

**CENTURION UNIVERSITY OF TECHNOLOGY AND
MANAGEMENT, ODISHA**

SCHOOL OF BASIC SCIENCES



2-YEAR M.Sc. PROGRAMME

IN

APPLIED MATHEMATICS

1st YEAR SYLLABUS

SEMESTER-I				
Sl. No	Subject Code	Subject	Contact Hours per week (L+T+P)	Credits
1	MSMA4701	MATHEMATICAL MODELLING	3+1+0	4
2	MSMA4702	ABSTRACT ALGEBRA-I	3+1+0	4
3	MSMA4703	ADVANCED ANALYSIS	3+1+0	4
4	MSMA4704	PARTIAL DIFFERENTIAL EQUATION-II	3+1+0	4
5	MSMA4705	DIFFERENTIAL GEOMETRY	3+1+0	4
6	As per course	FREE ELECTIVE-I	As per course	4
TOTAL CREDITS				24

SEMESTER-II				
Sl. No	Subject Code	Subject	Contact Hours per week (L+T+P)	Credits
1	MSMA4801	MEASURE THEORY	3+1+0	4
2	MSMA4802	ADVANCED CALCULUS	3+1+0	4
3	MSMA4803	TOPOLOGY	3+1+0	4
4	MSMA4804	FLUID DYNAMICS-I	3+1+0	4
5	MSMA4805	TENSOR ANALYSIS	3+1+0	4
6	As per course	FREE ELECTIVE-II	As per course	4
TOTAL CREDITS				24

SEMESTER - I

MSMA 4701 MATHEMATICAL MODELLING

MODULE – I

Mathematical modelling through ordinary differential equations of first order.

MODULE – II

Mathematical modelling through the systems of ordinary differential equations of the first order.

MODULE – III

Mathematical modelling through ordinary differential equations of second order.

BOOK PRESCRIBED

1. Mathematical Modelling – J. N. Kapoor (New Age International)
Chapters: 2, 3 (except 3.13 and 3.14) and 4.

MSMA 4702 ABSTRACT ALGEBRA - I

MODULE – I

Group Theory:

Automorphisms, Cayley's Theorem, Permutations Groups, Another Counting Principle, Sylow's Theorems.

MODULE – II

Ring Theory:

More Ideals and Quotient Rings, The Field of Quotients of an Integral Domain, Euclidean Rings, A Particular Euclidean Ring, Polynomial Rings, Polynomial Rings over the Rational Field, Polynomial Rings over Commutative Rings.

MODULE – III

Vector Spaces:

Elementary Basic Concepts of Vector Space, Linear Independence and Basis, Dual Spaces, Inner Product Spaces

BOOK PRESCRIBED

1. Topics in Algebra – I. N. Herstein (John Wiley and Sons or Vikas Publication), 2nd Edition
Chapters: 2 (2.8 to 2.12), 3 (3.5 to 3.11), 4 (4.1 to 4.4)

BOOKS FOR REFERENCE

1. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publishing House, 1990
2. P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, Basic Abstract Algebra, Cambridge University Press, 1995.

MSMA 4703 ADVANCED ANALYSIS

MODULE – I

Metric space, with examples, \mathbb{R} , \mathbb{R}_2 , \mathbb{R}_3 and $C(a, b)$ as metric spaces, limit in metric spaces, continuous function on a metric space, open sets, closed sets, Discontinuous function on \mathbb{R} .

MODULE – II

Connected sets, Bounded sets, Totally Bounded sets, Complete Metric Spaces.

MODULE – III

Compact metric spaces, Uniform Continuity.

BOOK PRESCRIBED

1. Methods of Real analysis-R.G. Goldberg
Chapters: 4, 5, 6 (up to 6.8) and 10 (10.1 to 10.2).

BOOKS FOR REFERENCE

1. S.C. Malik and S. Arora – Mathematical Analysis (New Age International)
2. Principles of Mathematical Analysis – Walter Rudin, III Edition, McGRAW-Hill Book Co.

MSMA 4704 PARTIAL DIFFERENTIAL EQUATION-II

MODULE – I

Basic Concepts and Classification of Second Order Equation.

