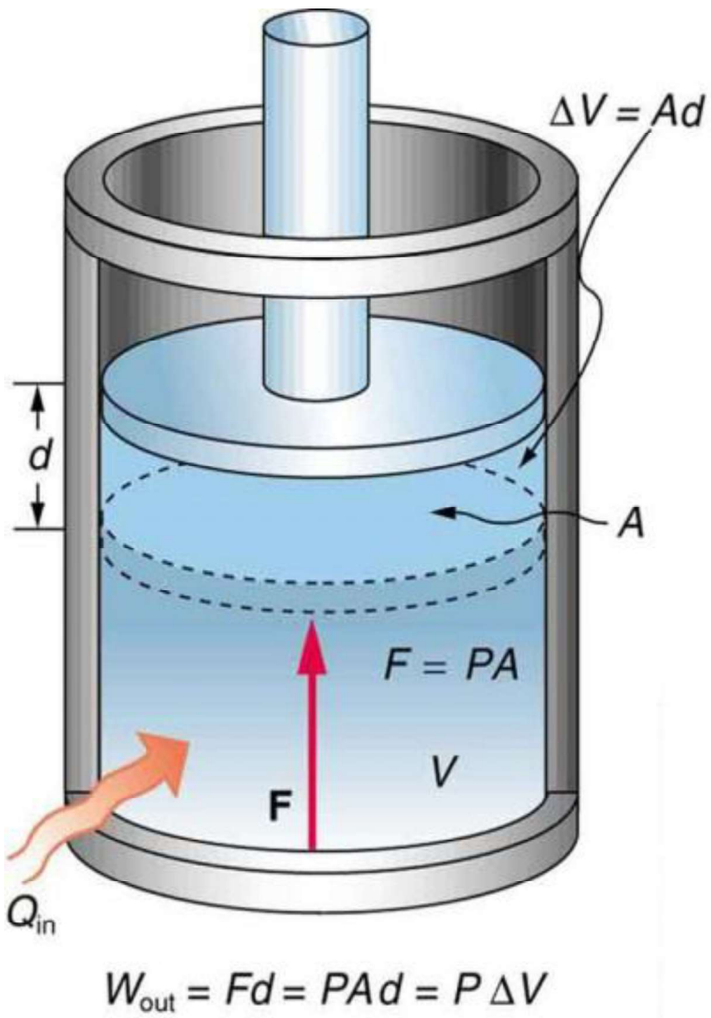


Tikrit University

Engineering College

Mechanical Department

The Second Course

Thermodynamics-I (MECH-101)

Weekly load 3 hours

Module Aims أهداف المادة الدراسية

-To cover the *basic principles* of thermodynamics

-To present a wealth of real-world engineering examples to give students a feel for how thermodynamics is applied in engineering practice.

-To develop an intuitive understanding of thermodynamics by emphasizing the physics and physical arguments

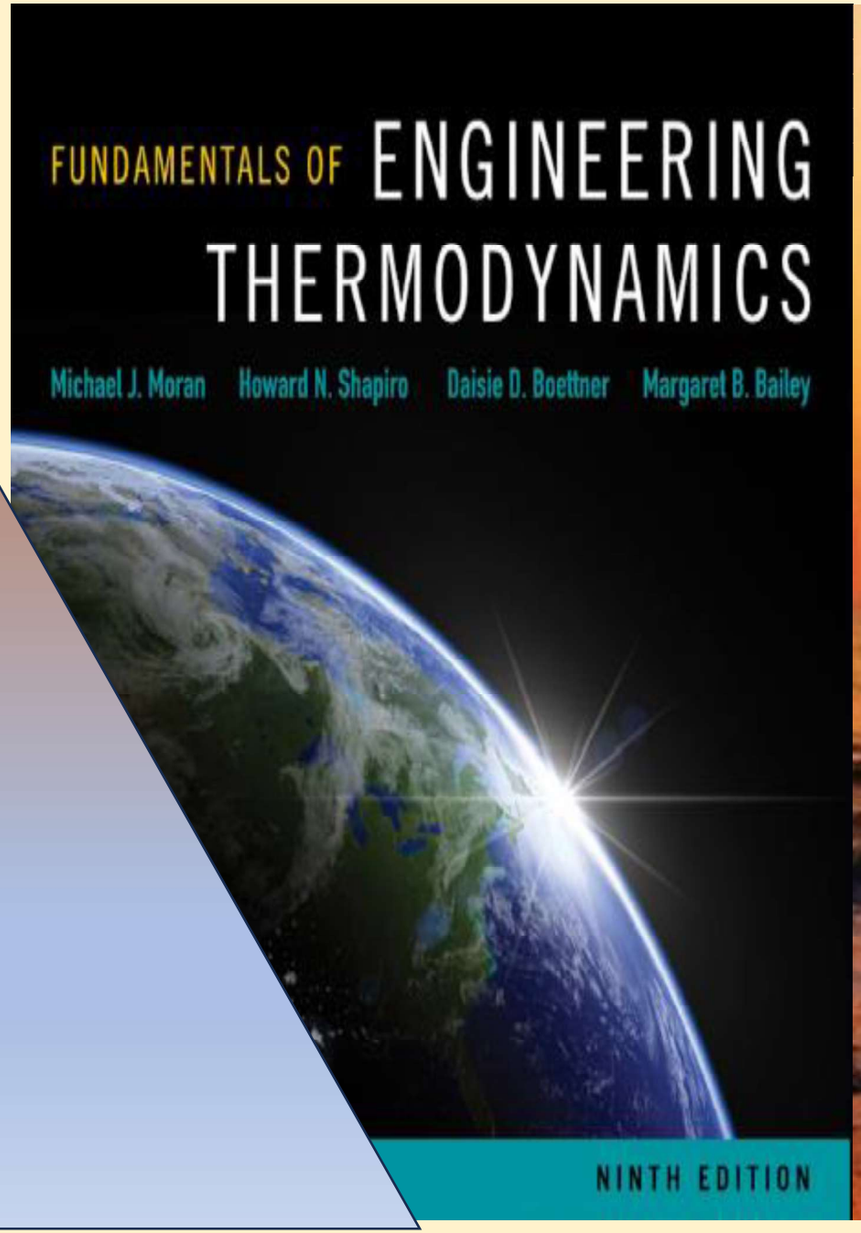
Module Learning Outcomes مخرجات التعلم للمادة الدراسية

