# NARAJOLE RAJ COLLEGE

*(NAAC Accredited 'B' Grade Govt. Aided College)*
*NARAJOLE: PASCHIM MEDINIPUR: WEST BENGAL: Pin-721211*
E-mail: *arajolerajcollege@rediffmail.com*
Website: *https://www.narajolerajcollege.ac.in*


## *Programme Specific Outcomes (PSOs)*

## Mathematics (HONS)

*The mission of the under graduate Mathematics Program is to give students the mathematical skills and literacy required by their chosen field of study. The following are the program specific outcomes of undergraduate mathematics Course.*

***After completion of the programme, the graduates will be capable of-***

PSO 1: Students will simplify and evaluate algebraic expressions.

PSO 2: Students will solve nonlinear equations using analytic method.

PSO 3: Students will use mathematics concepts in real world situations.

PSO 4: Students will simplify and perform operations with nonlinear expressions.

PSO 5: Students will demonstrate the ability to solve financial math problems.

PSO 6: Students will demonstrate the ability to solve exponential growth and decay problems.

PSO 7: Students will demonstrate the ability to solve problems in probability and statistics.

PSO 8: Students will understand numbers, way of representing numbers, relationships among numbers, and number systems.

PSO 9: Students will use mathematical models to represent and understand quantitative relationships.

PSO 10: Students will communicate their mathematical thinking coherently and clearly to students, peers, and others.

PSO 11: Students will relate geometric ideas to number and measurement ideas.

PSO 12: Students will demonstrate the ability to algebraically analyze functions. PSO

13: Students will demonstrate the ability to graphically analyze functions.

PSO 14: Students will demonstrate the ability to model real-life scenarios using functions.

PSO 15: Students will be able to solve Polar Equations.

PSO 16: Students will demonstrate the ability to use statistical concepts to analyze "real world" issues.

PSO 17: Compute limits of functions as the independent variable approaches some finite value or infinity.

PSO 18: Interpret the derivative of a function graphically, numerically and analytically.

PSO 19: Students will gain the ability to evaluate indefinite and definite integrals by selecting and correctly applying appropriate integration techniques(s).

PSO 20: Students will be able to develop an appropriate integral form to solve a specific applied problem in geometry, physics, or probability.

PSO 21: Students will be able to utilize appropriate theory and computational techniques to construct Taylor series with its interval of convergence for use in a variety of applications such as approximating values of a function, creating series for new functions, and studying the behavior of a function.

PSO 22: Students will use Boolean algebra to design and simplify logic circuits.

PSO 23: Students will demonstrate the ability to compute derivatives and integrals of real valued and vector valued functions of several variables.

PSO 24: Students will demonstrate the ability to interpret geometrically the derivatives and integrals of real valued and vector valued functions of several variables.

PSO 25: Students will demonstrate the ability to apply the techniques of multivariable calculus to problems in mathematics, the physical sciences, and engineering.

PSO 26: Students will demonstrate the ability to formulate models of natural phenomena using differential equations.

PSO 27: Students will demonstrate the ability to solve a variety of differential equations analytically and numerically.

PSO 28: Students will demonstrate the ability to interpret a differential equation qualitatively.

PSO 29: Apply mathematical concepts and principles to perform computations.

PSO 30: Apply Mathematics to solve various real life problems.

PSO 31: Create, use and analyze graphical representations of mathematical relationships.

PSO 32: Communicate mathematical knowledge and understanding.

PSO 33: Apply technology tools to solve problems.

PSO 34: Perform abstract mathematical reasoning.

PSO35: Learn independently.

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## *Programme Specific Outcomes (PSOs)*

## Mathematics (General)

*The students of Mathematics (Gen or DSC) will acquire their theoretical basic knowledge about the different branches of Mathematics like Classical Algebra, Linear Algebra, Modern Algebra, Geometry, Probability, Statistics, Computer, Differential Calculus, integral Calculus, Operations Research, Dynamics, Mathematical modelling, Numerical methods etc. by studying this programme. This programme also opens up the career paths to select in many related and sub-related areas like academics, computer scientist, statistician etc.*

***After completion of the programme, the graduates will be capable of-***

PSO1: Acquiring the knowledge about the different core branches of Mathematics like Algebra, Geometry, Calculus, Operations Research etc.

PSO2: Developing the ability to use skills in Mathematics and its related domains of science for formulating and tackling mathematics related problems.

PSO3: Students will demonstrate the ability to model real-life scenarios using mathematics.

PSO4: Students will demonstrate the ability to apply mathematical concepts and principles to perform computations.

