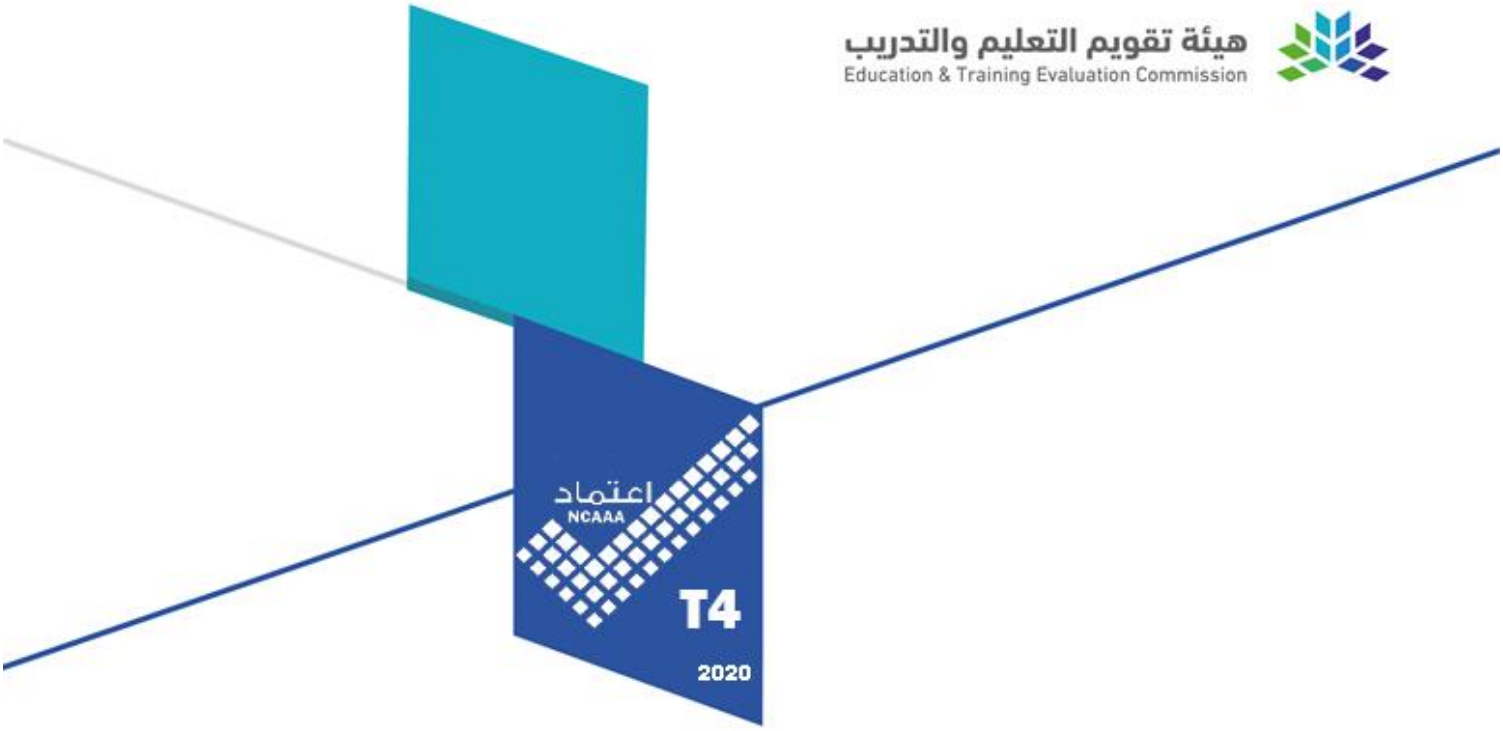
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	Computational Mechanics
Course Code:	CE 418
Program:	B.Sc. in Civil Engineering
Department:	Civil Engineering
College:	Jubail University College
Institution:	Jubail University College

Table of Contents

A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☑ Elective ☐
3. Level/year at which this course is offered: Level 7, Fourth Year
4. Pre-requisites for this course (if any)**:** MATH 314 Numerical Methods
5. Co-requisites for this course (if any)**:** None

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	✓	100
2	**Blended**		
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
Contact Hours		
1	**Lecture**	45
2	**Laboratory/Studio**	
3	**Tutorial**	
4	**Others** (specify)	
	Total	**45**

B. Course Objectives and Learning Outcomes

1. Course Description

CE 418 Computational Mechanics (3-0-3) ***Prerequisite: MATH 314***

Introduction to computational mechanics: mappings and iterative methods; Numerical methods & techniques for solving initial boundary value problems. Finite difference methods, direct methods, variational methods. Introduction to the finite element method (FEM).Finite elements in small strains & at finite deformation for applications in structural mechanics & fluid mechanics. Solution of ordinary differential equations & partial differential equations arising in structural mechanics & fluid mechanics. Computational aspects and development and use of finite element code.

