University: Benha University
Faculty: Faculty of Engineering at Shoubra
Department offering the program: Electrical Engineering Department
Department offering the course: Electrical Engineering and Control Program

1- Course Data (Basic Information)

Course Code & Title: MEC100 Thermo-Fluid Engineering **Semester/Year:** First / 2023-2024
Prerequisite Course(s): BAS011 Physics of Materials & Electricity **Core or Elective:** Core Course
Credit Hours: 2 **Weekly Contact Hours**: **Lecture:** 2 **Tutorial:** 0 **Laboratory:** 0

2- Course Objectives

- Provide students with different types of thermodynamic processes, obtain the basic properties of working fluids.
- Understanding the concepts and basic principles of applications of the first law thermodynamics for different types of systems.
- Know how to determine the variation of pressure in a fluid at rest.
- Applying the conservation of mass equation to balance the incoming and outgoing flow rates in a flow system.
- Understanding the use of the Bernoulli equation and apply it to solve a variety of fluid flow problems.

3- Course Contents (As indicated in the program Bylaw)

Thermodynamics: macroscopic approach to energy analysis, energy transfer as work and heat, and the first law of thermodynamics, Properties and states of simple substances, Control-mass and control- volume analysis, The essence of entropy and the second law of thermodynamics,
Fluid dynamic: fluid properties, similarity of fluid flows, conservation equations, conservation of mass-momentum, Newton second law, energy conservation of mechanical energy (Bernoulli Equation), Application: flow through pipes: laminar and turbulent flow.

4- Program Competences Served by The Course (A1, A3, and A4)

Level (A) General Engineering Competences

A.1 Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science, and mathematics.

A.3 Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development.

A.4 Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles.

5- Learning Outcomes (LO's)

At the end of the course, the student will be able to:

Cognitive Domain	
LO1	Discuss the system states, properties, and processes according to fluid base and thermal base
LO2	Check the properties of pure substances using thermodynamics' tables and Fluid tables
LO3	Apply the first law of thermodynamics and mass conservation on different thermal and fluid systems.
LO4	Analyze the energy of open and closed systems in thermal and fluid applications
LO5	Analyze the static fluid properties and pressure distribution along deep surfaces
Psychomotor Domain	
LO6	Select the proper processes and components to achieve the heat/work energy demand for thermal and fluid applications.
Affective Domain	
	None

6- Mapping Learning Outcomes (LO's) with competences

LO's / NARS	A1	A3	A4
Cognitive Domain			
LO1	■		
LO2	■		■
LO3	■		
LO4		■	
LO5		■	
Psychomotor Domain			
LO6		■	

7- Lecture Plan

Topics to be Covered weekly & Matrix of LO's

Week	Topics	Learning Outcomes					
		LO1 A1	LO2 A4	LO3 A3	LO4 A3	LO5 A3	LO6 A3
W1 Thermal	**Fundamentals of Thermodynamics** Introduction and basic concepts of thermodynamics science, definition of open and closed thermodynamic systems, surroundings, boundary, state and equilibrium, thermodynamic process	■					
W2 Fluid	**Understand the basic concepts of fluid mechanics** Fluid Mechanics, What is a Fluid, Liquids, Gases	■					
W3 Thermal	**Fundamentals of Thermodynamics** Path of the process, steady-flow process, thermodynamic cycle, units, density and specific gravity, temperature, and temperature scales.	■					