PSO5: Students will able to apply Mathematics to solve various real life problems and analyze graphical representations of mathematical relationships.

PSO6: Students will able to communicate mathematical knowledge and understanding. They can apply technology tools to solve problems and learn independently.

PSO7: Opening the career paths to select a career in many related and sub-related areas like academics, computer scientist, statistician etc.

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## *Course Outcome*

## Mathematics (Hons.)

| Semester | I |
|---|---|
| Title of Course | Calculus, Geometry & Differential Equation(CC-1) |
| Paper Code | C1T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics (H) of Semester-I will acquire the knowledge about the Leibnitz rule, L'Hospital'a rule, reduction formula, conics, solution of differentiation equation, Bernoulli differential Equation* by*studying this course*

***The theory paper (C1T) of this course (CC-1) provides the student with-***

CO1. Describe Leibnitz rule and its application to various problems.

CO2. Write DownL'Hospital's rule with applications in business, economics and life sciences.

CO3. Illustrate reduction formula for different types of functions.

CO4. Classification of conics.

CO5. Write down general, particular, explicit, implicit and singular solutions of a differential equation.

CO6. Illustration of exact differential equation and integrating factors.

CO7. Reduction to separable differential equation.

CO8. Describe linear equation and Bernoulli differential equations.

| Semester | I |
|---|---|
| Title of Course | Algebra (CC-2) |
| Paper Code | C2T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-I will acquire the knowledge about the Complex numbers, De Moivre's Theorem, Equivalence relation, well-ordering property, Division algorithms, Principles of Mathematical induction, linear Transformation, Eigen values and Eigen vectors, Rank of matrix , Cayley Hamilton theorem*by *studying this course*

***The theory paper (C2T) of this course (CC-2) provides the student with-***

CO1.Representation of complex numbers in polar forms.

CO2. Write Down De Moivre's theorem with rational indices with applications.

CO3. Identify relation between roots and coefficients.

CO4. Describe different types of inequalities.

CO5. Describe equivalence relation, well-ordering property of positive integers.

CO6. Write down division algorithm, congruence relation, principles of mathematical induction.

CO7. Representation of linear system of equations in matrix form and derivation of solutions.

CO8. Describe linear transformation.

CO9. Identify rank of a matrix, eigen values, eigen vectors, characteristics equation of a matrix.

CO10. Describe Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

| Semester | II |
|---|---|
| Title of Course | Real Analysis (CC-3) |
| Paper Code | C3T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-II will acquire the knowledge about the Algebraic and ordered properties of R, Completeness, Archimedean property, density property, Bolzano-Weierstrass theorem and Heine-Borel theorem , convergenceand divergence of sequences and series, Cauchy's criterion for convergence. Leibnitz test by studying this course.*

***The theorypaper (C3T) of this course (CC-3) provides the student with-***

CO1.Describe Algebraic and order properties of R.

CO2. Classification of different types of sets.

CO3. Describe completeness property, Archimedean property and density property of real numbers.

CO4. Describe Bolzano-Weierstrass theorem and Heine-Borel theorem.

CO5. Classification of real sequences with examples.

CO6. Describe convergence and divergence of sequences, Cauchy's criterion for convergence.

CO7. Describe convergence and divergence of real series, Cauchy's criterion for convergence.

CO8. Write down different tests for convergence of series with examples.

CO9. Describe alternating series, absolute and conditional convergence.

CO10. Write down Leibnitz test with examples.

| Semester | II |
|---|---|
| Title of Course | Differential Equations & Vector Calculus(CC-4) |
| Paper Code | C4T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics (H) of Semester-II will acquire the knowledge about theLipschitz condition and Picard's method, method of undetermined coefficients, method of variation of parameters, Power series solution of a differential equation about an ordinary point and solution about a regular singular point, vector triple productby studying this course.*

***The theory paper (C4T) of this course (CC-4) provides the student with-***

CO1.Describe Lipschitz condition and Picard's method

CO2. Solution of Linear homogeneous and non-homogeneous equations of higher order with constant coefficients.

CO3. Describe method of undetermined coefficients, method of variation of parameters for solving differential equation.

CO4. Solution and classification of systems of linear differential equations.

CO5. Write down Power series solution of a differential equation about an ordinary point and solution about a regular singular point.

CO6. Describe vector triple product with examples.

CO7. Describe limits, continuity, differentiation and integration of vector functions.

| Semester | III |
|---|---|
| Title of Course | Theory of Real Functions & Introduction to Metric Space(CC-5) |
| Paper Code | C5T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-III will acquire the knowledge about the limit,Continuity, differentiation,Rolle's theorem, mean value theorems, Ellustrateintermediate value property of derivatives, Darboux's theorem, ofTaylor's series and Maclaurin's series, Metric spaceby studying this course.*

***The theory paper (C5T) of this course (CC-5) provides the students with-***

CO1.Describe sequential criterion for limits with examples.

