

Sammilani Mahavidyalaya

Baghajatin, E. M. Bypass, Kolkata - 700094

Department of Mathematics

Program Outcomes

For

B.Sc. Under-graduate Mathematics Honours course 2010, (Duration 3 years) under 1+1+1 system

Going through the study of a three year degree course in Mathematics, the upgradation of knowledge, skill, logical and reasoning sense, capability of problem solving etc. are developed among the students. These are narrated by the following:

1. ACADEMIC DEVELOPMENT

They get a good grounding in rudiments of higher mathematics, both pure and applied. This should prepare them for post graduate studies and doing research in various fields of Mathematics and its allied areas.

2. SKILL DEVELOPMENT

The students learn “C”, a high level computer language as well as skill developing software. They have to solve mathematical problems by using this software. As these knowledge are in much demand in the job market, it should help them in their career. Students are also skilled with the study of Boolean Algebra, Modelling theory and Discrete Mathematics, Numerical Analysis, Linear programming problems which are very demandable in various fields in academic and corporate sectors.

3. JOB ORIENTED COURSE

Statistics, Discrete Mathematics, Computer programming are all part of the syllabus. The students may pursue higher studies in Statistics or related fields like big data analytics, financial statistics, Operational research, Coding Theory etc. These also have high demand in the job market and students are able to succeed in the competitive examinations.

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Course Outcomes For B.Sc. Under-graduate Mathematics Honours and General course 2010, (Duration 3 years) under 1+1+1 system

Paper	Topic	Course Outcomes (CO) for 2nd year students
Honours Papers		
<u>Paper III</u>	<p><u>MODULE V</u></p> <p>Group A Modern Algebra II</p> <p>Group B Linear Programming and Game Theory</p> <p><u>MODULE VI</u></p> <p>Group A Analysis II</p> <p>Group B Differential Equations I</p>	<p>CO 3 For 2nd year students</p> <p>This course will help students to know about Modern Algebra: This course is designed as a basic theory of Abstract Algebra. In this course students are go through</p> <ol style="list-style-type: none"> 1. the study of definition and examples of groups, subgroups & their properties which are the pivotal concepts of modern algebra. 2. the next step of defining special types of groups i.e., cyclic groups and its properties 3. the concept of permutations, their types and algebra of permutations. 4. the ideas of cosets, order of group & its elements, Lagrange's theorem & its consequences including Fermat's Little theorem. 5. the study of Normal subgroups, Quotient group, Cayley's theorem, Homomorphism and Isomorphism of groups which are very essential to study unknown groups. 6. Get to study the ring as an arbitrary set with two operators. Definition, examples, properties of subring, subfield, integral domains and field and their properties. 7. Acquire knowledge about some well-known theorems such as isomorphism theorem, correspondence theorem. 8. These ideas are very important to study advanced algebra, linear algebra in semester 5 of undergraduate courses as well as for further study of any branch of mathematics. <p>LPP & Game Theory: On completion of this course, the students will acquire</p> <ol style="list-style-type: none"> 1. fundamental knowledge on the theory of basic and basic feasible solutions and their properties, convex sets based on the knowledge of linear algebra studied in previous semesters. 2. the skills on the solution of a Linear Programming Problem by Simplex Method. Also acquire knowledge on duality, transportation problem, assignment problem and

