ARYAVART INTERNATIONAL UNIVERSITY

Tilthai, Dharmanagar, North Tripura-799250

Syllabus for M.Sc. (Mathematics)

Semester 1

Theory									
Course Code	Topic	L	T	P	Credit	Theory Marks	Internal Marks	Practical Marks	Total Marks
24MT102	Real Analysis	4	0	0	4	70	30	0	100
24MT103	Abstract Algebra	4	0	0	4	70	30	0	100
24MT104	Ordinary Differential Equations	4	0	0	4	70	30	0	100
24MT105	Complex Analysis	4	0	0	4	70	30	0	100
24CS102	C Programming	4	0	0	4	70	30	0	100
Practical									
24CS192	C Programming Lab	0	0	2	2	0	30	70	100
	Total				**22**	**350**	**180**	**70**	**600**

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Detailed Syllabus

REAL ANALYSIS

Code: 24MT102
Max Marks: 70

UNIT I
Lebesgue outer measure, Measurable sets, Regularity, Measurable functions, Borel and Lebesgue measurability, non-measurable sets.

UNIT II
Integration of non-negative functions, General integral, Fatou's lemma, Integration of series, Riemann and Lebesgue integrals.

UNIT III
Functions of bounded variation, Lebesgue differentiation theorem, Differentiation and integration, Absolute continuity of functions, Measures and outer measures, Measure spaces, Integration with respect to a measure.

UNIT IV
The L^P-spaces, Holder and Minkowski inequalities, Completeness of L^P-spaces, Convergence in measure, almost uniform convergence, Egorov's theorem.

Text Books:

1. Barra G. de, Measure Theory and Integration, New Age International (P) Ltd., New Delhi, 2014.
2. Hewitt E. and Stromberg K., Real and Abstract Analysis: A Modern Treatment of the Theory of Functions of a Real Variable, Springer, Berlin, 1975.

Reference Books

1. Capinski M. and Kopp E., Measure, Integral and Probability, Springer, 2005.
2. Royden H.L. and Fitzpatrick P.M., Real Analysis, 4th edition, Pearson, 2015.

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ABSTRACT ALGEBRA

Code:24MT103
Max Marks: 70

UNIT I
Conjugacy, Class equations, p-groups, Sylow p-subgroups, Sylow theorems, Applications of Sylow theorems, Description of groups of order p^2 and p.q, Survey of groups up to order 15.

UNIT II
Normal and subnormal series, Solvable series, Derived series, Solvable groups, Solvable groups, Solvability of S_n -the symmetric group of degree $n \geq 2$, Central series, Nilpotent groups and their properties, Jordon Holder's Theorem.

UNIT III
Rings, Ideals, Prime and maximal ideals, Homomorphism, Quotient- rings, Integral domains, Field, Prime fields, Field of quotients of an Integral domain, Euclidean domains, Principal ideal domains, Unique factorization Domain.

UNIT IV
Gauss lemma, Eisenstein's irreducibility criterion, Primitive polynomials, Cyclotomic polynomials, Unique factorization in R[x] where R is a Unique factorization Domain, Finite fields, Construction of finite fields.

Text Books:

1. Gallian J. A., Contemporary Abstract Algebra.
2. David S. Dummit and Richard M. Foote, Abstract Algebra, Wiley.

Reference Book:

1. Herstein I.N., Topics in Algebra, New Age International (P) Limited, New Delhi, 2005.
2. Bhattacharya P. B., Nagpaul S.K., Basic Abstract Algebra, 2nd edition, Cambridge University Press, Indian Edition, 1997.

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ORDINARY DIFFERENTIAL EQUATIONS

Code: 24MT104
Max Marks: 70

UNIT I

Initial-value problem and the equivalent integral equation, e-approximate solution, Cauchy- Euler construction of an e-approximate solution, Equi-continuous family of functions, Ascoli- Arzela theorem, Cauchy-Peano existence theorem. Existence and uniqueness of solutions, Lipschitz condition, Picard-Lindelof theorem for local existence and uniqueness of solutions, solution of initial value problems by Picard method

UNIT II

Power Series Solutions, Review of power series, Series solutions of first order equations, Second order linear equations, Ordinary points, Regular singular points, Indicial equations, The point at infinity, Frobenius method. Sturm Liouville Theory, Sturm separation theorem. Normal form, Sturm's comparison theorem, Sturm Liouville problems, Characteristic values and Characteristic functions in Sturm Liouville problems.

UNIT III

System of Linear Differential Equations, Basic theory of linear systems in normal form, two equations in two unknown functions, homogeneous linear systems with constant coefficients, two equations in two unknown functions.

UNIT IV

Non-linear differential equations, Autonomous systems, Phase plane, Critical points, Concepts of stability, Critical points and paths of linear system, Liapunov's direct method, Liapunov functions.

Text Books:

1. Ross S. L., Differential Equations, John Wiley and Sons Inc., NY, 1984.
2. Raisinghania M. D., Ordinary Differential Equations, S. Chand.

Reference Book:

1. Coddington E. A. and Levinson N., Theory of Ordinary Differential Equations, McGraw Hill, NY, 1955.
2. Birkhoff G. and Rota G. C., Ordinary Differential Equations, John Wiley and Sons Inc..NY, 1978.
3. Boyce W. E. and Diprima R. C., Elementary Differential Equations and Boundary Value Problems, John Wiley and sons Inc., NY, 1986.

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COMPLEX ANALYSIS

Code: 24MT105
Max Marks: 70

UNIT I
Analytic functions and their properties, Cauchy-Riemann equations in cartesian and polar coordinates, Power series, Radius of convergence, Differentiability of sum function of a power series, Branches of many valued functions with special reference to arg z, log z and z^a.

UNIT II
Path in a region, Contour, Complex integration, Cauchy's theorem, Cauchy's integral formula, Extension of Cauchy's integral formula for multiple connected domains, Poisson integral formula, Higher order derivatives, Complex integral as a function of its upper limit, Morera's theorem, Cauchy's inequality, Liouville's theorem.

UNIT III
Zeros of an analytic function, Taylor series, Laurent series, Isolated singularities, CassoratiWeierstrass theorem, Limit point of zeros and poles, Maximum modulus principle, Schwarz's lemma, Meromorphic functions, Argument principle, Rouche's theorem, Fundamental theorem of algebra, Inverse function theorem.

UNIT IV
Calculus of residues, Cauchy's residue theorem, Application of residue theorem in evaluation of improper real integrals and evaluation of sum, Definitions and examples of conformal mappings, Bilinear transformations, their properties and classifications, Orientation principle.

Text Books:

1. Conway J. B., Functions of one Complex variable, 2nd edition, Narosa Pub., New Delhi, 1996.
2. Goyal and Gupta, Functions of a Complex Variable, Pragati Edition, 2016.

Reference Books:

1. Churchill R. V. and Brown J. W., Complex Variables and Applications, McGraw-Hill Publishing Company, 2009.
2. Priestly H. A., Introduction to Complex Analysis, Clarendon Press, Oxford, 1990
3. Ahlfors L. V., Complex Analysis, 3rd edition, Mc Graw Hill Co., Indian Edition, 2017.
4. Rudin W, Real and Complex Analysis, 3rd edition, Mc Graw Hill, 1987

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C PROGRAMMING

Code: 24CS102
Max Marks: 70

UNIT I

Computer Programming: Basic Programming concepts, Modular programming and structured programming, Problem solving using Computers, Concept of flowcharts and algorithms.

Overview of C: Introduction, Importance of C, Sample C Programs, Basic structure of C programs, programming style, Executing a C Program.

Constants, Variables and Data types: C Tokens, keywords, and identifiers, constants, variables, datatypes, declaration of variables, assigning values to variables, defining symbolic constants.

