GONDWANA UNIVERSITY
GADCHIROLI

Proposed Syllabus For

M.Sc. Mathematics

Semester-I and Semester-II

Under Choice Based Credit System

(C.B.C.S.)

With effect from

Academic Year: 2020-21

(Considered and approved by B.O.S. in Mathematics)
M.Sc. Mathematics
Semester wise Syllabus

M.Sc. Semester- I

CORE COURSES
PSCMTH01: Group Theory & Ring Theory
PSCMTH02: Real Analysis
PSCMTH03: Topology
PSCMTH04: Linear Algebra
PSCMTH05: CORE ELECTIVE COURSE (Opt any one of the following)
(a) Numerical Analysis
(b) Ordinary Differential Equations
(c) Calculus of Variations
(d) Number Theory
(e) Fuzzy Mathematics- I

M.Sc. Semester- II

CORE COURSES
PSCMTH06: Field Theory
PSCMTH07: Lebesgue Measure Theory
PSCMTH08: Advanced Topics in Topology
PSCMTH09: Classical Mechanics
PSCMTH10: CORE ELECTIVE COURSE (Opt any one of the following)
(a) Differential Geometry
(b) Coding Theory
(c) Cryptography
(d) SCILAB Programming
(e) Fuzzy Mathematics- II
Semester I for M.Sc. Program in Mathematics

<table>
<thead>
<tr>
<th>Code</th>
<th>Teaching Scheme (Hours/Week)</th>
<th>Credits</th>
<th>Examination Scheme</th>
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<tr>
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<td>Theory</td>
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<td>PSCMTH01</td>
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<td>4</td>
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<td>PSCMTH02</td>
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<td>4</td>
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<td>PSCMTH03</td>
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<td>4</td>
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<tr>
<td>PSCMTH04</td>
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<td>5</td>
<td>4</td>
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<tr>
<td>ELECTIVE COURSE PSCMTH05</td>
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Semester II for M.Sc. Program in Mathematics

<table>
<thead>
<tr>
<th>Code</th>
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<th>Examination Scheme</th>
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<td>PSCMTH07</td>
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<td>PSCMTH08</td>
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<td>4</td>
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<tr>
<td>ELECTIVE COURSE PSCMTH10</td>
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</table>

**Guidelines about Internal Assessment for all Semesters:**

The internal assessment marks shall be awarded by the concerned teacher. The internal assessment marks shall be sent to the University.

In case, the candidate fails in Theory Examination, the Internal Assessment marks will be carried forward for his next supplementary Examination.

There shall be no separate / extra allotment of work load to the teacher concerned. He/ She shall conduct the internal assessment activity during the regular teaching days / periods as a part of regular teaching activity.
The concerned teacher / department / college shall have to keep the record of all the internal assessment activities until six months after the declaration of the results of that semester.

DISTRIBUTION OF MARKS FOR INTERNAL ASSESSMENT

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activities</th>
<th>Max. Marks</th>
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<tbody>
<tr>
<td>1</td>
<td>Attendance</td>
<td>05(Compulsory)</td>
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<tr>
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<td>Any Two of the Following Activities</td>
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<tr>
<td>1</td>
<td>Seminar</td>
<td>10</td>
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<tr>
<td>2</td>
<td>Unit Tests</td>
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<tr>
<td>3</td>
<td>Home Assignments</td>
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Total Marks -25
Minimum Passing Marks -10
University Question Paper Pattern

A student of M. Sc. Sem-I, Sem-II, Sem-III and Sem-IV in Mathematics has to attempt all five questions in each paper.

