

**STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI**  
**COURSE PLAN June - November 2024**

**Department** : Mathematics  
**Name/s of the Faculty** : Dr. Fancy V. F.  
**Course Title** : Real Analysis  
**Course Code** : 23MT/PC/RA14  
**Shift** : I

**COURSE OUTCOMES (COs)**

<b>COs</b>	<b>Description</b>	<b>CL</b>
<b>CO1</b>	Recall the fundamental concepts, theorems, and techniques from point set topology, functions of bounded variation, Riemann-Stieltjes integral, multivariable differential calculus, and implicit functions and extremum problems in real analysis.	K1
<b>CO2</b>	Demonstrate understanding and articulate the significance of the concepts learnt.	K2
<b>CO3</b>	Apply analytical and problem-solving skills to solve complex mathematical problems and demonstrate proficiency in techniques such as integration by parts, change of variable in integrals, and determining extrema of real-valued functions of one or several variables.	K3
<b>CO4</b>	Analyze the relationships between different concepts and theorems in real analysis, such as the connections between open sets, closed sets, compactness, and continuity, as well as the interplay between the Riemann-Stieltjes integral and functions of bounded variation.	K4
<b>CO5</b>	Evaluate and critique mathematical arguments and proofs, specifically in the context of real analysis, including analysis of differentiability conditions, properties of upper and lower integrals, and the applicability of concepts studied in theorems	K5

Week	Unit No.	Content	Cognitive Level	Teaching Hours	COs	Teaching Learning Methodology	Assessment Methods
Jun 24 – 26, 2024 (Day Order 4 - 6)	1	<b>Elements of point set Topology</b> 1.1 Euclidean Space $R^n$	K1-K5	2	CO1-CO5	Revision of preliminary concepts & Group Discussion	Group Discussion
Jun 27 – July 4, 2024 (Day Order 1 - 6)	1	<b>Elements of point set Topology</b> 1.1 Euclidean Space $R^n$ 1.2 Open Balls and Open Sets in $R^n$ 1.3 Closed Sets – Adherent and Accumulation points	K1-K5	5	CO1-CO5	Lecture & Group Discussion	Slip test
July 5 – 12, 2024 (Day Order 1 - 6)	1	<b>Elements of point set Topology</b> 1.4 Bolzano-Weierstrass Theorem 1.5 Cantor Intersection Theorem 1.6 Lindelöf Covering Theorem	K1-K5	5	CO1-CO5	Lecture & Group Discussion	Quiz
July 15 – 23, 2024 (Day Order 1 - 6)	1  2	<b>Elements of point set Topology</b> 1.7 Heine–Borel Covering Theorem 1.8 Compactness in $R^n$ <b>Functions of Bounded Variation</b> 2.1 Properties of Monotonic Functions	K1-K5	5	CO1-CO5	Lecture & Group Discussion	Group Discussion

July 24 – 31, 2024 (Day Order 1 - 6)	2	<b>Functions of Bounded Variation</b> 2.2 Functions of Bounded Variation 2.3 Total Variation 2.4 Additive Property of Total Variation 2.5 Total Variation on $[a, x]$ as a function of $x$ 2.6 Functions of bounded variation expressed as the difference of increasing functions 2.7 Continuous functions of Bounded Variation	K1-K5	5	CO1-CO5	Lecture & Group Discussion	Quiz
Aug 1 – 5, 2024 (Day Order 1 - 3)	2	<b>Riemann-Stieltjes Integral</b> 2.8 Linear Properties 2.9 Integration by Parts 2.10 Change of Variable in a Riemann- Stieltjes Integral	K1-K5	3	CO1-CO5	Lecture & Group Discussion	Group Discussion
Aug 6 – 10, 2024	<b>C.A. Test – I</b> (Portions: Unit 1 and Unit 2: Secs. 2.1 – 2.5)						
Aug 12 – 14, 2024 (Day Order 4-6)	3	<b>Riemann-Stieltjes Integral Integral(contd.)</b> 3.1 Reduction to a Riemann Integral 3.2 Step Functions as Integrators	K1-K5	2	CO1-CO5	Lecture & Group Discussion	Problem solving

