VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, ODISHA

BURLA, SAMBALPUR-768018, ODISHA

MASTER IN PHILOSOPHY

IN

MATHEMATICS

SEMESTER – I					
COURSE-NO	**COURSE NAME**	**L**	**T**	**P**	**CREDIT**
MPMA-101	Problem Solving in Analysis, Algebra and Topology	4	0	0	4
MPMA-102	Elective-I*	4	0	0	4
MPMA-103	Elective-II*	4	0	0	4
MPMA104	Research Methodology	4	0	0	4
MPMA-105	Journal Paper Review & Seminar	0	0	6	4
	TOTAL				20
SEMESTER-II					
COURSE-NO	**COURSE NAME**	**L**	**T**	**P**	**CREDIT**
MPMA-201	Dissertation/Project Work	0	0	0	16
MPMA-202	Comprehensive Viva & Seminar	0	0	0	4
	TOTAL				20
GRAND TOTAL		**40**			

List of Elective Courses(Theory)

Course Code	Name of the Course	L-T-P	Credits
MPMA-106	Distribution Theory and Calculus on Banach Spaces	4-0-0	4
MPMA-107	Rings and Modules	4-0-0	4
MPMA-108	Multi-objective Optimization	4-0-0	4
MPMA-109	Matrix Analysis	4-0-0	4
MPMA-110	Advanced Fluid Dynamics	4-0-0	4

VISION

The department of Mathematics VSSUT since its inception has strived to be a center of excellence in Mathematics. It is vigorously engaged in teaching and research.

MISSION

- To transform young people to competent and motivated professionals.
- To produce PG students with strong foundation to join research or serve in academics.
- To cater to the development of nation particularly in Odisha for research and training.

Programme Educational Objectives (PEO)

- P1: VSSUT Department of Mathematics provides a M.Phill course, suitable for students of high ability, combining and relating mathematics, science and technology.
- P2: VSSUT Department of Mathematics prepares students for further study, and research particularly in areas requiring the application of mathematics.
- P3: VSSUT Department of Mathematics **p**rovides students with a knowledge of Mathematics, its research poential and the interaction between the two.

Programme Outcomes (PO)

The Program Outcomes of M.Phill. in Mathematics are:

At the end of the programme, the students will be able to:

- Apply knowledge of Mathematics in different field of science and technology.
- To formulate and develop mathematical arguments.
- Understand, formulate and use mathematical models arising in science, technology and other areas.

DETAIL SYLLABUS

Problem Solving in Analysis, Algebra, Topology

Analysis: Real Analysis & Complex Analysis

Algebra: Abstract Algebra & Linear Algebra

Topology: Topology, Functional Analysis

[**Note:** The problems will be solved from the relevant portions of the Syllabus of Post- graduate course of VSSUT.]

Course Outcomes:

- Demonstrate problems and applications of abstract and linear Algebra.
- Demonstrate a basic working knowledge of the complex analysis.
- Use of Functional Analysis to solve problems.

Research Methodology

UNIT-1

Introduction to Research Methodology: Definition and objectives of Research. Types of research, Various steps in Research process, Mathematical tools for analysis, Developing a research question-choice of a problem, Literature review, Surveying, Synthesizing, Critical analysis, Critical evaluation, interpretation, Research purposes, Ethics in research, Citation, Impact factor, h-index, i-10 index.

UNIT-2

Research report writing: Structure and component of research report, Types of reports, Lay-out of research reports, Mechanism of writing a research report, Thesis writing, scientific editing, Popular articles writing, Patent writing and filing.

UNIT-3

Data collection and sampling designing: Data collection, Primary data, Secondary data, Processing and analysis of data, Measurement of relationship, Statistical measurement and significance, Random sampling, Systematic sampling, Stratified sampling, Cluster sampling and multistage sampling.

UNIT-4

Quantitative methods for problem solving: Probability, Sampling distribution, Fundamentals of statistical analysis and inference, Estimation, Hypothesis testing and application, Correlation and regression analysis, Types of study designing, Experimental designing, Error analysis.

