

QF01/0408-4.0E	Course Plan for Bachelor program - Study Plan Development and Updating Procedures/ Mathematics Department
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Study plan No.	2021/2022	University Specialization	Bachelor of Mathematics
Course No.	0101251	Course name	Real Analysis (1)
Credit Hours	3	Prerequisite/ Co-requisite	Calculus (1)+ Foundations of Mathematics
Course type	<input type="checkbox"/> MANDATORY UNIVERSITY REQUIREMENT	<input type="checkbox"/> UNIVERSITY ELECTIVE REQUIREMENTS	<input type="checkbox"/> FACULTY MANDATORY REQUIREMENT
			<input type="checkbox"/> Support course family requirements
			Mandatory requirements
			<input checked="" type="checkbox"/> Elective requirements
Teaching style	<input type="checkbox"/> Full online learning	<input checked="" type="checkbox"/> Blended learning	<input type="checkbox"/> Traditional learning
Teaching model	<input type="checkbox"/> 1 Synchronous: 1 asynchronous	<input checked="" type="checkbox"/> 1 face to face : 1 asynchronous	<input type="checkbox"/> 2 Traditional

Faculty member and study divisions' information (to be filled in each semester by the subject instructor)

Name	Academic rank	Office No.	Phone No.	E-mail	
Division number	Time	Place	Number of students	Teaching style	Approved model

Brief description

Properties of real numbers, Inequalities, Completeness property of R, Suprema and infima, Sequences of real numbers, Subsequences, Continuous functions, Uniform continuity, Lipchitz functions, Open and closed sets, Compact sets, Heine-Borel theorem.

Learning resources

Course book information (Title, author, date of issue, publisher ... etc)	1- Introduction to Real Analysis". By: R. Bartle and D. Sherbert. John Wiley & Sons, Third Edition (2000). 2- "Mathematical Analysis". By: T. Apostol Addison-Wesley Publishing Company, Second Edition (1974).				
Supportive learning resources (Books, databases, periodicals, software, applications, others)	1- Introduction to Mathematical Analysis". By: S. Douglass Pearson, 3 rd Edition (1996). 2- "The Elements of Real Analysis". By: R. Bartle John Wiley & Sons, 2 nd Edition (1975). 3- "Principals of Mathematical Analysis. By: W. Rudin McGraw Hill, 3 rd Edition (1976				
Supporting websites	http://www.freebookcentre.net/Mathematics/Real-Analysis-Books.html www.jirka.org/ra/realanal.pdf				
The physical environment for teaching	<input checked="" type="checkbox"/> Class room	<input type="checkbox"/> labs	<input checked="" type="checkbox"/> Virtual educational platform	<input type="checkbox"/> Others	
Necessary equipment and software					

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Supporting people with special needs	
For technical support	

Course learning outcomes (S = Skills, C = Competences K = Knowledge,)

No.	Course learning outcomes	The associated program learning output code
Knowledge		
K1	List the basic properties of real numbers	MK1
K2	Recognize the basic topological properties of the real numbers	MK2
K3	Describe the properties of the continuous function	MK3
K4	Define convergence and limit of sequences	MK4
K5	Explain the fundamental theorems of real analysis	MK5
Skills		
S1	Compute all types of indeterminate forms of limits by using the Hopital's rule	MS1
S2	Characterize the convergence of the sequences	MS2
S3	Find the Taylor's series for a given expansion.	MS3
S4	Analyze functions of one variable.	MS4
Competences		
C1	Using complex analysis to solve various problems in all branches of mathematics.	MC1

Mechanisms for direct evaluation of learning outcomes

Type of assessment / learning style	Fully electronic learning	Blended learning	Traditional Learning (Theory Learning)	Traditional Learning (Practical Learning)
Midterm exam	30%	30%	40%	30%
Participation / practical applications	0	0	10%	30%
Asynchronous interactive activities	30%	20%	0	0
Final exam	40%	50%	50%	40%

Schedule of simultaneous / face-to-face encounters and their topics

Week	Subject	learning style	Reference
1	The Algebraic and the Order Properties of \mathbf{R} ; Some Inequalities.	Lecture	22-30 Ref 1
2	Absolute Value and the Real Line; The Completeness Property of \mathbf{R} ; Suprema and Infima.	Lecture	31-38 Ref 1
3	Applications of the Supremum Property; The Archimedean Property.	Lecture	38-41 Ref 1
4	The Existence of \sqrt{p} ; Density of \mathbf{Q} in \mathbf{R} ; Sequences of Real Numbers.	Lecture	41-44 Ref 1

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5	Some topology of \mathbf{R} : Neighborhoods; Closed Sets and Open Sets; Cluster Points; Compact Sets.	Lecture	52-54 Ref 1
6	The Limit of a Sequence: The $\varepsilon - K$ Definition; Examples; Main Theorems.	Lecture	54-60 Ref 1
7	More Limit Theorems; Squeeze Theorem for Sequences.	Lecture	60-65 Ref 1
8	The Ratio Test for Convergence; Monotone Sequences; Monotone Convergence Theorem; Euler's Number as a Limit of a Sequence. Midterm	Lecture	66-74 Ref 1
9	Subsequences; Divergence Criteria; Monotone Subsequence Theorem; Bolzano-Weierstrass Theorem.	Lecture	75-80 Ref 1
10	The Cauchy Criterion; Limits of Functions: Definition of the Limit of a Function; Theorems.	Lecture	80-86 Ref 1 96-101 Ref 1
11	Sequential Criteria for Limits; Divergence Criteria; Theorems on Limits; Computing Limits.	Lecture	101-111 Ref 1
12	Squeeze Theorem for functions; Some Extensions of the Limit Concept; Infinite Limits.	Lecture	111-118 Ref 1
13	Continuous Functions; Combinations of Continuous Functions.	Lecture	119-129 Ref 1
14	Continuous Functions on Intervals; Location of Roots Theorem; Bolzano's Theorem; Uniform Continuity.	Lecture	129-138 Ref 1
15	More on the topology of \mathbf{R} ; the closure and the interior of a set.	Lecture	312-316 Ref 1
16	Final Exam		

Schedule of asynchronous interactive activities (in the case of e-learning and blended learning)

Week	Task / activity	Reference	Expected results
1	Background The Algebraic and the Order Properties of the field	Ref1	Self-reading and Discussion
2	Video 1 Solving exercises	E-learning	Discussion in the class
3	Home work1: On the subjects studied on the first three weeks	(Lecture notes and Ref.1)	Submit a pdf or word sheet
4	Quiz 1	On the subjects studied on the first three weeks	Submitting on the E-learning
5	Assignment 1	Internet sources and the other Supportive learning resources	Presentation
6	Video 2	Solving exercises	Discussion in the class
7	Homework 2 On the subjects studied in the weeks 4,5 and 6	(Lecture notes and Ref.1)	Submit a pdf or word sheet
8	Assignment 2: On Bertrand curves	Internet sources and the other Supportive learning resources	Submitted with the mid exam
9	Self-reading	Divergence Criteria. (Ref.2)	Talk
10	Video3 Solving exercises	E-learning	Discussion in the class
11	Homework 3: On the subjects studied after the midexam	(Lecture notes and Ref.1)	Submit a pdf or word sheet

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12	Self-reading	Extensions of the Limit Concept (Ref.2)	Talk
13	Quiz 2	On the subjects studied on the subject studied after midexam	Submitting on the E- learning
14	Presentation of the subject: The second fundamental form.	Internet sources and the reference book	Video
15	Video 4 Revision of all the course	E-learning	
16	Final Exam		