4/1/4. Course Specification:

COURSE SPECIFICATIONS

Form

Course Title: ..... **Introduction to Elasticity**.....

Course Code: ..... **4046702-4**..

Course Specifications

Institution: Umm Al-Qura University Date : 31/10/2018
College/Department : Faculty of Applied Science/ Department of Mathematical Sciences

A. Course Identification and General Information

1. Course title and code: Introduction to Elasticity (4046702-4)				
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 2/ Master				
6. Pre-requisites for this course (if any): Continuum Mechanics				
7. Co-requisites for this course (if any):				
8. Location if not on main campus: Al-Abidiyah campus and Al-Zahir campus				
9. Mode of Instruction (mark all that apply)				
a. traditional classroom	✓	What percentage?	85	
b. blended (traditional and online)		What percentage?		
c. e-learning	✓	What percentage?	15	
d. correspondence		What percentage?		
f. other		What percentage?		

Comments:

B Objectives

1. What is the main purpose for this course? The main purpose for this course is to introduce concepts and quantitative techniques for the study of the theory of Elasticity and its applications.
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. Updating references used in teaching process. 2. Using e-learning facilities more efficiently. 3. Encouraging students to collect problems from web based references and supervise discussions in the class.

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

Course Description: Elasticity is the ability of a body to resist a distorting influence or deforming force and to return to its original size and shape when that influence, or force is removed. The elasticity of materials is described by a stress-strain curve. If the material is Isotropic, the linearized stress-strain relationship is called Hooke's law. The course will provide a basic treatment of the formulation of elasticity theory and its application to problems of stress and displacement analysis. The fundamental field equations will be developed including strain energy concepts, torsion, bending and stress concentration, and an introduction to three-dimensional solutions.

1. Topics to be Covered		
List of Topics	No. of Weeks	Contact hours
Chapter 1 - Review of Principles of Continuum Mechanics - Review the concept of a body, reference coordinates and material coordinates. Review what is meant by a deformation. - Review the notion of a material or convicted derivative, material velocity and material acceleration. - Review the Transport Theorem. - Derive Nansen's formula. - Review conservation laws for mass, linear momentum, angular of momentum and conservation of energy. - Review what it means to say that a body is elastic. Develop the constitutive theory for a classical thermo-elastic material in terms of the strain energy. Refine the constitutive form of these equations as required by frame invariance (SRBM). - Use the Clausius Duhen Entropy inequality to deduce expressions for the stress tensor and specific entropy for a thermo-elastic solid in terms of the Helmholtz Free Energy. - Particularize the strain energy to the case of an isotropic solid. - Introduce the principle stretches. Express the stress tensor in terms of the principle stretches. - Introduce the Piola-Kirkoff and Cauchy-Green stress tensors.	3	12

Chapter 2 - Exact Solutions in Nonlinear Elasticity - Construct exact solution for the pure shear of a cube in nonlinear Elasticity. Particularization to an incompressible elastic solid. - Construct the exact solution for the flexure of a beam in nonlinear Elasticity. Particularization to an incompressible elastic solid. - Construct the exact solution for the pure inflation of a cylindrical tube in nonlinear Elasticity. particularization to an incompressible elastic solid. - Construct the exact solution of the pure inflation of a hollow spherical shell in nonlinear Elasticity. Particularization to an incompressible elastic solid.	3	12
Chapter 3 - Linear Elasticity - Develop the general equations for the infinitesimal deformation of a thermo-elastic solid from a pre-stressed state. - Particularize the stress tensor to an isotropic elastic solid. - Use the entropy inequality to deduce constraints of the material properties of the linearized isotropic stress tensor. Introduce Young's modulus and Poisson's ratio and express the linear stress tensor in terms of these quantities. - Establish uniqueness of the initial boundary value problem for linear thermo-elasticity. - Discuss wave propagation in a linearly elastic half space. Discuss S-waves and P-waves. - Formulate and solve the punch and torsion problems for an unstressed linear elastic half-s-pace.	3	12

Chapter 4 - Saint Venant Torsion - Establish the general solution for the torsion of a cylinder of arbitrary cross-section. - Examine the torsion of a notched circular cylinder and triangular cylinder.	3	12
Chapter 5 - Deformation of a Beam - Establish the Euler-Lagrange model of a loaded rectangular beam. - Construct the deformation of a rectangular beam with point and distributed loads. - Examine the vibration of a rectangular beam for various boundary conditions. - Establish the Timoshenko model of a rectangular beam for various boundary conditions. - Examine the vibration of a rectangular beam for various boundary conditions according to the Timoshenko model.	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

3. 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.)

Code #	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
1.0	**Knowledge:** upon completion of this course, the student is expected to		
1.1	Have a knowledge on the basics of linear and nonlinear elasticity.	Lectures Discussion	Exams Home work
1.2	Recognize the formulas in 2D and 3D for the stress and strain fields in elastic bodies related to various states.		
2.0	**Cognitive Skills** upon completion of this course, the student is expected to		
2.1	Construct the exact solution for some problems in linear and nonlinear Elasticity.	Lectures Solve Problems Brain Storming	Exams Quizzes Homework Discussion
2.2	Specify the general equations for the stress tensor for special kinds of elastic materials in Cartesian and cylindrical coordinates.		
3.0	**Interpersonal Skills & Responsibility** upon completion of this course, the student is expected to		
3.1	Show the ability to work independently and within groups.	Competitive education	Home work. Quizzes.
4.0	**Communication, Information Technology, Numerical** upon completion of this course, the student is expected to		
4.1	use many programs in computers in studying mathematics.	Use Maple software to solve some problems numerically.	Discussion Home Work.
4.2	Ability to analyze mathematical problems and to implement short programs for solving it.		
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	Periodic exam (1)	6th week	20 %
2	Periodic exam (2)	10th week	20%
3	Homework + Quizzes	During the semester	50%
4	Final exam	End of semester	40 %

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) 1. Office hours per week in the lecturer schedule (4 hours per week). 2. Contact with students by e-mail, SMS, and e-learning facilities.

E Learning Resources

1. List Required Textbooks - Mechanics of continuous media. S.C. Hunter, Ellis Horwood (1975). - Continuum Mechanics, A.J.M. Spencer: Dover publications (2004). - Non-Linear Elastic Deformations, R.W. Ogden: Dover publications (1997).
2. List Essential References Materials (Journals, Reports, etc.)
3. List Recommended Textbooks and Reference Material (Journals, Reports, etc) - https://www.journals.elsevier.com/international-journal-of-plasticity/
4. List Electronic Materials, Web Sites, Facebook, Twitter, etc. - http://esag.harvard.edu/rice/e0_Solid_Mechanics_94_10.pdf - http://homepages.engineering.auckland.ac.nz/~pkel015/SolidMechanicsBooks/Part_III/index.html
5. Other learning material such as computer-based programs/CD, professional standards

or regulations and software.

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.) - Provide a suitable classroom.
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.
3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list)

G Course Evaluation and Improvement Processes

1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching Electronically in UQU website.
2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department Monitoring the achievement of the students in solving homework and periodical exams
3 Processes for Improvement of Teaching - Course report. - Lecture development.
4. Processes for Verifying Standards of Student Achievement (e.g. 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) The instructors watch and give their feedbacks to their students through all work done by them, including exams to verify standards of achievements for different domains of learning outcomes
5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. - Student's feedback. - Course report.

Name of Instructor: Dr. Sameha Raad
Signature:_ *Sameha Raad* _Date Report Completed: 31/10/2018
Name of Field Experience Teaching Staff : _____
Program Coordinator:_____
Signature: _____ Date Received:_____