CO2. Describe sequential criterion for continuity and discontinuity with examples.

CO3. Describe differentiability of a function at a point and in an interval.

CO4. Write down Rolle's theorem, mean value theorems with applications of mean value theorem to inequalities and approximation of polynomials.

CO5.Ellustrateintermediate value property of derivatives, Darboux's theorem.

CO6. Write down Taylor's theorem with Lagrange's form of remainder, Cauchy's form of remainder.

CO7. Expansion of Taylor's series and Maclaurin'sseries.

CO8. Describe metric spaces with examples.

| Semester | III |
|---|---|
| Title of Course | Group Theory I(CC-6) |
| Paper Code | C6T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics (H) of Semester-IIIwill acquire the knowledge about the permutation groups and quaternion groups, symmetries of a square, dihedral groups, Cauchy's theorem, Lagrange's theorem, , first, second and third isomorphism theorems,Cayley's theoremby studying this course.*

***The theory paper (C6T) of this course (CC-6) provides the students with-***

CO1.Describe different groups including permutation groups and quaternion groups (through matrices), symmetries of a square, dihedral groups with examples.

CO2. Describe subgroups with examples.

CO3. Classification of subgroups of cyclic groups.

CO4. Write down Lagrange's theorem and consequences including Fermat's Little theorem.

CO5.Ellustratenormal subgroups Cauchy's theorem for finite abelian groups.

CO6. Describe properties of homomorphisms, first, second and third isomorphism theorems.

CO7. Describe Cayley's theorem.

| Semester | III |
|---|---|
| Title of Course | Numerica Models(CC-7) |
| Paper Code | C7T (Theory) |
| Credits | 04 |
| Hours | 04 hours/week |

*The students of Mathematics(H) of Semester-III will acquire the knowledge about the by bisection method, Newton's method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method, Numerical differentiation, down Gaussian elimination, Gauss Jordan methods, Gauss Jacobi method, Gauss Seidel method studying this course.*

***The theorypaper (C7T) of this course (CC-7) provides the student with-***

CO1.Classification of different types of errors.

CO2. Describe bisection method, Newton's method, Secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method.

CO3. Describe rate of convergence of these methods.

CO4. Write down Gaussian elimination, Gauss Jordan methods, Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

CO5.Ellustrate Lagrange and Newton's methods of interpolation.

CO6. Describe Numerical differentiation.

CO7. Describe Newton Cotes formula, Trapezoidal rule, Simpson's 1/3rd rule, Simpsons 3/8th rule, Weddle's rule, Boole's Rule. midpoint rule, composite Trapezoidal rule, composite Simpson's 1/3rd rule, Gauss quadrature formula for numerical Integration.

CO8. Describe the method of successive approximations, Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four for solving ordinary differentialequati

| Semester | III |
|---|---|
| Title of Course | Numerical Models (CC-7) |
| Paper Code | C7P (Lab) |
| Credits | 02 |
| Hours | 04 hours/week |

*The students of Mathematics(H) of Semester-III will acquire the practical knowledge about write a program using any softwar for summing of n numbers; sorting 100 integers; solution of transcendental and algebraic equations by bisection method, Newton Raphsonmethod,Secant method, RegulaFalsi method; solution of system of linear equations by LU decomposition method, Gaussian elimination method, Gauss-Jacobi method, Gauss-Seidel method; Interpolation; Numerical Integration; Method of finding Eigenvalue by Power method; Fitting a Polynomial Function; Solution of ordinary differential equations.on practical experiments.*

***The labpaper (C7P) of this course (CC-7) provides the student with-***

CO1. How to calculate the sum 1/1 + 1/2 + 1/3 + 1/4 + ----------+ 1/ N.

CO2. Sorting 100 integers into an array in an ascending order.

CO3. Write a program to solve the transcendental and algebraic equations by

a.Bisection method

b. NewtonRaphson method

c. Secant method

d. RegulaFalsi method.

CO4. Write a program to solve system of linear equations by

a. LU decomposition method

b. Gaussian elimination method

c. Gauss-Jacobi method

d. Gauss-Seidel method.

CO5. Write a program for interpolation by

a. Lagrange Interpolation

b. Newton Interpolation.

CO6. Write a program for numerical integration by

a. Trapezoidal Rule

b. Simpson's one third rule

c. Weddle's Rule

d. Gauss Quadrature.

