+3 1ST YEAR SCIENCE, 1ST SEMESTER

MATHEMATICS (HONOURS)

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+3 2ND YEAR SCIENCE/ARTS, 3RD SEMESTER

MATHEMATICS (HONOURS)

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+3 3RD YEAR SCIENCE/ARTS

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Core-1(Calculus I)

Course Objectives and Course Outcomes : -Upon successful completion of Calculus , a student will be able to:

- Compute limits and derivatives of algebraic, trigonometric, and piece-wise defined functions,
- Compute definite and indefinite integrals of algebraic and trigonometric functions using formulas and substitution,
- Use the derivative of a function to determine the properties of the graph of the function and use the graph of a function to estimate its derivative,
- Solve problems in a range of mathematical applications using the derivative or the integral,
- Apply the Fundamental Theorem of Calculus,
- Determine the continuity and differentiability of a function at a point and on a set, and
- Use appropriate modern technology to explore calculus concepts.
- Define, graph, compute limits of, differentiate, and integrate transcendental functions,
- Examine various techniques of integration and apply them to definite and improper integrals,
- Approximate definite integrals using numerical integration techniques and solve related problems,
- Model physical phenomena using differential equations,
- Define, graph, compute limits of, differentiate, integrate and solve related problems involving functions represented parametrically or in polar coordinates,
- Distinguish between the concepts of sequence and series, and determine limits of sequences and convergence and approximate sums of series, and
- Define, differentiate, and integrate functions represented using power series expansions, including Taylor series, and solve related problems.
- Represent vectors analytically and geometrically, and compute dot and cross products for presentations of lines and planes,
- Analyze vector functions to find derivatives, tangent lines, integrals, arc length, and curvature,
- Compute limits and derivatives of functions of 2 and 3 variables,
- Apply derivative concepts to find tangent lines to level curves and to solve optimization problems,
- Evaluate double and triple integrals for area and volume,
- Differentiate vector fields,
- Determine gradient vector fields and find potential functions,
- Evaluate line integrals directly and by the fundamental theorem, and
- Use technological tools such as computer algebra systems or graphing calculators for visualization and calculation of multivariable calculus concepts.

Core-2(Algebra I)

Course Objectives and Course Outcomes : -Upon successful completion of Algebra I, students will be able to:

- Solve systems of linear equations,
- Analyze vectors in R^n geometrically and algebraically,
- Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces,
- Use matrix algebra and the related matrices to linear transformations,
- Compute and use determinants,
- Compute and use eigenvectors and eigenvalues,
- Determine and use orthogonality, and
- Use technological tools such as computer algebra systems or graphing calculators for visualization and calculation of linear algebra concepts.

Perform algebra with complex numbers

- Compute sums, products, quotients, conjugate, modulus, and argument of complex numbers.
- Write complex numbers in polar form.
- Compute exponentials and integral powers of complex numbers.
- Find all integral roots and all logarithms of nonzero complex numbers.

Core-3(Analysis-I)

Course Objectives and Course Outcomes : - Upon successful completion of Real Analysis -I, students will be able to:

- Describe the real line as a complete, ordered field,
- Determine the basic topological properties of subsets of the real numbers,

- Use the definitions of convergence as they apply to sequences, series, and functions,
- Determine the continuity, differentiability, and integrability of functions defined on subsets of the real line,
- Apply the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis, and
- Produce rigorous proofs of results that arise in the context of real analysis.
- Write solutions to problems and proofs of theorems that meet rigorous standards based on content, organization and coherence, argument and support, and style and mechanics.

Core-4(Differential Equations)

Course Objectives and Course Outcomes : -Upon successful completion of Theory of Ordinary Differential Equations, a student will be able to:

- Solve differential equations of first order using graphical, numerical, and analytical methods,
- Solve and apply linear differential equations of second order (and higher),
- Solve linear differential equations using the Laplace transform technique,
- Find power series solutions of differential equations, and
- Develop the ability to apply differential equations to significant applied and/or theoretical problems.

CORE-5 (ANALYSIS-II)

Course Objectives	Course Outcomes
Have the knowledge of real functions-limits of functions and their properties.	Define and recognize the real functions and its limits . Interpret how to Know the real functions using the internet .
Studying the notion of continuous functions and their properties.	Define and recognize the continuity of real functions . Interpret how to Know the continuity using the internet .
Studying the differentiability of real functions and related theorems .	Define and recognize the differentiability of real functions and its related theorems . Interpret how to Know the differentiability and related theorems using the internet .
Studying about maxima & minima of functions with related theorems and series expansions of functions.	Define and recognize the maxima & minima of functions and its related theorems . Illustrate how to find the series expansions of functions using Taylor's series . Interpret how to Know the series expansions using the internet .

