PONDICHERRY UNIVERSITY
DEPARTMENT OF MATHEMATICS

5-YEAR M.Sc. INTEGRATED PROGRAMMES

RAMANUJAN SCHOOL OF MATHEMATICAL SCIENCES
&
SCHOOL OF PHYSICAL, CHEMICAL & APPLIED SCIENCES

SYLLABI

WITH EFFECT FROM THE ACADEMIC YEAR

2011 - 2012
MATER OF SCIENCE  
(5 YEAR INTEGRATED)  
(CBCS)  

Regulations  

Eligibility for Admission  
Candidates who have passed in +2 with minimum 50% marks and should have studied Mathematics as one of the main subjects. Those who studied only Business Mathematics are not eligible.  

Medium  
The medium of instruction shall be English
### Integrated M.Sc. Programme of Ramanujan School of Mathematical Sciences
#### From 2011-2012 onwards

<table>
<thead>
<tr>
<th>Course Code No.</th>
<th>Name of the Course</th>
<th>No. of Credits</th>
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<tbody>
<tr>
<td>MATH-111</td>
<td>Differential Calculus</td>
<td>3</td>
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<td>Elements of Discrete Mathematics</td>
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<tr>
<td>MATH-241</td>
<td>Introduction to Real Analysis</td>
<td>3</td>
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<tr>
<td>MATH-242</td>
<td>Abstract Algebra</td>
<td>3</td>
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<tr>
<td>MATH-351</td>
<td>Elements of Differential Equations</td>
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<tr>
<td>MATH-352</td>
<td>A First Course in Linear Algebra</td>
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<td>MATH-361</td>
<td>Fundamentals of Complex Analysis</td>
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<tr>
<td>MATH-362</td>
<td>Elements of Mechanics</td>
<td>3</td>
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<tr>
<td>MATH-243</td>
<td>Foundations in Geometry</td>
<td>3</td>
<td>Soft Core</td>
</tr>
<tr>
<td>MATH-353</td>
<td>Theory of Equations and Numerical Methods</td>
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<td>Soft Core</td>
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4th and 5th year Syllabi same as that of M.Sc. Mathematics I & II Year respectively
Courses offered by the Department of Mathematics for the
Integrated M.Sc. Program of School of Physical, Chemical and Applied Sciences
From 2011-2012 onwards

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5 Year Integrated M.Sc. Program

HARD CORE COURSE
MATH 111: DIFFERENTIAL CALCULUS
3 Credits

Unit -I
Derivative of a function, Differentiation rules, Rate of change, Derivatives of trigonometric functions, Chain Rule, Implicit differentiation rational exponents Inverse functions and their derivatives. Hyperbolic function.

Unit -II
Application of Derivatives
Increasing decreasing functions, Maxima Minima, Error –approximation, optimization, Newton method, mean value theorems, Taylor theorem, and Maclaurians theorem.

Unit- III
Asymptotes, test of concavity & convexity point of inflexion, Multiple point Training curves in cartiean & Polar co-ordinates.

Unit -IV
Successive differation. Leibritz Rule, Problems and examples.

Unit -V
Exponent function a^x, log—functions, Theorems on Exponent & Log functions. Partial Differentiation, chain rule, Eulers Theorem.

Text Book


3) Serge Larg, A First course in Calculus, 5th edition Springer, 1999
5 Year Integrated M.Sc. Program

MATH 121: INTEGRAL CALCULUS
3 Credits

Unit -I

Unit -II
Definite Integrals - Properties of Definite Integrals - Integral as the Limits of a Sum- Evaluation of Integrals- Area and the Mean Value Theorem-The Fundamental Theorem-Substitution in Definite Integrals.

Unit- III
Integration by Parts (Theorem and Examples) – Integration of Rational Fractions – Irrational Fractions-Trigonometric Substitutions.

Unit -IV
Reduction Formulae for $\sin^n x$, $\cos^n x$, $\tan^n x$, $\cot^n x$, $\sec^n x$, $\cosec^n x$, $\cos^m x \cos nx$, $\cos^m x \sin nx$, $\sin^m x \cosec nx$, $\sin^m x \cosec nx$.

