Shri Shivaji Education Society Amravati's

Shri Shivaji Arts, Commerce and Science College, Motala, Dist. Buldhana

Program Outcomes & Course Outcomes

Department of Mathematics

Program Outcomes: Bachelor of Science (B. Sc.)

- Enrich knowledge of students in all basic sciences
- Ability to identify, formulate and develop solutions to computational challenges
- Develop Scientific temper and Scientific thinking
- Inculcate sense of scientific responsibilities and social & environment awareness
- Help student to build-up a progressive and successful career in academics and industry
- Sensitivity towards environmental concerns and contribute in the development of Nation

Name of the Program: B. Sc. Mathematics

Program Outcomes

- Understanding of major concepts in all discipline of mathematics.
- Formulate and develop mathematical arguments in a logical manner.
- Acquire good knowledge and understanding in advanced mathematics.
- Create an awareness of the impact of mathematics on the environment, society and development outside the scientific community.

Course Outcomes

B. Sc. I Semester-I Mathematics Paper-I

Algebra and Trigonometry

Students will able to

- Understand and application of De Moivre's theorem in finding the roots of complex numbers, separation of real and imaginary parts of the circular and the hyperbolic functions of complex variables.
- Find the Gregory series, Machin's series, Euler's series, Rutherford's series, summation of series, series based upon sin x, cos x, sinh x, cosh x, exponential series, logarithmic series and series based upon Gregory series.
- Understand quaternions its Definition, concept of Equality and addition, multiplication of quaternions, complex conjugate of a quaternion, norm, inverse, quaternion as a rotation operator, and its geometric interpretation. special quaternion product, operator algorithm, quaternion to matrices.
- Know the relations between the roots and coefficients and can find roots of the polynomial Use the transformation of equations Solve the cubic equations using Cardon method, Solve biquadratic equations
- Find the rank of a matrix, row rank, column rank, eigenvalues, eigenvectors and the characteristic equation of a matrix, Verify Cayley- Hamilton theorem and its

application.

B. Sc. I Semester-I Mathematics Paper-II

Course Outcomes of Differential and Integral Calculus

Students will able to

- Understand the concept and definition of a limit of a function and continuity and the basic difference between them.
- find the limit of the function and verify the continuity of the function.
- Verify types of discontinuities and problems based on it.
- Familiar with the techniques finding the derivatives using successive differentiation.
- Apply Leibnitz theorem for successive differentiation of multiplication of two different functions
- Identify and apply the L'Hospital's rule in case of indeterminate form of the limits.
- Verify Rolle's theorem, Lagrange's Mean Value Theorem, Cauchy's Mean value theorem and their application.
- Know the Maclaurin's and Taylor series expansions and their applications in solving problems for finding their power series expansion.
- Understanding and solving the partial derivatives problems homogenous functions and verify the Euler's theorem.
- Know the quadrature, rectification.

B. Sc. I Semester-II Mathematics Paper-III

Course Outcomes of Differential Equations: Ordinary and Partial

Students will able to

- Determine Degree and order of a ordinary differential equation,
- Solve linear differential equations and differential equations reducible to the linear form. Verify and solve the exact differential equations.
- Solve differential equations of first order and higher degree using the methods differential equations solvable for p and y, differential equations in Clairaut's form and find the orthogonal trajectories.
- Complementary function for the homogeneous linear differential equation and Particular integral of the linear ordinary differential equations.
- Study and apply the reduction of order, transformation of the equation by changing the dependent variable and independent variable,
- Learns the normal form (removal of first order derivative) and the method of variation of parameters
- Find the solution of Ordinary simultaneous differential equations.

- Form partial differential equations,
- Find the solution of total partial differential equations of the first order or Pfaffian using various methods.
- Solve the Lagrange's method, some special types of equations which can be solved easily by methods other than the general method.
- Solve Compatible differential equations. Use Charpit's general method of solution, Learn and find the solution of partial differential equations of second and higher orders. Solve Homogeneous and non-homogeneous equations with constant coefficients.