<p>Aug 16 – 23, 2024 (Day Order 1-6)</p>	<p>3</p>	<p><b>Riemann-Stieltjes Integral Integral(contd.)</b> 3.2 Step Functions as Integrators 3.3 Reduction of a Riemann-Stieltjes Integral to a Finite Sum 3.4 Monotonically Increasing Integrators - Upper and Lower Integrals 3.5 Additive and Linearity Properties of Upper and Lower Integrals 3.6 Riemann's Condition 3.7 Comparison Theorems 3.8 Integrators of Bounded Variation</p>	<p>K1-K5</p>	<p>5</p>	<p>CO1- CO5</p>	<p>Lecture &amp; Group Discussion</p>	<p>Problem solving  <b>III Component Test I:</b> Individual Seminar Presentation (20 marks)</p>
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<p>Aug 27 – Sep 3, 2024 (Day Order 1-6)</p>	<p>3</p>	<p><b>Riemann-Stieltjes Integral(contd.)</b>  3.9 Necessary and Sufficient Condition for Existence of Riemann-Stieltjes Integrals  3.10 Mean Value Theorems for Riemann-Stieltjes Integrals  3.11 The Integral as a Function of the Interval  3.12 Change of Variable in a Riemann Integral  3.13 Riemann-Stieltjes Integrals depending on a Parameter  3.14 Differentiation under the Integral Sign  3.15 Interchanging the order of Integration</p>	<p>K1-K5</p>	<p>5</p>	<p>CO1-CO5</p>	<p>Lecture &amp; Group Discussion</p>	<p>Individual Seminar Presentation</p>
<p>Sep 4 – 11, 2024 (Day Order 1-6)</p>	<p>4</p>	<p><b>Multivariable Differential Calculus</b>  4.1 The directional derivative  4.2 Directional derivative and continuity  4.3 Total Derivative - Total Derivative expressed in terms of Partial Derivatives</p>	<p>K1-K5</p>	<p>5</p>	<p>CO1-CO5</p>	<p>Lecture &amp; Group Discussion</p>	<p><b>III Component Test II:</b>   Test from Unit 2:  Secs. 2.6 – 2.10 (15 marks)</p>

Sep 12 - 20, 2024 (Day Order 1-6)	4	<b>Multivariable Differential Calculus</b> 4.4 Jacobian matrix 4.5 Chain rule – Matrix Form 4.6 Mean Value Theorem 4.7 Sufficient Condition for Differentiability	K1-K5	5	CO1- CO5	Lecture & Group Discussion	Slip test
Sep 23 - 26, 2024 (Day Order 1-4)	4	<b>Multivariable Differential Calculus</b> 4.7 Sufficient Condition for Differentiability 4.8 Equality of Mixed Partial Derivatives 4.9 Taylor’s formula for functions from $R^n$ to $R^1$	K1-K5	4	CO1- CO5	Lecture & Group Discussion	Theorem writing technique
Sep 27 – Oct 3, 2024	<b>C.A. Test – II</b> (Portions: Unit 3 and Unit 4: Secs. 4.1-4.6)						
Oct 4 – 5, 2024 (Day 5 & 6)	5	<b>Implicit Functions and Extremum Problems</b> 5.1 Functions with non- zero Jacobian determinant	K1-K5	1	CO1- CO5	Lecture & Group Discussion	Quiz
Oct 7 - 15, 2024 (Day Order 1 to 6)	5	<b>Implicit Functions and Extremum Problems</b> 5.2 The inverse function theorem 5.3 Implicit function theorem 5.4 Extrema of real valued functions of one variable	K1-K5	5	CO1- CO5	Lecture & Group Discussion	Quiz

<p>Oct 16 - 22, 2024 (Day Order 1 to 6)</p>	<p>5</p>	<p><b>Implicit Functions and Extremum Problems</b> 5.4 Extrema of real valued functions of one variable 5.5 Extrema of real valued functions of several variables</p>	<p>K1-K5</p>	<p>5</p>	<p>CO1-CO5</p>	<p>Lecture &amp; Group Discussion</p>	<p><b>III Component Test III:</b>  Test from Unit 5: Secs. 5.1 – 5.3 (15 marks)</p>
<p>Oct 23 - 24, 2024 (Day Order 1 to 2)</p>	<p><b>REVISION</b></p>						