

Table – 6: Course Structure for **M.Sc. (Maths) Degree Programme**

(with effect from the academic year 2017-2018 onwards)

Sem. (1)	Sub. No. (2)	Subject Status (3)	Subject Title (4)	Contact Hrs./ Week (5)	Credits (6)
I	1	Core - 1	Algebra - I	6	4
	2	Core - 2	Analysis – I	6	4
	3	Core - 3	Analytic Number Theory	6	4
	4	Core - 4	Ordinary Differential Equations	6	4
	5	Core - 5	Numerical Analysis	6	4
	Subtotal				30
II	6	Core - 6	Algebra II	5	4
	7	Core - 7	Analysis II	5	4
	8	Core - 8	Classical Mechanics	5	4
	9	Core - 9	Differential Geometry	5	4
	10	Core - 10	Graph Theory	5	4
	11	Elective - 1	1) Programming With C++ 2) Discrete Mathematics 3) Partial Differential Equations	5	3
	Subtotal				30

III	12	Core - 11		5	4	
	13	Core - 12		5	4	
	14	Core - 13		5	4	
	15	Core - 14		5	4	
	16	Core - 15	Research Methodology	5	4	
	17	Elective - 2		5	3	
				Subtotal	30	23
IV	18	Core - 16		6	4	
	19	Core - 17		6	4	
	20	Core - 18		5	4	
	21	Core - 19		5	4	
	22	Core - 20	Project	8	8	
				Subtotal	30	24
				Total	120	90

For the Project, flexible credits are b/w 5 – 8 & Hours per week are b/w 10 - 16.

Total number of credits \geq 90	:	90
Total number of Core Courses	:	20 (19 T + 1 Prj.)
Total number of Elective Courses	:	2
Total hours	:	120

SEMESTER I

1.1 Paper 1: ALGEBRA - I

Text Book: Topics in Algebra , I.N. Herstein, 2nd Edition, Wiley India Edition.

Unit I: A Counting Principle – Normal Subgroups and quotient groups – Homomorphisms.

Sections: 2.5, 2.6, 2.7.

Unit II: Automorphisms – Cayley’s theorem – Solvable groups.

Sections: 2.8, 2.9.

Supplementary Problems : 10 -17.

Unit III: Permutation groups – Another counting principle.

Sections: 2.10, 2.11.

Unit IV: Sylow’s theorems.

Sections: 2.12.

Unit V: Direct products – Finite abelian groups.

Sections: 2.13, 2.14.

1.2 Paper 2: ANALYSIS – I

Text Book: Principles of Mathematical Analysis, Walter Rudin, Third Edition, McGraw Hill International Book Company .

Unit I: Metric spaces – Compact sets – Perfect sets – Cantor sets – Connected sets .

Chapter II : Sections 2.15 to 2.47.

Exercise Problems: Chapter II : 5 -14, 20.

Unit II: Convergence sequences – Sub sequences – Cauchy sequence - Lower and Upper limits – Some special sequences – Series – Series of non negative terms – The number e.

Chapter III : Sections 3.1 to 3.32.

Exercise Problems: Chapter III : 1 - 8.

Unit III: Root test and Ratio test – Power series – Summation by parts – Absolute convergence – Addition and multiplication of series.

Chapter III : Sections 3.33 to 3.51.

Exercise Problems : Chapter III : 9, 11 - 13.

Unit IV: Continuity – Limit of functions – Continuous functions – Continuity and compactness – Continuity and connectedness – Discontinuous – Monotonic functions.

Chapter IV : Sections 4.1 to 4.31.

Exercise Problems : Chapter IV: 1 – 5, 14,15.

Unit V: Differentiation – Derivative of a real function – Mean value theorems – The continuity of derivatives – L'Hospital Rule – Derivatives of higher order – Taylor's theorem.

Chapter V : Sections 5.1 to 5.15.

Exercise Problems : Chapter V : 1 - 5 and 12.

1.3 Paper 3: ANALYTIC NUMBER THEORY

Text Book: Introduction to Analytic Number Theory – Tom M. Apostol – Springer
International Student Edition.

Unit I: The fundamental Theorem of Arithmetic.