CO7. Write a program of finding eigenvalues by Power method.

CO8. How to fit a polynomial function.

CO9.Write a program to solve ordinary differential equations

a. Euler method

b. Modified Euler method

c. RungeKutta method.

| Semester | III |
|---|---|
| Title of Course | Logic and Set (SEC-1) |
| Paper Code | SEC1T (Theory) |
| Credits | 02 |
| Hours | 02 hours/week |

*The students of Mathematics(H) of Semester-III will acquire the knowledge about thepropositions, truth table and logical operators,Propositional equivalence, Predicates and quantifiers, mathematicize daily life incidentby studying this course.*

***The theory paper (SEC1T) of this course (SEC-1) provides the student with-***

CO1:Learn propositions, truth table and logical operators

CO2:Get basic idea about Propositional equivalence, Predicates and quantifiers

CO3:Learn to mathematicize daily life incident using mathematical logic.

| Semester | IV |
|---|---|
| Title of Course | Riemann Integration and Series of Functions(CC-8) |
| Paper Code | C8T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-IV will acquire the knowledge about theRiemann Integrability, uniform convergence of series , Pointwise convergence and Uniform Convergence, continuity, differentiability, and integrability of limit functionby studying this course.*

***The theory paper (C8T) of this course (CC-8) provides the students with-***

CO1. Apply the knowledge of convergence to problems and the various theorems on convergence, absolute convergence and conditional convergence

CO2. Understand partitions and their refinement

CO3. Understand Integrability and theorems on integrability

CO4. Acquire the idea about Riemann Integrability and Riemann Integration and Understand various theorems associated with Riemann Integration

CO5.Develop skill in checking the uniform convergence of series using various tests of convergence

CO6. Distinguish between Pointwise convergence and Uniform Convergence

CO7. Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability.

Estd.-1966

| Semester | IV |
|---|---|
| Title of Course | **Multivariable Calculus** (CC-9) |
| Paper Code | C9T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-IV will acquire the knowledge about theline integral, double and triple integral, of Green, Gauss and Stokes' theorems , architecture of curves and surfaces in plane and spaceby studying this course.*

***The theory paper (C9T) of this course (CC-9) provides the student with-***

CO1. Learn conceptual variations while advancing from one variable to several variables in calculus.

CO2. Apply multivariable calculus in optimization problems.

CO3. Inter-relationship amongst the line integral, double and triple integral formulations.

CO4. Applications of multivariable calculus tools in physics, economics, optimization, and understanding the architecture of curves and surfaces in plane and space etc.

CO5. Realize importance of Green, Gauss and Stokes' theorems in other branches of mathematics.

| Semester | IV |
|---|---|
| Title of Course | **Ring Theory and Linear Algebra** (CC-10) |
| Paper Code | C10T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics (H) of Semester-IV will acquire the knowledge about theideals, quotient rings, integral domains, and fields, polynomial rings, fundamental properties of finite field extensions, inner product spaces, adjoint of a linear transformationby studying this course.*

***The theory paper (C10T) of this course (CC-10) provides the student with-***

CO1. Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, and fields.

CO2. Learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields.

CO3. Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.

CO4. Relate matrices and linear transformations, compute eigen values and eigen vectors of linear transformations.

CO5. Learn properties of inner product spaces and determine orthogonality in inner product spaces.

CO6. Realise importance of adjoint of a linear transformation and its canonical form

| Semester | IV |
|---|---|
| Title of Course | **Graph Theory** (SEC-2) |
| Paper Code | SEC2T (Theory) |
| Credits | 02 |
| Hours | 02 hour/week |

*The students of Mathematics(H) of Semester-IV will acquire the knowledge about theHamiltonian and Eulerian graph, real world problemsby studying this course.*

***The theory paper (SEC2T) of this course (SEC-2) provides the student with-***

CO1:Solve problems using basic graph theory

CO2:Identify various types of graphs e.g., path, cycle, tree etc.

CO3:identify whether graphs are Hamiltonian and/or Eulerian

CO4: Representation of graph using computer

CO5:Model real world problems using graph theory.

| Semester | V |
|---|---|
| Title of Course | Partial Differential Equations & Applications(CC-11) |
| Paper Code | C11T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-Vwill acquire the knowledge about thePartial differential Equations, techniques to solve first & second order partial differential equations, the heat and wave equationsby studying this course.*

***The theory paper (C11T) of this course (CC-11) provides the students with-***

CO1. To understand the concept of Partial differential Equations in more than two variables.

CO2. Be familiar with the modeling assumptions and derivations that lead to PDEs.

