series - Picard's method of successive approximations – Runge - Kutta Methods - Milne's Predictor - Corrector Method.

Text Book:

1. S. S. Sastry, **Introductory Methods of Numerical Analysis**, Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2005.

Unit 1: Chapter 1: Section 1.3 to 1.5, Chapter 2: Section 2.1 to 2.5

Unit 2: Chapter 3: Section 3.3.1 to 3.3.4, 3.6, 3.7.1, 3.7.2, 3.3.9

Unit 3: Chapter 5: Section 5.1, 5.2.1, 5.3, 5.4.1, 5.4.2, 5.4.3

Unit 4: Chapter 6: Section 6.3.2, 6.3.3, 6.4

Unit 5: Chapter 7: Section 7.2, 7.3, 7.5, 7.6

References:

1. Gerald & Wheatly, **Applied Numerical Analysis**, Sixth Edition, Pearson Education Pvt. Ltd., New Delhi, 2002.
2. S. Arumugam, A. Thangapandi Isaac & A. Somasundaram, **Numerical Methods**, Scitech Publications Pvt. Ltd., 2001.
3. V. N. Vedamurthy & N. Ch. S. N. Iyengar, **Numerical Methods**, Vikas Publishing House Pvt. Ltd. New Delhi, 2000.

Major Elective
15MATU04E2

Semester IV
FINANCIAL MATHEMATICS

Credits: 3

Objective: To impart mathematical concepts related to finance and insurance.

Specific outcome of learning:

- Specialise advanced topics in the area of financial mathematics and actuarial analysis and their applications
- Differentiate between simple and compound interest and extrapolate the advantages and disadvantages of each in specific situations
- Do calculations using computational tools efficiently and correctly and verify solutions in terms of the context.
- Use solutions to calculations effectively to define the changes that occur over a period.
- Students will use methods of correlation and regression to analyse and interpret a given data set and make predictions.

Unit 1: Mathematics of Compound interest - Mathematical base of life contingencies - effective interest rate, nominal interest rate - continuous payments, interest in advance - perpetuities - annuities - repayment of debit- internal rate of return future life time of a life aged x - the model - force of mortality - analytical distribution of T - the curate future life time of (x) - Life table - Probabilities of deaths for fraction of a year.

Unit 2: Life insurance - insurance types - whole life and term insurance - pure Endowment - Endowments - insurance, payable at the moment of death- general type of life insurance - variable life insurance - recursive formula. Life annuities - elementary life annuities - payment made more frequently than once a year - variables life annuities - types of life annuities - recursive formula - inequalities - Payment starting at non-integral age. Net premium - elementary forms of insurance - whole life - Term insurance, pure Endowment - Endowments - deferred life annuities - premium paid m times year - general type of life insurance - policies with premium refund - stochastic interest.

Unit 3: Net premium reserves - examples - recursive consideration - survival risk - net premium risk of a whole life insurance - net premium reserve at fractional duration - allocations of overall loss to policy year - conversion of an insurance - Technical gain - procedure for pure endowment - continuous model - multiple decrements model - forces of decrement - curate life time of (x) , general type of insurance, net premium reserve - continuous model. Multiple life insurance - Joint life status - simplification- last survivor status general symmetric status - Schuette-Nesbitt formula - asymmetric annuities- asymmetric insurances.

Unit 4: The total claim amount in a portfolio - normal approximations - calculation of total claim amount distribution - compound Poisson approximation - recursive calculation of compound Poisson distribution - reinsurance stop-loss reinsurance - expense loading – introduction expenses loaded premium - expense loaded premium reserves - estimating probabilities of death - problem description - classical method - Alternative solution - maximum likelihood method - statistical inference - Bayesian approach - multiple causes of decrement - interpretation of result.

Unit 5: Applications in regression analysis - Functional form -dummy variable - distributed log model - forecasting - binary choice model - interpretation of binary choice model - solved problems.

Text Books:

1. Hans U.Gerber, **Life Insurance Mathematics**, Third edition, Springer Verlag, New York 1997. Chapters: 1-11.
2. D.Salvalore & D.Reagle, **Statistics and Economics**, Schaum's outline Series, Tata McGraw Hill, New Delhi, 2005. Chapter 8 only.

Major Elective
15MATU05E1

Semester V
DISCRETE MATHEMATICS

Credits: 3

Objective: To impart theoretical knowledge about discrete mathematics.

Specific outcome of learning:

- Formulate and interpret statements presented in Boolean logic. Reformulate statements from common language to formal logic. Apply truth tables and the rules of propositional and predicate calculus,
- Formulate short proofs using the following methods: direct proof, indirect proof, proof by contradiction, and case analysis,
- Demonstrate a working knowledge of set notation and elementary set theory, recognize the connection between set operations and logic, prove elementary results involving sets, and explain Russell's paradox,
- Apply the different properties of injections, surjections, bijections, compositions, and inverse functions,
- Solve discrete mathematics problems that involve: computing permutations and combinations of a set, fundamental enumeration principles, and graph theory.

