# Lecture Plan

**Name of the College:** Government College of Arts, Science and Commerce, Sanquelim-Goa

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| **Name of Faculty:** Minoshka D'Souza | **Subject:** Mathematics | |
| **Paper code:** MAT 500 - Real Analysis | **Program:** M.Sc. Mathematics | **Division: -** |
| **Academic year:** 2024-25 | **Semester:** I | **Total Lectures:** 60 |

**Course Objectives:** This course will develop fundamental concepts in Real Analysis and make the student acquainted with tools of analysis which is essential for the study and appreciation of many related branches of mathematics and applications.

**Course Outcome:** On completion of this course the learner will be familiar with various topics including real number system, sequences, limits and continuity and derivatives.

**Student Learning Outcome:** At the end of the course the student will be able to

1. Recall and explain concepts in the real number system, finite sets and countability, sequences, continuity and derivatives
2. Prove important theorems related to topics studied.
3. Apply knowledge gained to solve basic mathematical problems in real analysis and metric spaces.
4. Analyse, compare and differentiate between various concepts studied in order to solve problems.

| Month | Lecture From | Lecture To | No. of lectures allotted | Topic, Subtopic to be covered | Exercise/ Assignment | ICT Tools | Reference books |
|---|---|---|---|---|---|---|---|
| June | 28/06/2024 | 29/06/2024 | 2 | **Real Number System:** Peano's Axioms for Natural Numbers and Induction Principle | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| July | 01/07/2024 | 06/07/2024 | 4 | **Real Number System:** Peano's Axioms for Natural Numbers and Induction Principle, equivalence of induction, strong induction and the well-ordering principle, Integers and Rational numbers (Discussion) | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| | 08/07/2024 | 13/07/2024 | 4 | **Real Number System:** Ordered sets and LUB Property, Ordered Field Axioms Field of Real Numbers and Completeness, Archimedean property, integral part of a real number, density of rationals and irrationals in the reals | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| | 15/07/2024 | 20/07/2024 | 4 | **Real Number System:** Existence of roots of nonnegative reals, proof of existence of decimal representation of reals, Extended Real Number System, Finite sets, cardinality of finite sets, Subset of finite sets, a proper subset of a finite set has cardinality strictly less that the super set | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |

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| | 22/07/2024 | 27/07/2024 | 4 | **Real Number System:** Countable sets – definition and equivalent reformulations of countability, Countability of unions and Cartesian products of sets, Uncountable sets, Countabilty of Rationals, Uncountability of Reals | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| July August | 29/07/2024 | 03/08/2024 | 4 | **Elements of Point Set Topology:** Metric Spaces, Euclidean Spaces, Open balls and Open sets in Euclidean Spaces, Structure of open sets in Euclidean Spaces , Adherent points and Accumulation points | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| August | 05/08/2024 | 10/08/2024 | 4 | **Elements of Point Set Topology:** Closed sets, Perfect sets, Every non-empty perfect set of is uncountable, Bolzano-Weierstrass Theorem, Cantor Intersection Theorem, Lindelof Covering Theorem, The Heine-Borel Covering Theorem | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| | 12/08/2024 | 17/08/2024 | 4 | **Elements of Point Set Topology:** Compactness in , Compactness in metric spaces, Connected sets in metric spaces, Connected subsets of R | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| | 19/08/2024 | 24/08/2024 | 4 | **Elements of Point Set Topology:** Cantor set-construction and basic properties, Cantor set and ternary expansion. | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |

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| | | | | **Limits and Continuity:** Convergent sequences in a Metric space | | | |
| | 26/08/2024 | 31/08/2024 | 4 | **Limits and Continuity:** Cauchy sequences and Complete metric spaces, Limit inferior and Limit superior of a sequence, Limit of a Function- (Real valued, complex valued, vector valued functions) | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| September | 02/09/2024 | 07/09/2024 | 2 | **Limits and Continuity:** Continuous Functions, Continuity and Compactness, Continuity and Connectedness | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| | 09/09/2024 | 14/09/2024 | 2 | **Limits and Continuity:** Bolzano's Theorem and Intermediate value Theorem, Uniform Continuity, | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| | 16/09/2024 | 21/09/2024 | 4 | **Limits and Continuity:** Uniform Continuity and Compactness, Discontinuities of Real valued Functions, Monotonic Functions, Infinite limits and Limits at infinity | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| | 23/09/2024 | 28/09/2024 | 4 | **Derivatives:** Derivatives and Continuity, Algebra of Derivatives and Chain rule, One sided derivatives and Infinite Derivatives | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| September October | 30/09/2024 | 05/10/2024 | 2 | **Derivatives:** Functions with non-zero derivatives, Zero derivatives and Local extrema | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |

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| October | 07/10/2024 | 12/10/2024 | 4 | **Derivatives:** Rolle's Theorem, Mean value Theorems and consequences, Intermediate value Theorem for Derivatives,<br>Taylor's Formula with Remainder | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| | 14/10/2024 | 19/10/2024 | 4 | **Derivatives:** Derivatives of Vector valued Functions and Complex valued Functions, Derivatives of Higher Order, L'Hospital's Rules with proof. | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |
| | 21/10/2024 | 23/10/2024 | 4 | Revision | Exercises on topics covered | Latex, Smart Board | Mathematical Analysis by Tom Apostol |

*** Assessment Rubrics**

| Component | Max Marks |
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| ISA 1 | 20 |
| ISA 2 | 20 |
| ISA 3 | 20 |
| Semester End Exam | 40 |