2. Course Main Objective

The main purpose of this course is to enable the students to acquire the knowledge of Finite element analysis and its application in the areas of fluid mechanics & structural mechanics

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding: N/A**	
2	**Skills :**	
2.1	Establish the solution of boundary value ,initial value , Eigen value problems , finite difference methods & variational methods	1
2.2	Analyze the finite element models formed & its application for solving the problems in structural mechanics & fluid mechanics	1
2.3	Use finite element software for solving civil engineering problems	1
3	**Values: N/A**	

C. Course Content

No	List of Topics	Contact Hours
1	**Unit 1. Introduction to Computational Mechanics** 1.1 Problems & history 1.2 Mathematical models 1.3 Numerical Simulations 1.4 The nature of computational solid & fluid mechanics problems.	6
2	**Unit 2. Numerical methods & techniques** 2.1 Boundary Value, Initial Value, and Eigenvalue Problems 2.2 Finite difference methods 2.3 Variational methods	12
3	**Unit 3. Finite Element Models** 3.1 Introduction to finite element method 3.2 Basic steps of finite element analysis 3.2.1 Model Boundary Value Problem 3.2.2 Discretization of the Domain 3.2.3 Derivation of Element Equations 3.2.4 Connectivity of Elements 3.2.5 Imposition of Boundary Conditions 3.2.6 Solution of Equations	9
4	**Unit 4. Application of finite element models in fluid mechanics & structural mechanics** 4.1 Governing equations 4.1.1 direct formulation of flow through pipes 4.1.2 pipes in series 4.1.3 pipes in parallel 4.1.4 formulation of equations for beams and frames 4.2 Finite Element Model 4.2.1 finite element formulation of fluid mechanics problems like flow through pipes	9

	4.2.2 finite element formulation of structural mechanics problems like beams & frames 4.3 Numerical examples	
5	**Unit 5. Use of finite element software in civil engineering problems** 5.1 ANSYS program 5.2 ANSYS data base and files 5.3 Creating finite element model with ANSYS : preprocessing 5.4 Applying boundary conditions ,loads and solutions 5.5 Results of finite element model : post processing 5.6 An example problem	9
Total		45

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
2.0	**Skills**		
2.1	Establish the solution of boundary value ,initial value , Eigen value problems , finite difference methods & variational methods	Interactive learning Self-directed learning	Quiz 1, midterm, assignment1, Final
2.2	Analyze the finite element models formed & its application for solving the problems in structural mechanics & fluid mechanics		Quiz-2, Assignment-2, Final exam
2.3	Use finite element software for solving civil engineering problems		Assignments
3.0	**Values**		

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Quiz 1	4	10%
2	Assignment 1	6	10%
3	Mid-term LT	8	20%
4	Quiz 2	12	10%
5	Assignment 2	13	10%
6	Final Exam LT	17-19	40%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

- Office hours 6 hr/week; students can go in times of office hours for teacher to explain what could not be understood from the lesson.
- Students can communicate with a staff member outside the official working hours by email.
- Students are also encouraged to visit their academic advisors.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Reddy J. N. (2009). *An Introduction to the Finite Element Method*, U.S.A: McGraw-Hill Education.
Essential References Materials	Chapra S.C and Canale R.P (2009) .*Numerical Methods for Engineers*, USA :McGraw-Hill Education. Ayyub B and McCuen R.H (2016) .*Numerical Analysis for Engineers: Methods and Applications*, Florida .USA: CRC Press.
Electronic Materials	None
Other Learning Materials	ANSYS Software

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Lecture rooms with a capacity of at least 25 students and fitted with multimedia projector and a computer.
Technology Resources (AV, data show, Smart Board, software, etc.)	ANSYS Software
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Computer lab equipped with finite element software

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment as per QMS-Policy-006 Feedback Survey, QMS-QAP-116 Monitoring Students' Satisfaction	Students	Indirect: Analyzing the results of the following surveys Course Evaluation Survey(CES), Program Evaluation Survey (PES), Student Experience Survey (SES)
Quality of Exam papers and Verifying Standards of Student Achievement as per QMS-Policy-004 Policy for Examinations and Marking, QMS-ACP-102 Procedure for Marking Examinations	Examination Committee	Direct: Peer review of examination papers and review or double check a minimum of three or 10% of answer papers. Verifying the entries in the Activity Mark Sheet.
Achievement of learning outcomes as per QMS-Policy-001		

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Course Review, QMS-CDP-106, QMS-CDP-112 Curriculum Review	Faculty	Direct: Course Report (Section B-3)
Implementation of the action plans based on previous semester as per QMS-Policy-001 Course Review, QMS-CDP-106 Procedure for Course Review, QMS-CDP-112 Procedure for Curriculum Review	Faculty	Direct and Indirect: Course report (Section G-1, G-2)
Monitoring Teaching and Learning as per QMS-Policy-005 Monitoring of Teaching and Learning	Chairperson/Program Director/Course Director	Indirect: Feedback by Chairperson/Program director/Course director. Program Delivery Record.
Effectiveness of planned Teaching Strategies QMS-Policy-001 Course Review	Faculty	Indirect: Course Report (Section B-4)
Course effectiveness and planning for improvement as per QMS-Policy-001 Course Review, QMS-CDP-106 Procedure for Course Review, QMS- CDP-112 Procedure for Curriculum Review	Faculty	Direct and Indirect: Course report (Section G-3)
Verifying Standards of Student Achievement and Quality of Exam papers as per QMS-ACP-119 External Assessment Review	Assessment External Reviewer	Direct: Report of assessment external reviewer. Review of sample of ten or 10% of student's assessments and coursework scripts.

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Civil Engineering Department Council
Reference No.	REG MIN-CED-10
Date	27-04-2020

Appendix A
Revision Details

Revision no.	DESCRIPTION	Reference MoMs			
		DC		CDC	
		Sem	#	Sem	#
1	Revision of Course Teaching Strategies and action verbs based on the comments of NCAAA reviewer	392	4	392	4
2	Course Specification Template 2018	402			