N.S.S. COLLEGE OTTAPALAM

DEPARTMENT OF MATHEMATICS

Programmes offered by the department: M.Sc. Mathematics & B.Sc. Mathematics

M.Sc. Mathematics

Programme Specific Outcomes:

- To develop problem-solving skills and apply them independently to problems in pure and applied mathematics.
- To assimilate complex mathematical ideas and arguments.
- To improve your own learning and performance.
- To develop abstract mathematical thinking.

Course out comes:

Sl No	Name of the paper	Course Code	Course outcome
1	ALGEBRA - I	MTH1C01	•Learns Direct products & finitely generated Abelian groups, Factors groups, Group action, Sylow theorems & applications, rings of polynomials, Homomorphisms and factor rings
2	LINEAR ALGEBRA	MTH1C02	•Vector Spaces & Linear Transformations Linear Transformations and Elementary Canonical Forms , Inner Product Spaces
3	REAL ANALY SIS I	MTH1C03	•Introduces Basic topology, Differentiation, The Riemann Stieltjes integral, Uniform convergence and continuity •Uniform convergence and integration, Uniform convergence and differentiation

4	DISCRETE MATHEMATICS	MTH1C04	•Order Relations, Lattices; Boolean Algebra Definition and Properties, Boolean Functions •Subgraphs, Degree of vertices, Paths and connectedness, Automorphism of a simple graph, Operations on graphs, Vertex cuts and Edge cuts, Connectivity and Edge connectivity •Trees-Definition, Characterization and Simple properties, Eulerian graphs, Planar and Non planar graphs, Euler formula and its consequences, K5 and K3,3 are non-planar graphs, Dual of a plane graph •Automata and Formal Languages: Introduction to the theory of Computation, Finite Automata.
5	NUMBER THEORY	MTH1CO5	•Introduces Arithmetical functions, Dirichlet multiplication, elementary theorems on the distribution of prime numbers, Quadratic residues and quadratic reciprocity law, Cryptography, Public key
6	Ability Enhancement Course	MTH1A01(Audit course)	Class room seminar: One seminar of duration one hour based on topics in mathematics beyond the prescribed syllabus.
7	ALGEBRA I I	MTH2C06	•Introduces Prime and Maximal ideals, Extension fields, Algebraic extensions, Geometric constructions, Finite fields, Automorphisms of fields, Isomorphism extension theorem, Splitting fields, separable extensions, Galois theory
8	REAL ANALYSIS II	MTH2CO7	•Lays foundation The Real Numbers: Sets, Sequences and Functions Sigma Algebra , Borel sets •Lebesgue Measure Lebesgue Measurable Functions Lebesgue Integration •Differentiation and Integration ,$L\ p$ spaces : Completeness and Approximation
9	TOPOLOGY	MTH2C08	•Introduces topological spaces, Basic concepts, quotient spaces, Spaces with special properties, Separation axioms, Hierarchy of Separation axioms •Compactness and separation axioms, the Urysohn Characterisation of Normality, Tietze characterization of Normality

10	ODE AND CALCULUS OF VARIATIONS	MTH2C09	Introduces Power series solutions and special functions, Special functions of mathematical physics, systems of first order equations, Nonlinear equations, Oscillation theory of boundary value problems, The Calculus of variations
11	OPERATIONS RESEA RCH	MTH2C10	Introduces convex functions, linear programming, Transportation problem, integer programming, sensitivity analysis, Flow and potential in networks, Theory of games
12	Technical writing with LATEX	MTH2A02 (Professional Competency Course)	•Understand LATEX compilation, Basic Syntex, Writing equations, Matrix, Tables •Beamer presentation, Pstricks: drawing simple pictures, Function plotting, drawing pictures with nodes Tikz: drawing simple pictures, Function plotting, drawing pictures with nodes
13	MULTIVARIABLE CALCULUS AND GEOMETRY	MTH3C11	•Introduces Functions of Several Variables – Linear Transformations, Differentiation, The Contraction Principle, The Inverse Function Theorem, the Implicit Function Theorem •Curves, Reparametrization, Closed curves Level curves versus parametrized curves, Curvature, Plane curves, Space curves, Surface, Smooth surfaces, Smooth maps, Tangents and derivatives, Normals and orientability • Applications of the inverse function theorem, Lengths of curves on surfaces, The second fundamental form, The Gauss and Weingarten maps, Normal and geodesic curvatures. Gaussian and mean curvatures, Principal curvatures of a surface.
14	COMPLEX ANALYSIS	MTH3C12	•The extended plane and its spherical representation, Power series, Analytic functions, Analytic functions as mappings, Mobius transformations, Riemann-Stieltijes integrals •Power series representation of analytic functions, Zeros of an analytic function, The index of a closed curve, Cauchy's Theorem and Integral Formula, The homotopic version of Cauchy's Theorem and simple connectivity, Counting zeros; the Open Mapping Theorem and Goursats Theorem. •The classification of singularities, Residues, The Argument Principle and The Maximum Principle, Schwarz's Lemma, Convex functions and Hadamards three circles theorem