Unit 1: Mathematical Logic- Propositional calculus- Basic Logical operators- conditional statements- Bi conditional statement- tautologies- contradictions- equivalence implications.

Unit 2: Norms forms- Theory of inference for the statement calculus- The predicate calculus- inference theory and predicate calculus.

Unit 3: Recurrence relations and generating functions- recurrence relation- solution of linear recurrence relation with constant coefficients- Non homogeneous recurrence relations- solution of Non – homogeneous recurrence relations- Methods of generating functions.

Unit 4: Basic theorems on Boolean Algebra- Duality principle Boolean functions.

Unit 5: Boolean functions- Applications of Boolean algebra- Logic gates and circuits- combinatorial circuits- Boolean expression – karnaugh map.

Text Book:

1. M.K. Venkatraman, N.Sridharan& N.Chandrasekaran, **Discrete Mathematics**, The National Publishing company India, 2000.

References:

1. J.B.Tremblay, R. Manohar, **Discrete Mathematical structures with applications to computer Science**, Tata McGraw Hill, International edition New Delhi:1997, Reprint 2007.
2. K.D.Joshi, **Foundations of Discrete Mathematics**, New Age International, New Delhi.
3. SartajSahni, **Concepts in discrete Mathematics**, Narosa Publishing House, New Delhi.
4. Garrett Birkhoff Thomas C. Bartee, **Modern Applied Algebra**, CBS Publishers, New Delhi.

Major Elective**Semester V**

15MATU05E2

INTRODUCTION TO ACTUARIAL SCIENCE

Credits: 3

Objective: To impart various concepts related to insurance.

Specific outcome of learning:

- Develop an understanding of the actuarial profession, what actuaries do, and how they do it.
- How liabilities in general insurance and life insurance are modelled and evaluated.
- why life insurance is so different and more predictable and despite
- Develop the critical and analytical thinking skills necessary for success in the profession.
- application of quantitative skills to problems in finance that normally involve risk or uncertainty.

Unit 1: The widening scope of Actuarial Theory and practice: Introduction – Financial Intermediaries -their role in resolving the “constitutional weakness” - Functional Approach to the Analysis of Intermediaries - Intermediating function If Banks, insurance, unit Trust and mutual funds. Banks, Insurance Companies and Pension Funds: Fundamental Similarities and Differences- Banks loans, Credit Risk and Insurance -The Evolving Relationship Banking and Insurance - Some examples of the Evolving Product Links between Banks and Non-banks – conclusion.

Unit 2: Investment and Valuation: Introduction-Cash Instruments-General Characteristics-Specific Cash instruments and Valuation Issues-Risk Characteristics – General Characteristics of conventional Bonds- Government Bonds-Corporate Bonds – Bond Valuation- Economic Analysis-Risk Characteristics-General Characteristics of Index Linked Bonds - Valuation - Economic Analysis - Risk Characteristics – Estimating Market Expectations of Inflation using Market Information.

Unit 3: General Characteristics of Foreign Currency Bonds: Valuation-Economic Analysis - Risk Characteristics. General Characteristics of Equity Investment: Equity Valuation-Economic Analysis - Risk Analysis. Real Estate Investment: Valuation - Economic Analysis - Risk Analysis. International Equity Investment: International Equity Valuation - Economic Analysis - Risk Analysis - Derivatives - General Characteristics – Valuation - Risk Characteristics.

Unit 4: Investment Risk: Introduction-Utility theory and Risk measures - Relating Utility Functions to Risk Aversion and the Risk Premium -Summary Risk Measures – Standard Deviation of Returns- Downside/Shortfall Risk Measures-Value at Risk-Practical Issues when Calculating VAR- Tail Loss-Combining Risk and Return Measures – Coherent Risk Measures-The use of Shortfall Constraints.

Unit 5: Portfolio selection Techniques and Investment Modeling: Introduction – Immunization - Derivation of Conditions - Observation on the Theory of Immunization-The usefulness of Immunization in Practice-Modern Portfolio Theory – Portfolio Diversification-Efficient Portfolios-Capital Market Line- The Capital Asset Pricing Model. Modern Portfolio Theory: Insights and Limitations - Extension of Portfolio Theory to Include Actuarial Liabilities-Portfolio Optimization in the Presence of Liabilities-Connection between Redington and the Wise-Willkie Approach-Generalization of Portfolio Optimization in the Presence of Liabilities-Portfolio Selection in an Asset/Liability Framework using a Generalized Approach to Risk.

Text Book:

1. Philip Booth, **Modern Actuarial Theory and Practice**, Second Edition, Chapman and Hall / CRC, New York, 2004. Chapter 1: Secs1.1 to. 1.11, Chapter 2: Secs2.1 to 2.9,Chapter 4: Secs4.1 to 4.6, Chapter 5: Secs5.1 to 5.4.