NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
DEPARTMENT OF MATHEMATICS

COURSE PLAN – PART I			
Name of the programme and specialization	M. Sc. / Mathematics		
Course Title	REAL ANALYSIS		
Course Code	MA701	No. of Credits	3(L) + 0(T) = 3
Course Code of Pre-requisite subject(s)	Nil		
Session	July 2022	Section (if, applicable)	
Name of Faculty	Dr. Vamsinadh Thota	Department	Mathematics
Email	vamsinadh@nitt.edu	Telephone No.	+91 – 8173980996
Name of Course Coordinator(s) (if, applicable)			
E-mail		Telephone No.	
Course Type	✓ Core course	☐ Elective course	

Syllabus (approved in BoS-2019)

MA701 – REAL ANALYSIS

Infimum, supremum, and limit point of a subset of real numbers. liminf, limsup and limit of a sequence of real numbers. Nature of series of real numbers. Limit, continuity, differentiation, and Riemann integration of real valued functions. Riemann-Stieltjes Integral, existence of the integral. Condition for integrability, properties, integral as a limit of a sum, first mean value theorem, Second mean value theorem. The Riesz representation theorem.

Sequences and series of real valued functions, pointwise convergence, uniform convergence, Cauchy's criterion, and test for uniform convergence of sequence of functions. Tests for uniform convergence of series of functions (Weierstrass's M-test, Abel's test, Dirichlet's test). Uniform convergence versus continuity (Dini's theorem), integration and differentiation. The Weierstrass approximation theorem.

Metric spaces, basic concepts, Cauchy's sequence, and convergence of a sequence in metric spaces. Complete metric spaces. Connectedness, intermediate value theorem. Separable metric spaces. Compactness, Heine-Borel theorem. Continuous and uniformly continuous functions from one metric space to other. The Banach Contraction Principle. Continuous functions on a metric space. Homeomorphisms, Equivalent metrics. Completion of a metric space. Equi-continuous family of functions. The Arzela-Ascoli theorem, The Baire Category Theorem.

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc

Reference Books:

1. N. L. Carothers, Real Analysis, Cambridge University Press, 2000
2. H. L. Royden, P. M. Fitzpatrick, Real Analysis, 4th ed., Pearson education, 2011
3. W, Rudin, Principles of Mathematical Analysis, Mc-Graw Hill, 1976
4. G. F. Simmons, Introduction to and Modern Analysis, Kreiger Publishing Co., 1983

COURSE OBJECTIVES

The course objective is to

1. discuss about the basic calculus properties of subsets of real line and real functions
2. introduce Riemann-Stieltjes integral and study about its properties
3. find the convergence properties of sequences and series of functions
4. study about the subsets, sequences of a metric space
5. examine the sontinuity properties of functions defined on a metric space.

COURSE OUTCOMES (CO)

Course Outcomes	**Aligned Programme Outcomes (PO)**
On completing this course student will be able to 1. find liminf, limsup and discuss continuity and differentiability of functions 2. define Riemann- Stieltjes integral, evaluate them for various functions and understand their properties. 3. check the pointwise convergence and uniform convergence of sequences and series of functions. 4. understand the various properties of subsets of metric spaces 5. examine the continuity properties of functions defined on metric spaces.	a, b, c, d, e, f

COURSE PLAN – PART II

COURSE OVERVIEW

This course will

1. introduce the Riemann-Stieltjes integral and a detailed study about its properties
2. discuss about the types of convergence of sequences and series of functions
3. introduce various tests to check the convergence of series of functions
4. explore the basic properties of subsets of metric spaces
5. discuss about the continuity properties of functions defined on metric spaces.