Week	Topics	Learning Outcomes					
		LO1 A1	LO2 A4	LO3 A3	LO4 A3	LO5 A3	LO6 A3
W4 Fluid	**Understand the basic concepts of fluid mechanics** External flow. internal flow, Compressible versus Incompressible Flow, Laminar flow, turbulent, forced flow, natural flows, Steady, Unsteady Flow	■					
W5 Thermal	**Energy, Energy Transfer, and General Energy Analysis** Forms of energy, energy transfer by heat, energy transfer by work, mechanical forms of work, work due to moving boundary, the ideal-gas equation of state, internal energy of ideal gas, specific heats of ideal gas.	■			■		
W6 Fluid	**Have a working knowledge of basic properties of fluids** Intensive and extensive, Density and Specific Gravity Viscosity, Newton's law of viscosity, Kinematic viscosity	■					
W7 Thermal	**The First Law of Thermodynamics** First law of thermodynamics, enthalpy, first law of thermodynamics applied to a cycle, specific heats of ideal gas, thermodynamic processes of the ideal gas, first law of thermodynamics applied to various processes on closed systems			■	■		■
W8 Fluid	**Have a working knowledge of basic properties of fluids** Moving plate in fluid media, Shear stress, Moving cylinder in fluid media, Shear stress around cylinder	■				■	■
W9 Thermal	**Properties of Pure Substances** The temperature-volume diagram, - The pressure-volume diagram, - The liquid-vapor (wet) region, - Superheated vapor region, - Thermodynamic property tables.	■	■	■	■		
W10 Fluid	**Pressure And Fluid Statics** Pressure, Absolute, gage, and vacuum pressures, Variation of pressure with depth, Pascal Law, The Barometer, The Manometer, Multiple unmixable fluids, The differential Manometer,	■				■	
W11 Thermal	**Properties of Pure Substances** The temperature-volume diagram, the pressure-volume diagram, the liquid-vapor (wet) region, superheated vapor region, thermodynamic property tables.	■	■	■			■
W12 Fluid	**Pressure And Fluid Statics** The Barometer, The Manometer, Multiple unmixable fluids, The differential Manometer, The inverted Manometer, pressure drops across a horizontal flow section, Vertical surface, inclined surface.			■		■	■
W13 Thermal	**Mass and Energy Analysis of Control Volumes** Mass conservation, mass balance for steady-flow processes, flow work, energy of a flowing fluid, energy analysis of steady-flow systems, steady-flow engineering devices (nozzles and diffusers, turbines and compressors, boilers and condensers, heat exchangers, throttling devices, pumps), energy analysis of unsteady-flow processes.			■	■		■
W14 Fluid	**Fluid Kinematics** The conservation of Mass (The Continuity Equation) The conservation of Energy (Bernoulli equation			■			■

8) Teaching and Learning Methods

Learning Outcomes		Teaching and Learning Methods									
		Face-to-face Lecture	Online Lectures	Tutorial / Exercise	Group Discussions	Laboratory	Self-Reading	Presentation	Collaborate Learning (Team Project)	Research and Reporting	Brainstorming
Cognitive Domain	LO1	●		●							●
	LO2	●		●	●					●	●
	LO3	●		●							●
	LO4	●		●	●						●
	LO5	●		●							●
Psychomotor Domain	LO6	●		●	●					●	●

Student Academic Counseling and Support

- Students are directed to contact teaching staff for academic support during specific office hours.
- Regarding this course, Instructors will be available two hours a week as indicated on the timetable declared for students from the beginning of the semester.
- A Telegram group is created where students can ask questions and share files with teaching staff. Moreover, the group is used to announce the student marks, exam days …etc.
- There are no disabled students in the programs, so no special support is needed.

9- Student Assessment

a) Student Assessment Methods

Learning Outcomes		Assessment Methods*									
		Written Exams	Online Exams	Oral Exam	Pop Quizzes	In-class Problem Solving	Take-Home Exam	Research Assignments	Reporting Assignments	Project Assignments	In-class Questions
Cognitive Domain	LO1	●				●			●		●
	LO2	●			●	●			●		●
	LO3	●			●	●			●		●
	LO4	●			●	●			●		●
	LO5	●			●	●			●		●
Psychomotor Domain	LO6	●				●			●		●

b- Assessment Schedule and Weight

Assessment Tools	Week	Weight
First Midterm Examination	7	20 %
Second Midterm Examination	12	20%
Final Examination	(As Scheduled)	40 %
Quizzes (#3)	3, 9, 13	15 %
Home assignments (#8)	1, 2, 5, 6, 9, 10, 11, 13	5 %
Total		**100 %**

10- Facilities

The following facilities are needed for this course:

- ■ Classroom
- ■ Lecture Hall
- ■ Sound and Microphone
- □ Other: ……
- □ Smart Board
- ■ White Board
- ■ Data Show
- □ Computer with software
- □ MIS system
- □ Internet Access

11- List of References

a- Course Notes

Lectures Notes in PDF introduced by instructors.

b- Books

- Allan D. Kraus, James R. Welty, Abdul Aziz, Introduction to Thermal and Fluid Engineering, 1st Edition, CRC Press, 2019.

- Course Coordinator: Prof. Dr. Ahmed Attia **Signature:**

Assoc. Prof. Dr. Mohamed Reda Salem **Signature:**

- Program Coordinator: Prof. Mohamed Anwar **Signature:**