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		<p>travelling salesman problem.</p> <p>This course is very much important in present day Mathematics, like in the field of Operation Research, Modelling, Financial Mathematics.</p> <p>Analysis - II:</p> <p>This course is intended to expose students to the basic ideas of Real Analysis, a part of mathematical analysis which is considered to be the base of mathematics.</p> <ol style="list-style-type: none"> 1. Infinite series and their convergence and various tests for convergence like comparison test, limit test, Gauss test etc and alternate series are points of highlight in this unit. 2. Differentiability of a real function at a point, relation between continuity and differentiability of a function and related theorems, Rolle's theorem, Cauchy's MVT to be specially mentioned with. 3. The concept of maxima, minima of a function in an interval and their application. This portion plays an important role in applied sciences, specially on ODE and Multivariate Calculus which is also in the UG course. <p>This course is the base for any further studies of analysis and many other fields and also help them to grow analytical ideas in the real field and make mathematical arguments within this system.</p> <p>Differential Equation - I</p> <p>On completion of this topic, the students will acquire knowledge on</p> <ol style="list-style-type: none"> 1. acquire elementary knowledge and skill of solving problems on certain types of linear and non-linear ordinary differential equations, also acquire knowledge on certain types of second order ordinary differential equations and their applications in Applied Science. 2. solving various problems related to Power series solution, Biological & Mechanical model, vector calculus which has useful applications in various branches of Mathematics and Physics. 3. solving various problems related to multivariate calculus, which is a powerful tool for understanding the geometry of real n-dimensional space. 4. Obtain the knowledge on limit, continuity and differentiability of n-dimensional space curves and surfaces.
<p><u>Paper -IV</u></p>	<p><u>MODULE VII</u></p> <p>Group A Real-Valued Functions of</p>	<p>CO 4 For 2nd year students</p> <p>Function of Several Variables:</p> <ol style="list-style-type: none"> 1. solving various problems related to multivariate calculus, which is a powerful tool for understanding the geometry of real n-dimensional space. 2. Obtain the knowledge on limit, continuity and differentiability of n-dimensional space curves and surfaces.

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	<p>Several Real Variables</p> <p>Group B Application of Calculus</p> <p><u>MODULE VIII</u></p> <p>Group A Analytical Geometry of Three Dimensions II</p> <p>Group B Analytical Statics I</p> <p>Group C Analytical Dynamics of A Particle I</p>	<p>Application of Calculus: The learners mainly gain the nature of curves in Cartesian or polar coordinates by applying derivatives and integration. In this module the students acquire knowledge about</p> <ol style="list-style-type: none"> equations of tangent, subtangent, normal, subnormal, angle of intersection of curves. Rectilinear asymptotes, pedal equation, pedal of a curve, curvature envelopes of families of curves and straight lines, concavity, convexity of curve, area enclosed by a curve, determination of C.G., moments and products of inertia. curve tracing and familiarity with the figure of periodic curves, cycloid, catenary, Lemniscate of Bernoulli, Astroid, cardioid etc. <p>which are very much essential for Physics and Applied Mathematics.</p> <p>3D Geometry: Here students have the scope to gain knowledge of curves and surfaces of three dimensions. They also find</p> <ol style="list-style-type: none"> Equation of straight lines, sphere, surface, cone, cylinder equation of tangent plane and lines, generating surface. shortest distance, line of shortest distance <p>Statics & Dynamics: On completion of this course, the students will acquire knowledge on</p> <ol style="list-style-type: none"> Reduction of forces in 2D and 3D system. condition of stability and instability of a system by a system of forces how the frictional force work with the interaction two bodies and also the stability in the environment of frictional force virtual work and one can check the condition of stability using virtual work done. rectilinear motion of a particle in straight line and in two and three dimension orbital motion and its stability. It will help in research of artificial satellite. work, power, energy and energy conservation maintain in different systems. linear and angular momentum principle and energy conservation in many particle systems. overall study helps to research particle physics.
<p>Paper V</p>	<p><u>MODULE IX</u></p> <p>Group A</p>	<p>CO 5 For 3rd year students Analysis - III</p> <p>This course will help students to acquire knowledge about</p> <ol style="list-style-type: none"> The compactness of sets in \mathbb{R}, Functions of bounded variations and associated theorems and properties. Riemann integration which is a generalisation of definite integration. Concept of negligible set, primitive,