Operators and Expressions: Arithmetic operators, Relational operators, Logical operators, Assignment operators, increment and decrement operators, conditional operator, bitwise operators, type conversion in expressions, operator precedence and associativity.

Mathematical functions.

UNIT II

Input and Output statements, reading a character, writing a character, formatted input, formatted output statements.

Decision-making, Branching and Looping: 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, The WHILE statement, The DO statement, The FOR statement, Jumps in loops.

UNIT III

Arrays: One dimensional array, Two-dimensional arrays, initializing arrays, Programs based on arrays such as sorting, Fibonacci sequence, Matrix operations, etc.

Handling of Characters and Strings: Declaring and initializing string variables, Reading string from terminal, writing string to screen, Arithmetic operations on characters, Putting strings together. Comparison of two strings, Character and string handling functions.

UNIT IV

User defined functions: Need for user-defined functions, A multi-functional program, The form of 'C' function, 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, Nesting of functions, Recursion, Functions with arrays as parameters.

UNIT V

Structure and Union: Structure definition, Giving values to members, Structure initialization; Comparison of structure variables, Array of structures, Array within structure, Union.

Pointers: Understanding pointers, Accessing the address of variables, Declaring and initializing pointers, Accessing a variable through its pointer.

Text Book:

1. Kamthane, Programming with ANSI and Turbo C; Pearson Education 2003

Reference Books:

1. E. Balaguruswamy: Programming in ANSI C", Tata McGraw-Hill (1998)
2. Yeshvant Kanetkar: "Let us C"
3. V.Rajaraman: "Programming in C", PHI (EEE) (2000)
4. Rajesh Hongal: "Computer Concepts & C language"
5. Brain Kernighan & Dennis M. Ritchie "ANSI C Programming" (PHI)

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C PROGRAMMING LAB

(BASED ON 24CS102) C Programming:

Core Practical (Implement minimum 8 out of 10 practical)

1. Write a program to convert temperature from Celsius to Fahrenheit by taking input from the user.
2. Write a program to find the greatest number among 3 numbers given by the user.
3. Write a program to check if a given number is a prime number or not.
4. Write a program to display the following pattern up to N rows, taking the value of N from the user:

   1
   2 3
   4 5 6
   7 8 9 10
5. Write a program to input marks of 50 students using an array and display the average marks of the class.
6. Write a program to search for a number entered by the user in a given array and display the array in ascending order.
7. Write a program to check if a string is palindrome or not.
8. Write a program to add, subtract, multiply and divide two numbers using pointers.
9. Write a program to create a structure for employees containing the following data members: Employee ID, Employee Name, Age, Address, Department and Salary. Input data for 10 employees and display the details of the employee from the employee ID given by the user.
10. Write a program to create two files with names EvenFile and OddFile. Input 20 numbers from the user and save even numbers in EvenFile and odd numbers in OddFile.

Application Based Practical (Implement minimum 5 out of 10 practical)

11. Write a menu driven program to construct a calculator for following arithmetic operations: addition, subtraction, multiplication, division, average and percentage.
12. Write a menu driven program to perform the following operations:
    (i) Print armstrong numbers upto N,
    (ii) Display prime numbers between 1 to N,
    (iii) Reverse of an integer
13. Write a program to convert a hexadecimal number into a binary number.
14. Write a program to calculate factorial of a number and display fibonacci series upto N terms using recursive functions.
15. Write a program to perform
    (i) matrix addition,
    (ii) matrix multiplication, and
    (iii) Matrix transpose on 2D arrays.
16. Write a program to make use of arrays with structures in the following ways:
    (i) Use array as a structure data member
    (ii) Create array of structure variables
17. Write a program to compare the contents of two files by taking names of the files through command line arguments.
18. WAP to perform I/O and make use of file positioning functions on Binary files. (using fseek, ftell, rewind functions)
19. Write a menu driven program to implement the following string operations:
    (i) Calculate length of a string
    (ii) Concatenate at the end of a given
    (iii) Copy one string to another
    (iv) Compare contents of two strings
    (v) Copy nth character string to another
20. Write a program to read time in string format and extract hours, minutes and second also check time validity

Note:

1. **In total 15 practical to be implemented. 2 additional practical may be given by the course instructor.**
2. **This is a suggestive list of programs. However, the instructor may add programs as per the requirement of the course.**

Theory Paper

Total: 100 Marks
External: 70 Marks
Internal: 30 Marks
External: 70 Marks
10 Question (MCQ): 1 mark each (1x10 = 10)
Answer any 6 out of 8 (Very Short 20-30 Words): 2 marks each (2x6 = 12)
Answer any 6 out of 8 (Short 50-70 Words): 3 marks each (3x6 = 18)
Answer any 6 out of 8 (Long 100-120 Words): 5 marks each (5x6 = 30)

Internal: 30 Marks
Two Internal Assessment Examinations will be conducted, each carrying 50 marks. The higher of the two scores will be considered for the final assessment.

Lab

Practical: 100 Marks
External: 70 Marks
Internal:30 Marks
External (Two programs): 70 Marks
Program Writing: 10 + 10 Marks
Algorithm& Flowchart: 5 + 5 Marks
Program Execution: 15 + 15 Marks
Viva: 10 Marks

Internal Assessment (30 Marks)
Internal Assessment Examinations will be conducted, carrying 50 marks
Record: 5 Marks
Attendance: 5 Marks
Program Writing: 15 Marks
Program Execution: 15 Marks
Viva: 10 Marks

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Syllabus for M.Sc. (Mathematics)

Semester 2

Theory									
Course Code	Topic	L	T	P	Credit	Theory Marks	Internal Marks	Practical Marks	Total Marks
24MT202	Mathematical Statistics	4	0	0	4	70	30	0	100
24MT203	Linear Algebra	4	0	0	4	70	30	0	100
24MT204	Mathematical Methods	4	0	0	4	70	30	0	100
24MT205	Numerical Methods	4	0	0	4	70	30	0	100
24CS301	Object Oriented Programming with C++	4	0	0	4	70	30	0	100
24GN402	Universal Human Values	2	0	0	2	70	30	0	100
Practical									
24CS391	C++ Lab	0	0	2	2	0	30	70	100
	Total				**24**	**420**	**210**	**70**	**700**

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Detailed Syllabus

MATHEMATICAL STATISTICS

Code: 24MT202
Max. Marks: 70

UNIT I
Random variable and probability functions: definition and properties, Discrete and continuous random variables, probability mass and density function, Two-dimensional random variable, joint, marginal and conditional distribution, Mathematical expectation and its properties, Moment generating function: definition and their properties.

UNIT II
Discrete Distributions, Uniform and Bernouli distribution (definition only), Binomial Distribution: definition and their properties, Poisson Distribution: definition and their properties. Continuous Distribution, Normal Distribution: definition, Properties of Normal Distribution, Area under Normal Probability Curve, Importance of normal distribution, Chebyshev's inequality, Weak law of large number, Central limit theorem.

UNIT III
Testing of Hypothesis: Parameter and Statistic, null and alternate hypothesis, Simple and Composite hypothesis, Critical region, Level of Significance, One tailed and two tailed test, two types of error. Test of Significance: Large sample test for single mean, single proportion, difference between two means and two proportions.

UNIT IV
Gamma distribution and their properties, Exponential distribution and their properties, Sampling distribution: chi –square test (Goodness of fit test, Independence of Attributes), t- test (for single mean, for difference of mean), F-test (for equality of two population variances).

Textbooks:

1. Gupta, S. C. and Kapoor V. K., Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi.
2. Baisnab and Jas, M., Element of Probability and Statistics, Tata McGraw Hill.