MODULE – II

The Cauchy Problem, The method of Separation of Variables

MODULE – III

Eigen value Problems.

BOOK PRESCRIBED

1. Linear Partial Differential Equations for Scientists and Engineers By Tyn Myint-U & Lokenath Debnath (Birkh'ouser Boston, 4th Edition)

Chapters: 1, 4, 5 (5.1 to 5.8), 7, 8 (8.1 to 8.5).

BOOK FOR REFERENCE

1. Partial Differential Equations of Mathematical Physics By Tyn Myint-U- Elsevier Science Ltd (August 1973).

MSMA 4705 DIFFERENTIAL GEOMETRY

MODULE – I

Fundamental Triads, Curves, Serret-Frenet Formulae, Curvatures and torsion of a curve at a point.

MODULE – II

Indicatrix, Evolutes and Involutives, Osculating planes, Spheres and circles.

MODULE – III

Surface: tangent planes and normals, The two fundamental forms, Asymptotic lines, Cartesian formulation of fundamental magnitudes.

BOOK PRESCRIBED

1. A text book of vector calculus - Shanti Narayana and J.N. Kapoor

Chapters: II and III

BOOK FOR REFERENCE

1. An Introduction to Differential Geometry by T.G. Willmore - Oxford University Press (1983)

SEMESTER - II

MSMA 4801 MEASURE THEORY

MODULE – I

Introduction, Outer measure, Measurable sets and Lebesgue measure, A nonmeasurable set.

Measurable functions, Littlehood's three principles.

MODULE – II

The Lebesgue Integral.

MODULE – III

Differentiation and Integration, The classical Banach Spaces.

BOOK PRESCRIBED

1. Real Analysis – H. L. Royden (Macmillan)

Chapters: 3, 4, 5, 6.

BOOKS FOR REFERENCE

1. G. De Barra, Measure theory and integration.
2. I. K. Rana, An introduction to measure and integration. Narosa Publishing House, 1997.

MSMA 4802 ADVANCED CALCULUS

MODULE – I

Derivatives of functions on \mathbb{R}^n , Differentiation of composite functions, Taylor's theorem, Differential forms, Theorems of Green, Gauss & Stokes, Exact forms and closed forms.

MODULE – II

Differentiation of Transformations, inverses, implicit function theorem, Functional Dependence.

MODULE – III

Set functions, Transformations and Multiple integrals, curves and Arc Length, surfaces and surface area, integrals over curves and surfaces.

BOOK PRESCRIBED

1. Advanced calculus – R. C. Buck (Mc. Graw hill– Kogakusha Ltd.)

Chapters: 3 (3.3, 3.4, 3.5), 7, 8, 9 (9.2, 9.4, 9.5)

MSMA 4803 TOPOLOGY

MODULE – I

Open sets and limit points, closed sets and closure, Bases and relative topologies.

Connected sets and components, compact and Countable compact spaces, continuous functions, homeomorphisms.

MODULE – II

T_0 - and T_1 - spaces and sequence, Axioms of countability.

Regular and normal spaces, completely regular spaces, Urysohn's metrization theorem.

MODULE – III

Finite products, product invariant properties, metric products, product topology.

BOOK PRESCRIBED

1. W. J. Pervin, Foundations of General Topology, Academic Press.
Chapters: 3 (3.1, 3.2 and 3.4), 4 (4.1 to 4.4), 5 (5.1 to 5.3, 5.5 and 5.6), 8 (8.1 to 8.4), 10 (10.1 only).

BOOKS REFERENCE

1. J. R. Munkres, Topology – A First Course, Prentice Hall of India, 1996.
2. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

MSMA 4804 FLUID DYNAMICS – I

MODULE – I

Kinematics of Fluids. Methods describing Fluid motion. Lagrangian and Eulerian Methods. Translation Rotation and Rate of Deformation. Streamlines, Pathlines and Streaklines.

MODULE – II

Fundamental equations of the flow of viscous compressible fluids. Equations of continuity, motion and energy in Cartesian coordinate systems.

The equation of state. Fundamental equations of continuity, motion and energy in Cylindrical & Spherical coordinate systems.