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<p style="text-align: center;">Analysis III</p> <p>Riemann Integration, Improper integral, Beta gamma functions, Sequence and Series</p> <p style="text-align: center;"><u>MODULE X</u></p> <p style="text-align: center;">Group A</p> <p>Linear Algebra II and Modern Algebra II</p> <p style="text-align: center;">Group B</p> <p>Tensor Calculus</p> <p style="text-align: center;">Group C</p> <p>Differential Equation II</p> <p style="text-align: center;">Or</p> <p style="text-align: center;">Group C</p> <p>Graph Theory</p>	<p>application of Lebesgue theorem and many important properties and theorems.</p> <ol style="list-style-type: none"> 3. Improper integral and existence of their finite values and Beta Gamma functions with their application. 4. Sequence and series of functions, power series and their pointwise convergence, uniform convergence to limit function. <p>All these concepts are widely applied in integral and differential calculus, differential equations to physics problems.</p> <p>Linear Algebra - II & Abstract Algebra - II</p> <p>This course is designed as a basic theory of Abstract Algebra. In this course students are go through</p> <ol style="list-style-type: none"> 1. the study of Normal subgroups, Quotient group, Cayley's theorem, Homomorphism and Isomorphism of groups which are very essential to study unknown groups. 2. Get to know linear transformations, its algebra and representations, Eigenvalues, Eigen vectors, characteristic equations, Cayley-Hamilton theorem which gives a new method for finding the inverse of a matrix. <p>Tensor</p> <p>The tensor calculus is introduced in the syllabus to grow knowledge of students about multidimensional space. They find the following idea of n-dimensional space</p> <ol style="list-style-type: none"> 1. concept of summation convention, contravariant, covariant and about invariant of vectors. 2. concept of algebra of tensors. 3. Magnitude of a vector. Inclination of two vectors. Orthogonal vectors. Christoffel symbols and their laws of transformations. Covariant differentiation of vectors and tensors. <p>Differential Equation - II</p> <p>Here is a scope to gain knowledge on</p> <ol style="list-style-type: none"> 1. Laplace Transformation, Inverse Laplace transformation and their properties and also how to use it to solve the differential equation. 2. to find a series solution of ODE at ordinary points. <p>Graph Theory</p> <p>In this section, students acquire knowledge on</p> <ol style="list-style-type: none"> 1. graphs and its properties, different types of graphs like Undirected graphs. Directed graphs. 2. Basic properties, Walk. Path, Cycles. Connected graphs. Components of a graph. Complete graph. 3. Complement of a graph. Bipartite graphs. Necessary and sufficient condition for a Bipartite graph. 4. Euler graphs: Necessary and Sufficient condition for a Euler graph. Königsberg Bridge Problem.
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<p>Paper VI</p>	<p>MODULE XI</p> <p>Group A Vector calculus II</p> <p>Group B Analytical Statics II</p> <p>Group C Analytical Dynamics of A Particle II</p> <p>MODULE XII</p> <p>Group A Hydrostatics</p> <p>Group B Rigid Dynamics</p>	<p>CO 6 For 3rd year students</p> <p>Vector Calculus II</p> <p>They gained knowledge on Line integrals as integrals of vectors, circulation, irrotational vector, work done, conservative force, potential orientation. Statements and verification of Green's theorem, Stokes' theorem and Divergence theorem.</p> <p>Analytical Statics & Dynamics - II</p> <p>In these Groups, students will learn about</p> <ol style="list-style-type: none">1. the General formula for the determination of C.G. Determination of position of C.G. of any arc, area of solid of known shape by method of integration.2. Principle of virtual work for a single particle and application of it on statics.3. Also the deduction of many theorems and principles by using it.4. virtual work is to check stability5. knowledge on Forces in the three dimensions and its conversion into moment and force.6. Conditions of equilibrium of a system of forces acting on a body.7. Poisson's central axis. A given system of forces can have only one central axis. Wrench, Pitch, Intensity and Screw. Equation of the central axis of a given system of forces. <p>Hydrostatics & Dynamics</p> <p>In this group student about know that</p> <ol style="list-style-type: none">1. The characteristic nature of Fluid, Perfect Fluid, Pressure and its application on plane surface.2. Centre of pressure of a circular area. Position of the centre of pressure refers to coordinate axes through the centroid of the area. Centre of pressure of an elliptical area when its major axis is vertical or along the line of greatest slope.3. Pressure of gases. The atmosphere. Relation between pressure, density and temperature. Pressure in an isothermal atmosphere. Atmosphere in convective equilibrium.4. Definition of Momental ellipsoid, Equipomental system. Principal axis. D'Alembert's principle and its application. Independence of the motion of centre of inertia and the motion relative to the centre of inertia. Principle of energy. Principle of conservation of energy.5. Equations of motion of a rigid body moving in two dimensions. Expression for kinetic energy and angular momentum about the origin of rigid body moving in two dimensions.
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		<p>6. the change of K.E. of a system of particles moving in any manner under the application of impulsive forces is equal to the work done by the impulsive forces.</p>
<p style="color: purple; font-weight: bold; font-size: 1.2em;">Paper VII</p>	<p style="color: green; font-weight: bold; text-decoration: underline;">MODULE XIII</p> <p>Group A Analysis IV</p> <p>Group B Metric Space</p> <p>Group C Complex Analysis</p> <p style="color: green; font-weight: bold; text-decoration: underline;">MODULE XIV</p> <p>Group A Probability</p> <p>Group B Statistics</p>	<p style="color: blue; font-weight: bold; font-size: 1.2em;">CO 7 For 3rd year students</p> <p>Analysis - IV</p> <p>Student know about</p> <ol style="list-style-type: none"> 1. Improper integral and existence of their finite values and Beta Gamma functions with their application. 2. Fourier series and its existence 3. Multiple integral and use of it to find volume & surface. <p>Metric space Metric space is a generalization of the Real line. On completion of study of metric space, the students</p> <ol style="list-style-type: none"> 1. get the idea of abstraction of modulus distance function from real line to abstract field to form a metric space by axiomatic approach. 2. acquire knowledge of extension of real analysis i.e., open set, interiors, closure, convergence of sequence, continuity, uniform continuity, various types of compactness, connectedness, contraction maps, etc. in arbitrary Metric space. 3. now about Banach Fixed Point theorem which has an application for solving ordinary differential equations. <p>These ideas help the students to study arbitrary vector spaces and topological spaces.</p> <p>Complex analysis:</p> <p>In semester 2, the students already had ideas of real analysis and a set of complex numbers in a superset of real numbers. Here, in this course, students get to know about</p> <ol style="list-style-type: none"> 1. Well-known stereographic projection, complex plane, differential calculus and integral calculus of complex numbers 2. Uniform and absolute convergence of power series, radius of convergence <p>Difference between real analysis and complex analysis.</p> <p>Probability and Statistics: This course will introduce students to</p> <ol style="list-style-type: none"> 1. the theory of probability, basic knowledge about one and two dimensional probability distribution, distribution function, conditional probability, expectation, some special distributions, generating functions etc. and problems related to all these topics.

