	P.R.Government College (Autonomous) **KAKINADA**	**Program&Semester** II B.Sc. (IV Sem)
CourseCode MAT-401/4201	**TITLEOFTHECOURSE** **Real Analysis**	

		L	T	P	C
Teaching	HoursAllocated:60(**Theory**)	L	T	P	C
Pre-requisites:	Basic Mathematics Knowledge on number system.	4	1	-	4

Course Objectives:

To formalise the study of numbers and functions and to investigate important concepts such as limits and continuity. These concepts underpin calculus and its applications.

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Get clear idea about the real numbers and real valued functions.
CO2	Obtain the skills of analyzing the concepts and applying appropriate methods for testing convergence of a sequence/ series.
CO3	Test the continuity and differentiability and Riemann integration of a function.
CO4	Know the geometrical interpretation of mean value theorems.

Course with focus on employability/entrepreneurship /Skill Development modules

Skill Development			Employability			Entrepreneurship	

UNIT I (12 Hours)

Introduction of Real Numbers (No question is to be set from this portion)

Real Sequences: Sequences and their limits, Range and Boundedness of Sequences, Limit of a sequence and Convergent sequence. The Cauchy's criterion, properly divergent sequences, Monotone sequences, Necessary and Sufficient condition for Convergence of Monotone Sequence, Limit Point of Sequence, Subsequences , Cauchy Sequences – Cauchy's general principle of convergence theorem.

UNIT II: (12 Hours)

INFINITIE SERIES :

Series : Introduction to series, convergence of series. Cauchy's general principle of convergence forseries tests for convergence of series, Series of Non-Negative Terms.

1. P-test
2. Cauchy's n^{th} root test or Root Test.
3. D'-Alemberts' Test or Ratio Test.

UNIT III: (12 Hours)

CONTINUITY:

Limits: Real valued Functions, Boundedness of a function, Limits of functions. Some extensions of the limitconcept, Infinite Limits. Limits at infinity. (No question is to be set from this portion).

Continuous functions: Continuous functions, Combinations of continuous functions, Continuous Functionson interval, Uniform Continuity.

UNIT IV: (12 Hours)

DIFFERENTIATION AND MEAN VALUE THEOREMS: The derivability of a function, on an interval, at a point, Derivability and continuity of a function, Graphical meaning of the Derivative, Mean value Theorems; Rolle's Theorem, Lagrange's Theorem, Cauchy's Mean value Theorem.

UNIT V: (12 Hours)

RIEMANN INTEGRATION : Riemann Integral, Riemann integral functions, Darboux theorem. Necessary and sufficient condition for R – integrability, Properties of integrable functions, Fundamental theorem of integral calculus, First mean value Theorem.

Co-Curricular Activities **(15 Hours)**

Seminar/ Quiz/ Assignments/ Real Analysis and its applications / Problem Solving.

TEXT BOOK:

1. Introduction to Real Analysis by Robert G.Bartle and Donlad R. Sherbert, published by JohnWiley.

REFERENCE BOOKS:

1. A Text Book of B.Sc Mathematics by B.V.S.S. Sarma and others, published by S. Chand &Company Pvt. Ltd., New Delhi.
2. Elements of Real Analysis as per UGC Syllabus by Shanthi Narayan and Dr. M.D. Raisinghania,published by S. Chand & Company Pvt. Ltd., New Delhi

Additional Inputs :

Taylor's Theorem , McLaren theorem .

CO-POMapping:

(1:Slight[Low]; 2:Moderate[Medium]; 3:Substantial[High], '-':NoCorrelation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	1	2	2	3	2	3	2
CO2	3	2	3	3	2	3	3	1	3	2	3	2	1
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3
CO4	3	2	3	2	2	1	3	3	2	1	3	1	2

BLUE PRINT FOR QUESTION PAPER PATTERN
SEMESTER-IV

Unit	TOPIC	S.A.Q	E.Q	Marks allotted to the Unit
I	Real Sequences	1	1	15
II	Infinite Series	2	2	30
III	Continuity	2	1	20
IV	Differentiation And Mean value theorems	1	1	15
V	Riemann Integrations	1	1	15
Total		7	6	95

S.A.Q. = Short answer questions (5 marks)

E.Q = Essay questions (10 marks)

Short answer questions : 4 X 5 = 20 M

Essay questions : 3 X 10 = 30 M

……………….