Reference Books:

1. Freund J.E., Mathematical Statistics, Prentice Hall of India.
2. Hogg, R. V. and Craig, A. T., Introduction to Mathematical Statistics, Pearson Education Limited-2014.
3. Speigel, M., Probability and Statistics, Schaum Outline Series.
4. A. M. Mood, F. A. Graybill, and D. C. Boes, Introduction to the theory of Statistics, McGraw Hill Book Company

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LINEAR ALGEBRA

Code: 24MT203
Max. Marks: 70

UNIT I

Dual spaces, Dual basis, Second dual space, Annihilators, Characteristic polynomial, Cayley Hamilton theorem, Diagonalization, Eigenvalues and Eigenvectors, Algebraic and Geometric multiplicity of an eigenvalue, Minimal polynomial, Characteristic and minimal polynomial of block matrices.

UNIT II

Canonical forms: Triangular form, Invariance, Invariant-direct sum decompositions, Primary decomposition, Normal form, Nilpotent operators, Jordon Canonical form, cyclic subspaces, Rational Canonical form, Raw and column space of a matrix, Quotient Space.

UNIT III

Inner product space: Inner product spaces, Orthogonality and orthonormality, Orthogonal expansion, Adjoint of a linear transformation, self-adjoint transformation, Cauchy-Schwarz inequality, Gram Schmidt orthogonalization process, Inner product space isomorphism, Complex inner product space, Unitary operator, Normal operator, positive operator, Invariance and reducibility in inner product space.

UNIT IV

Bilinear, Quadratic and Hermitien forms: Bilinear forms, Bilinear forms and matrices, Alternating bilinear forms, Symmetric bilinear forms, Real symmetric bilinear forms, Quadratic forms, Law of inertia, Orthogonal diagonalization of the quadratic form, Conversion of a symmetric matrix into quadratic form, rank of a quadratic form, Hermitian forms, Matrix representation of a Hermitian form.

Textbooks:

1. Lipschutz S. and Lipson M., Schaum's Outline of Linear Algebra, McGraw Hill, India, 2004.
2. Halmos P.R., Linear Algebra with Problems. Mathematical Association of America, 2013.
3. Pundir S.K., A competitive approach to Linear Algebra, CBS Publishers & Distributors, 2015.

Reference Books:

1. Andrilli S. and Hecker D, Elementary Linear Algebra, Academic Press, 2012.
2. Kolman B and Hill D. R., Introductory Linear Algebra with Applications, Pearson Education, 2003.
3. Hoffman K. & Kunze R., Linear Algebra, Second Edition, Pearson Education, 2002.

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MATHEMATICAL METHODS

Code: 24MT204
Max. Marks: 70

UNIT I
Curvilinear Co-ordinates: co-ordinate transformation, orthogonal co-ordinates, change of coordinates, cartesian, cylindrical and spherical coordinates, expressions for velocity and acceleration ds, dv and ds2 in orthogonal coordinates, area, volume and surface area in cartesian, cylindrical and spherical coordinates in few simple cases, gradient, divergence, curl, Laplacian in orthogonal coordinates, contravariant and co-variant components of a vector, metric coefficients and the volume element.

UNIT II
Fourier Series: Periodic Functions, Euler's formulae for Fourier series, Fourier series for discontinuous functions, half range series, Parseval's identity, Fourier integral theorem. Fourier Transform: Definition and properties, Fourier transform of some elementary functions, convolution theorem, application of Fourier transforms to solve ordinary and partial differential equation.

UNIT III
Mellin Transform: Definition, elementary properties, Mellin transform of derivatives, Integrals, Inverse Mellin transform, Convolution theorem, Inverse Mellin transform of two functions. Hankel Transform: Definition, Elementary properties, Hankel transform of derivatives, Exponential functions, Inversion formula for Hankel transformation, Parseval's theorem, relation between Hankel and Laplace transform.

UNIT IV
Bessel's functions, Bessel function of second kind of order n, Trigonometric expansion involving Bessel Functions, Bessel Integral, Fourier-Bessel Expansion, ber and bei function. Legendre's associated functions and differential equation, integral expression for associated Legendre polynomial, recurrence relation for associated Legendre polynomial.

Textbooks:

1. Sneddon, I. N., The Use of integral Transforms, McGraw Hill, 1972.
2. Bell W. W., Special Functions for Scientists and Engineers, Courier Corporation, 2004.
3. Spiegel M., Lipschutz S., Spellman D., Vector Analysis, Schaum's Series 2011.

Reference Books:

1. Goyal S. P., Goyal A. K., Integral Transforms and its Applications, Jaipur Publishing House, 2014.
2. Raisinghania M. D., Ordinary Differential Equations, S. Chand & Co., New Delhi, 2013.

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NUMERICAL METHODS

Code: 24MT205
Max. Marks: 70

UNIT I

Solution of algebraic and transcendental equations: Bisection method, Newton's Raphson method. Solution of simultaneous algebraic equations: Gauss Elimination method, Gauss Jordon method, LU decomposition method, Jacobi's method, Gauss-Seidal method, Relaxation method. Curve fitting: Least square curve fit- Straight line fitting, parabolic curve fitting, fitting of exponential curve.

UNIT II

Langrage's interpolation formula and Newton's divided difference formulae. Numerical differentiation and integration: Formula for derivatives, Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Boole's rule and Weddle's rule, Gaussian and Romberg's Integration.

UNIT III

Numerical solution of O.D.E.: Taylor series, Picard's method, Euler's Method, Modified Euler method, Runge-Kutta second and fourth order methods, predictor collector methods (Adams- Bash forth and Milne's method only). Finite element method for finding approximate solution of boundary value differential equation problems.

UNIT IV

Numerical solution of P.D.E.: Finite difference approximations of partial derivatives, solution of Laplace equation (Standard 5-point formula only), one-dimensional heat equation (Schmidt method, Crank-Nicolson method, Dufort and Frankel method) and wave equation.

Textbooks:

1. K. Atkinson and W. Han, Elementary Numerical Analysis, John Wiley, 2006.
2. S. S. Shastri, Introductory Methods of Numerical Analysis, PHI learning Pvt. Ltd., 2012.
3. B. S. Grewal, Numerical Methods in Engineering & Science, Khanna publications, 2014.

Reference Books:

1. H. C. Taneja, Advanced Engineering Mathematics, IK International, New Delhi, 2013.
2. M. K. Jain, S. R. K. Iyenger and R. K. Jain, Numerical Methods for Scientific and Engineering. Computations, Wiley Eastern Ltd., 1985.

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OBJECT ORIENTED PROGRAMMING WITH C++

Code: 24CS301
Max Marks: 70

UNIT I

Object Oriented Paradigm: Procedural vs. object-oriented development, Basic concepts of object-oriented programming, Applications and benefits of OOP, Comparison between C and C++.

Beginning with C++: Stream based I/O, Literals- constant qualifiers, Operators in C++, Reference variable, Functions, Default arguments, Parameter passing by value, Reference and pointer, Inline functions, Type conversion, Basic C++ programs, New, Delete operators- basic use and dynamic memory allocation for arrays.

UNIT II

Classes and Objects: C++ class declaration, Access specifiers, Member functions, Arrays within a class, Array of objects, Memory allocation of objects, passing objects as arguments, Returning objects from functions, Function overloading, Static data and member functions, Friend function and friend class, This pointer.

Constructors & Destructors: Introduction to constructor and destructor, Parameterized constructor, Constructor with default arguments, Multiple constructors in a class, Copy constructor.

UNIT III

Inheritance: Types of inheritance, Derivation – public, private & protected, Ambiguity resolution (function overriding), Aggregation, Composition v/s Classification, Virtual base class, Constructor and destructor in derived classes.

Polymorphism: Types of polymorphism, early v/s late binding, Virtual Functions: Need for virtual functions, Pointer to derived class objects, Pure virtual functions, Abstract classes.