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		<p>2. the statistical theory build up on the basis of probability theory and help students in solving problems on parameter estimation viz., point and interval estimation, level of significance, concept of hypothesis and their various applications based on real life data.</p> <p>This course lay foundation to one of the most beautiful and practically oriented subject Statistics.</p>
Paper VIII	<p><u>MODULE XV</u></p> <p>Group A</p> <p>Numerical Analysis</p> <p>Group B</p> <p>Computer Programming</p> <p><u>MODULE XVI</u></p> <p>Practical on Numerical and Statistics</p>	<p>CO 8 For 3rd year students</p> <p>Numerical Analysis:</p> <p>Nowadays, application of numerical analysis spreads in various areas in social sciences. Those problems are difficult to solve in an analytic method but it can be solved through a numerical method. But has a limitation that there may involve small errors that do not affect much. On completion of this course, the students will acquire knowledge on</p> <p>(a) numerical calculation, which gives most of the time some errors. Here is a scope to learn different types of errors that appear during calculation.</p> <p>(b) different interpolation, numerical differentiation and numerical integration rule.</p> <p>(c) finding roots of polynomial and transcendental equations in different methods. In general, we cannot find the roots of transcendental equations in an analytic method.</p> <p>(d) to find the solution of a system of linear equations in different numerical methods.</p> <p>(e) to find the eigenvalues of a real symmetric matrix.</p> <p>(f) solution of initial and boundary value problem.</p> <p>All the above said numerical methods are hugely used in solving different research problems in the real world. So it gained serious attention to the students of science Background.</p> <p>Computer Programming:</p> <p>This course introduces students about the Fundamentals of Computer Science and Computer Programming C or Fortran Language. Also from this course will gain the following concept:</p> <ol style="list-style-type: none">1. Historical evolution, computer generations, functional description, operating system, hardware & software.2. Positional number system : binary, octal, decimal, hexadecimal system. Binary arithmetic.3. Algorithm and Flowchart for doing program4. Basic programming by C or Fortran Language5. technique to solve numerical problems using programming languages.

