Course Specification
(Bachelor)

Course Title:	**Fluid Mechanics**
Course Code:	**464MATH-3**
Program:	**B. Sc. in Mathematics**
Department:	**Mathematics**
College:	**Science**
Institution:	**Jazan University**
Version:	**2024**
Last Revision Date:	**9/2024**

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:	03 Hours

2. Course type

A. University ☐ College ☐ Department☒ Track☐ Others☐

B. Required ☒ Elective☐

3. Level/year at which this course is offered:

Level 8 / Year 4

4. Course General Description:

- Introduction, Fluid Concept, Fluid Continuum, Lagrange Description, Eulerian Description, Acceleration Field, Material Derivative, Streamlines, Path lines, Kinematic Description, Rate of Translation and Rotation, Linear Strain Rate, Shear Strain Rate, Vorticity Rotationality
- The Stream Function and the Velocity Potential Function - Complex potential function, Irrotational Flow, Plane Potential Flows, Uniform Flow, Source and Sink Flow, Vortex flow, Circulation around various paths in a free vortex, The combination of a source and sink of equal strength located along the x-axis (Doublet).
- Conservation of Mass, Differential Form of Continuity Equation, Cylindrical Polar Coordinates, The Stream Function, Inviscid Flow, Euler's Equations of Motion, The Bernoulli Equation, Irrotational Flow, The Bernoulli Equation for Irrotational Flow.
- Description of Forces Acting on Differential Element, Equations of Motion, Inviscid Flow, Euler's Equations of Motion, The Bernoulli Equation, The Navier.

5. Pre-requirements for this course (if any): 434 MATH

6. Co- requirements for this course (if any): None

7. Course Main Objective(s)

After finishing the course, the student is expected to be familiar with the following:

- Solving problems and proving theorems on Fluid Kinematics.
- Solving problems and proving theorems on Navier Stokes`s Equations, Boundary Conditions, Bernoulli`s Equation, and Euler`s Equation.
- Solving problems and proving theorems on Complex potential functions.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1.	Traditional classroom	45	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	42
2.	Laboratory/Studio	
3.	Field	
4.	Tutorial	3
5.	Others (specify)	
	Total	45

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

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Distinguish mathematical concepts relevant to Fluid Kinematics-Euler`s, Lagrange's methods, continuity equation, velocity potential, and Vorticity. The motion of incompressible fluid: Stress Tensor, Navier Stokes`s equations, boundary conditions, Bernoulli`s equation, Euler`s equation, Stream, potential functions and complex potential function.	K1	Lectures, Web-based work, Classroom discussions	Written exam (Solve the problems, MCQs, true/false, proof of the theorem, Short answer), Quizzes, Assignments
1.2	Identify background science, features and structure of the mathematical problem in fluid Kinematics-Euler`s, Lagrange's methods, continuity equation, velocity potential, and Vorticity. The motion of incompressible fluid: Stress Tensor, Navier Stokes`s equations, boundary conditions, Bernoulli`s equation, Euler`s equation, Stream, potential functions and complex potential function.	K2	Lectures, Web-based work, Classroom discussions	Written exam (Problem solve, MCQs, true/false, Proof, Short answer), Quizzes, Assignments
1.3	Explain notations and concepts required for the solution of the mathematical problem in fluid Kinematics-Euler`s, Lagrange's methods, continuity equation, velocity potential, Vorticity. The motion of Incompressible fluid: Stress Tensor, Navier Stokes`s Equations, boundary conditions, Bernoulli`s equation, Euler`s Equation,	K3	Lectures, Web-based work, Classroom discussions	Written exam (solve the problems, MCQs, true/false, Proof, Short answer), Quizzes, Assignments