15	FUNCTIONAL ANALYSIS	MTH3C13	•Linear Spaces; normed spaces;first examples: Linear spaces, Normed spaces,Holder's inequality, Minkowski's inequality, Topological and geometric notions •Quotient normed space, Completeness; completion. Hilbert spaces: Basic notions; first examples, Cauchy-Schwartz inequality and Hilbertian norm, Bessels inequality, Complete systems, Gram-Schmidt orthogonalization procedure •Orthogonal decomposition; linear functionals; Linear functionals in a general linear space, Bounded linear functionals,, Bounded linear functionals in a Hilbert space •The dual space; The Hahn Banach Theorem and its first consequences, Bounded linear Operators; Completeness of the space of bounded linear operators, Examples of linear operators, Compact operators, Compact sets, Dual operators ,Operators of finite rank, Compactness of the integral operators in L2, Convergence in the space of bounded operators, Invertible operators
16	PDE and Integral Equations	MTH3C14	• Learns about First-order equations. Second-order linear equations in two independent variables The one-dimensional wave equation The method of separation of variable Elliptic equations: Greens functions and integral representations: Introduction, Integral Equations
17	MEASURE AND INTEGRATIO N	MTH3E03	•The concept of measurability, Simple functions, Elementary properties of measures, Integration of Positive Functions, Integration of Complex Functions, The Role Played by Sets of Measure zero, Topological Preliminaries, •The Riesz Representation Theorem, Regularity Properties of Borel Measures, Lebesgue Measure, Continuity Properties of Measurable Functions. Total Variation, Absolute Continuity, Consequences of Radon Nikodym Theorem. Bounded Linear Functionals on $L\ P$, The Riesz Representation Theorem, Measurability on Cartesian Products, Product Measures, The Fubini Theorem, and Completion of Product Measures.

18	ADVANCED FUNCTIONAL ANALYSIS	MTH4C15	• Learns about Spectrum, Fredholm Theory of Compact operators; Classification of spectrum, Fredholm Theory of Compact operators. Self adjoint operators; General properties, Self adjoint compact operators, spectral theory, Minimax principle, Applications to integral operators. •Order in the space of self-adjoint operators, properties of the ordering; Projection operators; properties of projection in linear spaces, Orthoprojectios. Functions of Operators spectral decomposition; Spectral decomposition, The main inequality, Construction of the spectral integral, Hilbert Theorem The fundamental theorems and the basic methods; Auxiliary results, • The Banach open mapping Theorem, The closed graph Theorem, The Banach- Steinhaus theorem, Bases in Banach spaces, Linear functionals; the Hahn Banach theorem, Separation of Convex sets. Banach Algebras; Preliminaries, Gelfand's theorem on maximal ideals
19	ALGEBRAIC NUMBER THEORY	MTH4E06	Symmetric polynomials, Modules, Algebraic integers Quadratic fields , Factorizations, Lattices, Minkowski theorem, kummers lemma
20	DIFFERENTIAL GEOMETRY	MTH4E09	Introduces Graphs and Level Set, Vector fields, The Tangent Space, Surfaces, Vector Fields on Surfaces, Orientation. The Gauss Map Geodesics, Parallel Transport, The Weingarten Map, Curvature of Plane Curves, Arc Length and Line Integrals, Curvature of Surfaces, Parametrized Surfaces, Local Equivalence of Surfaces and Parametrized Surfaces
21	GRAPH THEORY	MTH4C11	Introduces Basic concepts of Graph. Trees, Cut edges and Bonds, Cut vertices, Cayley's Formula, The Connector Problem, Connectivity, Blocks, Construction of Reliable Communication Networks, Euler Tours, Hamilton Cycles, The Chinese Postman Problem, The Travelling Salesman Problem. Matchings, Matchings and Coverings in Bipartite Graphs, Perfect Matchings, The Personnel Assignment Problem, Edge Chromatic Number, Vizing's Theorem, The Timetabling Problem, Independent Sets, Ramsey's Theorem, Vertex Colouring-Chromatic Number, Brooks' Theorem, Chromatic Polynomial, Girth and Chromatic Number, A Storage Problem, Plane and Planar Graphs, Dual Graphs, Euler's Formula, Bridges, Kuratowski's Theorem, The Five-Colour