Total Marks = 50 M

………………..

P.R. Government College (Autonomous), Kakinada
II year B.Sc., Degree Examinations - III Semester
Mathematics Course: REAL ANALYSIS
Paper IV (Model Paper w.e.f. 2023-24)

…………………………………………………………………………………………………….

Time: 2Hrs **Max. Marks: 50**

SECTION-A

Answer any three questions selecting atleast one question from each part

Part – A **3 X 10 = 30**

1. Show that a monotonic sequence is convergent iff it is bounded.
2. State and prove Cauchy's n^{th} root test.
3. State and prove Leibnitz test.

Part – B

4. State and Prove Intermediate value theorem.
5. State and Prove Role's theorem.
6. State and prove fundamental theorem of Integral Calculus.

SECTION-B

Answer any four questions **4 X 5 M = 20 M**

1. Prove that every convergent sequence is a Cauchy sequence
2. If $\sum u_n$ convergences absolutely then prove that $\sum u_n$ converges.
3. Test for the convergence of $\sum_{n=1}^{\infty} \frac{1.3.5\ldots(2n-1)}{2.4.6\ldots 2n} x^{n-1}\ (x > 0)$
4. Examine for continuity the function f defined by $f(x) = |x| + |x-1|$at 0 and 1
5. Show that $f: R \to R$ defined by f(x) = 1 if x ∈ Q ; f(x) = -1 if x∈ $R - Q$ is discontinuous for all x∈ R .
6. Show that $f(x) = x\, sin(1/x), x \neq 0; f(x) = 0, x = 0$ is continuous but not derivable at $x = 0$.
7. By considering the integral $\int_0^1 \frac{1}{1+x} dx$ show that $log2 = \lim_{n\to\infty} [\frac{1}{n+1} + \frac{1}{n+2} + \cdots + \frac{1}{2n}]$

<table>
<tr><td rowspan="1"></td><td>P.R.Government College (Autonomous)
KAKINADA</td><td colspan="4" rowspan="2">Program&Semester
II B.Sc. (IV Sem)</td></tr>
<tr><td>CourseCode
MAT-401P</td><td>TITLEOFTHECOURSE
Real Analysis</td></tr>
<tr><td>Teaching</td><td>HoursAllocated:30(Practicals)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisites:</td><td>Basic Mathematics Knowledge on number system.</td><td>-</td><td>-</td><td>2</td><td>1</td></tr>
</table>

UNIT I **(12 Hours)**

Introduction of Real Numbers (No question is to be set from this portion)

Real Sequences: Sequences and their limits, Range and Boundedness of Sequences, Limit of a sequence and Convergent sequence. The Cauchy's criterion, properly divergent sequences, Monotone sequences, Necessary and Sufficient condition for Convergence of Monotone Sequence, Limit Point of Sequence, Subsequences , Cauchy Sequences – Cauchy's general principle of convergence theorem.

UNIT II: (12 Hours)

INFINITIE SERIES :

Series : Introduction to series, convergence of series. Cauchy's general principle of convergence forseries tests for convergence of series, Series of Non-Negative Terms.

4. P-test
5. Cauchy's n^{th} root test or Root Test.
6. D'-Alemberts' Test or Ratio Test.

UNIT III: (12 Hours)

CONTINUITY:

Limits: Real valued Functions, Boundedness of a function, Limits of functions. Some extensions of the limitconcept, Infinite Limits. Limits at infinity. (No question is to be set from this portion).

Continuous functions: Continuous functions, Combinations of continuous functions, Continuous Functionson interval, Uniform Continuity.