COURSE TEACHING AND LEARNING ACTIVITIES			
S. No.	**Week/ Contact Hours**	**Topic**	**Mode of Delivery**
1.	1st week to 3rd week	Infimum, supremum, and limit point of a subset of real numbers. liminf, limsup and limit of a sequence of real numbers. Nature of series of real numbers. Metric spaces, basic concepts, Cauchy's sequence, and convergence of a sequence in metric spaces. Complete metric spaces. Connectedness, intermediate value theorem. Separable metric spaces. Compactness, Heine-Borel theorem.	Chalk and Talk
2.	4th week and 6th week	Continuous and uniformly continuous functions from one metric space to other. The Banach Contraction Principle. Continuous functions on a metric space. Homeomorphisms, Equivalent metrics. Completion of a metric space. Equi-continuous family of functions. The Arzela-Ascoli theorem, The Baire Category Theorem.	
3.	5th week	**Assessment - I**	
4.	7th week to 9th week	Sequences and series of real valued functions, pointwise convergence, uniform convergence, Cauchy's criterion, and test for uniform convergence of sequence of functions. Tests for uniform convergence of series of functions (Weierstrass's M-test, Abel's test, Dirichlet's test). Uniform convergence versus continuity (Dini's theorem), integration and differentiation. The Weierstrass approximation theorem.	
5.	10th week	**Assessment - II**	
6.	10th week to 14th week	Limit, continuity, differentiation, and Riemann integration of real valued functions. Riemann-Stieltjes Integral, existence of the integral. Condition for integrability, properties, integral as a limit of a sum, first mean value theorem, Second mean value theorem. The Riesz representation theorem.	
7.	13th week	**Compensation Assessment**	
8.	15th week	**Final Assessment**	

COURSE ASSESSMENT METHODS				
S. No.	**Mode of Assessment**	**Week/Date**	**Duration**	**% Weightage**
1.	Assessment – 1 (Quiz/Written test)	5th week	90 Minutes	20 %
2.	Assessment – 2 (Quiz/Written test)	10th week	90 Minutes	20 %
CPA	Compensation Assessment (Quiz/Written test)	13th week	90 Minutes	20 %
3.	Assessment – 3 (Quiz/Assignments)		Will be announced during the course	20 %
4.	Assessment – 4 (Final Assessment)	15th week	3 hours	40 %

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

1. Feedback form issued to students to express their comments about the course before Assessment 1 & after completing the syllabus. Students are requested to give genuine feedback about the course.
2. Student knowledge about the topic covered in this course will be judged through marks obtained in examination.

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

1. Examination:
   a) Students who have missed either assessment 1 or assessment 2 or both can register for compensation assessment which shall be conducted soon after the completion of the assessment 2 and before the regular semester examination. Other students were strictly NOT allowed to register for compensation assessment.
   b) The compensation assessment shall be conducted for 20 % marks comprising the syllabus of both assessment -1 & assessment - 2.
   c) Students should submit the assignments (if any) before the last date of submission. In case, any student fails to submit their assignments within last date of submission, he/she will get zero mark for that assignment.
2. The Institute follows relative grading with flexibility given to teachers to decide the mark ranges for grades.
3. If a student fails to appear semester examination due to genuine/medical reason, can register for special end semester examination after approval from course instructor & head of department of mathematics. The special end semester examination will be conducted within ten days from reopening of institute for next semester. Students should register their names with course teacher to appear for special end semester examination within three days from reopening of institute for next semester. Grade issued as per the guidelines followed for his/her batch students.
4. There will be one reassessment for the students who have secured "F" in this course and will be conducted within ten days from reopening of institute for next semester. Students should register their names with course instructor to appear for reassessment within three days from reopening of institute for next semester. If students satisfy, the criteria fixed by the faculty to promote E grade will be given E grade and others given 'F' grade.

ATTENDANCE POLICY (A uniform attendance policy as specified below shall be followed)

- **At least 75% attendance in each course is mandatory.**
- **A maximum of 10% shall be allowed under On Duty (OD) category.**
- Students with **less than 65% of attendance** shall be prevented from writing the final assessment and **shall be awarded 'V' grade.**

ACADEMIC DISHONESTY & PLAGIARISM

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION

Students can contact the course faculty (virtually) for discussion after the class hours by fixing appointment through e-mail (vamsinadh@nitt.edu) during the office hours (8.30 am to 5.30 pm).

FOR APPROVAL

25/08/22
Dr. Vamsinadh Thota
Course Faculty

25/8/2022
Prof. P. Saikrishnan
PAC-Chairperson

25/08/2022
Dr. V Lakshmana Gomathi Nayagam
Head of the Department