Chapter 1 and Exercise Problems: 1-11.

Unit II: Arithmetic functions.

Chapter 2: Sections 2.1 -2.8.

Exercise problems: Chapter 2: (1-6).

Unit III: Multiplicative functions and Dirichlet Multiplication.

Sections 2.9 – 2.14.

Exercise problems: Chapter 2: (21-23, 25,26).

Unit IV: Averages of Arithmetical functions.

Chapter 3: (1-9).

Exercise problems: Chapter 3: (1-4).

Unit V: Partial sums of Dirichlet product, Chebyshev's functions – equivalent forms of prime number theorem.

Chapter 3: Sections: 3.10, 3.11 and **Chapter 4:** 4.1 – 4.5.

Exercise problems: Chapter 4: (3,4,5,8,9,10).

1.4 Paper 4: ORDINARY DIFFERENTIAL EQUATIONS

Text Book: Differential Equations with application and historical notes, G.F. Simmons, Second Edition, Tata McGraw Hill.

Unit I: **Second Order linear equations :** General solution of the Homogeneous equations – The use of a known solution to find another – The method of variation of parameters.

Sections: 14 – 16.

Unit II: **Power series solutions:** A review of power series solutions – Series solution of first order equations – Second order equations – Ordinary points.

Sections: 26 – 28.

Unit III: Regular singular points – Legendre polynomials- Properties of Legendre polynomials

Sections: 29, 30, 44, 45.

Unit IV: Bessel functions – The Gamma functions – Properties of Bessel functions.

Sections: 46, 47.

Unit V: **Linear systems :** Homogeneous linear systems with constant coefficients

Sections: 55, 56.

1.5 Paper 5: NUMERICAL ANALYSIS

Text Book: Numerical Methods, S. Arumugam and others, Scikech(2001).

Unit I: Interpolation : Newton's Interpolation Formula – Central difference Interpolation
Lagrange's Interpolation formula – Divided differences - Newton's Divided
differences formula – Inverse Interpolation – Hermit's Interpolating Polynomial.

Chapter 7: Sections 7.1 to 7.7.

Unit II: Numerical differentiation – Derivatives using Newton's forward, backward,
central difference formulae

Chapter 8: Sections 8.1 to 8.3.

Unit III: Numerical Integration –Gaussian Quadrature formula –Numerical evaluation of
double integrals.

Chapter 8: Sections 8.5 to 8.7.

Unit IV: Numerical solutions of ordinary differential equations – Taylor's series Method –
Picard's Method – Euler's Method – Runge Kutta Method.

Chapter 10: Sections 10.1 to 10.4.

Unit V: Predictor corrector Method – Milnes Method – Adams-Bashforth Method.

Chapter 10: Sections 10.5 to 10.7.

SEMESTER II

2.1 Paper 6: ALGEBRA II

Text book 1: Topics in Algebra, I.N. Herstein, 2nd edition, Wiley Student edition.

Text book 2: A First Course in Rings and Ideals, David M. Burton, Addison – Wesley Publishing Company.

Unit I: Ring Homomorphisms – Ideals and Quotient rings – More ideals and Quotient rings – The field of Quotients of an integral domain.

Text book 1: **Sections:** 3.3 – 3.6.

Unit II: Euclidean rings - A particular Euclidean ring.

Text book 1: **Sections:** 3.7 and 3.8.

Unit III: Polynomial rings – Polynomials over rational field – Polynomial rings over commutative rings.

Text book 1: **Sections:** 3.9 – 3.11.

Unit IV: Certain radicals of a ring – Jacobson radical of a ring – Semi simple ring – nil radical – Primary ring.

Text book 2: **Chapter 8:** Definition 8.1 – Theorem 8.15.

Unit V: Quasi regular – J-semi simple – Direct sum of rings.

Text book 2: **Chapter 8:** Theorem 8.16 – Theorem 8.18 and **Chapter 10.**

2.2 Paper 7: ANALYSIS II

Text Book: **Principles of Mathematical Analysis**, Third Edition, Walter Rudin – McGraw Hill International Book Company.

Unit I: Definition and Properties of Integral – Integration and Differentiation.