CORE-6(Abstract Algebra II)

Course Objectives and Course Outcomes : -

The main objective of this course is to provide students with a solid understanding of the most important algebraic systems: groups and commutative rings. They should understand about permutation groups,cyclic groups,centraliser,normaliser and center of a group,Lagranges theorem.Use Cauchy's theorem in finite abelian groups.Also they should know about properties of homomorphism and isomorphism.

Time permitting they should have some idea about nilpotent groups and Cayleys theory. A student who successfully completes this course will:

1. be able to manipulate these systems and prove basic facts about them

2. have the skill to use the basic theorems about these systems to solve theoretical exercises and to construct examples and counter-examples

3. understand the basic proof techniques of these subjects and be able to apply them

4. have an appreciation of some of the open questions in these subjects and the role of such questions in the development of the theory

5. have an appreciation of the beauty of these structures and their historical significance.

CORE-7(Ordinary and Partial Differential Equations)

Course Objectives and Course Outcomes : -

Upon successful completion of Ordinary and Partial Differential Equations, the student will be able to :

1. Identify an ordinary differential equation and its order
2. Verify whether a given function is a solution of a given ordinary differential equation (as well as verifying initial conditions when applicable)
3. Classify ordinary differential equations into linear and nonlinear equations
4. Solve first order linear differential equations
5. Find solutions of separable differential equations
6. Model radioactive decay, compound interest, and mixing problems using first order quations
7. Model population dynamics using first order autonomous equations
8. Apply first order equations to problems in elementary dynamics
9. Find solutions of exact equations
10. Find the general solution of second order linear homogeneous equations with constant coefficients
11. Understand the notion of linear independence and the notion of a fundamental set of solutions
12. Use the method of reduction of order to find a second linearly independent solution of a second order, linear homogeneous equation when one solution is given
13. Use the method of undetermined coefficients to solve second order, linear homogeneous equations with constant coefficients
14. Use the method of variation of parameters to find particular solutions of second order, linear homogeneous equations
15. Use second order linear equations with constant coefficients to model mechanical vibrations
16. Compute the Laplace transform of a function
17. Use shift theorems to compute the Laplace transform and inverse Laplace transform
18. Use the Laplace transform to compute solutions of second order, linear equations with constant coefficients
19. Use the Laplace transform to compute solutions of equations involving impulse functions 20. Perform standard operations on vectors in R2 and 2 × 2 matrices
21. Recognize linearly independent vectors in R2
22. Find eigenvalues and eigenvectors of 2 × 2 matrices
23. Use the eigenvalue-eigenvector method to find the general solution of first order linear 2 × 2 homogeneous systems with constant coefficients
24. Use the method of separation of variables to reduce some partial differential equations to ordinary differential equations
25. Find the Fourier series of periodic functions
26. Find the Fourier sine and cosine series for functions defined on an interval
27. Apply the Fourier convergence theorem
28. Find solutions of the heat equation, wave equation, and the Laplace equation subject to boundary conditions

CORE-8(Numerical Methods)

Course Objectives and Course Outcomes :-

Many applications in engineering , physics, geology and other specifications containing a complicated problems that need one of numerical methods to be solved , and this course teaching the student the classification of many of these problem and the numerical methods suitable for solving it by finding an approximated solution with desired accuracy, also the student will learn how to apply each method in this course and how to design a suitable algorithms and write a MATLAB program for each of which, and applying this programs in the computer laboratory to solve many selected problems.

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. Apply numerical methods to obtain approximate solutions to mathematical problems.
3. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
4. Analyse and evaluate the accuracy of common numerical methods.
5. Implement numerical methods in Matlab.
6. Write efficient, well-documented Matlab code and present numerical results in an informative way.

CORE-9(Riemann Integration and Series of Functions)

Course Objectives and Course Outcomes :-Upon successful completion of Real Analysis II, a student will be able to:

- Determine the Riemann integrability and its properties of a bounded function and prove a selection of theorems concerning integration,
- Convergence of beta & gamma Functions.
- Recognize the difference between pointwise and uniform convergence of a sequence of functions,
- Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability, and
- Illustrate the convergence properties of power series.