MODULE – III

2-D and 3-D inviscid incompressible flow. Basic equations and concepts of flow. Circulation theorems. Velocity potential, Rotational and Irrotational flows. Integration of the equations of motion. Bernoulli's Equation.

BOOK PRESCRIBED

1. Foundations of Fluid Mechanics by S. W. Yuan. Publisher: Prentice – Hall of India.
Chapters: 3 (3.1 to 3.4), 5 (5.1 to 5.6), 7 (7.1 to 7.5).

BOOK REFERENCE

1. Viscous Fluid Dynamics by J. L. Bansal, IBH Publication, Joypur.

MSMA 4805 TENSOR ANALYSIS

MODULE – I

Tensor Algebra, Applications of Tensor methods to surface Geometry.

MODULE – II

Tensor Calculus.

MODULE – II

Riemann Geometry

BOOK PRESCRIBED

1. An Introduction to Differential Geometry – T. J. Willmore (Oxford University Press)
Chapters: V, VI, VII (Sections 1, 2, 3, 4, 5), VIII.

BOOK FOR REFERENCE

1. Tensor Analysis - Edward Nelson (Princeton University Press & University of Tokyo Press), 1967
2. Introduction to Tensor Analysis and the Calculus of Moving Surfaces - Pavel Grinfeld, Springer

2nd YEAR SYLLABUS

SEMESTER-III				
Sl no	Subject Code	Subject	Contact Hours per week (L+T+P)	Credits
1	MSMA5101	ABSTRACT ALGEBRA-II	3+1+0	4
2	MSMA5102	COMPLEX ANALYSIS-II	3+1+0	4
3	MSMA5103	FLUID DYNAMICS-II	3+1+0	4
4	MSMA5104	OPERATION RESEARCH-II	3+1+0	4
5	MSMA5105	NUMBER THEORETIC CRYPTOGRAPHY	3+1+0	4
6	MSRM5101	INTRODUCTION TO RESEARCH	2+0+0	2
7	MSSM5101	SEMINAR		2
TOTAL CREDITS				24

SEMESTER-IV				
Sl no	Subject Code	Subject	Contact Hours per week (L+T+P)	Credits
1	MSMA5201	THEORY OF COMPUTATION	3+1+0	4
2	MSMA5202	ADVANCED NUMERICAL ANALYSIS	3+1+0	4
3	MSSM5201	SEMINAR		4
4	MSPJ5202	PROJECT/DISSERTATION		12
TOTAL CREDITS				24

SEMESTER-III

MSMA 5101 ABSTRACT ALGEBRA-II

MODULE – I

Fields, Elements of Galois Theory, Solvability by Radicals.

MODULE – II

Algebra of Linear Transformations, Characteristic Roots, Matrices, Canonical Forms.

MODULE – III

Trace and Transpose, Determinants, Hermitian, Unitary and Normal Transformations, Real Quadratic Roots.

BOOK PRESCRIBED

Topics in Algebra – I. N. Herstein (John Wiley and Sons or Vikas Publication), 2nd Edition

Chapters: 5 & 6

MSMA 5102 COMPLEX ANALYSIS-II

MODULE – I

General form of Cauchy's Theorem, Calculus of Residues, Evaluation of Definite Integrals, Harmonic Functions.

MODULE – II

Series and Product Developments: Power Series Expansion, Partial Fraction and Factorization, Entire functions, Riemann Zeta Function.

MODULE – III

Elliptic Functions: Simple and Double Periodic Functions, Weirstrass Theory.

BOOK PRESCRIBED:

Complex Analysis – L. V. Ahlfors, Mc – Graw – Hill international Editions

(Vikas Publications – Second Edition)

Chapters: 4 (Subsections 4, 5, 6 only), 5(Subsections 1,2,3,4 only), 7(Subsections 1,2,3 only)

MSMA 5103 FLUID DYNAMICS – II

MODULE – I

Laminar Flow of Viscous Incompressible Fluids, Similarity of Flows, Reynold's Number, Flow between parallel flat plates, Couette flow, Plane Poiseuille flow, Steady Flow in pipes, Hagen-Poiseuille flow, Flow between two Coaxial Cylinders, Theory of very slow motion, Unsteady motion of a flat Plate.