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MATHEMATICS General Course (MTMG)(2nd year & 3rd Year)

Paper II	<p><u>MODULE - III</u></p> <p>Group A: Modern Algebra</p> <p>Group B: Analytical Geometry of 3D</p> <p><u>MODULE - IV</u></p> <p>Group A: Differential Calculus</p> <p>Group B: Integral Calculus</p> <p>Group C: Differential Equations</p>	<p>Modern Algebra This course is designed as a basic theory of Abstract Algebra. In this course students are go through</p> <ol style="list-style-type: none">1. the study of definition and examples of groups, subgroups & their properties which are the pivotal concepts of modern algebra.2. the next step of defining special types of groups i.e., cyclic groups and its properties3. the concept of permutations, their types and algebra of permutations.4. the ideas of cosets, order of group & its elements, Lagrange's theorem & its consequences including Fermat's Little theorem.5. the study of Normal subgroups, Quotient group, Cayley's theorem, Homomorphism and Isomorphism of groups which are very essential to study unknown groups.6. Get to study the ring as an arbitrary set with two operators. Definition, examples, properties of subring, subfield, integral domains and field and their properties.7. Acquire knowledge about some well-known theorems such as isomorphism theorem, correspondence theorem.8. These ideas are very important to study advanced algebra, linear algebra in semester 5 of undergraduate courses as well as for further study of any branch of mathematics. <p>3D Geometry Here students have the scope to gain knowledge of curves and surfaces of three dimensions. They also find</p> <ol style="list-style-type: none">1. Equation of straight lines, sphere, surface, cone, cylinder2. equation of tangent plane and lines, generating surface.3. shortest distance , line of shortest distance <p>Differential Calculus This course is intended to expose students to the basic ideas of Real Analysis, a part of mathematical analysis which is considered to be the base of mathematics.</p> <ol style="list-style-type: none">4. Infinite series and their convergence and various tests for convergence like comparison test, limit test, Gauss test etc and alternate series are points of highlight in this unit.5. Differentiability of a real function at a point, relation between continuity and differentiability of a function and related theorems, Rolle's theorem, Cauchy's MVT to be specially mentioned with.6. The concept of maxima, minima of a function in an interval and their application. This portion plays an
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		<p>important role in applied sciences, specially on ODE and Multivariate Calculus which is also in the UG course.</p> <p>This course is the base for any further studies of analysis and many other fields and also help them to grow analytical ideas in the real field and make mathematical arguments within this system.</p> <p>Integral Calculus: From this course, students acquire knowledge of integral calculus and its application in geometry, numerical analysis</p> <p>Differential Equation</p> <p>On completion of this topic, the students will acquire knowledge on</p> <ol style="list-style-type: none"> 1. acquire elementary knowledge and skill of solving problems on certain types of linear and non- linear ordinary differential equations, also acquire knowledge on certain types of second order ordinary differential equations and their applications in Applied Science. 2. solving various problems related to Power series solution, Biological & Mechanical model, vector calculus which has useful applications in various branches of Mathematics and Physics. 3. solving various problems related to multivariate calculus, which is a powerful tool for understanding the geometry of real n-dimensional space. 4. Obtain the knowledge on limit, continuity and differentiability of n-dimensional space curves and surfaces.
<p>Paper III</p>	<p><u>MODULE - V</u></p> <p>Group A : Numerical Methods</p>	<p>Numerical Methods</p> <p>Nowadays, application of numerical analysis spreads in various areas in social sciences. Those problems are difficult to solve in an analytic method but it can be solved through a numerical method. On completion of this course, the students will acquire knowledge on</p> <ol style="list-style-type: none"> (a) numerical calculation, which gives most of the time some errors. Here is a scope to learn different types of errors that appear during calculation. (b) different interpolation, numerical differentiation and numerical integration rule. (c) finding roots of polynomial and transcendental equations in different methods. In general, we cannot find the roots of transcendental equations in an analytic method. (d) to find the solution of a system of linear equations in different numerical methods. (e) to find the eigenvalues of a real symmetric matrix. (f) solution of initial and boundary value problem. <p>All the above said numerical methods are hugely used in solving different research problems in the real world. So it gained serious attention to the students of science Background.</p>