CORE-10(Ring Theory &Linear Algebra-III)

Course Objectives and Course Outcomes :-Upon successful completion of Ring Theory &Linear Algebra III, a student will be able to:

- Analyze finite and infinite dimensional vector spaces and subspaces over a field and their properties, including the basis structure of vector spaces,
- Use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism,
- Compute with the characteristic polynomial, eigenvectors, eigenvalues and eigenspaces, as well as the geometric and the algebraic multiplicities of an eigenvalue and apply the basic diagonalization result,
- Compute inner products and determine orthogonality on vector spaces, including Gram-Schmidt orthogonalization, and
- Identify self-adjoint transformations and apply the spectral theorem and orthogonal decomposition of inner product spaces, the Jordan canonical form to solving systems of ordinary differential equations.
- Study properties of ring and field.

CORE-11(MULTIVARIATE CALCULUS)

Course Objectives and Course Outcomes :-

To present the fundamental concepts of multivariable calculus and to develop student understanding and skills in the topic necessary for its applications to science and engineering.

Course outcomes:- Upon completion of this course, students should be able to

1. Manipulate vectors to perform geometrical calculations in three dimensions.
2. Calculate and interpret derivatives in up to three dimensions.
3. Integrate functions of several variables over curves and surfaces.
4. Use Green's theorem and the Divergence theorem to compute integrals.
5. Communicate Calculus and other mathematical ideas effectively in speech and in writing.

CORE-12(Probability and Statistics)

Course Objectives and Course Outcomes :-Upon successful completion of Elements of Probability and Statistics, a student will be able to:

- Organize, present and interpret statistical data, both numerically and graphically,
- Use various methods to compute the probabilities of events,
- Analyze and interpret statistical data using appropriate probability distributions, e.g. binomial and normal,
- Apply central limit theorem to describe inferences,
- Construct and interpret confidence intervals to estimate means, standard deviations and proportions for populations,
- Perform parameter testing techniques, including single and multi-sample tests for means, standard deviations and proportions, and
- Perform a regression analysis, and compute and interpret the coefficient of correlation.

CORE-13(METRIC SPACES & COMPLEX ANALYSIS)

Course Objectives and Course Outcomes :- Upon successful completion of METRIC SPACES, a student will be able to:

give students an understanding of metric spaces and concepts and more general notions of topology.

Having successfully completed this module you will be able to:

- Recall the defining properties of a metric space, and determine whether a given function defines a metric
- State and prove the Contraction Mapping Theorem
- Recall the definition of a topological space, and be able to verify the axioms in examples
- Apply the Contraction Mapping Theorem to problems in differential equations and numerical analysis
- Determine whether or not a given subset of a metric space is open or closed; determine the interior, closure, and boundary of a given set
- Prove straightforward results concerning open and closed sets
- Understand the construction and basic properties of the Cantor set
- State and prove the Heine-Borel theorem and use it to determine compactness of subsets of R^n
- Understand the concepts of subspace and product topologies
- Recall the definition of homeomorphism
- Recall the definitions of connectedness and compactness
- State Tychonov's theorem and be able to use it in examples
- Be able to determine if a given space is Hausdorff, connected, path-connected, compact

Upon successful completion of Complex Analysis, a student will be able to:

- Represent complex numbers algebraically and geometrically,
- Define and analyze limits and continuity for complex functions as well as consequences of continuity,
- Apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra,
- Analyze sequences and series of analytic functions and types of convergence,
- Evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula, and
- Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.

<u>CORE-14(Linear Programming)</u>

Course Objectives and Course Outcomes :- Upon successful completion of Linear Programming , a student will be able to:

- Formulate and model a linear programming problem from a word problem and solve them graphically in 2 and 3 dimensions, while employing some convex analysis,
- Place a Primal linear programming problem into standard form and use the Simplex Method or Revised Simplex Method to solve it,
- Find the dual, and identify and interpret the solution of the Dual Problem from the final tableau of the Primal problem,
- Be able to modify a Primal Problem, and use the Fundamental Insight of Linear Programming to identify the new solution, or use the Dual Simplex Method to restore feasibility,
- Interpret the dual variables and perform sensitivity analysis in the context of economics problems as shadow prices, imputed values, marginal values, or replacement values,
- Explain the concept of complementary slackness and its role in solving primal/dual problem pairs,
- Classify and formulate integer programming problems and solve them with cutting plane methods, or branch and bound methods, and
- Formulate and solve a number of classical linear programming problems and such as the minimum spanning tree problem, the assignment problem, (deterministic) dynamic programming problem, the knapsack problem, the XOR problem, the transportation problem, the maximal flow problem, or the shortest-path problem, while taking advantage of the special structures of certain problems.