

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.	0101272		Course name		Numerical Analysis (1)	
Credit Hours	3		Prerequisite/ Co-requisite		Linear Algebra (1)+ Calculus (1)	
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	<input checked="" type="checkbox"/> Mandatory requirements	<input 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

Introduction to representation of numbers, Errors and their sources, Numerical solution of nonlinear equations with one variable (the bisection, the fixed- point, Newton-Raphson and the secant methods), Multiplicity, the modified Newton's method, Synthetic division, Approximating functions by Taylor polynomials, Interpolation (Lagrange's formula and Newton's finite divided differences formula), Numerical methods to solve systems of linear equation: direct methods (Cramer's Method, inverse method, Gauss elimination method) and iterative methods (Jacobi method and Gauss-Seidel method).

Learning resources

Course book information (Title, author, date of issue, publisher ... etc)	"Numerical Analysis", by R. Burden & D. Fairs , 7 th Ed.				
Supportive learning resources (Books, databases, periodicals, software, applications, others)	1-"Applied Numerical Analysis", by Gerald & Wheatley , 7th Ed., (2004), Addison-Wesley Publishing Company. 2-"Numerical Methods: Using Matlab", by John H. Mathews and Kurtis D. Fink, 4 th Ed., (2004) , Prentice-Hall Pub. Inc. 3-"Numerical Methods and Computing", by Cheney & KinCaid , 6 th Ed., (2008), Thomson Learning Academic Resource Center. 4-"Numerical Methodsfor Engineers", by S. K. Gupta, 3 rd Ed., (2013), New Academic Science Ltd, United Kingdom.				
Supporting websites	1- http://ins.sjtu.edu.cn/people/mtang/textbook.pdf 2- http://www.mathworks.com/products/matlab 3- https://www.wolfram.com/mathematica				
The physical	<input checked="" type="checkbox"/> Class room	<input type="checkbox"/> labs	<input checked="" type="checkbox"/> Virtual educational	<input type="checkbox"/> Others	

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environment for teaching			platform	
Necessary equipment and software				
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	Use the various methods to approximate roots of functions.	MK1
K2	Use the polynomials used to approximate functions.	MK2
K3	Define some numerical methods to solve the nonlinear system	MK1
K4	Describe factorization of matrices for solving linear system.	MK2
K5	Recognize the error analysis for iterative methods	MK1
Skills		
S1	Compute approximation errors for numerical approximations.	MS1
S2	Apply basic numerical methods and techniques for solving nonlinear equations.	MS2
S3	Operate computational algorithms for solving mathematical problems.	MS1
Competences		
C1	Work independently to solve assignments in the course.	MC1
C2	Develop the individual's ability to communicate and interact with other mathematical courses	MC 1

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	I. Mathematical Preliminaries Continuity, differentiation, Rules of differentiation. Rolle's Theorem. Mean value theorem. Extreme value theorem. Intermediate value theorem. Bolzano theorem.	Lecture	2-10
2	Applications of the I.V.T. and Rolle's Theorem to prove the existence and uniqueness of a root of a function.	Lecture	11-18
3	II. Solutions of Equations in One Variable	Lecture	48 - 55

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	The bisection method. Analysis of the bisection method, error analysis. Applications of the bisection method.		
4	The Fixed-Point method: definition, theorem of existence, theorem of uniqueness. Analysis of the Fixed-point method.	Lecture	55 – 66
5	The Newton-Raphson Method, derivation and applications.	Lecture	66 – 78
6	The Secant method, derivation and applications. Zeros of Polynomials and multiplicity. Applications.	Lecture	78 – 86
7	The Modified Newton method. Horner's Method (synthetic division).	Lecture	86 – 91
8	III. Interpolation and Polynomial Approximation Taylor Polynomial; applications. Midterm Exam	Lecture	107 – 122
9	Interpolation and Lagrange's Polynomial.	Lecture	107 – 122
10	Iterated Interpolation; Newton's Divided Differences form. Analysis and applications. Midterm	Lecture	122 – 133
11	IV. Direct Methods for Solving Linear Systems Review of systems and matrices.	Lecture	345 – 359
12	Gaussian Elimination and Backward Substitution, applications. Matrix inversion.	Lecture	370 – 388
13	V. Iterative Techniques in Matrix Algebra Norms of Vectors and Matrices.	Lecture	418 – 430
14	Iterative Techniques for Solving Linear Systems. Derivation, analysis, and applications. Jacobi method.	Lecture	437 - 454
15	Gauss-Seidel method, applications.	Lecture	437 – 454
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	On derivatives and introduction of linear algebra. Students Notes or any Calculus book	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)	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: On applications of the I.V.T. and Rolle's Theorem.	Internet sources and the other Supportive learning resources	Presentation
6	Video 2	Solving exercises	Discussion in the class
7	Home work 2 On the subjects studied in the weeks 4,5 and 6	(Lecture notes)	Submit a pdf or word sheet
8	Assignment 2: On the Fixed-Point method Newton-Raphson method	Internet sources and the other Supportive learning resources	Submitted with the mid exam
9	Self-reading	Interpolation and Lagrange's Polynomial	Talk

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10	Video3 Solving exercises	E-learning	Discussion in the class
11	Home work 3: On the subjects studied after the midterm	(Lecture notes)	Submit a pdf or word sheet
12	Self-reading	Gaussian Elimination and Backward Substitution, applications. Matrix inversion.	Talk
13	Quiz 2	On the subjects studied on the subject studied after midterm	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		