Q1 to Q4 are long answer questions with internal choice within unit whereas Q5 is compulsory question of short answers on all four units. Setting of the question paper is as under:

<table>
<thead>
<tr>
<th>Total Marks: 100</th>
<th>Time 3 hours</th>
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<tbody>
<tr>
<td>Q1</td>
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</tr>
<tr>
<td>(A) Unit I</td>
<td>(10 marks)</td>
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<tr>
<td>(B) Unit I</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>(C) Unit I</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>(D) Unit I</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>Q2</td>
<td></td>
</tr>
<tr>
<td>(A) Unit II</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>(B) Unit II</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>(C) Unit II</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>(D) Unit II</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>Q3</td>
<td></td>
</tr>
<tr>
<td>(A) Unit III</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>(B) Unit III</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>(C) Unit III</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>(D) Unit III</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>Q4</td>
<td></td>
</tr>
<tr>
<td>(A) Unit IV</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>(B) Unit IV</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>(C) Unit IV</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>(D) Unit IV</td>
<td>(10 marks)</td>
</tr>
<tr>
<td>Q5</td>
<td></td>
</tr>
<tr>
<td>(A) Unit I</td>
<td>(05 marks)</td>
</tr>
<tr>
<td>(B) Unit II</td>
<td>(05 marks)</td>
</tr>
<tr>
<td>(C) Unit III</td>
<td>(05 marks)</td>
</tr>
<tr>
<td>(D) Unit IV</td>
<td>(05 marks)</td>
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</table>
SEMESTER-I

Core Course Code: – PSCMTH01
Credit - 05

Group Theory & Ring Theory

UNIT-I
Permutation Groups, Normal subgroups and quotient groups, Isomorphism Theorems, Automorphisms, Conjugacy and G- Sets.

UNIT-II
Normal Series, Solvable groups, Nilpotent groups, Cyclic decomposition, Alternating groups $A_n$, Simplicity of $A_n$.

UNIT-III
Direct products, Sylow theorems, Groups of order $p^2$ and $pq$.

UNIT-IV
Ideals, Homomorphisms, Sum and direct sum of ideals, Maximal and prime ideals, Nilpotent and Nil ideals, Zorn’s Lemma.

Text Book:

Reference Books:
Real Analysis

UNIT-I
Uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation, Equicontinuous families of functions, The Stone-Weierstrass theorem.

UNIT-II
Differentiation, The Contraction Principle, The Inverse Function Theorem, The Implicit Function Theorem,

UNIT-III
Topological Manifolds, Compatible Charts, Smooth Manifolds, Examples of Smooth Manifolds.

UNIT-IV
Smooth functions on a Manifold, Smooth Maps between Manifolds, Diffeomorphisms, Smoothness in terms of Components, Examples on Smooth maps, Partial derivatives, The inverse function theorem.

Text Books:

Reference Books:
Core Course Code:- PSCMTH03

Credit- 05

Topology

UNIT-I
Equipotent sets, Cardinal Numbers, Order Types, Ordinal Numbers.

UNIT-II
Open sets and limit points, Closed sets and closure, Operators and Neighbourhoods, Bases and Relative topologies.

UNIT-III
Connected sets and components, Compact and countably compact spaces, Continuous functions, Homeomorphisms.

UNIT-IV
$T_0$- and $T_1$- spaces, $T_2$- spaces and sequences, Axioms of countability, Separability.,Regular and Normal spaces.

Text Book:

Reference Books:
Linear Algebra

UNIT-I

UNIT-II

UNIT-III
Diagonalization: Eigen values and eigen vectors, Diagonalizability, Invariant Subspaces and the Cayley-Hamilton Theorem.

UNIT-IV

Text Book:

Scope: Ch 1: Art.1.1 to 1.7, Ch 2: Art. 2.1 to 2.7, Ch 5: Art 5.1,5.2,5.4, Ch 6: Art 6.1 to 6.7, Ch 7: Art 7.1 to 7.4.

Reference Books:
(a) Numerical Analysis

UNIT-I

UNIT-II
Polynomial interpolation theory, Newton divided differences, Finite difference and table oriented interpolation formulas, Errors in data and Forward-differences, Hermite interpolation.

UNIT-III

UNIT-IV
The Trapezoidal rule and Simpson’s rule, Newton- Cotes integration formulas, Gaussian Quadrature.

Text book:
An Introduction to Numerical Analysis: Kendal E. Atkinson, John Wiley and sons, Inc.

