

Course Description Form

1. Course Name: Integral Equations					
2. Course Code: MATH502					
3. Semester / Year: First / 2023-2024					
4. Description Preparation Date:					
5. Available Attendance Forms: Class Attendance					
6. Number of Credit Hours (Total) / Number of Units (Total): 45					
7. Course administrator's name (mention all, if more than one name)					
Name: Prof.Dr. Ali Hassan Nasser Al-Fayadh Email: ali.hassan@nahrainuniv.edu.iq					
8. Course Objectives					
Course Objectives		By the end of the course the students will learn the following main concepts:			
		<ul style="list-style-type: none"> • Some numerical methods for solving Volterra and Fredholm integral Equations, as well as the Integro-differential equations. • Techniques for solving Volterra integral equation of the first kind. • Treatment of Fredholm integral equation with Singular kernel. • An overview of Nonlinear Volterra and Fredholm integral equations, as well as the mixed type of these equations. 			
9. Teaching and Learning Strategies					
Strategy		<ul style="list-style-type: none"> • Lectures. • Tutorials. • Discussion. • Problem solving. • Home work. • Exam. 			
10. Course Structure					
Week	Hours	Required Learning Outcomes	Unit or subject name	Learning method	Evaluation method

1	3	<ul style="list-style-type: none"> • Have understanding regarding different types of integral equations. 	<p>Introduction: The basic concept of integral equations with respect to its formulas and kernels.</p>	Attendance interactive lectures	Ask questions and give assignments.
2	3	<ul style="list-style-type: none"> • Apply analytical methods and a range of theorems to treat problems involve integral equations. 	<p>Some analytic methods For solving integral equations: Review some different methods for solving Volterra and Fredholm integral equations of the second kind with continuous kernels, using some analytic methods.</p>	Attendance interactive lectures	Ask questions and give assignments.
3	3	<ul style="list-style-type: none"> • Apply numerical methods to treat problems involve integral equations. 	<p>Numerical methods: Some numerical methods for solving Volterra integral equation with continuous kernels</p>	Attendance interactive lectures.	Ask questions and give assignments.
4	3	<ul style="list-style-type: none"> • Apply numerical methods to treat problems involve integral equations. 	<p>Numerical methods (cont.) Some numerical methods for solving Fredholm integral equation with continuous kernels.</p>	Attendance interactive lectures.	Ask questions and give assignments.
5	3	<ul style="list-style-type: none"> • Apply numerical methods to treat problems involve Integro-differential equations. 	<p>Numerical methods (cont.) Some numerical methods for solving Integro-differential equations</p>	Attendance interactive lectures.	Ask questions and give assignments.
6	3	<ul style="list-style-type: none"> • How to convert Volterra integral equation of the first kind to a second type and apply 	<p>Volterra integral equation of the first kind: The solution of Volterra integral</p>	Attendance interactive lectures.	Ask questions and give assignments.

7	3	<p>numerical methods to treat these problems.</p> <p>•Have understanding Abel's integral equation.</p>	<p>equation of the first kind using Laplace transformation.</p> <p>Abel's equations: Abel's integral equation in general form</p>	Attendance interactive lectures.	Ask questions and give assignments.
8	3	<p>•Have solving Abel's integral equation by different approaches.</p>	<p>Abel's equations (cont.) Dynamical systems and Abel integral equation,</p> <p>• Midterm exam (1)</p>	Attendance interactive lectures.	Ask questions and give assignments.
9	3	<p>•Have understanding Abel's integral equation in fractional integral.</p>	<p>Abel's equations (cont.) Abel equations in view of fractional integral</p>	Attendance interactive lectures.	Ask questions and give assignments.
10	3	<p>•How to convert this type to another one.</p>	<p>Volterra Equations: Reduction of Volterra equations of the second kind to Volterra equations of the first kind</p>	Attendance interactive lectures.	Ask questions and give assignments.
11	3	<p>•How to treat the discontinuities.</p>	<p>Integral equations with discontinuous kernels: Fredholm and Volterra integral equations with singular kernel</p>	Attendance interactive lectures.	Ask questions and give assignments.
12	3	<p>•Have understanding theorems of existence of uniqueness solution of integral equations.</p>	<p>Integral equations with discontinuous kernels: (cont.) The existence of a unique solution of</p>	Attendance interactive lectures.	Ask questions and give assignments.

13	3	<ul style="list-style-type: none"> Apply some numerical methods to solve problems involve integral equations with singular kernel arising in various scientific fields. 	<p>Fredholm integral equation with singular kernel</p> <p>Integral equations with discontinuous kernels: (cont.) Some methods to solve linear Fredholm integral equation with singular kernel, some applications,</p> <p>• Midterm exam (2)</p>	Attendance interactive lectures.	Ask questions and give assignments.
14	3	<ul style="list-style-type: none"> Apply some numerical methods to solve integral equations involve nonlinear terms. 	<p>Nonlinear Volterra and Fredholm integral equations: Theory of existence and uniqueness of the solution using Picard method- Banach fixed point theorem.</p>	Attendance interactive lectures.	Ask questions and give assignments.
15	3	<ul style="list-style-type: none"> Apply some numerical methods to solve integral equations involve nonlinear terms. 	<p>Nonlinear Volterra and Fredholm integral equations (cont.) Some analytics methods to solve the nonlinear integral equations. Some numerical methods to solve the nonlinear integral equations.</p>	Attendance interactive lectures.	Ask questions and give assignments.

11. Course Evaluation

15% Exam1, 15% Exam2, 70% Final Exam.

12. Learning and Teaching Resources

Required textbooks (curricular books, if any)

Rahman, M. (2007). Integral Equations and their Applications. WIT Press.

Main references (sources)

Atkinson, K. (1997). The numerical solution of

	integral equations of the second kind. Cambridge: Cambridge University Press.
Recommended books and references (scientific journals, reports...)	<ul style="list-style-type: none"> • Linz, P. (1969). Numerical methods for Volterra integral equations of the first kind. The Computer Journal, 12(4), pp.393-397. • Abdou, M., Mohamed, K. and Ismail, A. (2003). the numerical solutions of Fredholm–Volterra integral equation. Applied Mathematics Computation, 146(2-3), pp.713-728.
Electronic References, Websites	<ul style="list-style-type: none"> • https://projecteuclid.org/journals/journal-of-integral-equations-and-applications • http://www.papersciences.com/J-Int-Eqs.htm