Operator Overloading: Overloading unary operators, Nameless objects, Overloading binary operators, Overloading with friend functions, Conversion between basic types and user-defined types.

UNIT IV

Parametric polymorphism: Generic Programming with Templates, Introduction, Function templates/generic functions, Characteristics, Overloading of template functions, Class templates, Template arguments.

Exception Handling: Exception-handling model, Types of exception, Catching and Handling exceptions, Generic catch, Rethrowing an exception, Specifying exceptions for a function.

Streams & Files: C++ Streams, Basic stream classes, C++ predefined streams, I/O operations, Unformatted console I/O operations, Manipulators, Opening and closing a file- different modes and methods, Error handling during file operations, File pointers and their manipulations, Sequential access to file, Random input and output operations, Persistent objects, Command line arguments.

Text Book:

1. K.R. Venugopal, Rajkumar, T. Ravishanker, “Mastering C++”, TMH
2. E. Balagurusamy, “Object Oriented Programming with C++”, McGraw-Hill Education

Reference Books:

1. Ashok N. Kamthane, “Object-Oriented Programming with ANSI And Turbo C++”, Pearson Education.
2. Schildt Herbert, “C++: The Complete Reference”, Tata McGraw Hill.
3. R. Lafore, “Object Oriented Programming using C++”, Galgotia Publications.

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UNIVERSAL HUMAN VALUES

Code: 24GN402
Max Marks: 70

UNIT I (5 Hrs)

Introduction to Value Education: Value Education- Definition, Concept and Need, The Content and Process of Value Education, Basic Guidelines for Value Education, Self-exploration as a means of Value Education, Happiness and Prosperity as parts of Value Education.

UNIT II (7 Hrs)

Harmony in the Human Being

Human Being is more than just the Body, Harmony of the Self ('I') with the Body, Understanding Myself as Co-existence of the Self and the Body, Understanding Needs of the Self and the needs of the Body, Understanding the activities in the Self and the activities in the Body

UNIT III (8 Hrs)

Harmony in the Family and Society and Harmony in the Nature

Family as a basic unit of Human Interaction and Values in Relationships, The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love, Comprehensive Human Goal: The Five Dimensions of Human Endeavour, Harmony in Nature: The Four Orders in Nature, The Holistic Perception of Harmony in Existence.

UNIT IV (8 Hrs)

Social Ethics

The Basics for Ethical Human Conduct, Defects in Ethical Human Conduct, Holistic Alternative and Universal Order, Universal Human Order and Ethical Conduct, Human Rights violation and Social Disparities.

UNIT V (9 Hrs)

Professional Ethics

Value based Life and Profession, Professional Ethics and Right Understanding, Competence in Professional Ethics, Issues in Professional Ethics – The Current Scenario, Vision for Holistic Technologies, Production System and Management Models.

Text Book:

1. A.N Tripathy, New Age International Publishers, 2003.
2. Bajpai. B. L, New Royal Book Co, Lucknow, Reprinted, 2004
3. Bertrand Russell Human Society in Ethics & Politics

Reference Books:

1. Gaur. R. R., Sangal. R, Bagaria. G.P, A Foundation Course in Value Education, Excel Books, 2009.
2. Gaur. R. R., Sangal. R, Bagaria. G.P, Teachers Manual Excel Books, 2009.
3. I.C. Sharma. Ethical Philosophy of India Nagin & co Julundhar.
4. Mortimer. J. Adler, – Whatman has made of man.
5. William Lilly Introduction to Ethic Allied Publisher.

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C++ LAB

(BASED ON 24CS301) Object Oriented Programming with C++
Core Practical (Implement minimum 8 out of 10 practical)

1. WAP to implement 'Inline function'.
2. WAP to implement call by reference and return by reference using class. [Hint. Assume necessary functions].
3. WAP to implement friend function by taking some real life example.
4. WAP to implement 'Function Overloading'.
5. WAP to implement Parameterized Constructor, Copy Constructor and Destructor.
6. WAP to show the usage of constructor in base and derived classes, in multiple inheritance.
7. WAP to show the implementation of 'containership'.
8. WAP to show swapping using template function (Generic).
9. WAP to implement 'Exception Handling'.
10. WAP to read and write values through object using file handling.

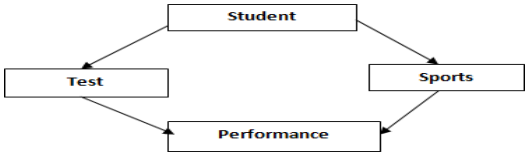
Application Based Practicals (Implement minimum 5 out of 10 practical)

11. Create a class employee which have name, age and address of employee, include functions getdata() and showdata(), getdata() takes the input from the user, showdata() display the data in following format:

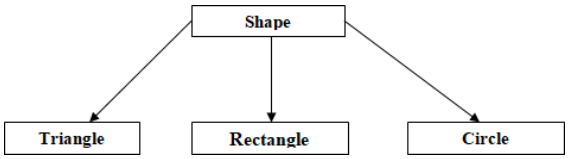
    Name:
    Age:
    Address:

12. Write a class called **C Account** which contains two private data elements, an integer **Account Number** and a floating-point **account Balance** and three member functions:
    - A constructor that allows the user to set initial values for **Account Number** and A**ccount Balance** and a default constructor that prompts for the input of the values for the above data numbers.
    - A function called **Input Transaction**, which reads a character value for **Transaction Type** ('D' for deposit and 'W' for withdrawal) and a floating-point value for **Transaction Amount**, which updates **Account Balance**.
    - A function called **Print Balance**, which prints on the screen the **Account Number** and **Account Balance.**

13. Define a class *Counter* which contains an int variable *count* defined as static and a static function Display () to display the value of *count*. Whenever an o b j e c t of this class is created *count* is incremented by 1. Use this class in main to create multiple objects of this class and display value of count each time.
14. WAP to add and subtract two complex numbers using classes.
15. Write program to overload Binary + to add two similar types of objects. (Both with and without using friend functions)
16. WAP to implement += and = operator
17. Implement the following class hierarchy considering appropriate data members and member functions:



18. Implement the following hierarchy considering appropriate data members and member functions (use Virtual functions).



19. WAP to convert meter to centimetre and vice versa, using data conversions and operator overloading
20. WAP to count digits, alphabets and spaces, stored in a text file, using streams.

Note:

1. **In total 10 practical to be implemented. 2 additional practicals may be given by the course instructor.**
2. **This is a suggestive list of programs. However, the instructor may add programs as per the requirement of the course.**

Theory Paper

Total: 100 Marks
External: 70 Marks
Internal:30 Marks

External: 70 Marks

10 Question (MCQ): 1 mark each (1x10 = 10)
Answer any 6 out of 8 (Very Short 20-30 Words): 2 marks each (2x6 = 12)
Answer any 6 out of 8 (Short 50-70 Words): 3 marks each (3x6 = 18)
Answer any 6 out of 8 (Long 100-120 Words): 5 marks each (5x6 = 30)

Internal: 30 Marks

Two Internal Assessment Examinations will be conducted, each carrying 50 marks. The higher of the two scores will be considered for the final assessment.