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	<p>Group B :</p> <p>Linear Programming</p> <p>MODULE - VI</p> <p>Any one of the following groups :</p> <p>Group A : Analytical Dynamics</p> <p>Group B : Probability & Statistics</p>	<p>Linear Programming</p> <p>On completion of this course, the students will acquire</p> <ol style="list-style-type: none"> 1. fundamental knowledge on the theory of basic and basic feasible solutions and their properties, convex sets based on the knowledge of linear algebra studied in previous semesters. 2. the skills on the solution of a Linear Programming Problem by Simplex Method. Also acquire knowledge on duality, transportation problem, assignment problem and travelling salesman problem. <p>This course is very much important in present day Mathematics, like in the field of Operation Research, Modelling, Financial Mathematics.</p> <p>Analytical Dynamics</p> <p>Students acquire the knowledge of</p> <ol style="list-style-type: none"> (a) rectilinear motion of a particle in straight line and in two and three dimension (b) orbital motion and its stability. It will help in research of artificial satellites. (c) work, power, energy and energy conservation are maintained in different systems. (d) linear and angular momentum principle and energy conservation in many particle systems. <p>Probability & Statistics</p> <p>This course will introduce students to</p> <ol style="list-style-type: none"> 3. the theory of probability, basic knowledge about one and two dimensional probability distribution, distribution function, conditional probability, expectation, some special distributions, generating functions etc. and problems related to all these topics. 4. the statistical theory build up on the basis of probability theory and help students in solving problems on parameter estimation viz., point and interval estimation, level of significance, concept of hypothesis and their various applications based on real life data. <p>This course lay foundation to one of the most beautiful and practically oriented subject Statistics.</p>
<p>Paper IV</p>	<p>MODULE VII :</p> <p>Computer Science & Programming</p>	<p>Computer Programming</p> <p>This course introduces students about the Fundamentals of Computer Science and Computer Programming C or Fortran Language. Also from this course will gain the following concept:</p> <ol style="list-style-type: none"> 1. Historical evolution, computer generations, functional description, operating system, hardware & software.

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	<p><u>MODULE V :</u></p> <p>Any one of the following groups :</p> <p>Group A : A Course of Calculus</p> <p>Group B: Discrete Mathematics</p>	<ol style="list-style-type: none">2. Positional number system : binary, octal, decimal, hexadecimal system. Binary arithmetic.3. Algorithm and Flowchart for doing program4. Basic programming by C or Fortran Language <p>Course of Calculus</p> <p>This course is an extension of Real Analysis. Here students will study the concept of pointwise and Uniform convergence of sequence of functions and series of functions. They also learn the periodic Fourier series and its convergence, Laplace Transform, its properties and application to the solution of ordinary Differential equations.</p> <p>Discrete Mathematics</p> <p>Discrete mathematics is very essential nowadays in application to computer science, modern algebra, graph theory, mathematical logic etc. It has immense application in our everyday life while using Debit and Credit Cards, ISBN number for Books, Bar code for any product, in sports (Round Robin Method) etc.</p>
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