Chapter 6: Section: 6.1 – 6.22.

Exercise Problems: Chapter 6: 1, 2, 4, 5, 10, 11.

Unit II: Integration of vector valued functions – Rectifiable arcs, Sequence and Series of functions: Discussion of main problem – Uniform Convergence – Uniform Convergence and Continuity.

Chapter 6: Section: 6.23 – 6.27 & **Chapter 7 :** Section: 7.1 – 7.15.

Exercise Problems: Chapter 7 : 1, 4, 6 and 7.

Unit III: Uniform Convergence and Integration – Uniform Convergence and Differentiation – Equicontinuous families of functions.

Chapter 7: Section: 7.16 – 7.25.

Unit IV: The Stone Weierstrass Theorem - Power Series.

Chapter 7: Section: 7.26– 7.33 and **Chapter 8:** Section: 8.1 – 8.5.

Exercise Problems: Chapter 8: 1 – 5.

Unit V: The algebraic completeness of the complex field – Fourier Series – The Gamma function.

Chapter 8: Section: 8.8 – 8.22

Exercise Problems: Chapter 8: 13, 14, 15.

2.3 Paper 8: CLASSICAL MECHANICS

Text Book: Classical Mechanics, H. Goldstein, second edition, Addison Wesley India edition.

Unit I: Mechanics of particle – Mechanics of a system of particles constraints.

Chapter 1: Section 1-3, Problems: 2, 4 and 5.

Unit II: D'Alembert's Principle and Lagrange's equation – Velocity dependent potentials and dissipation functions – Simple applications of Lagrangian formulation.

Chapter 1: Section 4, 5 and 6, Problems: 11, 13 and 17.

Unit III: Hamilton's Principle – Some techniques of Calculus of Variation – Derivation of Lagrange's equations from Hamilton's principle – Extension of Hamilton principle to non-holonomic systems.

Chapter 2: Section 1 - 4, Problems: 1 - 3.

Unit IV: Reduction to the equivalent one-body problem – The equations of motion and first Integrals – The equivalent one dimensional problem and classification of orbits - The virial theorem.

Chapter 3: Section 1 - 4, Problems: 2 - 4.

Unit V: The differential equation for the orbit and integrable power law potentials – The Kepler problem: Inverse square law of force – The motion in time in the Kepler problem – The Laplace – Runge – Lenz vector.

Chapter 3: Section 5, 7 - 9.

2.4 Paper 9: DIFFERENTIAL GEOMETRY

Text book: An Introduction to Differential Geometry, T.J. Willmore, Oxford University Press, (17th Impression), New Delhi, 2002, (Indian Print).

Unit I: The theory of space curves – Definitions , Arc length – Tangent – Normal and Binormal – Curvature and Torsion.

Chapter 1: Section: 1.1 – 1.5.

Problems: Chapter 1: Miscellaneous Exercise I: 1 – 3.

Unit II: Contact between curves and surfaces – Tangent Surface – Involutives and evolutes – Helices

Chapter 1: Section: 1.6, 1.7 and 1.9

Problems: Chapter 1: Miscellaneous Exercise I: 8 – 12.

Unit III: Definition of a surface – Curves on a surface – Helicoids – Metric – Direction Coefficients.

Chapter 2: Section: 2.1, 2.2, 2.4, 2.5, 2.6

Problems: Chapter 2: Miscellaneous Exercise II : 1 – 4.

Unit IV: Families of curves – Geodesics , Canonical geodesic equation, Normal Property of geodesics (Christoffel symbols not included).

Chapter 2: Section: 2.7, 2.10 – 2.12

Problems: Chapter 2: Miscellaneous Exercise II: 6, 7, 8.

Unit V: Geodesic curvature , The Second Fundamental form – Principal Curvature – Lines of Curvature (Dupin's indicatrix not included).

Chapter 2: Section: 2.15, **Chapter 3:** Section: 3.1 – 3.3.

Problems: Miscellaneous Exercise III: 1 – 5.

2.5 Paper 10: GRAPH THEORY

Text Book: Graph Theory with applications, H.J.A. Bondy and Murthy, The MacMillan Press Limited.

Unit I: Trees - Connectivity – Blocks.