Lab

Practical: 100 Marks
External: 70 Marks
Internal: 30 Marks

External (Two programs): 70 Marks

Program Writing: 10 + 10 Marks
Algorithm& Flowchart: 5 + 5 Marks
Program Execution: 15 + 15 Marks
Viva: 10 Marks

Internal Assessment (30 Marks)

Internal Assessment Examinations will be conducted, carrying 50 marks

Record: 5 Marks
Attendance: 5 Marks
Program Writing: 15 Marks
Program Execution: 15 Marks
Viva: 10 Marks

ARYAVART INTERNATIONAL UNIVERSITY

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Syllabus for M. Sc. (Mathematics)

Semester 3

Theory									
Course Code	Topic	L	T	P	Credit	Theory Marks	Internal Marks	Practical Marks	Total Marks
24MT301	Topology	4	0	0	4	70	30	0	100
24MT302	Mechanics and Calculus of Variations	4	0	0	4	70	30	0	100
24MT303	Partial Differential Equations	4	0	0	4	70	30	0	100
24MT304	Operations Research	4	0	0	4	70	30	0	100
Discipline Specific Electives (DSE-I) Choose any one									
24MT311	Mechanics of Solids	4	0	0	4	70	30	0	100
24MT312	Analytical Number Theory	4	0	0	4	70	30	0	100
24MT313	Advanced Complex Analysis	4	0	0	4	70	30	0	100
Practical									
24MT391	MATLAB	0	0	4	4	0	30	70	100
	Total				**24**	**350**	**180**	**70**	**600**

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Tilthai, Dharmanagar, North Tripura

Detailed Syllabus

TOPOLOGY

Code: 24MT301
Max. Marks: 70

UNIT I

Topological spaces, basis and sub basis, ordered topology, quotient topology, product topology, Limit points, adherent points, Derived sets, Closure, interior, exterior and boundary points of a set, subspace.

UNIT II

Continuity, homeomorphism, countability axioms, first and second countable spaces, Separable space Connectedness: connected sets, component, path component, local connectedness, disconnected sets, Totally Disconnected sets, locally connected spaces.

UNIT III

Compact spaces; limit point compact and sequentially compact spaces, local compactness and one-point compactification, finite product of compact spaces, Tychonoff's theorem (without proof).

UNIT IV

Separation axioms (T0, T1, T2, T3 spaces, Regular space, completely regular spaces, Normal spaces), their characterizations and basic properties, Urysohn's lemma, Statement of Tietze's extension theorem, statement of Urysohn's metrization theorem.

Textbooks:

1. Munkres J. R. Topology, Second Edition, Pearson, 2015.
2. Singh T.B., Elements of Topology, CRC Press, Taylor & Francis, 2013

Reference Book:

1. Kelley J.L., General Topology, Dover Publications, 2017.
2. Willard S., General Topology, Dover Publications, 2004.

MECHANICS AND CALCULUS OF VARIATIONS

Code: 24MT302
Max. Marks: 70

UNIT I

Constraints and their classification: Scleronomic and rheonomic, holonomic and non-holonomic dynamical systems, conservative and dissipative; Virtual work: virtual displacement, principle of virtual work; D'Alembert's principle and its applications; Lagrangian formulation: Degrees of freedom, generalized coordinates, generalized force, generalized velocity, expression of kinetic energy using generalized velocity, Lagrange's equation of motion and simple applications, cyclic coordinates, generalized momenta, conjugate momenta.

UNIT II

Hamiltonian formulation- Legendre's dual transformations and its extension to include passive variables, Hamilton's function and Hamilton's equations of motion, properties of Hamiltonian, simple applications of the Hamiltonian equations of motion; Routhian function; canonical transformation, properties of generator functions, Poisson bracket: Jacobi identity for Poisson bracket, Poission's theorem, Hamilton's equation in Poisson bracket, invariance of Lagrange and Poisson brackets under canonical transformation.

UNIT III

Central force, equivalent one-body problem, moments and product of inertia, theorems of perpendicular and parallel axis, angular momentum of a rigid body about a fixed point and about fixed principal axes, Euler's dynamical equations for motion of rigid body; Variation of a functional and its properties, fundamental lemma of calculus of variations, Euler's equation for one dependent function and its different forms, Motivational problems of calculus of variation: Shortest distance in a plane, minimum surface of revolution, Brachistochrone problem.

UNIT IV

Geodesics, variational problems for functionals involving several dependent variables and higher order derivatives, functional involving functions of several independent variables, isoperimetric problems; Variational problems with moving boundaries- One end point are fixed and the other is movable, both the end points movable, variational problem with a moving boundary for a functional dependent on two functions; Hamilton's principle and principle of least action, difference between these principles, solving problems using these principles, Lagrange's equation from Hamilton's principle and vice-versa.

Textbooks:

1. Goldstein H., Poole C. and Safko J., Classical Mechanics, 3rd edition. Pearson Publications, New Delhi, 2011.
2. Chorlton F., Text book of Dynamics. CBS Publishers, Reprint, 2002.
3. Elsgolts, L., Differential Equations and the Calculus of Variations. University Press of the Pacific, 2003.

Reference Books:

1. Andrilli Rana N.C. and Joag P.S., Classical Mechanics. McGraw Hill Education, Chennai, 2016.
2. Grantmacher F., Lecture in analytical Mechanics. Mir Publication, 1975.
3. Fox C., An Introduction to the Calculus of Variation. Dover Publications, New York,1987.
4. Raisinghania M.D., Advanced Differential equations. S. Chand Publications, New Delhi, 1998.

PARTIAL DIFFERENTIAL EQUATIONS

Code: 24MT303
Max. Marks: 70

UNIT I

Method of separation of variables to solve B.V.P. associated with one dimensional heat equation, heat equation in semi-infinite and infinite regions. Solution of three-dimensional Laplace equation in Cartesian, cylindrical and spherical coordinates. Solution of Wave equation in two dimensions and three dimensions (Cartesian, Cylindrical, Spherical).

UNIT II

Partial Differential Equation of kth order: Definition, examples and classifications, Initial value problems, Transport equations: definition, solution of homogeneous and non-homogeneous transport equations, Laplace Equation, Fundamental solution of Laplace equation, Harmonic function, Mean Value formula for Harmonic function

UNIT III

Green's formula, Corrector function, Green's function and its derivation, Representation formula using Green's function, Symmetry of Green's function, Energy methods: uniqueness, Dirichlet's Principle. Heat Equations: Fundamental solution of Heat equation, Uniqueness of Heat Equation: Energy methods.

UNIT IV

Wave equation: Physical interpretation, solution for one dimensional wave equation, Reflection method, derivation of Euler-Poisson-Darboux equation, Kirchhoff's and Poisson's formulas (for $n = 2, 3$ only), solution of non-homogeneous wave equation for $n = 1, 3$. Energy method, uniqueness of solution.

Text Books:

1. Peter V. O'Neil, Advanced Engineering Mathematics, ITP 2. Evans L.C., Partial Differential Equations, Graduate Studies in Mathematics) 2nd Edition, American Mathematical Society,2014 3. Sneddon I.N., Elements of Partial Differential Equation, McGraw Hill, New York.

Reference Books:

1. Weinberger H. F., A First Course in Partial Differential Equation, John Wiley &Sons, 1965. 2. Amarnath T., An Elementary Course in Partial Differential Equations, Jones & Bartlett, 2009

OPERATIONS RESEARCH

Code: 24MT304
Max. Marks: 70

UNIT I

The origin of OR, Definition and scope of Operation Research, Types, methodology and typical applications of OR, Phases of an O.R. study, Formulation of Linear-programming model, graphical solution, converting the linear programming problem to standard form, Simplex method. Big-M method, two-phase method, degeneracy, alternate optima, unbounded and infeasible solution, definition of the dual problem, prima-dual relationship, Dual Simplex method.

UNIT II

Assignment problem and its mathematical formulation, solution of assignment problem (Hyngarian method), Transportation problem and its mathematical formulation. Initial basic feasible solution of transportation problem by North-West corner rule. Lowest-Cost Entry method and Vogel's Approximation method, Optimal solution of transportation problem (Modi method).

UNIT III

Game theory: Two person zero games, Minimax and maximum principle, Game with saddle point, Rule of dominance, Algebraic and graphical method, Sequencing problem – processing through 2 machines, 3 machine – s jobs and k machines.