B. Sc. I Semester-II Mathematics Paper-IV
Course Outcomes of Scalar and vector Analysis and Geometry

Students will able to

- Have knowledge of Scalar and vector product of three vectors, and solve the product of four vectors, vector differentiation and vector integration.
- Have knowledge of the geometry of space curve t, n, b vectors, fundamental planes, Frenet - Serret formulae.
- Find the curvature, torsion,
- Define and find the Gradient, divergence and Curl, directional derivative, line integral (existence and evaluation),
- Find and evaluate the work done, and apply the Greens theorem.
- Solve the problems of lines in three dimensions, planes of different forms of spheres.
- Have the knowledge different forms of spheres. Section of a sphere by a plane and their geometry by using their algebraic equations.
- Have the knowledge of intersection of sphere and a line. Condition of orthogonality of two intersecting spheres
- Study the equation of cone with guiding curve, equation of cone with vertex and origin.
- Equation of right circular cylinder and its geometry.

B. Sc. II Semester-III Mathematics Paper-V
Course Outcomes of Advanced Calculus

Students will able to

- Have a knowledge and proofs of theorems on limits of sequences, bounded and monotonic sequences, Cauchy's convergence criterion.
- Series of non negative terms, convergence of geometric series and Comparison tests, Use of Cauchy's integral test, Ratio test, Root test.
- Understand the concept of absolute Convergent, conditional convergent, Leibnitz rule, Abel's test, Dirichlet's test.

- Understand the limit and continuity of functions of two variables, Algebra of limits and continuity, Taylor's theorem for function of two variables.
- Define and find the maxima and minima of functions of two variables
- Apply the Lagrange's multipliers method to find the maxima and minima of the functions of two variables.
- Evaluate the Jacobian of the function of two variables.
- Define and evaluate the double integrals.
- Change the order of integration in double integrals
- Define and evaluate the triple integrals.
- Prove and apply the Guass and Stoke's theorem.

B. Sc. II Semester-III Mathematics Paper-VI
Course Outcomes of Elementary Number Theory

Students will able to

- Understand the concept and definition of the divisibility and their properties and results.
- Prove division algorithm and its application in finding the results on greatest common divisor , find the gcd and lcm of two or more integers.
- Understand the knowledge of Euclidean algorithm and its applications
- Define and find Prime numbers,
- Prove and apply the fundamental theorem of arithmetic or Unique factorization theorm, Find Fermat numbers, Understand the concept of linear Diophantine equations
- Define the Congruence and its properties. Have the knowledge of special divisibility test, linear congruences,
- Understand the proof and application of Chinese remainder theorem.
- Define and understand the concept of Arithmetic functions,
- Understand the proof of the apply Euler's theorem,
- Define and find the τ *and* σ functions, Mobius μ function.

- Define and find the Primitive roots, primitive roots for prime, polynomial congruences, the congruence $x^2 \equiv a \pmod{p}$) , general quadratic congruence, quadratic residues.

B. Sc. II Semester-IV Mathematics Paper-VII
Course Outcomes of Modern Algebra: groups and rings

Students will able to

- Define and verify a group with examples, properties of a group, subgroups, cyclic groups, order of a generator of a cyclic group, permutation groups even and odd permutations.

- Define and find Cosets and normal subgroups: Cosets, Lagrange's theorem, normal subgroups, different characterization of normal subgroups, algebra of normal subgroups, quotient group.
- Define and verify Homomorphism, homomorphic image, kernel of homomorphism, isomorphism of a group, Fundamental theorem on homomorphism of a group, natural homomorphism, second isomorphism theorem, third isomorphism theorem.
- Define and verify left ideal, right ideal, examples, algebra of ideals, prime ideal, maximal ideal, principle ideal, quotient ring, ring homomorphism.