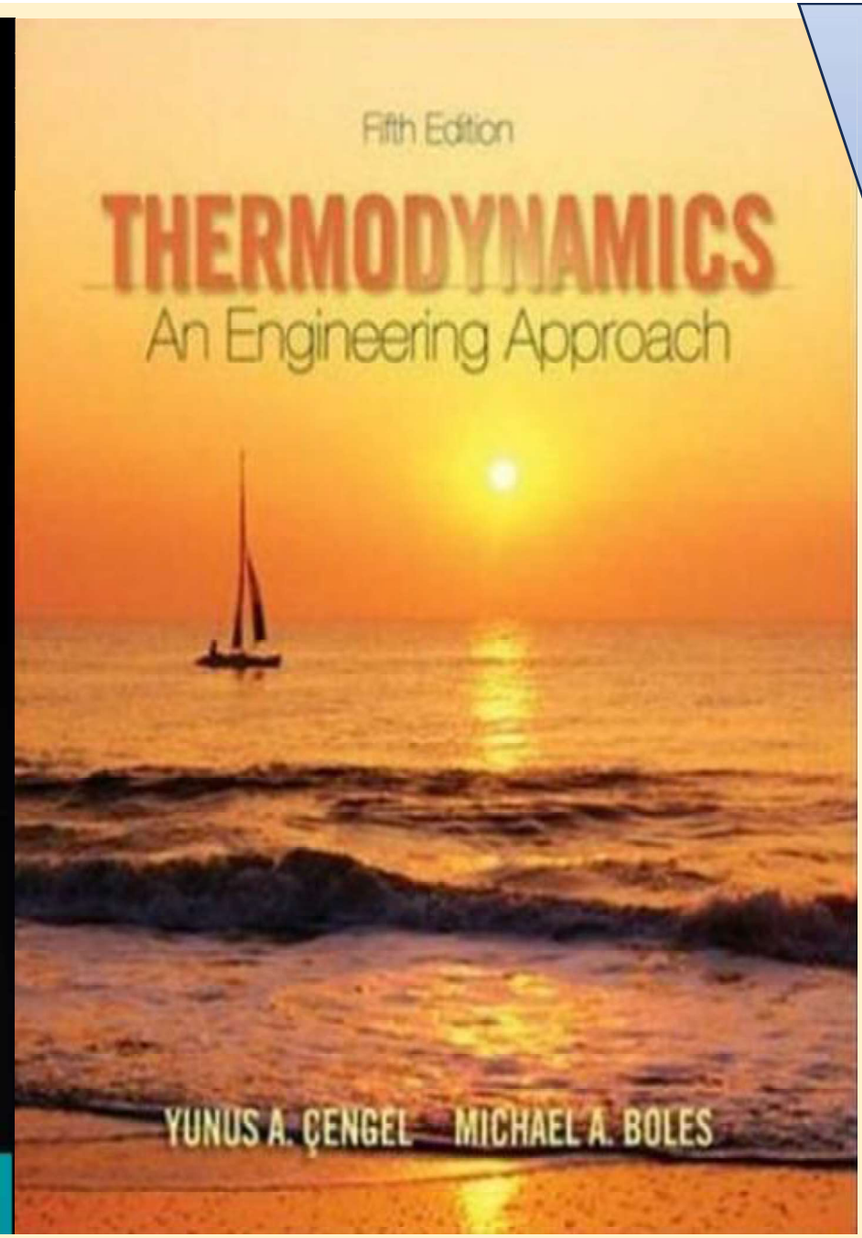
On completion of this course, students will be able to:

1. Understand the principles of thermodynamics, develop the schematic diagram for the system, and apply energy balance models to develop governing equations.
2. Set up and solve for engineering thermal systems according to the first and second law of thermodynamics
3. Understand the energy conversion and where it is used.
4. Understand the approach for open and closed systems and its practical applications.