CO3.Recognize the major classification of PDEs and the qualitative differences between the classes of equations.

CO4. Apply a range of techniques to solve first & second order partial differential equations.

CO5. Model physical phenomena using partial differential equations such as the heat and wave equations.

Estd.-1966

| Semester | V |
|---|---|
| Title of Course | **Group Theory II**(CC-12) |
| Paper Code | C12T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-V will acquire the knowledge about theclosure, identity, inverse and generators, the Sylow theorems, homomorphism and isomorphism, group actions and their applicationsby studying this course.*

***The theory paper (C12T) of this course (CC-12) provides the student with-***

CO1. To learn fundamental properties and mathematical tools such as closure, identity, inverse and generators.

CO2. To study algebraic structure 'Groups' in detail which is useful in study of Rings, Modules, Algebraic topology, Analysis'

CO3. To enhance abstract thinking of students.

CO4. To learn to compare two different algebraic structures and study transfer of properties in between these structures through homomorphism and isomorphism

CO5. Understand the basic concepts of group actions and their applications.

CO6. Recognize and use the Sylow theorems to characterize certain finite groups.

| Semester | V |
|---|---|
| Title of Course | Linear Programming Problem(DSE-1) |
| Paper Code | DSE1T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-V will acquire the knowledge about thesimplex Two-phased and Big M methods , game theory by studying this course.*

***The theory paper (DSE1T) of this course (DSE-1) provides the student with-***

CO1:Explain basic concepts of optimization, modelling and linear modeling.

Explain the mathematical background of LP.

CO2: Formulate the decision making problems using LP techniques. Idea of FS, OS and BFS

CO3:Solve LP models by using simplex Two-phased and Big M methods

CO4:Construct the dual model of a given LP model

CO5:Solve Transportation and assignment problems

CO6:Get idea of game theory. Solve two persons zero sum game.

| Semester | V |
|---|---|
| Title of Course | Probability & Statistics(DSE-2) |
| Paper Code | DSE2T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Physics (H) of Semester-V will acquire the knowledge about the probabilistic and statistical analysis, probabilities and derive the marginal and conditional distributions, frequency distributions, cummulative frequency distributions, statistical data by studying this course.*

***The theory paper (DSE2T) of this course (DSE-2) provides the student with-***

CO1:Foundations of probabilistic and statistical analysis mostly used in various branch of science.

CO2:Determine probabilities and derive the marginal and conditional distributions.

CO3:Use the basic probability rules such as addition and multiplication laws.

CO4:Derive the probability density function of transformation of random variables.

CO5:Analysis of statistical data graphically using frequency distributions and cummulative frequency distributions.

CO6:Analysis of statistical data using measures of central tendency

| Semester | VI |
|---|---|
| Title of Course | **Metric Spaces and Complex Analysis**(CC-13) |
| Paper Code | C13T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-VI will acquire the knowledge about the open & close sets, continuity, connectedness, compactness , the notion of distance, convergent sequence, Bolzano-Weierstrass property, stereographic projection of complex plane, Cauchy Riemann equationsby studying this course.*

***The theory paper (C13T) of this course (CC-13) provides the student with-***

CO1. To equip students with basic mathematical tools such as open & close sets, continuity, connectedness, compactness which can be used to study general topology and real & complex analysis.

CO2. To enhance abstract thinking and visualization of students.

CO3. To generalize the notion of distance, convergent sequence and continuity of functions.

CO4. To increase problem solving ability by solving examples and counter-examples of various concepts involved.Learn basic facts about the cardinality of a set

CO5. Understand several standard concepts of metric spaces and their properties like openness, closed ness, completeness, Bolzano-Weierstrass property, compactness, and connectedness.

CO6. Identify the continuity of a function defined on metric spaces

CO7. Visualize complex numbers as points of plane and stereographic projection of complex plane on the Riemann sphere.

CO8. Understand the significance of differentiability and analyticity of complex functions leading to the Cauchy Riemann equations.

| Semester | VI |
|---|---|
| Title of Course | **Ring Theory and Linear Algebra II**(CC-14) |
| Paper Code | C14T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-VI will acquire the knowledge about the algebraic structure Ring, the construction of field, the Rings of polynomials, Unique Factorization domain, Euclidean Domain, Eigen values and Eigen vectors of a matrix, Gram-Schmidt process of orthogonalizationby studying this course.*

***The theory paper (C14T) of this course (CC-14) provides the student with-***

CO1: To study the algebraic structure Ring in detail through various examples.

CO2: To learn the construction of field of quotients of an integral domain.

CO3: To study the Rings of polynomials and its factorization over a field.