B. Sc. II Semester-IV Mathematics Paper-VIII

Course Outcomes of Classical Mechanics

Students will able to

- Understand the concept of Constraints, generalized coordinates,
- State and prove D' Alembert's principle and able to derive Lagrange's equations of motion from it.
- To construct the Lagrangian find the Lagrange's equations of motion.
- Understand the concept of central force field, types of central force. Equivalent one body problem, Define Areal velocity, obtain the equations of central orbit.
- State and prove the Virial theorem and the Kepler's laws of motion.
- Define a functional, extremals, Euler's differential equation, Brachistochrone problem, invariance of Euler's equation, study and able to apply Euler-Poisson equations for a functional dependent on higher derivatives and obtain Euler-Ostrogradsky equations.
- Understand Hamilton's principle, Lagrange's equations for non-holonomic system, Routh's procedure, least action principle.
- Find the generalized co-ordinates of a rigid body, Eulerian angles, Euler's theorem and understand finite rotations, infinitesimal rotations.

B. Sc. III Semester-V Mathematics Paper-IX

Course Outcomes of Mathematical Analysis

Students will able to

- Define Riemann Integral, Integrability of continuous and monotonic functions,
- Understand the proof fundamental theorem of integral calculus, mean value theorem of integral calculus.
- Understand Improper integrals and their convergence, comparison and limit tests.
- Define and Beta and gamma and its applications.
- Have a knowledge of Continuity and differentiability of complex function, analytic function, Cauchy- Riemann equations and their application in analytic functions, harmonic and conjugate functions.
- Find the analytic functions by Milne-Thomson method.

- Have a knowledge of Elementary function, mapping by elementary function, Mobius transformation, fixed point, cross ratio and its application to find the bilinear transformation, inverse and critical points, conformal mapping.
- Have a knowledge about Metric spaces, Definition and examples of metric spaces, neighbourhood, limit point, interior point, open and closed sets, Cauchy sequences, completeness.

B. Sc. III Semester-V Mathematics Paper-X
Course Outcomes of Mathematical Methods

Students will able to

- Define and solve Legendre's equation, Legendre's polynomials, generating function, recurrence formula, orthogonality of Legendre's polynomial, Rodrigue's formula.
- Define and evaluate Bessel's equation, solution of Bessel's equation, generating function.
- Understand Recurrence formulae. Strun-Liouville boundary value problem.
- Understand and apply the fundamental concept of Fourier series,
- Find the Fourier series for odd and even functions, half-range Fourier sine series and half-range Fourier cosine series.
- Learns the method and properties of Laplace transform of some elementary functions, existence of Laplace transform
- Understand Laplace transform of derivatives and integrals, multiplications and division by *t*, inverse Laplace transform,
- Understand the convolution property, application of Laplace transform in solving ordinary and partial differential equations.
- Understand and apply the fundamental concept of Fourier Transform: Finite Fourier sine transform, inverse finite Fourier sine transform and cosine transform, Infinite Fourier transform, infinite Fourier sine transform and cosine transform, properties of Fourier transform, application to pde.

B. Sc. III Semester-VI Mathematics Paper-XI
Course Outcomes of Linear Algebra

Students will able to

- Understand the Definition and example of vector spaces, subspaces, sum and direct sum of subspaces, linear span, linear dependence, independence and their basic properties, basis , finite dimensional vector spaces ,existence theorem for bases, invariance of the number of elements of a basis set, dimension
- Apply the properties of linear transformations to linearity of transformations, kernel and rank of linear transformations using rank – nullity theorem, inverse transformations to solve the problems of matrix transformations, change of basis.

B. Sc. I Semester-I Mathematics Paper-II
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- Find and evaluate the work done, and apply the Greens theorem.
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- Have the knowledge different forms of spheres. Section of a sphere by a plane and their geometry by using their algebraic equations.
- Have the knowledge of intersection of sphere and a line. Condition of orthogonality of two intersecting spheres
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- To construct the Lagrangian find the Lagrange's equations of motion.
- Understand the concept of central force field, types of central force. Equivalent one body problem, Define Areal velocity, obtain the equations of central orbit.
- State and prove the Virial theorem and the Kepler's laws of motion.
- Define a functional, extremals, Euler's differential equation, Brachistochrone problem, invariance of Euler's equation, study and able to apply Euler-Poisson equations for a functional dependent on higher derivatives and obtain Euler-Ostrogradsky equations.
- Understand Hamilton's principle, Lagrange's equations for non-holonomic system, Routh's procedure, least action principle.
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B. Sc. III Semester-V Mathematics Paper-IX

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- Define and Beta and gamma and its applications.
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- Find the analytic functions by Milne-Thomson method.