MODULE – II

The Laminar boundary layer, Properties of Navier-Stokes equations, Boundary layer equations in 2-D flow, The boundary layer along a flat plate, Boundary layer on a surface with pressure gradient, Momentum Integral theorems for the boundary layer.

MODULE – III

Von karman-Pohlhausen method, Boundary layer for axially symmetrical flow, Separation of boundary layer flow, Boundary layer control.

The origin of Turbulence, Reynold's modification of the Navier-Stokes equations for Turbulent flow, Reynold's and Reynold's stresses, Prandtl's mixing length theory.

BOOKS PRESCRIBED

Foundations of Fluid Mechanics by S. W. Yuan. Publisher: Prentice – Hall of India.

Chapters: 8(8.1 to 8.4, 8.7 to 8.8) ,9, 10(10.1 to 10.3(a)).

BOOK REFERENCE

Viscous Fluid Dynamics by J.L.Bansal, IBH Publication, Joypur.

MSMA 5104 OPERATION RESEARCH – II

MODULE – I

Integer Programming : Gomory's Algorithm for pure integer linear programs, Gomory's mixed integer-continuous variable algorithm, Branch and Bound method, Kuhn-Tucker optimality conditions : Some theorem, Kuhn-Tucker first order Necessary optimality conditions.

MODULE – II

Second order optimality condition, Lagranges method, Converse programming problem, Sufficiency of Kuhn-Tucker condition, Lagrangian saddlepoint and duality, duality for convex program

MODULE – III

Game Theory : Game theory problem, Two person zero sum game, Finite matrix Game, Graphical method for $2 \times n$ and $m \times 2$ matrix games, Some theorems, Dominance principal.

BOOKS PRESCRIBED

Mathematical Programming by N. S. Kambo.
Chapters : 6 (6.4 to 6.6), 7 (7.1 and 7.4), 8.16.

MSMA 5105 NUMBER THEORETIC CRYPTOGRAPHY

MODULE –I

Time estimates for doing arithmetic, Divisibility and Euclidean algorithm, Congruences.

Some applications to factoring, Finite fields, Quadratic residues and reciprocity, Some simple Cryptosystems.

MODULE – II

Enciphering matrices, The idea of public key Cryptography, RSA.

Discretelog, Knapsack, Zero knowledge protocol and oblivious transfer, pseudo primes.

MODULE – III

The rho method, Fermat factorization and factor bases, The continued fraction method, The quadratic sieve method.

BOOKS PRESCRIBED

A Course in Number Theoretic Cryptography by Neal Koblitz, Springer Verlag, GTM No.114(1987).

Chapters: 1,2,3,4(4.1 & 4.5 only),5.

BOOK REFERENCE

1. Hand Book of Applied Cryptography by A.J.Menezes, P.C. Van Oorschot and Scoff A. Vanstone, CRC Press Lic(1997).
2. Cryptography: Theory And Practice by D.R.Stinson, CRC Press Lic(2006).
3. Cryptography and Network Security by W.Stallings, Prentice Hall(2005).

MSRM5101 INTRODUCTION TO RESEARCH

MODULE-I

Research: Introductory Concepts

Curiosity and Research, Common sense vs. Sciences, Role of Observation and Scientific Methods, Experiments as the basis of Sciences, Various types of Research Methods in Sciences, Discussion of various research methods.

Overview of Research Process:

Problem Definition, Proposition of Hypotheses, Hypothesis Testing, Types of Possible Errors in Hypothesis Testing, Proposition of Models and Theories, Literature Review, Experimental Design, Sampling and Survey, Measurement of Values and Dealing with Errors, Validation of Results, Improving Theories, Models and Experiments, Safety and Ethics.

MODULE-II

Data Analysis-I: Use of Statistics in Data Analysis, Probability Distributions, Central Limit Theorem and its applications in Data Analysis, Comparing many experimental measurements, Data with many values of independent variables.

Data Analysis-II: Building Mathematical Models, Ingredients of Mathematical Models, Estimation, Regression methods, Fourier Transforms, Iterative Maps, Differential Equations.

Other Methods of Data Analysis: Tables, Graphs and Charts.