CO4: To study the notion of ideals and factor rings with examples.

CO5: To study Unique Factorization domain, Euclidean Domain and related results

CO6: To learn the importance of linear transformation in Physics, Engineering, Social sciences and various branches of Mathematics.

CO7: To learn to find Eigen values and Eigen vectors of a matrix which is used in the study of vibrations, chemical reactions and geometry.

CO8: To learn Inner Product spaces and Gram-Schmidt process of orthogonalization.

CO9: To get well equipped with Mathematical Modelling abilities.

| Semester | VI |
|---|---|
| Title of Course | **Mechanics** (DSE-3) |
| Paper Code | DSE3T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathematics(H) of Semester-VI will acquire the knowledge about the the resultant of forces , analytical mechanics , friction, work and energy, virtual work , the principal moment of inertia by studying this course.*

***The theory paper (DSE3T) of this course (DSE-3) provides the student with-***

CO1: Learner should understand to determine the resultant of forces and/or moments

CO2:Introduction to analytical mechanics as a systematic tool for problem solving.

CO3:Understand friction, work and energy, virtual work.

CO4:Calculate the principal moment of inertia of plane areas.

CO5:Solve problems arise in motion of artificial satellite

CO6:Able to solve problems of motion in resisting medium

| Semester | VI |
|---|---|
| Title of Course | **Mathematical Modeling** (DSE-4) |
| Paper Code | DSE4T (Theory) |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Mathmatics(H) of Semester-VI will acquire the knowledge about thepredictions of the behaviour of a given physical system, the relationships between different areas of mathematics, Model real-world problems mathematicallyby studying this course.*

***The theory paper (DSE4T) of this course (DSE-4) provides the student with-***

CO1:Construct a mathematical model of a given physical system and analyze it

CO2:Make predictions of the behaviour of a given physical system based on the analysis of its mathematical model.

CO3:Identify the relationships between different areas of mathematics and the connections between mathematics and other disciplines.

CO4:Model real-world problems mathematically and analyze those models using their mastery of the core concepts.

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## *Course Outcome*

## Mathematics (GE)

| Semester | I |
|---|---|
| Title of Course | Calculus, Geometry & Differential Equation(GE-1) |
| Paper Code | GE1 |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of other science subjects (H) of Semester-I will acquire the knowledge about theLeibnitz rule and its application, reduction formula, general, particular, explicit, implicit and singular solutions of a differential equation, separable differential equation, and Bernoulli differential equations by studying this course.*

***The theory paper (GE1T) of this course (GE-1) provides the student with***

CO1. Describe Leibnitz rule and its application to various problems.

CO2. Illustrate reduction formula for different types of functions.

CO3. Classification of conics.

CO4. Write down general, particular, explicit, implicit and singular solutions of a differential equation.

CO5. Illustration of exact differential equation and integrating factors.

CO6. Reduction to separable differential equation.

CO7. Describe linear equation and Bernoulli differential equations

| Semester | II |
|---|---|
| Title of Course | Algebra(GE-2) |
| Paper Code | GE2 |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of other science subjects (H) of Semester-II will acquire the knowledge about the De Moivre's theorem with rational indices, equivalence relation, well-ordering property, division algorithm, congruence relation, principles of mathematical induction, rank of a matrix, eigen values, eigen vectors, characteristics equation of a matrix, Cayley-Hamilton theorem by studying this course.*

***(GE2T) of this course (GE-2) provides the student with-***

CO1. Write Down De Moivre's theorem with rational indices with applications.

CO2. Describe different types of inequalities.

CO3. Describe equivalence relation, well-ordering property of positive integers.

CO4. Write down division algorithm, congruence relation, principles of mathematical induction.

CO5. Representation of linear system of equations in matrix form and derivation of solutions.

CO6. Describe linear transformation.

CO7. Identify rank of a matrix, eigen values, eigen vectors, characteristics equation of a matrix.

CO8. Describe Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

| Semester | III |
|---|---|
| Title of Course | Differential Equations & Vector Calculus |
| Paper Code | GE3 |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of other science subjects (H) of Semester-III will acquire the knowledge about the Lipschitz condition and Picard's method, method of undetermined coefficients, method of variation of parameters, Power series solution of a differential equation about an ordinary point and solution about a regular singular point, vector triple product by studying this course.*

***The theory paper (GE3T) of this course provides the student with-***

CO1.Describe Lipschitz condition and Picard's method

CO2. Solution of Linear homogeneous and non-homogeneous equations of higher order with constant coefficients.

CO3. Describe method of undetermined coefficients, method of variation of parameters for solving differential equation.