Chapter 2: Section: 2.1 – 2.4. and Chapter 3: Section 3.1 – 3.3

Unit II: Euler tour – Hamilton cycle – Applications.

Chapter 4: Section: 4.1 – 4.3

Unit III: Matching – Perfect Matching – Edge colouring.

Chapter 5: Section: 5.1 – 5.3 & **Chapter 6 :** Sec : 6.1 & 6.2.

Unit IV: Independent sets – Cliques.

Chapter 7: Section: 7.1 – 7.3.

Unit V: Vertex Colouring.

Chapter 8: Section: 8.1 – 8.5.

2.6 Elective(Any One)

2.6.1 PROGRAMMING WITH C++

Text Book: Object oriented Programming with C++ (Fourth Edition), E.Balagurusamy, TMH Publications.

Unit I: Tokens, Expressions and Control Structures.

Chapter: 3

Programming Exercises: 3.1, 3.3, 3.5, 3.7, 3.9, 3.10

Unit II: Functions in C++, Classes & Objects.

Chapter: 4 & 5

Programming Exercises: 4.1, 4.2, 4.5, 4.7, 5.2, 5.5

Unit III: Constructors and destructors, Operator overloading & Type conversions.

Chapter: 6 & 7

Programming Exercises: 6.2, 7.2, 7.3, 7.4

Unit IV: Inheritance – Extending classes, Pointers, Virtual Functions & Polymorphism.

Chapter: 8 & 9

Programming Exercises: 9.1, 9.2

Unit V: Unformatted I/O Operations, Formatted Console I/O Operations, Managing Output with Manipulators, Working with Files.

Chapter: 10.4, 10.5, 10.6, 11

Programming Exercises: 10.1, 10.3, 11.1, 11.2

2.6.2 DISCRETE MATHEMATICS

Text Book: Discrete Mathematics and its Applications (Sixth Edition) – Kenneth H. Rosen.
WCB/ McGraw Hill Publications

Unit I: Propositional Logic – Propositional equivalence - Predicates and quantifiers.

Sections: 1.1 - 1.3.

Problems: Section 1.1(1 - 38), Section 1.2(1 - 35) and
Section 1.3(1 – 34)

Unit II: The Basics of counting – The Pigeonhole principle – Generalized permutation and combination.

Sections: 5.1, 5.2 and 5.5

Problems: Section 5.1(1 - 40), Section 5.2(1 - 22) and
Section 5.5(1 – 9)

Unit III: Relation and their properties – n-ary relations and their applications – representing relation – closures of relations.

Sections: 7.1 – 7.4 except Warshall's algorithm

Problems: Section 7.1(All exercise problems), Section 7.2(1 - 27),
Section 7.3(1 – 22) and Section 7.4(1 - 22)

Unit IV: Boolean functions – Representing Boolean functions.

Sections: 10.1 and 10.2

Problems: All exercise problems.

Unit V: Logic Gates –Minimization.

Sections: 10.3 and 10.4

Problems: All exercise problems.

2.6.3 PARTIAL DIFFERENTIAL EQUATIONS

Text Book: Elements Of Partial Differential Equations, IAN N. SNEDDON, McGraw Hill, New Delhi, 1983.

Unit I: Methods of Solution of $\frac{dx}{P} + \frac{dy}{Q} + \frac{dz}{R}$ - Pfaffian Differential Forms and Equations
- Solution of Pfaffian Differential Equations in three variables .

Chapter 1: Section: 3, 5 and 6 (all problems)

Unit II : Partial Differential equations - Origins of first order Partial Differential equations - Linear equations of the first order - Integral surfaces passing through a given curve .

Chapter 2: Section: 1,2,4 and 5 (all problems)

Unit III: Cauchy's Method of Characteristics - Compatible systems of First order Equations - Charpit's Method.

Chapter 2: Section: 8 - 10 (all problems)

Unit IV: Second order equations in Physics - Linear Partial Differential equations with Constant Coefficients.

Chapter 3: Section: 2 and 4 (all problems)

Unit V: Characteristics of Equations in three variables - Separation of variables.

Chapter 3: Section: 7 and 9 (all problems)