Unit -V
Areas between curves- Finding volume by slicing- Volumes of Solids of Revolution - Disk and Washers- Cylindrical Shell-Lengths of Plane Curves- Areas of Surface of Revolution

Text Book
Unit-I: Sections 4.1-4.4;
Unit-II: Sections 4.5-4.8;
Unit-III: Sections 7.1-7.4;
Unit-IV: Sections 7.5;
Unit-V: Sections 5.1-5.6.

Reference Books
2. Richard Courant and Fritz John, Introduction to Calculus and Analysis, Volumes I & II Springer, SIE, 2004
5 Year Integrated M.Sc. Program

HARD CORE COURSE
MATH 122: ANALYTICAL GEOMETRY OF THREE DIMENSIONS AND TRIGONOMETRY
3 Credits

Unit - I
Preliminaries: Rectangular coordinates- Distance between two points- Division of a line joining two points in a given ratio - Angle between two lines- Direction cosines and ratios of a straight line- Condition for parallelism and perpendicularity of two lines- Projection of a line segment on another line.
The plane- The general equation of the first degree in three variables always represents a plane surface-Direction cosines of the normal to a plane- Equation of a plane in intercept form- The form lx + my + nz = p- Angle between two planes- Pair of planes- Image of a point in a plane-Length of perpendicular from a point to a plane

Unit- II
The equation to a straight line- Symmetrical form- Parametric coordinates of any point on a line- Transformation from un-symmetrical form to the symmetric form- Condition for a line to be parallel to a plane- Angle between a line and a plane- Coplanar lines Lines intersecting two lines –Skew lines – Shortest distance between two lines

Unit- III
The sphere- The equation of a sphere with given centre and radius- The equation of a sphere on the line joining two given points as diameter- Plane section of a sphere- Equation of a sphere passing through a given circle- The intersection of two spheres- The equation of a tangent plane to a sphere- Length of tangent to a sphere- Orthogonal spheres.

Unit- IV

Unit -V
Hyperbolic functions- Inverse hyperbolic functions- Separation into real and imaginary parts.

Text Books:

Reference Books
1. S.L. Loney, The Elements of Coordinate Geometry, Macmillan India, 2010
2. R.J.T.Bill, Elementary Treatise on Coordinate Geometry of Three Dimensions, Macmillan India, 1918
5 Year Integrated M.Sc. Program

Semester – III
HARD CORE COURSE
MATH 231: MULTIVARIABLE CALCULUS
3 Credits

Unit I: Differentiation

Unit II: Higher Derivatives and Extrema

Unit III: Multiple Integral
Double Integrals – Triple Integrals – Change of variables – Cylindrical and Spherical coordinates.

Unit IV: Integrals over Curves and Surfaces
Line integrals – Parametrized surfaces – Area of a surface – Surface integral.

Unit V: The Integral Theorems of Vector Analysis
Green’s Theorem – Stokes’s Theorem - Gauss Divergence Theorem.

Text Book
Unit-I: Sections 2.1-2.5;
Unit-II: Sections 3.1-3.5;
Unit-III: Sections 5.2-5.5;
Unit-IV: Sections 6.1-6.4;
Unit-V: Sections 7.1-7.3.

Reference Books
5 Year Integrated M.Sc. Program

HARD CORE COURSE
MATH-232: ELEMENTS OF DISCRETE MATHEMATICS

Unit –I Preliminaries:
Relations, Functions, Integers Division algorithm, Euclidean Algorithm, Prim numbers, congruence, Application of congruence.

Unit-II Introduction and recursion:
Mathematical induction, Recursively defined sequence, solving recurrence relations, Characteristic polynomials, Generating functions.

Unit-III Principals of counting:
Inclusion, Addition and multiplication rule, Pigeon hole Principle.

Unit-IV Permutation and combination:
Permutation, combination, Repetition, Derangements, Binomial Theorem.

Unit-V Algorithm:
Complexity, Searching and sorting, Enumeration of permutation and combination.