Reference Books

1. Donald R Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., 2006.
2. Kothari C. K. (2004) 2/e, Research Methodology--Methods and Techniques (New Age International, New Delhi).
3. Krishnswamy, K.N., Shivkumar, Appa Iyer and Mathiranjan M. (2006) Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi).
4. Bendar and Piersol, Random data: Analysis and Measurement Procedures, Willey Interscience, 2001.
5. Fundamental of research Methodology and Statistics, Yogesh Kumar Singh (New Age International Publisher

Course Outcomes:

- Able to know how to write a paper and a thesis.
- Demonstrate problems and applications of data collection.
- Use of testing of hypothesis to validate experimental data.

ELECTIVES

Distribution Theory and Calculus on Banach Spaces

Unit-I

Test functions and distributions, some operations with distributions, local properties of distributions,

Unit-II

Convolutions of distributions, tempered distributions

Unit-III

Fourier transforms fundamental solutions.

Unit-IV

The Frechet derivative, chain rule and mean value theorems, implicit function theorem, extremum problems and Lagrange multipliers.

References:

[1] W. Cheney : Analysis for Applied Mathematics; Springer -Verlag, 2001.
[2] S. Kesavan : Topics in Functional Analysis and Applications; New Age International Publishers, 2008
[3] W. Rudin : Functional Analysis; Tata Mc-Graw Hill, 1991.
[4] Robert S. Strichartz : A guide to distribution theory and Fourier transforms; World Scientific Publishing Co., 2003.

Course Outcomes:

- Demonstrate problems and applications of functions and distributions.
- Demonstrate a basic working knowledge of the Frechet derivative.

- Use of Fourier transforms fundamental solutions.

Rings and Modules

Unit-I

Essential and superfluous submodules, Decomposition of rings, Generating and cogenerating

Unit-II

Modules with composition series, Fitting Lemma, Indecomposable decompositions of modules, Projective modules and generators, Radicals of projective modules

Unit-III

Projective covers, Injective hulls, Cogenerators, Flat modules. Singular submodules, Localization and maximal quotient rings. Essential finite generation, Finite dimensionality

Unit-IV

Uniform modules and Goldie rings. Regular rings, Strongly regular rings, Unit regular rings, Right π-regular rings. Baer rings, Rickart rings. Baer*rings, Rickart*rings.

Course Outcomes:

- Demonstrate problems and applications of Decomposition of rings.
- Demonstrate a basic working knowledge of the Essential finite generation.
- Use of Rickart rings and their solutions.

References:

[1] A.F.Anderson and K.R.Fuller: Rings and categories of modules, Springer- Verlag,1991 (Relevant sections of Ch. 2,3,4,5).

[2] S.K.Berberian : Baer Vings,Springer Verlag, New York ,1972 (Ch.1, sections 3, 4).

[3] K.R.Goodear1 : Ring theory (Non singular rings and modules), Marcel Dekker,Inc. New York (Relevant sections of Ch. 1,2,3).

[4] K.R.Goodear1 : Von Neumann regular rings,Pitman, London, 1979 (Ch. 1,3,4).

[5] T.Y.Lam: Lectures on Modules and rings, Springer Verlag, 1998(Ch. 3 ,section 7(d)).

Multi-objective Optimization

Unit-I

Multiple Objective Linear Programming Problem, Multiple Criteria Examples, Utility Functions,Non Dominated Criterion Vectors and Efficient Points, Point Estimate Weighted Sums Approach

Unit-II

Optimal Weighting Vectors, Scaling and Reduced Feasible Region Methods, Vector Maximum Algorithm. Formulation of the Multiple Objective Model, Method of Solutions

Unit-III

Augmented Goal Programming, Interactive Multiple Objective Methods. Multiple Objective Linear Fractional Programming. Multiple Objective Non linear Programming Problem, Efficiency and Non- Dominance, Weakly and Strictly Efficient Solutions

Unit-IV

Proper Efficiency and Proper Non- Dominance. Weighted Sum Scalarization : (Weak) Efficiency, Proper Efficiency, Optimality Conditions. Scalarization Techniques : The €-Constraint Method, The Hybrid Method, The Elastic Constraint Method and Benson's Method.

