QF01/0408-4.0E	Course Plan for Master program - Study Plan Development and Updating Procedures/ Mathematics Department

Study plan No.	2021/2022		**University Specialization**		**Master of Mathematics**	
Course No.	0101744		**Course name**		**Advanced Numerical Analysis**	
Credit Hours	3		**Prerequisite/ Co-requisite**			
Course type	☐ MANDATORY UNIVERSITY REQUIREMENT	☐ UNIVERSITY ELECTIVE REQUIREMENTS	☐ FACULTY MANDATORY REQUIREMENT	☐ Support course family requirements	✓ **Mandatory requirements**	Elective requirements
Teaching style	☐ Full online learning		Blended learning		✓ **Traditional learning**	
Teaching model	☐ 1 Synchronous: 1 asynchronous		1 face to face : 1 asynchronous		✓ **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	
D. Tareq Hamadneh	Assistant professor	314	418	t.hamadneh@zuj.edu.jo	
Division number	**Time**	**Place**	**Number of students**	**Teaching style**	**Approved model**
1				Traditional	

Brief description

The advanced numerical analysis course is designed for introducing the master students to advanced numerical methods and strategies of solving different mathematical problems. Additionally, to teach the students about the applications of numerical analysis and do research about applied mathematics. These methods include polynomials, Des, optimization, solving PDE and systems.

Learning resources

Course book information (Title, author, date of issue, publisher ... etc)	1. Burden and Faires, " Numerical Analysis ", 7th ed., Brooks/Cole, 2001 and Class notes.			
Supportive learning resources (Books, databases, periodicals, software, applications, others)	2. "W. Cheney and D. Kincaid, " *Numerical Mathematics and Computing* ", 4th ed., Brook/Cole, 1999. 3. Dahlquist, Bjorck, and Anderson, " Numerical Methods", Prentice Hall. 4. Gregory and Redmond, " Introduction to Numerical Analysis", 1994. 5. K. Atkinson, " Elementary Numerical Analysis", 2nd ed., Wiley, 1993.			
Supporting websites	https://www.routledge.com/Advanced-Numerical-Methods-for-Differential-Equations-Applications-in-Science/Singh-Singh-Purohit-Kumar/p/book/9780367473112			
The physical environment for teaching	✓ **Class room**	☐ labs	☐ Virtual educational platform	☐ Others
Necessary equipment	Data Show			

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	Produce how to present most of the available numerical methods for solving problems with concentration on a sufficient number of methods to handle the problems likely to be encountered in practice.	**MK 1**
K2	Illustrate how to use advanced numerical for interpolating curves, Lagrange and Newton methods.	**MK 2**
K3	Practice numerical optimization for bounding the solution of mathematical problems.	**MK 3**
	Skills	
S1	Develop skills in programming by carrying out a variety of programming exercises.	**MS3**
S2	Transfer skills of expansion and analyzing problems	**MS4**
	Competences	
C1	Reaching the use of applied mathematics for solving real live problems	**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%	**30%**	0	0
Final exam	40%	**40%**	50%	40%

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

Week	Subject	learning style	Reference
1	Interpolation Theory: Polynomial Interpolation Theory; Newton Divided Differences	Lecture	Ref 1 (10-30)
2	Finite Differences and Table-Oriented Interpolation Formulas;	Lecture	Ref 1 (31-50)
3	Errors in Data and Forward Differences; Hermite Interpolation	Lecture	Ref 1 (51-70)
4	Approximation Theory: Review of dicrete Least	Lecture	Ref 1 (71-95)

	Squares Approximation		
5	Orthogonal Polynomials and Least Squares, Chebyshev, Polynomials	Lecture	Ref 1 (96-110)
6	Rational Functions, and Trigonometric Polynomial Approximations	Lecture	Ref 1 (111-130)
7	Numerical Integration: Newton's Cotes Formulas; Romberg Integration	Lecture	Ref 1 (131-147)
8	Adaptive Quadrature Methods; Multiple Integrals; Multiple Integrals; Improper Integrals	Lecture	Ref 1 (148-170)
9	Numerical Methods for ODE's: (IVP) :Taylor Series Methods	Lecture	Ref 1 (171-195)
10	**Midterm Exam**: Overview	Lecture	Ref 1 (230 -265)
11	Runge-Kutta Methods; Stability and Adaptive Runge-Kutta Methods; Multi-Steps Methods.	Lecture	Ref 1 (266-295)
12	Boundary-Value Problems: The Shooting Method; Finite-Difference Methods.	Lecture	Ref 1 (300-220)
13	The Matrix Eigenvalue Problem: Linear Algebra and Eigenvalues	Lecture	Ref 1 (321-340)
14	Gerschgorin Theorem; The Power Method; the QR Algorithm.	Lecture	Ref 1 (341-350)
15	Numerical Solutions to PDE's: Elliptic PDE	Lecture	Ref 1 (351-370)
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	Ref 1	Self-reading and Discussion
2	Video 1 Solving exercises	Ref 1	Discussion in the class
3	Home work1: On the advanced numerical	Ref 1	Submit a pdf or word sheet
4	Quiz 1	Ref 1	Submitting on the E-learning
5	Assignment 1: On polynomials	Ref 1	Talk
6	Video 2	Ref 1	Discussion in the class
7	Home work 2 On the subjects studied in weeks 4,5 and 6	Ref 1+Ref 2	Submit a pdf or word sheet
8	Assignment 2: On numerical integration	Ref 1+Ref 2	Submitted in week 9
9	Self-reading	Ref 2+Ref 3	Talk
10	Video3 Solving exercises	Ref 2+Ref 3	Discussion in the class
11	Home work 3: On the subjects studied after the Mid-Exam	Ref 2+Ref 3	Submit a pdf or word sheet
12	Self-reading	Ref 2+Ref 3	Talk
13	Quiz 2	Ref 2+Ref 3	Submitting on the E-learning
14	Presentation of the subject: Boundary	Ref 4 + Ref 5	Video presentation

	problems and matrices		
15	Video 4 Revision of all the course	Ref 1-5	Self-reading and Discussion
16	**Final Exam**	-	-