Reference Books:
(b) Ordinary Differential Equations

UNIT-I
Linear equations of first order, The equation \( y' + ay = 0 \), The equation \( y' + ay = b(x) \), The general linear equation of first order, The second order homogeneous equation, Initial value problems, Linear dependence and independence, A formula for the Wronskian, The homogeneous equation of order \( n \), The non-homogeneous equation of order \( n \), A special method for solving non-homogeneous equation.

UNIT-II
Linear equations with variable coefficients, Initial value problem for the homogeneous equation, Solution of the homogeneous equation, Wronskian and linear independence, Reduction of order of a homogeneous equation, Non-homogeneous equation, Homogeneous equations with analytic coefficients, The Legendre equation, The Euler equation, Second order equation with regular singular points, The Bessel equation.

UNIT-III

UNIT-IV
Some special equations, Complex \( n \)-dimensional space, Systems as vector equations, Existence and uniqueness of solutions to systems, Existence and uniqueness for linear systems, Equations of order \( n \).

Text Book:
Scope: Chapter 1 to 6.

Reference Books:
(c) Calculus of Variations

UNIT-I
Functionals- some simple variational problems, The variation of a functional, A necessary condition for an extremum, The simplest variational problem Euler’s equation, The case of several variables, A simple variable end point problem, The variational derivative, Invariance of Euler’s equation.

UNIT-II
The fixed end point problem for n-unknown functions, Variational problem in parametric form, Functionals depending on higher order derivatives, Variational problems with subsidiary conditions.

UNIT-III
Derivation of the basic formula, End points lying on two given curves or surfaces, Broken extremals, The Weierstrass Erdmann conditions.

UNIT-IV
The canonical form of Euler equations, First integrals of the Euler equations, The Legendre transformation, Canonical transformations, Noether’s Theorem, The principle of least action, Conservation laws, The Hamilton Jacobi equation, Jacobi theorem.

Text Book:

Reference Books:
(d) Number Theory

UNIT-I

UNIT-II
Prime Power Moduli, Prime Modulus, Primitive Roots and Power Residues, Congruence of Degree Two, Prime Modulus.

UNIT-III
Quadratic Residues, Quadratic Reciprocity, Greatest Integer Function.

UNIT-IV
Arithmetic Functions, Mobius Inversion Formula, The equation $ax + by = c$, Simultaneous linear equations, Pythagorean Triangles, Assorted Examples.

Text Book:

Reference Book:
(e)  Fuzzy Mathematics - I

UNIT-I
From classical (Crisp) Sets to Fuzzy Sets. Fuzzy sets versus Crisp sets, Operations on Fuzzy sets.

UNIT-II
Fuzzy Arithmetic.

UNIT-III
Fuzzy relations.

UNIT-IV
Fuzzy relation equations.

Text Book:

Reference Book:
SEMESTER-II

Core Course Code:- PSCMTH06  Credit - 05

Field Theory

UNIT-I
Unique factorization domains, Principal Ideal domains, Euclidean domains, Polynomial rings over unique factorization domains.

UNIT-II
Irreducible polynomials and Eisenstein criterion, Adjunction of roots, Algebraic extensions, Algebraically closed fields.

UNIT-III
Splitting fields, Normal extensions, Multiple roots, Finite fields, Separable extensions.

UNIT-IV
Automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of algebra.

Text Book:

Reference Books:
Lebesgue Measure Theory

UNIT-I
Introduction, Outer measure, Measurable sets and Lebesgue measure, A non-measurable set, Measurable functions, Littlewood’s three principles.

UNIT-II
The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure, Integral of a non-negative function, General Lebesgue integral, Convergence in measure.

UNIT-III
Differentiation of monotone functions, Functions of bounded variation, Differentiation of an integral, Absolute continuity, Convex functions.

UNIT-IV

Text Book:

Reference Books:
Advanced Topics in Topology

UNIT-I
Completely normal spaces, Completely Regular spaces, Metric spaces as Topological spaces, Topological Properties.

UNIT-II
Finite products, Product invariant properties, Metric products, Tichonov topology, Tichonov theorem.

UNIT-III
Quotient topology, Urysohn’s metrization theorem, Paracompact spaces.