CO4. Solution and classification of systems of linear differential equations.

CO5. Write down Power series solution of a differential equation about an ordinary point and solution about a regular singular point.

CO6. Describe vector triple product with examples.

| Semester | IV |
|---|---|
| Title of Course | Ring Theory and Linear Algebra-I |
| Paper Code | GE4 |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of other science subjects (H) of Semester-IV will acquire the knowledge about the ideals, quotient rings, integral domains, and fields, polynomial rings, fundamental properties of finite field extensions, inner product spaces, adjoint of a linear transformation by studying this course.*

***The theory paper (GE4T) of this course provides the student with***

CO1. Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains, and fields.

CO2. Learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields.

CO3. Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.

CO4. Relate matrices and linear transformations, compute eigen values and eigen vectors of linear transformations.

CO5. Learn properties of inner product spaces and determine orthogonality in inner product spaces.

CO6. Realise importance of adjoint of a linear transformation and its canonical form

# NARAJOLE RAJ COLLEGE

*(NAAC Accredited 'B' Grade Govt. Aided College)*
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## *Course Outcome*

## Mathematics (DSC)

| Semester | I |
|---|---|
| Title of Course | Differential Calculus (DSC 1A) |
| Paper Code | DSC 1A |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Semester-I will acquire the knowledge about thelimit, continuity and differentiability of a function, types of discontinuity, Leibnitz's theorem and Euler's theorem, Taylor's, Maclaurin's series by studying this course.*

***The theory paper (DSC 1A T) of this course (DSC- 1A) provides the student with:***

CO1: Describe limit, continuity and differentiability of a function

CO2:Explain types of discontinuity.

CO3:State Leibnitz's theorem and Euler's theorem on homogeneous functions.

CO4: Identify mean value theorems.

CO5. Describe Taylor's, Maclaurin's series for various functions.

| Semester | II |
|---|---|
| Title of Course | Differential Equations (DSC1B) |
| Paper Code | DSC 1B |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Semester-II will acquire the knowledge about theexact differential equations, Linear homogeneous and non-homogeneous equations, method of variation of parameters, Cauchy-Euler equation, simultaneous differential equations, linear partial differential equation by studying this course.*

***The theory paper* (DSC1BT) *of this course* (DSC-1B) *provides the student with-***

CO1.Solve first order exact differential equations.

CO2. Solution of Linear homogeneous and non-homogeneous equations of higher order with constant coefficients.

CO3. Describe method of variation of parameters for solving differential equation.

CO4. Describe Cauchy-Euler equation.

CO5. Solution of simultaneous differential equations.

CO6. Solution of linear partial differential equation of first order.

CO7. Classification of second order partial differential equations.

Estd.-1966

| Semester | III |
|---|---|
| Title of Course | Real Analysis (DSC1C) |
| Paper Code | DSC 1C |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Semester-III will acquire the knowledge about theCompleteness property, Archimedean property and density property of real numbers, Bolzano-Weierstrass theorem, convergence and divergence of sequences and series of real numbers, power series and radius of convergence by studying this course.*

***The theory paper* (DSC1CT) *of this course* (DSC -1C) *provides the student with-***

CO1. Classification of different types of sets.

CO2. Describe completeness property, Archimedean property and density property of real numbers.

CO3. Describe Bolzano-Weierstrass theorem.

CO4. Describe convergence and divergence of sequences, Cauchy's criterion for convergence.

CO5. Describe convergence and divergence of real series, Cauchy's criterion forconvergence.

CO6. Define power series and radius of convergence.

| Semester | III |
|---|---|
| Title of Course | Theory of Equations(SEC 1) |
| Paper Code | SEC1 |
| Credits | 02 |
| Hours | 02 hours/week |

*The students of Semester-III will acquire the knowledge about theProperties of polynomials and equations, Descarte's rule of signs, relation between roots and co-efficients, Algebraic solutions of the cubic and biquadratic equationsby studying this course.*

***The theory paper* (SEC 1T) *of this course* (SEC 1) *provides the student with-***

CO1. Describe general properties of polynomials and equations.

CO2. Explain Descarte's rule of signs.

CO3. Identify relation between roots and co-efficients.

CO4. Algebraic solutions of the cubic and biquadratic equations.

| Semester | IV |
|---|---|
| Title of Course | Algebra(DSC 1D) |
| Paper Code | DSC 1D |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Semester-IV will acquire the knowledge about thePermutation groups, Quaternion groups, Symmetries of a square, Dihedral groups, cyclic groups, normal subgroups, cyclic groups, normal subgroups, rings, subrings, ideals, polynomial rings, Integral domains, fields by studying this course.*

***The theory paper* (DSC1DT) *of this course* (DSC-1D) *provides the student with***

CO1.Describe different groups including permutation groups and quaternion groups (through matrices), symmetries of a square, dihedral groups with examples.

