Course Description Form

1. Course Name:
Numerical solutions of ODEs
2. Course Code:
MATH504
3. Semester / Year:
Second / 2023-2024
4. Description Preparation Date:
23-3-2024
5. Available Attendance Forms:
Attendance lectures in the classroom
6. Number of Credit Hours (Total) / Number of Units (Total)
45 hours/3 units
7. Course administrator's name (mention all, if more than one name)
Name: Asst. Prof. Dr. Fadhel Subhi Fadhel   Email: fadhel.subhi@nahrainuniv.edu.iq

8. Course Objectives

Course Objectives	• Study the numerical solutions of ordinary differential equations using multi-step methods (including the theoretical aspect as well) • Using Range-Kutta methods to find the numerical formulae to solve this type of equations. • Study the numerical stability, convergence and consistency of the methods that were derived previously (in the two methods above) • Apply these methods to find the numerical solutions of systems of differential equations. • Study the numerical solutions of boundary value problems • Studying approximation methods for solving ODEs

9. Teaching and Learning Strategies

Strategy	The teaching and learning strategy is considered a set of tools and practices carried out by both the teacher and the student in order to comprehend the academic material or course, which is the numerical solutions to ordinary differential equations in the best possible way. This depends on two basic factors: good transmission by the subject teacher, which is supported by teaching strategies, and good reception by the student, which is supported by learning strategies. Teaching strategies include a set of organized plans and methods followed by the subject teacher in order to guide students towards achieving learning goals, including cognitive goals for numerical analysis, skill goals for finding numerical solutions, including programming using computers, and emotional and value goals through sensory perception of the nature of

the problem and how to deal with it. This is done. Through specific teaching and learning methods in order for the student to acquire transferable general and qualifying skills.

10. Course Structure

Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method
1	4	Distinguish between different numerical effects	Numerical operators	Attendance interactive lectures	Ask questions and give assignments
2	4	Learn to solve finite difference equations analytically and numerically	Finite difference equations	Attendance interactive lectures	Ask questions and give assignments
3	4	Finding a solution to differential equations numerically	Solving Differential Equations Using Taylor Methods	Attendance interactive lectures	Ask questions and give assignments
4	4	Theoretical study and derive the method order	Euler's method	Attendance interactive lectures	Ask questions and give assignments
5	4	Theoretical study and derive the method order	Euler's method	Attendance interactive lectures	Ask questions, give assignments, and make a 1st attence mid exam
6	4	Study the methods of derivation to find the order of error and study the stability of the numerical method	Linear multistep methods	Attendance interactive lectures	Ask questions and give assignments
7	4	Study the methods of derivation to find the order of error and study the stability of the numerical method	Linear multistep methods	Attendance interactive lectures	Ask questions and give assignments
8	4	Study the methods of derivation to find the order of error and study the stability of the numerical method	Linear multistep methods	Attendance interactive lectures	Ask questions and give assignments
9	4	Study the methods of derivation to find the order of error and study the	Linear multistep methods	Attendance interactive lectures	Ask questions and give assignments

		stability of the numerical method			
10	4	Study the methods of derivation to find the order of error and study the stability of the numerical method	Runge-Kutta methods	Attendance interactive lectures	Ask questions and give assignments
11	4	Study the methods of derivation to find the order of error and study the stability of the numerical method	Runge-Kutta methods	Attendance interactive lectures	Ask questions and give assignments
12	4	Study the methods of derivation to find the order of error and study the stability of the numerical method	Runge-Kutta methods	Attendance interactive lectures	Ask questions, give assignments, and make a 2nd attendance mid exam
13	4	Using the shooting method	Boundary value problems	Attendance interactive lectures	Ask questions and give assignments
14	4	Using the finite difference method and the collocation method	Boundary value problems	Attendance interactive lectures	Ask questions and give assignments
15	4	Studying the approximation methods	Variational Iteration Method	Attendance interactive lectures	Ask questions and give assignments

11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports ... etc.

20% monthly written exams

10% daily and oral exams, homework's, and class activities

70% written final exam

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)	1. Lambert J. D., "Computational Methods in Ordinary Differential Equations", John Wiley and Sons, Ltd., 1973. 2. Burden R. L. and Faires J. D., "Numerical Analysis", 3rd Edition, PWS, 1985.
Main references (sources)	Butcher, J. C. (1987). The numerical analysis of ordinary differential equations: Runge-Kutta and general linear methods. Wiley-Interscience.
Recommended books and references (scientific journals, reports...)	Ph.D. and M.Sc. Theses of Al-Nahrain university

Electronic References, Websites	Online lectures recorded on YouTube by the lecturer.