Text Book:
Discrete mathematics with Graph Theory, Second edition, Edgar G. Goodaire and Michael M.Parmenter, Published by Pearson Education (SingaporeP Ptd) Ltd

Reference Book:
UNIT - I
Definition of sequence and subsequence - Limit of a sequence - Convergent sequence - Bounded sequence - Monotone sequence - Operation on convergent sequence - Limit superior and limit inferior - Cauchy sequence.

UNIT - II
Convergence and Divergence - Series with non-negative terms -- Alternating series - Conditional convergence and absolute convergence. Test of absolute convergence - Series whose terms form a non-increasing sequence - Summation by Parts.

UNIT - III
Limit of a function on the real line - Metric Spaces – Functions continuous at a point. On the real line – Reformulation – Functions. Continuous on a metric space.

UNIT - IV
Functions continuous at a point on the real line - Reformulation - Functions continuous on a metric space - Open sets and closed sets - More about open sets - Connected sets.

UNIT – V

Text Book

UNIT 1: Sec 2.1 - 2.10
Unit 2. Sec 3.1 - 3.8
Unit 3. Sec 4.1 - 4.3, 5.1 – 5.3
Unit 4. Sec 5.4 – 5.6, 6.1, 6.2, 6.3 (Bounded Set only), 6.4.
Unit 5. Sec 7.5 - 7.7, 8.1 - 8.7
5 Year Integrated M.Sc. Program

HARD CORE COURSE
MATH 242: ABSTRACT ALGEBRA
3 Credits

Unit- I
Definition of a group- Some examples of Groups- Some Preliminary Lemmas
-Subgroups

Unit- II
A Counting Principle- Normal Subgroups and Quotient Groups- Homomorphism

Unit -III
Automorphism – Cayley’s Theorem- Permutation Groups

Unit -IV
Definition and Examples of a Rings- Some Special Classes of Rings - Homomorphism-Ideals
and Quotients Rings-More Ideals and Quotients Rings

Unit -V
The Field of Quotients of an Integral Domain-Euclidean Rings- A Particular Euclidean Ring

Text Book

Unit-I: Sections 2.1-2.4;
Unit-II: Sections 2.5-2.7;
Unit-III: Sections 2.8-2.10;
Unit-IV: Sections 3.1-3.5;
Unit-V: Sections 3.6-3.8

Reference Book

I Neal H. Mc Coy and Gerald J. Janusz, Introduction to Abstract Algebra, Elsevier,
5 Year Integrated M.Sc. Program
HARD CORE COURSE
MATH 351: ELEMENTS OF DIFFERENTIAL EQUATIONS
3 Credits

Unit - I

Unit - II

Unit - III

Unit - IV

Unit - V

Text Book
Unit-I: Sections 1.5-1.8;
Unit-II: Sections 2.1-2.7;
Unit-III: Sections 2.8-2.10, 2.13, 2.14;
Unit-IV: Sections 3.0-3.4;
Unit-V: Sections 5.1-5.7

Reference Books
1. D George F. Simmons, Differential Equations, Tata McGraw-Hill, New Delhi, 1972
5 Year Integrated M.Sc. Program

MATH: 352 (Hard Core) - A FIRST COURSE IN LINEAR ALGEBRA

UNIT – I
Abstract Algebra Concepts – Groups, Subgroups, Fields, examples

Vector space, Subspace, linear combinations and systems of linear equations, Linear dependence and linear independence, Basis and dimension

UNIT – II
Linear Transformations, Null spaces, Range spaces, Dimension theorem, Matrix representation of linear transformation, composition of linear transformations and Matrix multiplication, Invertability and Isomorphism, The change of coordinate matrix

Unit – III
Elementary matrix Operations and elementary matrices, The rank of a matrix and matrix inverses, systems of linear equations, theory and computation

UNIT – IV
Determinants of order 2 and order n, properties of determinants, Important facts about determinants, Eigen values and Eigen vectors, Diagonalizability, Invariant spaces and Cayley-Hamilton theorem.