			Theorem, Directed Graphs, Directed Paths, Directed Cycles.
22	Project	MTH4P01	To Promote independent study and research in new areas

B.Sc. Mathematics

Programme Specific Outcomes :

Instead of cramming the course with too many ideas the stress is given in doing the selected concepts rigorously. The idea is to make learning mathematics meaningful and an enjoyable activity rather than acquiring manipulative skills and reducing the whole thing an exercise in using thumb rules. As learning Mathematics is doing Mathematics, to this end, some activities are prescribed to increase student's participation in learning.

COURSE OUTCOMES:

Sl No	Name of the paper	Course Code	Course outcome
1	Basic Logic and Number Theory	MTS1B01	Prove results involving divisibility, greatest common divisor, least common multiple and a few applications •Understand the theory and method of solutions of LDE. •Understand the theory of congruence and a few applications. •Solve linear congruent equations. •Learn three classical theorems viz. Wilson's theorem, Fermat's little theorem and Euler's theorem and a few important consequences
2	Calculus of Single variable-1	MTS2B02	Lays the foundation of Differential and Integral Calculus
3	Calculus of Single variable-2	MTS3B03	•Enable the students to handle vectors in dealing with the problems involving geometry of lines, curves, planes and surfaces in space •Acquire the ability to sketch curves in plane and space given in vector valued form
4	Linear Algebra	MTS4B04	•This course gives the students an opportunity to learn the fundamentals of linear algebra by capturing the ideas geometrically, by justifying them algebraically and by preparing them to apply it in several different fields such as data communication, computer graphics, modelling etc.
5	Theory of Equations and Abstract Algebra	MTS5B05	•Idea about polynomial equations and methods of finding their algebraic solution or solution by radicals. Introduces basic ideas and results of abstract algebra.
6	Basic Analysis	MTS5B06	•the learning will help them to appreciate the beauty of logical arguments and embolden them to apply it in similar and unknown problems •Learns about sequences, their limits, several basic and important theorems involving sequences and their applications. •get a rigorous introduction to algebraic, geometric and topological structures of complex number system, functions of complex variable, their limit and continuity

7	Numerical Analysis	MTS5B07	•Understand several methods to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy. •Understand the concept of interpolation and also learn some well-known interpolation techniques. •Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits. •Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods
8	Linear Programming	MTS5B08	•Solve linear programming problems geometrically •Understand the drawbacks of geometric methods •Solve LP problems more effectively •Understand duality theory •Understand game theory
9	Introduction to Geometry	MTS5B09	•Recognize and classify conics. •Understand Kleinian view of Euclidean geometry •Understand affine transformations, the inherent group structure, the idea of parallel projections and the basic properties of parallel projections. •Understand the fundamental theorem of affine geometry •Understand which conics are affine-congruent to each other •Realize the basic difference in identifying two geometric objects in Euclidean and affine geometries. •Understand Kleinian view of projective geometry
10	Real Analysis	MTS6B10	•Understand several deep and fundamental results of continuous functions •Realize the difference between continuity and uniform continuity •Understand the significance of uniform continuity in continuous extension theorem. •Develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition. •Understand a few basic and fundamental results of integration theory.
11	Complex Analysis	MTS6B11	•Understand the difference between differentiability and analyticity of a complex function and construct examples. •To know of harmonic functions and their connection with analytic functions •To know a few elementary analytic functions of complex analysis and their properties