UNIT-IV
Nets and filters.

Text books:
2. Introduction to General Topology: K. D. Joshi, Wiley Eastern Ltd. 1983. (For Unit -IV)

Reference books:
Classical Mechanics

UNIT-I
Hamilton’s Principle, Some techniques of calculus of variations, Derivation of Lagrange equations from Hamilton’s principle, Extension of principle to nonholonomic systems, Conservation theorems and symmetry properties.

UNIT-II
Legendre transformations and the Hamilton equations of motion, Cyclic coordinates and conservation theorems, Routh’s procedure and oscillations about steady motion, The Hamiltonian formulation of relativistic mechanics, The Principle of least action.

UNIT-III
The equations of canonical transformation, Examples of canonical transformations, The symplectic approach to canonical transformations, Poisson brackets and other canonical invariants.

UNIT-IV
Equations of motion, Infinitesimal canonical transformations, and conservation theorems in the Poisson bracket formulation, The angular momentum Poisson bracket relations, Symmetry groups of mechanical systems, Liouville’s theorem.

Text Book:

Reference Books:
(a) Differential Geometry

UNIT-I
The First Fundamental Form and Local Intrinsic Properties of a Surface.

UNIT-II
Geodesics on a Surface.

UNIT-III
The Second Fundamental Form and Local Non-Intrinsic Properties of a Surface.

UNIT-IV
The Fundamental Equations of Surface Theory.

Text Book:
Scope: Chapter 2,3,4 &5.

Reference Book:
(b) Coding Theory

UNIT-I
Error detection, correction and decoding: Communication channels, Maximum likelihood decoding, Hamming distance, Nearest neighbour / minimum distance decoding, Distance of a code.

UNIT-II
Linear codes: Vector spaces over finite fields, Linear codes, Hamming weight, Bases of linear codes, Generator matrix and parity check matrix, Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes, Cosets, Nearest neighbour decoding for linear codes, Syndrome decoding.

UNIT-III
Cyclic codes: Definitions, Generator polynomials, Generator and parity check matrices, Decoding of cyclic codes, Burst-error-correcting codes.

UNIT-IV
Some special cyclic codes: BCH codes, Definitions, Parameters of BCH codes, Decoding of BCH codes.

Text Book:
Scope: Chapters 2, 4, 7, 8.

Reference Book:
(c) Cryptography

UNIT-I
Time estimates for doing arithmetic, Divisibility and Euclidean algorithm, Congruences, Some applications to factoring, Finite fields, Quadratic residues and reciprocity.

UNIT-II
The idea of public key cryptography, RSA, Pseudo primes, The Rho method.

UNIT-III

UNIT-IV
Elliptic curves: Basic Facts, Elliptic curve cryptosystems, Elliptic curve primality test, Elliptic curve factorization.

Text Books:

Scope:
Unit - I - From Koblitz’s book (Chapter 1 and Chapter 2 excluding Existence and uniqueness of finite fields with prime power number of elements)
Unit - II – From Koblitz’s book (Chapter 4 –sections 1 and 2, Chapter 5- sections 1 and 2)
Unit - III – From Stinson’s book (Chapter 6- section 1, 2 and 7, Chapter 7- section 3)
Unit - IV - From Koblitz’s book (Chapter 6)
(d) **SCILAB Programming**

**UNIT-I**
Introduction to SCILAB, The SCILAB Environment, Scalars & vectors.

**UNIT-II**
Matrices, Programming in SCILAB.

**UNIT-III**
Polynomials, Menus and Dialogue Boxes, Graphic Output.

**UNIT-IV**
String handling functions, Statistics.

**Text Book:**
(e) Fuzzy Mathematics-II

Unit-I:
Possibility theory

Unit-II:
Fuzzy Logic

Unit-III:
Constructing Fuzzy sets and operations on Fuzzy sets, Approximate reasoning.

Unit-IV:
Fuzzy Systems, Pattern Recognition.

Text Book:
Fuzzy Sets and Fuzzy Logic, theory and applications. George J. Klir and Bo Yuan, Prentice Hall India.

Reference Book: