Course Specification
(Bachelor)

Course Title:	Fluid Mechanics II
Course Code:	ME3234
Program:	Bachelor's in Mechanical Engineering
Department:	Mechanical Engineering Department
College:	College of Engineering and Architecture
Institution:	Umm Al-Qura University
Version:	*Course Specification Version Number*
Last Revision Date:	12/23/2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3 hours)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Level 6)					
4. Course General Description:					
KINEMATICS OF FLUIDS-DYNAMICS OF INCOMPRESSIBLE FLUIDS-POTENTIAL FLOW ABOUT BODIES-INTRODUCTION TO TURBOMACHINERY-FLOW ABOUT AIRFOILS-BOUNDARY-LAYER FLOW-COMPRESSIBLE FLOW AND SHOCK WAVES					
5. Pre-requirements for this course (if any):					
Fluid Mechanics I					
6. Co-requisites for this course (if any):					
None					
7. Course Main Objective(s):					
Understanding kinematics of fluids. Ability to know dynamics of incompressible fluids. Learn the potential flow about bodies. Determination of classifications of turbomachines. Governing equations of turbomachinery. Understanding the flow about airfoils. Understanding the boundary-layer flow. Learn about compressible flow and shock waves. Ability to carry out experiments in fluid lab.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	80	100 %
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	32
2.	**Laboratory/Studio**	48
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		80

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Able to describe the fluid kinematics	K1, P	Lectures, tutorials and independent study assignments	Homework, Quizzes, Midterm and Exam
1.2	Recognized the potential flow and the Superposition of Plane-Flow Solutions	K1, P	Lectures, tutorials and independent study assignments	Homework, Quizzes, Midterm and Exam
1.3	Able to describe the turbomachinery and Airfoil Theory	K1, P	Lectures, tutorials and independent study assignments	Homework, Quizzes, Midterm and Exam
1.4	Recognized the Navier-Stokes equation and the boundary layer equations	K1, P	Lectures, tutorials and independent study assignments	Homework, Quizzes, Midterm and Exam
1.5	Able to describe the compressible flow and Shock waves	K1, P	Lectures, tutorials and independent study assignments	Homework, Quizzes, Midterm and Exam
	Able to describe the internal flow	K1, P	Lectures, tutorials and independent	Homework, Quizzes,

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
			study assignments	Midterm and Exam
2.0	**Skills**			
2.1	Ability to apply knowledge of mathematics, science, and engineering to fluid mechanics.	S2, P	Lectures, tutorials and independent study assignments	Homework, Quizzes, Midterm and Exam
2.2	Ability to identify, formulate, and solve engineering problems in fluid mechanics	S3, P	Lectures, tutorials and independent study assignments	Homework, Quizzes, Midterm and Exam
2.3	Description of the interpersonal skills and capacity to carry responsibility to be developed	S3, P	Lectures, tutorials and independent study assignments	Homework, Quizzes, Midterm and Exam
3.0	**Values, autonomy, and responsibility**			
3.1	Ability to self-learning about engineering problems in fluid mechanics	V3, P	Study presentation and report preparation	Oral presentation and minor projects.
3.2	Ability to work within a team to solve an engineering problems in fluid mechanics	V3, P	Study presentation and report preparation	Oral presentation and minor projects.
3.3	Ability to analyze and synthesize an engineering problems in fluid mechanics	V3, P	Study presentation and report preparation	Oral presentation and minor projects.

C. Course Content

No	List of Topics	Contact Hours
1.	1. **FLUID KINEMATICS**	**5**

			1.LAGRANGIAN AND EULERIAN DESCRIPTIONS 2. FLOW PATTERNS AND FLOW VISUALIZATION 3. PLOTS OF FLUID FLOW DATA 4.OTHER KINEMATIC DESCRIPTIONS 5.VORTICITY AND ROTATIONALITY	
2.		2. **FLUIDS**	**DYNAMICS OF INCOMPRESSIBLE** 1.EQUATION OF MOTION FOR NONVISCOUS FLUIDS 2. EQUATION OF MOTION FOR VISCOUS FLUIDS	**5**
3.		3.	**POTENTIAL FLOW ABOUT BODIES** 1. GOVERNING EQUATIONS 2. BOUNDARY CONDITIONS 3. SOLUTIONS OF LAPLACE EQUATION BY INDIRECT METHOD 4. FORCE ON CYLINDER 5. NUMERICAL SOLUTION FOR FLOW PAST TWO DIMENSIONAL SYMMETRIC BODIES	**4**
4.		4.	**TURBOMACHINERY** 1. CLASSIFICATIONS AND TERMINOLOGY 2. PUMPS 3. PUMP SCALING LAWS 4. TURBINES 5. TURBINES SCALING LAWS	**5**
5.		5.	**FLOW ABOUT AIRFOILS** 1. LIFT AND AIRFOILS IN IDEAL FLUID 2. EFFECT OF VISCOSITY ON FLOW ABOUT AIRFOIL 3. THIN AIRFOIL THEORY	**4**
6.		6.	**BOUNDARY-LAYER FLOW** 1. PHYSICS OF BOUNDARY LAYER FLOW 2. BOUNDARY LAYER PARAMETER 3. BOUNDARY LAYER EQUATIONS 4. APPROXIMATE METHOD 5. TRANSITION TO TURBULENT FLOW 6. TURBULENT BOUNDARY LAYER 7. BOTH LAMINAR AND TURBULENT BOUNDARY LAYER OVER FLAT PLATE	**5**

		8. TOTAL DRAG OF VAROUS SHAPED BODIES	
7.	7. WAVES	**COMPRESSIBLE FLOW AND SHOCK** 1. STAGNATION PROPERTIES 2. ONE-DIMENSIONAL ISENTROPIC FLOW 3. ISENTROPIC FLOW THROUGH NOZZLES 4. SHOCK WAVES AND EXPANSION WAVES 5. DUCT FLOW WITH HEAT TRANSFER AND NEGLIGIBLE FRICTION (RAYLEIGH FLOW) 6. ADIABATIC DUCT FLOW WITH FRICTION (FANNO FLOW)	**4**
8.	**LAB WORK**		**48**
Total			**80**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quiz and Home works	3	10%
2.	Midterm exam **1**	7	15%
3.	Group project	8	10%
4.	Midterm exam **2**	10	15%
5.	Final exam	16	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1. FLUID MECHANICS NOTES, Peter E. Clark, USA, 2007. 2. An Introduction to Fluid Mechanics, P. A. Sleigh and C. J. Noakes, UK, 2008, 3. An Introduction to Fluid Mechanics-Notes, A. Sleigh, School of Civil Engineering, University of Leeds, UK, 2001.
Supportive References	"Fluid Mechanics: Fundamentals and Applications, 4th edition, Yunus A. Cengel, John M. Cimbala " "Fluid Mechanics", Frank M. White, McGraw-Hill Publishers, 7th Edition.
Electronic Materials	All the lecture notes

Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (projector, smart board, software)	Data show
Other equipment (depending on the nature of the specialty)	Lab

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Faculty	Direct (project, HW, Quiz, midterm and final exam)
Effectiveness of Students assessment	Students	Indirect (Student Survey)
Quality of learning resources	Program Coordinator	Direct) CLOSO folder analysis)
The extent to which CLOs have been achieved		
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	**12/23/2024**