References:

[1] Ralph E.Steuer : Multi-Criteria Optimization, Theory Computation and Application, John Wiley and Sons, 1986. Chapters-1, 6, 7, 8, 9, 12.
[2] James P.lgnizeo : Linear Programming in Single and Multiple Objective Systems, Prentice Hall Inc. , Englewood Cliffs, N.J - 07632, 1982. Chapters- 16, 17, 20.
[3] Matthias Ehrgott: Multicriteria Optimization, Springer Berlin. Heidelberg-2005, Second Edition, Chapters- 2, 3,4.

Course Outcomes:

- Demonstrate problems and applications of Weighted Sum Scalarization.
- Demonstrate a basic working knowledge of the Multiple Objective Linear Programming Problem.
- Use of formulation of the Multiple Objective Model and their solutions.

Matrix Analysis

Unit-I

Unitary equivalence and normal matrices; Schur's Unitary triangularization theorem and its implications; QR-decomposition (factorization) canonical forms:

Unit-II

The Jordan form and its applications; Other canonical forms and factorizations, Polar decomposition; Triangular factorizations, LU-decomosition,

Unit-III

Norms for vectors and matrices; vector norms on matrices. Positive definite matrices; the Polar form and singular value decompositions. The Schur's product theorem; congruences; the positive definite ordering.

Unit-IV

Non-negative matrices and Primitive matrices. Stochastic and doubly stochastic matrices.

References:

[1] A. Bermann and R. Plemmans: Non-negative Matrices in Mathematical Sciences, Academic Press, 1979.
[2] R.A. Horn and C.R. Johnson: Matrix Analysis, Vol. I, Cambridge Univ. Press, 1985.
[3] H. Minc: Non-negative matrices, Wiley Interscience, 1988.
E. Seneta: Non-negative matrices, Wiley, New York, 1973.

Course Outcomes:

- Demonstrate problems and applications of Stochastic and doubly stochastic matrices.
- Demonstrate a basic working knowledge of the Unitary triangularization.
- Use of Jordan form and its applications.

Advanced Fluid Dynamics

Unit-I Introduction: Facts about Viscosity and heat transfer, General theory of stress and strain, Fundamental equation of viscous compressible fluids, Equation of state, Equation of continuity, Equation of motion, Equation of energy

Unit-II Some exact solution of Navier Stokes equation: Introduction, Laminar flow between parallel walls, plane coquette flow, plane Poisseuille flow, Hagen Poiseuille flow in a circular pipe, Flow in vicinity of a stagnation point, One dimensional steady flow of a viscous compressible fluid

Unit-III Dimensional analysis and π- theorem, Reynolds law of similarity, Important non-dimensional quantities with their physical significance.

Unit-IV Boundary layer theory: Two dimensional Boundary layer flow over a flat plate, Axial symmetric flow of Boundary layer, Momentum integral equation of Boundary layer flow, Boundary layer of an incompressible fluid on a surface with pressure gradient, Boundary layer on a circular cylinder, Boundary layer of an compressible fluid on a flat plate.

Text book

1. Viscous Flow Theory I- Laminar Flow, Shih-I – Pai, D. Van Nostrand Company

Reference books

1.Modern Fluid Dynamics, C.Kleinstreuer, Springer

2. An introduction to Fluid Dynamics, G.K. Batchelor, Cambridge Univ. Press

Course Outcomes:

- Demonstrate problems and applications of Boundary layer flow.
- Demonstrate a basic working knowledge of some exact solution of Navier Stokes equation.
- Use of similarity solutions.

DISSERTATION

(i) A candidate shall be required to write a dissertation under the guidance of a supervisor appointed by the M.Phil Committee. The dissertation will consist of a critical survey of some topic of interest in Mathematics, and /or involving research component.