- Have a knowledge of Elementary function, mapping by elementary function, Mobius transformation, fixed point, cross ratio and its application to find the bilinear transformation, inverse and critical points, conformal mapping.
- Have a knowledge about Metric spaces, Definition and examples of metric spaces, neighbourhood, limit point, interior point, open and closed sets, Cauchy sequences, completeness.

B. Sc. III Semester-V Mathematics Paper-X

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Students will able to

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- Define and evaluate Bessel's equation, solution of Bessel's equation, generating function.
- Understand Recurrence formulae. Strun-Liouville boundary value problem.
- Understand and apply the fundamental concept of Fourier series,
- Find the Fourier series for odd and even functions, half-range Fourier sine series and half-range Fourier cosine series.
- Learns the method and properties of Laplace transform of some elementary functions, existence of Laplace transform
- Understand Laplace transform of derivatives and integrals, multiplications and division by *t*, inverse Laplace transform,
- Understand the convolution property, application of Laplace transform in solving ordinary and partial differential equations.
- Understand and apply the fundamental concept of Fourier Transform: Finite Fourier sine transform, inverse finite Fourier sine transform and cosine transform, Infinite Fourier transform, infinite Fourier sine transform and cosine transform, properties of Fourier transform, application to pde.

B. Sc. III Semester-VI Mathematics Paper-XI

Course Outcomes of Linear Algebra

Students will able to

- Understand the Definition and example of vector spaces, subspaces, sum and direct sum of subspaces, linear span, linear dependence, independence and their basic properties, basis , finite dimensional vector spaces ,existence theorem for bases, invariance of the number of elements of a basis set, dimension
- Apply the properties of linear transformations to linearity of transformations, kernel and rank of linear transformations using rank – nullity theorem, inverse transformations to solve the problems of matrix transformations, change of basis.

- efine the Dual space, bidual space.
- State and prove the theorems on natural isomorphism, Define the adjoint of a linear transformation,
- Understand Eigen values and eigenvectors of a linear transformation and solve examples on it.
- Use the concept of inner product spaces to find norm of vectors, distance between vectors, check the orthogonality of vectors, to find the orthogonal and orthonormal basis.
- State and prove Cauchy-Schwarz inequality, orthogonal vectors, orthogonal complements, orthonormal sets and bases, Bessel's inequality for finite dimensional spaces, Gram Schmidt orthogonalisation process.
- Understand the concept of Modules, submodules, quotient modules, homomorphism and isomorphism theorems.

B. Sc. III Semester-VI Mathematics Paper-XII Course Outcomes of Linear Algebra

Students will able to

- Have a knowledge of Newtonian Mechanics and understand Inertial frames, speed of light and Galilean relativity, relative character of space and time, postulates of special theory of relativity, Lorentz transformation and its geometrical interpretation, group properties of transformation.
- Understand the concept of Composition of parallel velocities, length contraction, time dilation, transformation equation for components of velocities and acceleration of a particle, Lorentz contraction factor. The thermodynamics of moving systems : The two laws of thermodynamics for a moving system, the Lorentz transformation for thermodynamics quantities a) volume and pressure b) energy c) work d) heat e) entropy f) temperature.
- Have a knowledge of Four dimensional Minkowskian space-time of relativity , time like and space like intervals , proper time , world line, four vectors and tensors in Minkowskian space-time ,past, present and future null cone .
- Understand the concept of basic tensors, covariant, contravariant, mixed , operations on tensors, outer product, inner product, quotient law.
- Understand the concept of Relativistic Mechanics**.** Variation of mass with velocity, equivalence of mass and energy, transformation equation for mass, momentum and energy, relativistic force and transformation.
- Equations for its components, relativistic Lagrangian and Hamiltonian, the energy momentum tensor.