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Stream, potential functions and complex potential function.			
2.0	Skills			
2.1	Apply theoretical, computational or practical aspects relevant to fluid Kinematics-Euler`s, Lagrange's methods, continuity equation, velocity potential, and Vorticity. The motion of incompressible fluid: Stress Tensor, Navier Stokes`s equations, boundary conditions, Bernoulli`s equation, Euler`s equation, Stream, potential functions and complex potential function.	S1	Lectures, problem-solving, web-based work, and Classroom discussions.	Written exam (solve the problems, MCQs, true/false, Proof, Short answer), Quizzes, Assignments
2.2	Compute numerical quantities for various parameters to approximate the solution in fluid Kinematics-Euler`s, Lagrange's methods, continuity equation, velocity potential, and Vorticity. The motion of incompressible fluid: Stress Tensor, Navier Stokes`s equations, boundary conditions, Bernoulli`s equation, Euler`s equation, Stream, potential functions and complex potential function.	S2	Lectures, problem-solving, web-based work, and Classroom discussions.	Written exam (solve the problems, MCQs, true/false, Proof, Short answer), Quizzes, Assignments
2.3	Apply various mathematical rules, techniques and theorems in Application on Fluid Kinematics-Euler`s, Lagrange's methods, continuity equation, velocity potential, Vorticity. The motion of Incompressible fluid: Stress Tensor, Navier Stokes`s equations, boundary conditions, Bernoulli`s equation, Euler`s equation, Stream, potential functions and complex potential function.	S3	Lectures, problem-solving, web-based work, and Classroom discussions.	Written exam (solve the problems, MCQs, true/false, Proof, Short answer), Quizzes, Assignments
2.4	Solve mathematical problems using critical thinking in Fluid Kinematics-Euler`s, Lagrange's Methods, Continuity Equation, Velocity Potential, and Vorticity. The motion of Incompressible Fluid: Stress Tensor, Navier Stokes`s Equations, Boundary Conditions, Bernoulli`s Equation,	S4	Lectures, problem-solving, web-based work, and Classroom discussions.	Written exam (solve the problems, MCQs, true/false, Proof, Short answer), Quizzes, Assignments

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Euler`s Equation, Stream, potential functions and Complex potential function.			
3.0	Values, autonomy, and responsibility			
3.1	Cultivate a mathematical attitude and nurture interest	V1	Group work, problem-solving, web-based work	Assignments and discussion
3.2	Realize the importance of responsibilities through different modes of practice, competition and related activities.	V2	Group work, problem-solving, web-based work	Assignments and discussion
3.3	Inculcating values and ethics in thought, expression and deed.	V3	Group work, problem-solving, web-based work	Assignments and discussion

C. Course Content

No	List of Topics	Contact Hours
1.	Fluid concepts and Kinematics descriptions.	9
2.	The Stream Function and the Velocity Potential Function	12
3.	Conservation of Mass, Differential Form of Continuity Equation,	11
4.	Bernoulli and Euler equations	6
5.	Navier-Stokes equations, Laminar flow, Couette flow	7
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework	3	5%
2.	First Exam.	6	20%
3.	Second Exam	11	20%
4.	Homework	13	5%
5.	Final Exam	15	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	A Brief Introduction to Fluid Mechanics, 3rd Edition, Young, Wiley 2007.

Supportive References	Fundamental Mechanics of Fluids, 4th Edition, CRC Press, Taylor and Francis Group, I.G. Currie Incompressible fluid flow, 4th Editon, Wiley, Ronald L.Panton. Viscous fluid flow, Third Edition, 2006, Mc Graw Hill, Frank M. White.
Electronic Materials	Websites dedicated to Fluid Mechanics are available on the internet.
Other Learning Materials	

2. Required Facilities and equipment

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

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (Course Evaluation Survey)- Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/ Indirect
Quality of learning resources	Students, Faculty members	indirect
The extent to which CLOs have been achieved	Instructor	Direct/Indirect
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data

COUNCIL /COMMITTEE	**Board Of Mathematics Department**
REFERENCE NO.	**2417**
DATE	**29/03/1446 A. H.; 2/10/2024 A. D.**