	Department of Mechanical Power Engineering	Cairo University Faculty of Engineering	

Course Specifications

Program(s) on which this course is given	Bachelor Degree of Mechanical Power Engineering
Department offering the program	Mechanical Power Engineering
Department offering the course	Mechanical Power Engineering
Academic Level	Third Year
Date	2023-2024
Semester(based on final exam timing)	√ Fall Spring

A- Basic Information

1. Title:	Applications of Fluid Mechanics-1			**Code:**		MEP 3020 (New 2018 Bylaws)		
2. Units/Credit hours per week:	Lectures	2	Tutorial	2	Practical	**1**	Total	5

B- Professional Information

1. Course description:

Overall Aims of Course: This course builds upon the **2nd year** basic material in "Fluid Mechanics" but is more applied in nature. The course deals with different types of fluid flow problems from the differential control volume analysis point of view. The course examines various types of flows such as internal viscous flow, frictionless flow and boundary layer flow.

2. Intended Learning Outcomes of Course (ILOs):

1. Master essential facts and concepts relevant to various types of incompressible flow such as: Viscous flow, Frictionless Flow and Boundary Layer Flow.
2. Apply techniques of differential control volume analysis to drive basic governing conservation equations of fluid flow by using different types of coordinate systems.
3. Identify mass, linear momentum & energy equations for many incompressible flows.
4. Identify the importance and physical meaning of each term in the complex non-linear partial differential conservation equations for various types of fluid flows.
5. Apply analytic critical and systematic thinking to solve mass and linear momentum differential conservation equations for various types of fluid flows.
6. Identify essential boundary conditions, constrains and assumptions required to solve some limited applications of viscous flow problems.
7. Recognize the role and importance of the concept of frictionless flow and conformal mapping techniques to solve some fluid flow problems.
8. Apply the similarity and numerical solution methodology to solve the non-linear differential equations of the boundary layer flow.
9. Search for information related to variety of incompressible viscous flow& boundary layer problems.
10. Exchange knowledge with engineering community.
11. Work in stressful environment and within constraints.
12. Communicate effectively.
13. Effectively manage tasks and resources.
14. Refer to relevant literature

3. Contents

Topic	No.of hrs	*Lecture*	Tutorial
Chapter 1: Differential equation of mass conservation	4	2	2
Driving Navier-Stokes equations (linear momentum) for Newtonian fluids, angular momentum and energy eqns.	4	2	2
Chapter 2: Viscous flow in pipes and ducts	4	2	2
Flow between parallel plates with pressure gradients	4	2	2
Chapter 3: Differential equations for frictionless flow (Euler's eqns.)	4	2	2
Stream and potential functions, vorticity, irrotationality, elementary plane-flow solutions.	4	2	2
Superposition of plane-flows and Images	4	2	2
Plane flows past closed body shapes, axi-symmetric flows	4	2	2
Lift & drag on submerged bodies in ideal flow, airfoil theory	4	2	2
Chapter 4: Introduction to Boundary Layer flows, the differential equations, Exact equations for 2-D flow	4	2	2
Blasius exact solution for laminar flow, the Momentum Integral equations	4	2	2
Approximate solutions for 2-D laminar and turbulent boundary layers	4	2	2

Thermal Boundary Layer over a flat plate	4	2	2
Revision of the course to confirm the objectives	4	2	2
Time for Preparing for the term exam	--	--	--
Total teaching hours in 14 weeks (+ 1 office hr/wk)	**56**	**28**	**28**

4. Teaching and Learning Methods	Lectures (√)	Practical Training/ Laboratory (√)	Seminar/Workshop (x)
	Class Activity (√)	Case Study/Reports (√)	Projects (x)
	E-learning (√)	Assignments /Homework (√)	Other: Reports

Also for Teaching and Learning:

- Lectures and problem solving in tutorial classes.
- Information collection from text material, class notes and the Internet sites.
- Report and research assignments. Three assignment Sheets (1, 2 and 3)
- Group discussions in lectures and tutorial classes.
- Hand-outs materials.

5. Student Assessment Methods:

- Test (1) & Report (1) to assess understanding Chapter (1) and solving Sheet #1 and part of the ILO's
-Test (2) & Report (2) to assess understanding Chapter (2) and solving Sheet #2 and part of the ILO's
-Mid-term exam to assess understanding Chapters (1-3) and solving Sheets #1-3 and part of the ILO's
- Final Term Exam to assess gains of all completed topics and all of the course ILO's.

• **Assessment Schedule**	**Week**
-Assessment 1; Test (1) & Report (1)	End of Week 4
Mid-term Exam	In Week 8
-Assessment 2; Test (2) & Report (2)	End of Week 11
Final Term Exam	End of Term

• **Weighting of Assessments**	
Tests 1, 2, assignments & class performance	5 %
Reports 1, 2	5 %
Mid-term Exam	20 %
Final-term Examination	70 %
-Total	100 %

6. List of References

- Course Notes: Compiled Notes corresponding to different course sections
- Essential Books (Text Books):

1- B.R. Munson, D. F. Young, and T. H. Okishi, "*Fundamentals of Fluid Mechanics"*, John Wiley & Sons, Inc., New York, 4th Edition (2002).

- Recommended Books:

1- Frank M. White "Fluid Mechanics", 2nd ed., McGraw Hill, 1986.

2- R.W.Fox & A.T.McDonald "Introd. to Fluid Mechanics", 3rd ed., John Wiley & Sons, 1989

- Hand-outs and Web Sites information,… etc

7. Facilities Required for Teaching and Learning

- Data Show, white Screen, new reference in library
- Internet for Enhancing the ability to think for students in Engineering Schools

Course Coordinator:	**Prof.Samy Mourad Prof. Ahmed Abdelrahman Ibrahim A. Prof. Mohsen S.Soliman**
Head of Department:	**Prof. Sayed Kaseb**
Date:	**July 2023**