UNIT – V

TEXT BOOK:

Reference Book:
S. Kumaresan, Linear Algebra Geometric Approach, Prentice Hall of India PVT. LTD, 2000
5 Year Integrated M.Sc. Program

HARD CORE COURSE
MATH 361: FUNDAMENTALS OF COMPLEX ANALYSIS
3 Credits

Unit - I

Unit - II
Exponential Function - Trigonometric Functions, Hyperbolic Functions - Logarithm. General Power - Linear Fractional Transformation

Unit- III
Line Integral in the Complex Plane - Cauchy’s Integral Theorem - Cauchy’s Integral Formula - Derivatives of Analytic Functions

Unit - IV
Sequences, Series, Convergence Tests - Power Series - Functions Given by Power Series - Taylor Series and Maclaurin Series

Unit - V
Laurent Series - Singularities and Zeros, Infinity - Residue Integration Method Evaluation of Real Integrals

Text Book
Unit-I: Sections 12.1-12.5;
Unit-II: Sections 12.6-12.9;
Unit-III: Sections 13.1-13.4;
Unit-IV: Sections 14.1-14.4;
Unit-V: Sections 15.1-15.4

Reference Books
5 Year Integrated M.Sc. Program

HARD CORE COURSE
MATH 362: ELEMENTS OF MECHANICS

Unit -I
Newtonian Mechanics in Moving Coordinate Systems: Newton’s Equation in a Rotating Coordinate System- Free Fall on the Rotating Earth-Foucault’s Pendulum

Unit -II
Mechanics of Particle Systems: Degrees of Freedom- Center of gravity (Scattering theory excluded)

Unit -III
Mechanical Fundamental quantities of Systems of Mass Points-Linear and angular momentum-
Energy law- Transformation to center of mass coordinates- Transformation of the kinetic energy-
Vibrations of Coupled Mass Points- The vibrating chain- The Vibrating String-Solution of the
wave equation- Normal vibration

Unit -IV
Mechanics of Rigid Bodies: Rotation About a Fixed Axis-Moment of inertia-The physical pendulum-Rotation About a Point-Tensor of inertia- Kinetic energy of a rotating rigid body-The principal axes of inertia-Existence and orthogonality of the principal axes-Transformation of the
tensor of inertia-Tensor of inertia in the system of principal axes-Ellipsoid of inertia

Unit - V
Theory of the Top: Free top-Geometrical and analytical theory-The heavy symmetric top and application-The Euler angles-Motion of the heavy symmetric top

Text Book
Unit I: Sections 1-3;
Unit II: Sections 4-5;
Unit III: Sections 6-8;
Unit IV: Sections 11-12;
Unit V: Section 13

Reference Books
1. H. Goldstein, Classical Mechanics, Narosa Publishing House, New Delhi, 1985
3. S.L. Loney, Dynamics of a Particle and of Rigid Bodies, Cambridge University Press, 1927
5 Year Integrated M.Sc. Program

Soft Core
MATH 243: FOUNDATIONS IN GEOMETRY

Unit -I

Unit-II
Length of curve – Area contained in a simple closed curve. The Isoperimetric inequality – Four vertex theorem.

Surfaces

Unit-III

Unit-IV

Unit-V
Surface area – Second fundamental form – Curvature of curves on a surface – Meusnier theorem – Principal curvatures – Umplics – Euler’s theorem.

Text Book:
   (Relevant sections from Chapters 1 to 6)

Reference Book:
5 Year Integrated M.Sc. Program

SOFT CORE COURSE
MATH 353: THEORY OF EQUATIONS AND NUMERICAL METHODS
3 Credits

Unit- I
Relations between roots and coefficients of an algebraic equation - Imaginary roots-Irrational roots-
Symmetric functions of the roots in terms of the coefficients

Unit- II
Reciprocal equations– Descartes’ rule of signs – Transformations of equations

Unit- III
Numerical solutions of algebraic equations – Bisection method – Regula falsi method – Iteration method
– Newton –Raphson method

Unit- IV
System of linear equations – Gauss elimination method – Jordan method – Jacobi’s method – Gauss-
Seidel method

Unit -V
Finite difference operators – Newton’s forward difference formula – Newton’s backward difference

Text Book:
1. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice-Hall of India Private Ltd, New
Delhi.3rd Edition, 2000
2. Chadrika Prasad, Text Book on Algebra and Theory of Equations, Pothiskola Private Ltd., Allahabad
2001

Reference Books: