4/1/4. Course Specification:

COURSE SPECIFICATIONS
Form

Course Title: **Integral Equations**

Course Code: **4046701-4**

Course Specifications

Institution: Umm Al-Qura University Date : 8 / 11 / 2018
College/Department : Faculty of Applied Science/ Department of Mathematical Sciences

A. Course Identification and General Information

1. Course title and code: Integral Equations (4046708-4)				
2. Credit hours: 4 Hours				
3. Program(s) in which the course is offered: Master in Mathematics				
4. Name of faculty member responsible for the course: Dr. Sameha Raad				
5. Level/year at which this course is offered : Leve 3/ Master (Elective course)				
6. Pre-requisites for this course (if any): Integral Equations (4044505-3)				
7. Co-requisites for this course (if any): Introduction to Elasticity (4046702-4)				
8. Location if not on main campus: Al-Abidia campus and Al-Zahir campus				
9. Mode of Instruction (mark all that apply)				
a. traditional classroom	✓	What percentage?	90	
b. blended (traditional and online)		What percentage?		
c. e-learning	✓	What percentage?	10	
d. correspondence		What percentage?		
f. other		What percentage?		

Comments:

B Objectives

1. What is the main purpose for this course? By the end of the course the students will learn the following main concepts: 1- Some numerical methods for solving Volterra and Fredholm integral equation. 2- Techniques for solving Volterra integral equation of the first kind. 3- Treatment of Fredholm integral equation with Singular kernel. 4- An overview of Nonlinear Volterra and Fredholm integral equations.
2. Briefly describe any plans for developing and improving the course that are being implemented. (e.g. increased use of IT or web based reference material, changes in content as a result of new research in the field) 1. Encouraging students to solve different kinds of integral equations. 2. Update references used in teaching process. 3. Use e-learning facilities more efficiently. 4. Use computer packages for solving the integral equations numerically.

C. Course Description (Note: General description in the form used in Bulletin or handbook)

Course Description: The integral equation is one of the most important branch of mathematics. An integral equation is an equation in which an unknown function appears under one or more integral signs. The integral equation can be categorized and then processed according to the kernel and kind, as well as linearity and dimensions. The course provides numerical methods for solving Volterra and Fredholm integral equations of the second kind, some treatments for Volterra integral equation of the first kind and two famous methods for solving integral equations with discontinuous kernels, then gives a general view of nonlinear integral equations.

1. Topics to be Covered

List of Topics	No. of Weeks	Contact Hours
1. Review: the basic concept of integral equations with respect to its formulas and kernels. Review some different methods for solving Volterra and Fredholm integral equations of the second kind with continuous kernels, using some analytic methods.	2	8
2. Numerical methods ● Some numerical methods for solving Volterra integral equation with continuous kernels: 1-The Trapezoidal Rule- Simpson's Rule – Rung Kutta, Fast method . collection and Galerkian methods 2- Error Analysis. Applications ● Some numerical methods for solving Fredholm integral equation with continuous kernels: 1-The Trapezoidal Rule- Simpson's Rule-– Rung Kutta, Fast method, collection and Galerkian methods . 2- Error Analysis. Applications.	3	12
3. Volterra integral equation of the first kind: The solution of Volterra integral equation of the first kind using Laplace transformation. Abel's equations: Abel's integral equation in general form, Dynamical systems and Abel integral equation, **Midterm exam (1)** Abel equations in view of fractional integral. Reduction of Volterra Equations of the Second Kind › Volterra Equations of the First Kind.	4	12

4. Integral equations with discontinuous kernels Fredholm and Volterra integral equation with Singular kernel. ● The existence of a unique solution of Fredholm integral equation with singular kernel, Some methods to solve linear Fredholm integral equation with singular kernel: Toeplitz matrix method, Nystrom matrix method). Some applications using Maple soft-ware. **Midterm exam (2)**	3	12
5. Nonlinear Volterra and Fredholm integral equations. Theory of existence and uniqueness of the solution using Picard method- Banach fixed point theorem. Some analytics methods to solve the nonlinear integral equations. Some numerical methods to solve the nonlinear integral equations.	3	12

2. Course components (total contact hours and credits per semester):

	Lecture	Tutorial	Laboratory or Studio	Practical	Other:	Total
Contact Hours	60	--	--	--		60
Credit	4	--	--	--		4

2. Additional private study/learning hours expected for students per week.
Four hours weekly for homework and revision

4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy

On the table below are the five NQF Learning Domains, numbered in the left column. **First**, insert the suitable and measurable course learning outcomes required in the appropriate learning domains (see suggestions below the table). **Second**, insert supporting teaching strategies that fit and align with the assessment methods and intended learning outcomes. **Third**, insert appropriate assessment methods that accurately measure and evaluate the learning outcome. Each course learning outcomes, assessment method, and teaching strategy ought to reasonably fit and flow together as an integrated learning and teaching process. (Courses are not required to include learning outcomes from each domain.)

	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
1.0	**Knowledge**		
1.1	Define some integral transforms and integral operator.	Lectures Tutorials Discussion Problem Solving	Exams Home work.
1.2	Determine the appropriate method for solving the integral equation based on the kind and the kernel.		
2.0	**Cognitive Skills**		
2.1	Construct the analytical and numerical solution of some integral equations .	Lectures Tutorials Solve Problem Brain Storming	Exams Quizzes. Homework. Discussion
2.2	How to distinguish several methods in solving different kinds of integral equations.		
3.0	**Interpersonal Skills & Responsibility**		
3.1	Develop the concept of integral equations.	Cooperative education Competitive education	Home work. Reports. Quizzes. Discussion
	Apply a range of theorems and methods to treat problems in integral equations.		
3.2	Show the ability to work independently and effectively within a team.		
4.0	**Communication, Information Technology, Numerical**		
4.1	Be aware of using some computer		Home

	programs for solving problems.	Use Maple or MATLAB software to solve some problems numerically.	work. Reports. Discussion
4.2	Ability to analyze mathematical problems and to implement short programs for solving it.		
	Be able to write short programs for solving mathematical problems		
5.0	**Psychomotor**		
Not applicable			

5. Schedule of Assessment Tasks for Students During the Semester

	Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.)	Week Due	Proportion of Total Assessment
1	Midterm 1	7th week	20 %
2	Midterm 2	13th week	20%
3	Homework + Quizzes	During the semester	20%
4	Final exam	End of semester	60 %

D. Student Academic Counseling and Support

1. Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week)
Office hours per week in the lecturer schedule (6 hours per week).
2- Contact with students by e-mail,SMS, and e-learning facilities.
3- The lab technician will cooperate with the students to help them develop their software skills

E. Learning Resources

1. Required Text(s)

Rahman, M. (2007). Integral Equations and their Applications. WIT Press.
Kanwal, R. (2015). Linear Integral Equations. Kent: Elsevier Science.

2. Essential References

Atkinson, K. (1997). The numerical solution of integral equations of the second kind.

Cambridge: Cambridge University Press.

J. (2009). Computational Methods for Integral Equations. Cambridge, GBR: Cambridge University Press.

3. Recommended Books and Reference Material (Journals, Reports, etc) (Attach List):

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). On the numerical solutions of Fredholm–Volterra integral equation. Applied Mathematics and Computation, 146(2-3), pp.713-728.

4.Electronic Materials, Web Sites etc

https://projecteuclid.org/euclid.jiea

http://www.papersciences.com/J-Int-Eqs.htm

5. Other learning material such as computer-based programs/CD, professional standards/regulations: Maple 18.

F. Facilities Required

Indicate requirements for the course including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access etc.)
1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.) - -Classroom with suitable capacity. - Library.
2. Computing resources (AV, data show, Smart Board, software, etc.) -Smart board. - Classroom is equipped with a computer. - Provide projectors and related items. - Maple software.
4. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list) None

G Course Evaluation and Improvement Processes

1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching:

● Student feedback through electronic facilities organized by the deanship of registration and acceptance.
2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department ● Evaluation of the teachers by internal & external faculty members. ● Attend the classrooms. ● Mutual visits between colleagues and giving advices to each other.
3 Processes for Improvement of Teaching ● Analysis of student course evaluation and feedback ● Peer evaluation and feedback ● Workshops on pedagogical methods
4. Processes for Verifying Standards of Student Achievement (eg. check marking by an independent member teaching staff of a sample of student work, periodic exchange and remarking of tests or a sample of assignments with staff at another institution) ● Analysis of course assessments by other reviewers on a periodic basis.
5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. ● Material and learning outcomes are periodically reviewed internally and externally. ● Comparing course content and teaching methodologies with similar courses offered at other departments and universities. ● Studying the outcomes of the students' evaluations of the course and use it to improve teaching strategies.

Name of Instructor: Dr. Sameha Raad

Signature:____ *Sameha Raad* _____Date Report Completed: 8 / 11 / 2018

Name of Field Experience Teaching Staff : _____

Program Coordinator:_____

Signature: _____ Date Received:_____