CO2. Classification of subgroups of cyclic groups, normal subgroups.

CO3. Write down Lagrange's theorem and consequences .

CO4. Define rings, subrings, ideals, polynomial rings.

CO5. Define Integral domains, fields.

Estd.-1966

| Semester | IV |
|---|---|
| Title of Course | Integral Calculus(SEC 2) |
| Paper Code | SEC2 |
| Credits | 02 |
| Hours | 02 hours/week |

*The students of Semester-IV will acquire the knowledge about thepartial fractions, properties of definite integrals, reduction formulas, areas and length of plane curves, double and triple integrals by studying this course.*

***The theory paper* (SEC 2T) *of this course* (SEC 2T) *provides the student with-:***

CO1. Integrate by partial fractions.

CO2. Describe properties of definite integrals.

CO3. Explain reduction formulas for different functions.

CO4. Evaluate areas and length of plane curves.

CO5. Find volume by double and triple integrals.

| Semester | V |
|---|---|
| Title of Course | Linear Algebra (DSE-1) |
| Paper Code | DSE 1 |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Semester-V will acquire the knowledge about theconcepts of vector spaces, subspaces, bases, dimension ,Matrices and linear transformations, compute eigen values and eigen vectors, Cayley-Hamilton theoremby studying this course.*

***The theory paper (DSE 1T) of this course (DSE-1) provides the student with-***

CO1. Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.

CO2. Relate matrices and linear transformations, compute eigen values and eigen vectors of linear transformations.

CO3. Learn properties of inner product spaces and determine orthogonality in inner product spaces.

CO4. Realise importance of adjoint of a linear transformation and its canonical form

CO5.Identify rank of a matrix, eigen values, eigen vectors, characteristics equation of a matrix.

CO6. Describe Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

CO7. Social Justice and the concept of Ambedkar and Lihia

CO8. Nehru and Joyprakash Narayan on Democracy

CO9. Ramabai on patriarchy

| Semester | V |
|---|---|
| Title of Course | Mathematical Modeling(SEC 3) |
| Paper Code | SEC3 |
| Credits | 02 |
| Hours | 02 hours/week |

*The students of Semester-V will acquire the knowledge about thevibrations of a mass on a spring, damped motion, forced motion, electric circuit, conduction of heat in solids, gravitational potential and conservation laws by studying this course.*

***The theory paper* (SEC3T) *of this course* (SEC 3) *provides the student with:***

CO1. Compute vibrations of a mass on a spring.

CO2. Describe free damped motion, forced motion, electric circuit problems with applications.

CO3. State conduction of heat in solids.

CO4. Describe gravitational potential and conservation laws

| Semester | VI |
|---|---|
| Title of Course | Mechanics (DSE-2) |
| Paper Code | DSE2 |
| Credits | 06 |
| Hours | 06 hours/week |

*The students of Semester-VI will acquire the knowledge about condition of equilibrium of a particle, virtua work, velocity and acceleration of a particle along a curve, simple pendulum by studying this course.*

***The theory paper (DSE 2T) of this course (DSE-2) provides the student with-***

CO1: Learner should understand to determine the condition of equilibrium of a particle.

CO2:Introduction to analytical mechanics as a systematic tool for problem solving.

CO3:Understand friction, work and energy, virtuawork, velocity and acceleration of a particle along a curve.

CO4:Calculate the principal moment of inertia of plane areas.

CO5:Solve problems arise in motion of artificial satellite, simple pendulum

CO6:Able to solve problems of motion in resisting medium

Estd.-1966

| Semester | VI |
|---|---|
| Title of Course | Probability and Statistics (SEC 4) |
| Paper Code | SEC4 |
| Credits | 02 |
| Hours | 02 hours/week |

*The students of Semester-VI will acquire the knowledge about the probabilistic and statistical analysis, basic probability rules such as addition and multiplication laws, probability density functions, expectation, moment generating functions, joint probability density functions, marginal and conditional distributions, expectation of functions by studying this course.*

***The theory paper* (SEC4T) *of this course* (SEC 4) *provides the student with***

CO1: Foundations of probabilistic and statistical analysis mostly used in various branch of science

CO2:Use the basic probability rules such as addition and multiplication laws.

CO3:Derive the probability density functions, expectation, moment generating functions.

CO4:Derive joint probability density functions, marginal and conditional distributions, expectation of functions of two variables.