MODULE: III

Documentation and Presentation:

Scientific Proposal Writing, Scientific Report Writing, Parts of a Scientific Report, Presentations, Ethical Issues in Report Writing.

BOOKS RECOMMENDED:

1. Michael P Marder, 2011, Research Methods for Science, Cambridge University Press.
2. Eugene Bright Wilson, 1991, An Introduction to Scientific Research, Dover Publications Inc.
3. Ranjit Kumar, 2011, Research Methodology: A Step by Step Guide, Sage South Asia Publication.

SEMESTER-IV

MSMA 5201 THEORY OF COMPUTATION

MODULE – I

Automata and Languages: Finite Automata, Regular expression, Non regular languages, Deterministic and Non-deterministic automata, Minimization of finite automata, Pumping lemma and its applications, Context free grammars, Non- context-free Languages, Chomsky normal form, Push down automata, Pumping lemma for CFL.

MODULE – II

Computability Theory: Churh-Turing thesis, Turing machine and its variants, Halting problem, Diagonalization, Reducibility, Rice's theorem and its applications, The Recursion theorem.

MODULE – III

Complexity Theory: Time complexity of Turing machines, Classes P and NP, NP completeness, Other time classes, The time hierarchy.

BOOK PRESCRIBED

1. Introduction to the Theory of Computation by Michael Sipser, PWS Publishing Company, 1997.
Chapters: 1,2, 3(3.1,3.2), 4(4.2), 5, 6(6.1), 7(7.1 to 7.4), 9(9.1).

BOOKS FOR REFERENCE

1. Introduction to Automata theory, Languages and Computation by John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, Addison Wesley 2006.
2. Elements of the Theory of Computation by Harry Lewis, Christos H. Papadimitriou, Prentice Hall 1997.
3. Theory of Computer Science by K.L.P.Mishra, N.Chandrasekaran, Prentice Hall of India, 2nd Edition, 2006.

MSMA 5202 ADVANCED NUMERICAL ANALYSIS

MODULE – I

Interpolation: Piecewise Linear Interpolation, Piecewise Quadratic Interpolation, Piecewise Cubic Hermite Interpolation, Piecewise Spline Interpolation.

Numerical Differentiation: First Derivative, Higher Derivatives, Partial Derivative, Richardson's Extrapolation.

Romberg algorithm for numerical integration.

MODULE – II

Eigen values and Eigen Vectors: Basic power method, Rayleigh Quotient, Shifted power method, Accelerating convergence,

Inverse power method, Basic QR method, Better QR method, Finding eigen vectors, Accelerating convergence

Fourier methods: Discrete Fourier Transforms, Fast Fourier Transforms, Matrix form of FFT, Algebraic form of FFT, Mixed-Radix FFT

MODULE – III

Ordinary Differential Equations: Runge-Kutta Fourth order method, Adams-Bashforth Methods, Adams-Moulton Methods, Adams Predictor-Corrector methods

Parabolic Partial Differential Equation: Explicit Method, Implicit method, Crank-Nicolson method

Hyperbolic Partial Differential Equation: Explicit Method, Implicit method.

Elliptic Partial Differential Equation: Finite-Element method.

BOOK PRESCRIBED

1. L.V. Fausett," Applied Numerical Analysis Using MATLAB", Pearson Education, 2nd Edition

Chapters: 5(5.1, 5.1.1 to 5.1.4, 5.2, 5.2.1, 5.2.2, 5.3, 5.3.1 to 5.3.4)

8(8.2, 8.3, 8.3.1 to 8.3.4), 10(10.2.1 to 10.2.4, 10.3),

11(11.1, 11.1.1 to 11.1.4, 11.2.4), 12(12.2.4, 12.3, 12.3.1 to 12.3.3)

15(15.1, 15.1.1 to 15.1.3, 15.2, 15.2.1, 15.2.2, 15.4)

BOOKS FOR REFERENCE

1. W.Cheney and D. Kincaid,"Numerical Mathematics and Computing", Fifth Edition,

Thomson/CENGAGE Learning

2. S.C.Chapra,"Applied numerical methods with MATLAB", second edition, TataMcGraw Hills

3. R.J. Schilling and S.L.Harris,"Applied Numerical Methods for Engineering", CENGAGE learning