UNIT IV: **(12 Hours)**

DIFFERENTIATION AND MEAN VALUE THEOREMS: The derivability of a function, on an interval, at a point, Derivability and continuity of a function, Graphical meaning of the Derivative, Mean value Theorems; Rolle's Theorem, Lagrange's Theorem, Cauchy's Mean value Theorem.

UNIT V: **(12 Hours)**

RIEMANN INTEGRATION : Riemann Integral, Riemann integral functions, Darboux theorem. Necessary and sufficient condition for R – integrability, Properties of integrable functions, Fundamental theorem of integral calculus, First mean value Theorem.

TEXT BOOK:

1. Introduction to Real Analysis by Robert G.Bartle and Donlad R. Sherbert, published by JohnWiley.

REFERENCE BOOKS:

3. A Text Book of B.Sc Mathematics by B.V.S.S. Sarma and others, published by S. Chand &Company Pvt. Ltd., New Delhi.
4. Elements of Real Analysis as per UGC Syllabus by Shanthi Narayan and Dr. M.D. Raisinghania,published by S. Chand & Company Pvt. Ltd., New Delhi

Semester – IV End Practical Examinations

Scheme of Valuation for Practical's

Time : 2 Hours **Max.Marks : 50**

- **Record - 10 Marks**
- **Viva voce - 10 Marks**
- **Test - 30 Marks**
- **Answer any 5questions. At least 2 questions from each section. Each question carries 6 marks.**

BLUE PRINT FOR PRACTICAL PAPER PATTERN

COURSE-IV, REAL ANALYSIS

Unit	TOPIC	E.Q	Marks allotted to the Unit
I	Real Sequences	1	06
II	Infinite Series	2	12
III	Continuity	1	06
IV	Differentiation And Mean value theorems	2	12
V	Riemann Integrations	2	12
	Total	08	48

P.R. GOVT. COLLEGE (AUTONOMOUS), KAKINADA
IIyear B.Sc., Degree Examinations - IV Semester
Mathematics Course-IV: REAL ANALYSIS
(w.e.f. 2022-23 Admitted Batch)
Practical Model Paper (w.e.f. 2023-2024)

....

Time: 2Hrs **Max. Marks: 50M**

Answer any 5questions. At least 2 questions from each section. **5 x 6 = 30 Marks**

SECTION – A

1. Prove that the sequence $\{s_n\}$ defined by $s_n = 1 + \frac{1}{1!} + \frac{1}{2!} + \cdots + \frac{1}{n!}$ is convergent.
2. Examine the convergence of $\sum_{n=1}^{\infty}\left(\sqrt{n^3+1} - \sqrt{n^3}\right)$.
3. Test for convergence of $\sum_{n=1}^{\infty}(-1)^n \frac{1}{n}(1 + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n})$.
4. If $f: [a, b] \to R$ is continuous on $[a, b]$, then f is bounded on $[a, b]$ and attains its bounds or infimum and supremum

SECTION – B

7. Find c of Cauchy's mean value theorem for $f(x) = \sqrt{x}, g(x) = \frac{1}{\sqrt{x}}$ in [a, b] where $0 < a < b$.

5. Show that $\frac{v-u}{1+v^2} < tan^{-1}v - tan^{-1}u < \frac{v-u}{1+u^2}\ for\ 0 < u < v$. Hence deduce that $\frac{\pi}{4} + \frac{3}{25} < tan^{-1}\frac{4}{3} < \frac{\pi}{4} + \frac{1}{6}$
6. If $f(x) = x^2\ \forall\ x \in [0,1]$ and P= {0,1/4 , 2/4, 3/4, 1}, then find $U(P,f)$ and $L(P,f)$.
7. Prove that $\frac{\pi^3}{24} \le \int_0^{\pi} \frac{x^2}{5+3\,cosx}\,dx \le \frac{\pi^3}{6}$.

- **Record - 10 Marks**
- **Viva voce - 10 Marks**