UNIT IV

Queuing Models: Introduction of Basic Concepts in Stochastic Processes. Markov Chain and Markov Processes. Queuing Systems. Probability Distribution of Arrival and Service Times. Markovian Queuing Systems: M/M/1, M/M/C, M/M/1/N, M/M/C/N

Textbooks:

1. Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications.
2. Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill.

Reference Books:

1. Taha, H.A., Operation Research-An introduction, Tata McGraw Hill, New Delhi.
2. Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co.

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MECHANICS OF SOLIDS

Code: 24MT311
Max. Marks: 70

UNIT I

Summation convention, coordinate transformation, cartesian tensor of various orders, algebra of tensors, contraction, symmetric and skew-symmetric tensor, Kronecker delta, Alternating tensor, Gradient, Divergence, Curl in tensor notations, Gauss-divergence theorem, partial derivatives, contravariant and covariant tensors.

UNIT II

Deformation in elastic bodies, homogeneous strain and its properties, Affine transformation, infinitesimal affine transformation, geometric interpretation of components of strain, strain quadric of Cauchy, strain-displacement relations, Strain invariants, principal direction and principal strain, homogeneous deformation.

UNIT III

Stress vector and stress tensor, symmetry of stress tensor, stress quadric of Cauchy, equation of equilibrium and motion, principal stresses.

UNIT IV

Generalized Hooke's Law- relation between stress and strain, Elastic constants and their physical significance, strain energy function and its connection with Hooke's Law, Beltrami-Michell compatibility equations.

Text Books

1. Chandrasekharaiah, D. S. and Debnath, L. Continuum Mechanics, Academic Press Inc., San Diego, CA, 1994.
2. Narayan, Shanti. A text book of Cartesian Tensors (with an introduction to general tensors), 3rd edition. New Delhi: S. Chand Publications, 1968

Reference Books

1. Young, E. C., Vectors and tensor analysis, 2nd edition, 1993.
2. Kolsky, H., Stress waves in Solids. Dover Publications, 1963.
3. Ghosh, P. K., Mathematics of waves and vibrations. New Delhi: The Macmillan Company of India Limited, 1975.
4. Timoshenko S. and Goodier N., Theory of Elasticity, McGraw Hill, New York, 1970.
5. Fung Y.C., Foundations of Solid Mechanics, Prentice Hall, New Delhi

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ANALYTICAL NUMBER THEORY

Code: 24MT312
Max. Marks: 70

UNIT I

Distribution of primes, Fermat and Mersenne numbers, Farey series and some results concerning Farey series, Approximation of irrational numbers by rational, Hurwitz's theorem, Irrationality of e and π.

UNIT II

The arithmetic in Zn, The group Un, Primitive roots and their existence, the group Upn (p-odd) and U2n, The group of quadratic residues Qn, Quadratic residues for prime power moduli and arbitrary moduli, The algebraic structure of Un and Qn.

UNIT III

Riemann Zeta Function and its convergence, Application to prime numbers, Riemann Zeta as Euler product, Evaluation of Zeta (2) and Zeta (2k). Diophantine equations $ax + by = c$, $x^2 + y^2 = z^2$ and $x^4 + y^4 = z^4$, The representation of number by two or four squares, Waring problem, Four square theorem.

UNIT IV

Arithmetic functions $\phi(n), \tau(n), \sigma(n), \sigma_k(n), U(n), I(n), N(n)$, Definitions, examples and simple properties of arithmetic functions, Perfect numbers, Mobius inversion formula, The Mobius function.

Text Books:

1. Hardy G. H. and Wright E. M., An Introduction to the Theory of Numbers, Oxford University Press, 2008
2. Gareth A. Jones and Jones J. M., Elementary Number Theory, Springer Edition, 1998
3. McCoy N. H., The Theory of Numbers, McMillan Company Limited, 1965

Reference Books

1. Burton D. M., Elementary Number Theory, McGraw Hill, 2017
2. Niven I. and Zuckermann H. S., An Introduction to the Theory of Numbers, John Wiley & Sons, 1991.

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ADVANCED COMPLEX ANALYSIS

Code: 24MT313
Max. Marks: 70

UNIT I

Convex functions, Hadamard's three circles theorem, Phragmen-Lindelöf theorem, Spaces of continuous functions, Arzela-Ascoli theorem, Spaces of analytic functions, Hurwitz's theorem, Montel's theorem, Spaces of meromorphic functions.

UNIT II

Integral functions, Riemann mapping theorem, Weierstrass factorization theorem, Factorization of sine function, Runge's theorem, simply connected regions, Mittag-Leffler's theorem.

UNIT III

Analytic Continuation, Harmonic functions, Maximum and minimum principles, Harmonic function on a disk, Harnack's theorem, Subharmonic and superharmonic functions, Maximum and minimum principles, Dirichlet's problems, Green's function.

UNIT IV

Entire functions, Jensen's formula, Bloch's theorem, The Little Picard theorem, Schottky's theorem, The Great Picard theorem

Text Books:

1. Conway J. B., Functions of one Complex variable, 2nd edition, Narosa, New Delhi, 1996.
2. Priestly H. A., Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.

Reference Books:

1. Rudin W., Real and Complex Analysis, 3rd edition, Mc Graw Hill, 1987.
2. Ahlfors L. V., Complex Analysis, 3rd Edition, Mc Graw Hill Co., Indian Edition, 2017.
3. Hahn L., Epstein B., Classical Complex Analysis, Jones and Bartlett, 1996.

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MATLAB

Code: 24MT391
Max. Marks: 70

List of Programs:

1. Operating MATLAB desktop.
2. Matrix operation (addition, multiplication, inverse, transpose etc.).
3. Plotting of graphs of function basic functions like$e^{ax+}b$, *log(ax+b), 1/(ax+b), sin(ax+b), cos(ax+b),* $|ax+b|$ and to illustrate the effect of *a* and *b* on the graph.
4. WAP to check whether a number is even or odd.
5. WAP to find greatest among ten numbers.
6. WAP to draw graph of ellipse.
7. WAP to find root of an equation using Bisection Method.
8. WAP to find root of an equation using Regula Falsi Method.
9. WAP to find root of an equation using Secant Method.
10. WAP to find root of an equation using Newton Raphson Method.
11. WAP to solve system of equations using Gauss Jacobi Method.
12. WAP to evaluate integral using Trapezoidal rule.
13. WAP to evaluate integral using Simpson's 1/3 Rule.
14. WAP to evaluate integral using Simpson's 3/8 Rule.
15. WAP to evaluate integral using Boole's rule.
16. WAP to evaluate integral using Weddle's Rule.
17. WAP for Lagrange's Interpolation formula.
18. WAP to solve differential equation using Euler's Method.
19. WAP to solve differential equation using Runge Kutta Method.

Textbooks:

1. Pratap R., Getting Started with MATLAB, Oxford University Press, New Delhi, 2015.
2. Mathews J. H. and Kurtis D. F., Numerical Methods using MATLAB, 4th edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

Reference Books:

1. Alam S. N. and Alam S. S., Understanding MATLAB: A Textbook for Beginners, I K International Pub., 2013.
2. Chapman S.J., MATLAB Programming for Engineers, 4th Edition, Cengage Learning, Boston. 2015.

Theory Paper

Total: 100 Marks
External: 70 Marks
Internal:30 Marks

External: 70 Marks

10 Question (MCQ): 1 mark each (1x10 = 10)
Answer any 6 out of 8 (Very Short 20-30 Words): 2 marks each (2x6 = 12)
Answer any 6 out of 8 (Short 50-70 Words): 3 marks each (3x6 = 18)
Answer any 6 out of 8 (Long 100-120 Words): 5 marks each (5x6 = 30)

Internal: 30 Marks

Two Internal Assessment Examinations will be conducted, each carrying 50 marks. The higher of the two scores will be considered for the final assessment.