			•To understand definition of complex integral, its properties and evaluation. •To know a few fundamental results on contour integration theory such as Cauchy's theorem, Cauchy-Goursat theorem and their applications. . To know a more general type of series expansion analogous to power series expansion viz. Laurent's series expansion for functions having singularity. • To see another application of residue theory in locating the region of zeros of an analytic function
12	Calculus of Multi variable	MTS6B12	• Understand several contexts of appearance of multivariable functions and their representation using graph and contour diagrams. •Formulate and work on the idea of limit and continuity for functions of several variables. •Understand the notion of partial derivative, their computation and interpretation •Get the idea of directional derivative, its evaluation, interpretation, and relationship with partial derivatives •Calculate the maximum and minimum values of a multivariable function using second derivative test and Lagrange multiplier method •Extend the notion of integral of a function of single variable to integral of functions of two and three variables. •Address the practical problem of evaluation of double and triple integral using Fubini's theorem and change of variable formula. •Realise the advantage of choosing other coordinate systems such as polar, spherical, cylindrical etc. in the evaluation of double and triple integrals. •See a few applications of double and triple integral in the problem of finding out surface area ,mass of lamina, volume, centre of mass and so on •Learn three major results viz.Green's theorem, Gauss's theorem and Stokes' theorem of multivariable calculus and their use in several areas and directions
13	Differential Equations	MTS6B13	•Students could identify a number of areas where the modelling process results in a differential equation •They will learn to solve DEs that are in linear, separable and in exact forms and also to analyse the solution •They will learn a method to approximate the solution successively of a first order IVP. •They will become familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.

			•They will learn to find out a series solution for homogeneous equations with variable coefficients near ordinary points. •Students acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field. •Students learn the technique of solving partial differential equations using the method of separation of variables
14	Graph theory	MTS6B14 (E01) (Elective)	•They will learn basics of Graph theory •Bridges Spanning Trees, Euler Tour, Hamiltonian Graphs Plane and Planar graphs Euler's Formula
15	Project Viva	MTS6P15(PR)	To Promote independent study and research in new areas

MATHEMATICS COMPLEMENTARY COURSE- COURSE OUTCOMES

Sl No	Name of the paper	Course Code	Course outcome
1	Mathematics-1	MTS1 C01	Lays the foundation of limits and continuity, derivatives, application of derivatives, integration Gives an idea of Fractional Power & Implicit Differentiation-rational power of a function rule, implicit differentiation Gives an idea of Anti derivatives, anti-differentiation and indefinite integrals, Definite and Indefinite integral-indefinite integral test, properties of definite integral, fundamental theorem of calculus: alternative version
2	Mathematics-2	MTS2 C02	Lays foundation of Polar coordinates and Trigonometry, Inverse functions, inverse function test, inverse function rule, Hyperbolic functions, Inverse hyperbolic functions, Arc length and surface area-Length of curves, Area of surface of revolution about axes Improper integrals, Numerical Integration, Power series, Taylor's formula Vector spaces systems of Linear Algebraic Equations, Vector spaces systems of Linear Algebraic Equations ,Diagonalization-LU Factorization

3	Mathematics-3	MTS3 C03	Lays foundation of Vector Functions ,Motion on a Curve, Curvature and components of Acceleration, Partial Derivatives, Directional Derivative Understand Line Integrals, independence of Path ,double Integral Line Integrals-independence of path, Double Integrals in Polar Coordinate, Green's Theorem, Surface Integral-Stokes's Theorem Understand Triple Integral, Divergence Theorem, Change of Variable in Multiple Integral, Complex Numbers, Powers and
			roots, Functions of a Complex Variable, Exponential and Logarithmic function Understand Contour integral, Cauchy-Goursat Theorem, dependence of Path, Cauchy's Integral Formula
4	Mathematics-4	MTS4C04	Lays foundation of Ordinary Differential Equations Higher Order Differential Equations Laplace Transforms Lays foundation of Orthogonal Functions, Fourier Series-Fourier Cosine and Sine Series-Separable Partial Differential Equations, Classical PDE's and BVP'sHeat Equation

OPEN COURSE- COURSE OUTCOMES

Sl No	Name of the paper	Course Code	Course outcome
1	Applied Calculus	MTS5D01	•Gives an idea about functions, graphs, and limits, basic concepts of differentiation and integration •applications of derivatives • Gives an idea about Exponential and logarithmic functions