4/1/4. Course Specification:

COURSE SPECIFICATIONS
Form

Course Title: **Applications of Elasticity**

Course Code: **4046706-4**

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: Applications of Elasticity 4045706-4
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: Level 3/Master
6. Pre-requisites for this course (if any) : Introduction to Elasticity (4046702-4)
7. Co-requisites for this course (if any): Continuum Mechanics
8. Location if not on main campus: Al-Abidiyah. and Al-Zahir

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 aim of this course is to investigate problems in Plane Strain, Plane Stress and Shell Theory.
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: This course will concentrate on applications which involve the solution of problems including two-dimensional problems of plane strain and plane stress, plasticity theory, the phenomenon of viscoelastic behavior and the special cases of classical shell theory. MAPLE or equivalent software will be used to evaluate and plot particular solutions.

1. Topics to be Covered		
List of Topics	No. of Weeks	Contact hours
Chapter 1 – Revision - Briefly revise the development of the full nonlinear equations of Thermo-Elasticity. - Revise the construction of the thermo-elastic strain energy in its most general form assuming that it is a function of temperature, temperature gradients and strain. - Derive the form of the stress tensor for several anisotropic materials, for example, a transversely isotropic material.	1	4

Chapter 2 - Plane Strain and Plain Stress - State what is meant by "Plane Strain" and "Plain Stress". Develop the elastic equations for plane strain and plane stress from the general nonlinear model of elasticity. - Introduce the Airy Stress function. - Reformulate the equations of plane stress and plane strain within the framework of functions of a complex variable. - Solve several problems in plane strain and plane stress, for example, the deformation under axial tension of a slab containing a circular hole.	2	8
Chapter 3 - Plasticity Theory - Discuss the various types of material behavior underlying loading and unloading, namely Linear elastic behavior, Nonlinear elastic behavior, Plastic behavior, Visco-elastic behavior and Visco-plastic behavior. - Introduce the notion of Yield Stress in terms of the strain-hardening factor and develop expressions for strain energy. - Introduce strain-energy density criterion proposed by Beltrami. - Introduce the Tresca, Von-Mises and Mohr-Coulomb criteria. Demonstrate that the latter reduces to the Tresca criterion in the case of a frictionless material. - Develop constitutive equations for the plastic stress tensor. - Supplement theory with a number of worked examples using the Tresca and Von-Mises criteria illustrating which is more conservative. Introduce the notion of Safety Factor.	3	12
Chapter 4 - Introduce Granular Materials - Define what is meant by a granular material. Set out the basic assumptions underlying the behavior of a granular material, for example, particles only interact when they touch; particle collisions are inelastic etc. - Investigate several mathematical models describing the flow of granular materials.	3	12

Chapter 5 - Visco-Elasticity - Describe the phenomenon of viscoelastic behavior. Compare the form of the stress tensor for elastic and viscoelastic materials. Introduce the idea of "creep" and "stress relaxation". - If the case of linear visco-elasticity introduces the general form for the stress-strain relationship in terms of the compliance matrix. Describe the Maxwell and Kelvin-Voigt models of visco-elasticity and state their advantages and disadvantages. - Illustrate Maxwell and Kelvin-Voigt visco-elastic behavior in one dimension via several examples.	3	12
Chapter 6 - Classical Shell Theory - Introduce the description of a surface in space via a power series expansion of a material point in terms of its location with respect to a membrane surface and a normal coordinate to that surface. - Develop the kinematics of the shell and conservation laws for density, momentum and energy. - Consider the special case of a thin shell in which the deformation p about the membrane surface r is of the form $\boldsymbol{p} = \boldsymbol{r}(t;\theta^{\alpha}) + \xi \boldsymbol{d}(t;\theta^{\alpha})$. - Discuss the example in which shell theory and the classical linear theory of elasticity are applied to the solution of a plate of thickness H and area occupying the region $(-a,a)x(-b,b)$ is deformed by uniform forces F_a and F_b along the respective boundaries $x = \pm a, y = \pm b$. - Repeat the previous problem with the forces Fa and Fb replaced by the couples M_a and M_b.	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 an enhanced knowledge and understanding of the definition of plane stress, plane strain.	Lectures Discussion	Exams, Quizzes, Homework
1.2	Identify how to solve the basic problems of the theory of elasticity by using Airy function expressed as bi-harmonic function.		
2.0	**Cognitive Skills** upon completion of this course, the student is expected to		
2.1	Construct the exact solution for some basic problems of the theory of elasticity by using Airy function expressed as bi-harmonic function.	Lectures Solve Problems Brain Storming	Exams, Quizzes, Homework.
2.2	Specifying the several mathematical models describing the phenomenon of viscoelastic behavior and the special cases of classical shell theory.		
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	Exams, Quizzes,

			Homework
4.0	**Communication, Information Technology, Numerical** upon completion of this course, the student is expected to		
4.1	Be aware of using 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**		
5.1	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)	7th week	20 %
2	Periodic exam (2)	13th week	20%
3	Homework + Quizzes	During the semester	20%
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

- An Introduction to Continuum Mechanics. Academic Press, New York Hunter SC (1976).
- Theory of Elasticity, L.D. Landau and E.M. Lifshitz . Pergamon Press, (1986).
- Theory of Plasticity 3rd Ed. J. Chakrabarty, Elsevier, (2006).

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://homepages.engineering.auckland.ac.nz/~pkel015/SolidMechanicsBooks/Part_IV/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. - The number of student not exceed 6 in the class.
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
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:_____