Lab

Practical: 100 Marks

External: 70 Marks

Internal: 30 Marks

External (Two programs): 70 Marks

- **Program Writing**: 10 + 10 Marks
- **Algorithm& Flowchart**: 5 + 5 Marks
- **Program Execution**: 15 + 15 Marks
- **Viva**: 10 Marks

Internal Assessment (30 Marks)

Internal Assessment Examinations will be conducted, carrying 50 marks

- **Record**: 5 Marks
- **Attendance**: 5 Marks
- **Program Writing**: 15 Marks
- **Program Execution**: 15 Marks
- **Viva**: 10 Marks

ARYAVART INTERNATIONAL UNIVERSITY

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Syllabus for M. Sc. (Mathematics)

Semester 4

Theory									
Course Code	Topic	L	T	P	Credit	Theory Marks	Internal Marks	Practical Marks	Total Marks
24MT401	Functional Analysis	4	0	0	4	70	30	0	100
24MT402	Differential Geometry	4	0	0	4	70	30	0	100
24MT403	Fluid Dynamics	4	0	0	4	70	30	0	100
24MT404	Integral Equations	4	0	0	4	70	30	0	100
24PR401	Minor Project	0	0	8	8	0	30	70	100
Discipline Specific Electives (DSE-I) Choose any one									
24MT411	Advanced Operation Research	4	0	0	4	70	30	0	100
24MT412	Advanced Discrete Mathematics	4	0	0	4	70	30	0	100
24MT413	Mathematical Modelling	4	0	0	4	70	30	0	100
	Total				**28**	**350**	**180**	**70**	**600**

ARYAVART INTERNATIONAL UNIVERSITY
Tilthai, Dharmanagar, North Tripura

Detailed Syllabus

FUNCTIONAL ANALYSIS

Code: 24MT401
Max. Marks: 70

UNIT I

Normed spaces, Banach spaces, Finite dimensional normed spaces and subspaces, Compactness and finite dimension, Bounded and continuous linear operators, Linear operators and functionals on finite dimensional spaces, Normed spaces of operators, Dual spaces.

UNIT II

Hahn Banach theorems for real and complex normed spaces, Adjoint operator, Reflexive spaces, Uniform boundedness theorem strong and weak convergence, Convergence of sequences of operators and functionals, Open mapping theorem, Closed graph theorem.

UNIT III

Hilbert spaces, Orthogonal complements and direct sums, Bessel's inequality, Total orthonormal sets and sequences, Representation of functionals on Hilbert spaces, Hilbert adjoint operators, Self-adjoint, unitary and normal operators.

UNIT IV

Compact operator and its relation with continuous operator, Compactness of linear transformation on a finite dimensional space, Properties of compact operators, Compactness of the limit of the sequence of compact operators.

Textbooks:

1. Kreyszig E., Introductory Functional Analysis with Applications, John Wiley & Sons, India, 2006.
2. Simmons George F., Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.

Reference Books:

1. Bachman G. and Narici L., Functional Analysis, Dover Publications, 2000.
2. Bhatia R., Notes on Functional Analysis, Hindustan Book Agency, India, 2009.
3. Schechter M., Principles of Functional Analysis, Second Edition, American Mathematical Society, 2001.

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DIFFERENTIAL GEOMETRY

Code: 24MT402
Max. Marks: 70

UNIT I

Curves with Torsion: Tangent, Principal normal, Curvature, Binormal, Torsion, Serret-Frenet formulae, Locus of centre of curvature, Spherical curvature, Locus of Centre of spherical curvature, Involutes, Evolutes

UNIT II

One-parameter family of surfaces, Envelope. Characteristics, Edge of regression, Developable surfaces. Developable associated with a curve, osculating developable, Polar developable, Rectifying developable, two-parameter family of surfaces: Envelope. Characteristic points, Envelopes, Edge of regression, Ruled surface, Developable surface, Monge's theorem, conjugate directions.

UNIT III

Curvilinear coordinates, First order magnitudes, Directions on a surface, The normal Second order magnitudes, Derivatives of n, Curvature of normal section, Meunier's theorem, Principal directions and curvatures, First and second curvatures, Euler's theorem, Dupin's indicatrix, The surface z = f(x,y), Surface of revolution.

UNIT IV

Conjugate system: Conjugate directions, Conjugate system Asymptotic lines, asymptotic lines, Curvature and torsion, Isometric lines: Isometric parameters, Null lines, or minimal curves, Geodesic Property, Equations of geodesics, Surface of revolution, Torsion of a geodesic.

Textbooks:

1. Goetz Abraham; Introduction to Differential Geometry: Addison Wesley Pub. Company.
2. Wetherburn C.E., Differential Geometry of 3- Dimentions, Cambridge University Press.

Reference Books:

1. Prakash Nirmala, Differential Geometry an Integrated Approach, McGraw-Hill.
2. Neill B.O., Elementary Differential Geometry, Academic Press.
3. Willmore T.J., An introduction to Differential Geometry.

FLUID DYNAMICS

Code: 24MT403
Max. Marks: 70

UNIT I

Real fluids and ideal fluids, Velocity at a point, Eulerian and Lagrangian methods, Velocity potential, Vorticity vector, Local and particle rate of change, Streamlines, Path lines, Streak lines, Equation of continuity and related problems, acceleration of fluid, conditions at a rigid boundary.

UNIT II

Pressure at a point in a fluid at rest and in a moving fluid, Euler's equation of motion, Bernoulli's equation, Practical problems, Potential theorems, Flows involving axial symmetry, Stationary sphere in a uniform stream, Impulsive motion: Kelvin's theorem of circulation, Equation of vorticity.

UNIT III

Some three-dimensional flows: sources, sinks and doublets, Images of sources, sinks and doublets in rigid plane and in solid spheres, Stoke's stream function.

UNIT IV

Two dimensional flows, Complex velocity potential, Milne Thomson circle theorem and its applications, Two-dimensional sources, sinks, doublets and their images, Theorem of Blasius, Vortex rows, Karman vortex street.

Textbooks:

1. Charlton, F. Text Book of Fluid Dynamics, GK Publishers, Reprint, New Delhi, 2009.
2. Raisinghania M.D., Fluid Dynamics. S. Chand Publications, New Delhi, 2010.

Reference Books:

1. Landau, L. D., and Lifhshitz E. M., Fluid Mechanics, 2nd Edition. Pergamon Press Ltd., New-York, 1987.
2. Batchelor, G. K. An Introduction to Fluid Mechanics. Cambridge University Press, 1967.
3. Kundu P. K., and Cohen I. M., Fluid Mechanics. Harcourt (India) Pvt. Ltd., New Delhi, 2003.
4. Yuan S.W., Foundations of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi, 1976.

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INTEGRAL EQUATIONS

Code: 24MT404
Max. Marks: 70

UNIT I

Linear Integral equations, some basic identities, Initial value problems reduced to Volterra integral equations, Methods of successive substitution and successive approximation to solve Volterra integral equations of second kind, Iterated kernels and Neumann series for Volterra equations, Resolvent kernel as a series, Laplace transform method for a difference kernel, Solution of a Volterra integral equation of the first kind, Convolution integral.

UNIT II

Boundary value problems reduced to Fredholm integral equations, Methods of successive approximation and successive substitution to solve Fredholm equations of second kind, Iterated kernels and Neumann series for Fredholm equations, Resolvent kernel as a sum of series, Fredholm resolvent kernel as a ratio of two series. Fredholm equations with separable kernels, Approximation of a kernel by a separable kernel, Fredholm Alternative, Non homogeneous Fredholm equations with degenerate kernels.

UNIT III

Singular integral equation, solution of Abel integral equation, Cauchy principal value for integrals: Cauchy's general and principal values, Holder condition, singular integrals, Plemelj formulas, Poincare-Bertrand transformation formula, solution of Cauchy-Type singular integral equation, closed contour, unclosed contours, Riemann-Hilbert problem. Hilbert kernel, Hilbert formula, solution of Hilbert-type singular integral equation of first and second kind.

UNIT IV

Green's function, use of method of variation of parameters to construct the Green's properties of the Green's function, Alternate procedure for construction of the Green's function by using its basic four properties, Green's function approach for IVP for second order equation, Reduction of a boundary value problem to a Fredholm integral equation with kernel as Green's function.

Textbooks:

1. Kanwal R.P., Linear Integral Equations: Theory and Techniques, New York: Birkhäuser, 2013.
2. Jerry A. J., Introduction to Integral Equations with Applications, 2nd edition, John Wiley & Sons, New York, 1999.
3. Lovitt W. V., Linear Integral Equations, McGraw Hill, New York.

Reference Books:

1. Raisinghania M. D., Integral Equation of Boundary Value Problem, S-Chand, 2016.
2. Corduneanu C., Integral Equations and Applications, Cambridge: Cambridge University Press, 2008.

ADVANCED OPERATIONS RESEARCH

Code: 24MT411
Max. Marks: 70

UNIT I

Sensitivity Analysis & Integer Linear Programming: Introduction of Sensitivity Analysis, Change in Objective function coefficient, Change in availability of resources, Addition of new variable and new constraint. Introduction to Integer Linear Programming, Gomory's all integer cutting plane method, Gomory's mixed-integer cutting plane method, Branch and bound method, Application of Zero-One integer Programming.

UNIT II

Dynamic Programming: Bellman's Principle of optimality of Dynamic Programming, Multistage decision problem and its solution by Dynamic Programming with finite number of stages, Solution of linear programming problems as a Dynamic Programming problem

UNIT III

Inventory control models: Economic order quantity (EOQ) model with uniform demand, EOQ when shortages are allowed, EOQ with uniform replenishment, Inventory control with price breaks.

UNIT IV

CPM and PERT: Common errors in network drawing, Rules for network construction, Fulkerson's Rule, Float and Network diagram, PERT computation, Critical Path Analysis, Estimation of Project Completion Time, Project crashing.

Textbooks:

1. Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications.
2. Taha H.A., Operation Research-An introduction, Tata McGraw Hill, New Delhi.

Reference Books:

1. Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill.
2. Hillier S. and Lieberman G. J., Introduction to Operations Research 8th edition, Tata Mc Graw Hill, Singapore, 2004.
3. Gupta P K. and Hira D.S., Operations Research. S. Chand & Co, New Delhi.
4. Satty T. L., Elements of Queueing Theory with Applications, Dover, NY, 1983.
5. Hadley G., Nonlinear and Dynamic Programming, Addison-Wesley, 1964.

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ADVANCED DISCRETE MATHEMATICS

Code: 24MT412
Max. Marks: 70

UNIT I

Partially ordered sets, Hasse diagram, Isomorphism, ordered sets, Principle of Mathematical induction, Formal logic statements, Symbolic representations and Tautologies, Quantifiers, proposition logic. Generating functions, recurrence relations, Explicit formula for a sequence, solution of recurrence relations, homogenous recurrence relations with constant coefficients, particular solution of difference equation, recursive functions solution of a recurrence relations by the method of generating function.

UNIT II

Lattices- Lattices as partially ordered sets, their properties, Lattices as algebraic systems, some special lattices e.g., complete, complemented and distributive lattices Boolean Algebra – Boolean Algebra as lattices, various Boolean identities, the switching algebra e.g., Toin-Irreducible elements, Atoms and Minterms, Boolean forms and their equivalence, Minterm Boolean forms, Sum of products canonical forms, minimization of Boolean functions.

UNIT III

Graph Theory- Definition of Graphs, special graphs, subgraphs, isomorphism of graphs, walk, Paths, Circuits, Euler's formula for connected planar graph, Complete and complete bipartite graphs Eulerian path and circuits, Hamiltonian circuits, matrix representation of graphs, planar graphs

UNIT IV

Directed graphs, weighted undirected graphs, coloring of graphs, trees, isomorphism of trees, indegree and outdegree of a vertex, spanning tree of a graph, shortest path problems, Minimal spanning tree, Prim algorithm, Kruskal's algorithm, tree searching.

Textbooks:

1. Babu Ram, Discrete Mathematics, Pearson Publications.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Edition, Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2018.

Reference Books:

1. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hill. 1985.
2. B. A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 2002.

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Tilthai, Dharmanagar, North Tripura

MATHEMATICAL MODELING

Code: 24MT413
Max. Marks: 70

UNIT I

Introduction and the technique of mathematical modelling, Classification and characteristics of mathematical models, Mathematical modelling through algebra, Finding the radius of the earth, Motion of planets, Motions of satellites, Linear and Non-linear growth and decay models, Population growth models, Effects of Immigration and Emigration on Population size, decrease of temperature, Diffusion, Change of price of a commodity, Logistic law of population growth, A simple compartment models, Diffusion of glucose or a Medicine in the blood stream.

UNIT II

Mathematical modelling of epidemics, A simple epidemics model, A susceptible-infected-susceptible (SIS) model, SIS model with constant number of carriers, Simple epidemic model with carriers, Model with removal, Model with removal and immigration, Mathematical modelling in economics, Domar macro model, Domar first debt model, Domar second debt model, Samuelson investment model, Stability of market equilibrium, Mathematical modelling in medicine, A model for diabetes mellitus, Arms race and battles: Richardson model for arms race, Lamechester combat model

UNIT III

Mathematical modelling through partial differential equations: Mass-balance Equations, Momentum-balance Equations, Variational principles, Probability generating function, modelling for traffic on a highway.

UNIT IV

Stochastic models of population growth, Need for stochastic models, Linear birth-death-immigration-emigration processes, Linear birth-death process, Linear birth-death-immigration process, Linear birth-death-emigration process, Non-linear birth-death process.

Textbooks:

1. Burghes D.N. and Wood A.D., Mathematical Models in the Social, Management and Life Sciences, John Wiley and Sons,1980.
2. Andrews J.G. and Mclone R.R, Mathematical Modeling, Butterworths (Pub.) Inc., 1976.

Reference Books:

1. Kapur J.N., Mathematical Modeling, New Age International Limited, 2015.
2. Kapur J.N., Mathematical Models in Biology and Medicine, Affiliated East-West Press (P) Ltd., 1985.

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Theory Paper

Total: 100 Marks
External: 70 Marks
Internal:30 Marks

External: 70 Marks
10 Question (MCQ): 1 mark each (1x10 = 10)
Answer any 6 out of 8 (Very Short 20-30 Words): 2 marks each (2x6 = 12)
Answer any 6 out of 8 (Short 50-70 Words): 3 marks each (3x6 = 18)
Answer any 6 out of 8 (Long 100-120 Words): 5 marks each (5x6 = 30)

Internal: 30 Marks
Two Internal Assessment Examinations will be conducted, each carrying 50 marks. The higher of the two scores will be considered for the final assessment.

Lab

Practical: 100 Marks
External: 70 Marks
Internal: 30 Marks

External (Two programs): 70 Marks
Program Writing: 10 + 10 Marks
Algorithm& Flowchart: 5 + 5 Marks
Program Execution: 15 + 15 Marks
Viva: 10 Marks

Internal Assessment (30 Marks)
Internal Assessment Examinations will be conducted, carrying 50 marks
Record: 5 Marks
Attendance: 5 Marks
Program Writing: 15 Marks
Program Execution: 15 Marks
Viva: 10 Marks