Week	Material Covered
Week 1	Basic concepts related to thermodynamics, introduction, definition of engineering thermodynamics, definition of thermodynamics
Week 2	Definition of thermodynamic laws, thermodynamic systems
Week 3	Thermodynamic systems, system, boundary, and surroundings, closed system, open system. control volume and control surface, isolated system, adiabatic system, macroscopic and microscopic approach, thermodynamic equilibrium, properties of systems, state, process, non-flow process and flow processes, cycle.
Week 4	Point functions, path functions, temperature, Zeroth-law of thermodynamics, pressure, definition of pressure, gauge pressure, vacuum pressure and absolute of pressure, units of pressure, manometer, barometer, U-Tube manometer, reversible and irreversible processes, energy, work and heat, reversible work
Week 5	Tutorial sheets
Week 6	The first-law of thermodynamic and its applications, corollaries of the first-law of thermodynamics, perpetual motion machine of the first kind(PMM1), the perfect gas, Boyle's law, Charle's law, the characteristic equation of gas, Avogadro's hypothesis.
Week 7	Midterm exam

Week 8	Specific heats, Joule's law, internal energy, enthalpy, forms of energies.
Week 9	Applications of first-law of thermodynamics to non-flow processes, steady non-flow energy equation, reversible constant-volume process(Isochoric process), reversible constant- pressure process(Isobaric process), constant temperature process(or Isothermal process), adiabatic process, polytropic process, relationship between T-V-P.
Week 10	Applications of first-law to steady-flow processes, steady-flow energy equation, engineering applications of steady flow-energy equation, water turbine, steam or gas turbine, centrifugal water pump, centrifugal compressor, reciprocating compressor.
Week 11	Steam and two-phase systems, the formation of steam, saturation of temperature and pressure, the triple point
Week 12	Enthalpy and the formation of steam at constant pressure, steam tables, reference state of tables, liquid enthalpy, enthalpy of evaporation, enthalpy of dry saturated vapor, enthalpy of superheated vapor
Week 13	Temperature-enthalpy diagram, volume of steam, volume of water, volume of dry saturated steam, volume of wet steam, volume of superheated steam, the internal energy of steam
Week 14	Dryness fraction of wet steam, Examples
Week 15	Summary of subject course
Week 16	Final Exam


FUNDAMENTALS OF ENGINEERING
THERMODYNAMICS
Michael J. Moran Howard N. Shapiro Daisie D. Boettner Margaret B. Bailey
NINTH EDITION


Fifth Edition
THERMODYNAMICS
An Engineering Approach
YUNUS A. ÇENGEL MICHAEL A. BOLES

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل **In class lectures 60** **In class tests 4**	64	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4.3
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل **Library, dorm, home memorizing 30** **Prepartion for tests 16** **Homeworks 15**	61	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	5.7
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation

تقييم المادة الدراسية

		Time (hr)	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	All	All
	Online assignments	4	8% (8)	All	All
	Project	1	4%(5)		
	Onsite assignments	4	8% (8)		
	Lab.	-	10% (10)		
Summative assessment	**Midterm Exam**	2	10% (10)	7	LO # 1-3
	Final Exam	3	50% (50)	16	All
Total assessment			100% (100 Marks)		

Chapter One

Basic Concepts Related To Thermodynamics

1.1 Introduction

Thermodynamics, like other physical sciences, is based on observation of nature.

- ❑ - **The first law of thermodynamics**: is simply an expression of the conservation of energy principle, and asserts that energy is a thermodynamic property.
- ❑ - **The second law of thermodynamics**: asserts that energy has quality as well as quantity, and actual processes occur in the direction of decreasing quality of energy.
- ❑ The term *thermodynamics* was first used in the publication of Lord Kelvin in 1849. -
- ❑ - The first thermodynamic textbook was written in 1859 by William Rankine a professor at the University of Glasgow.

1.2 Definition of Engineering Thermodynamics

Thermodynamics can be defined as the science of energy. The name thermodynamics stems from the Greek words thermos (heat) and dynamics (power).

Thermodynamics (Greek word) →Heat power

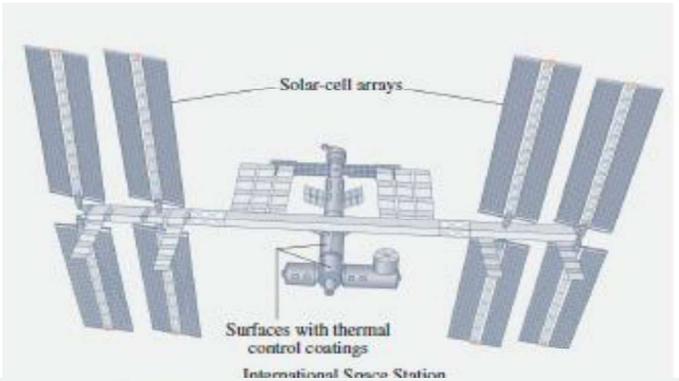
Today the same name is widely taken to include all parts of :

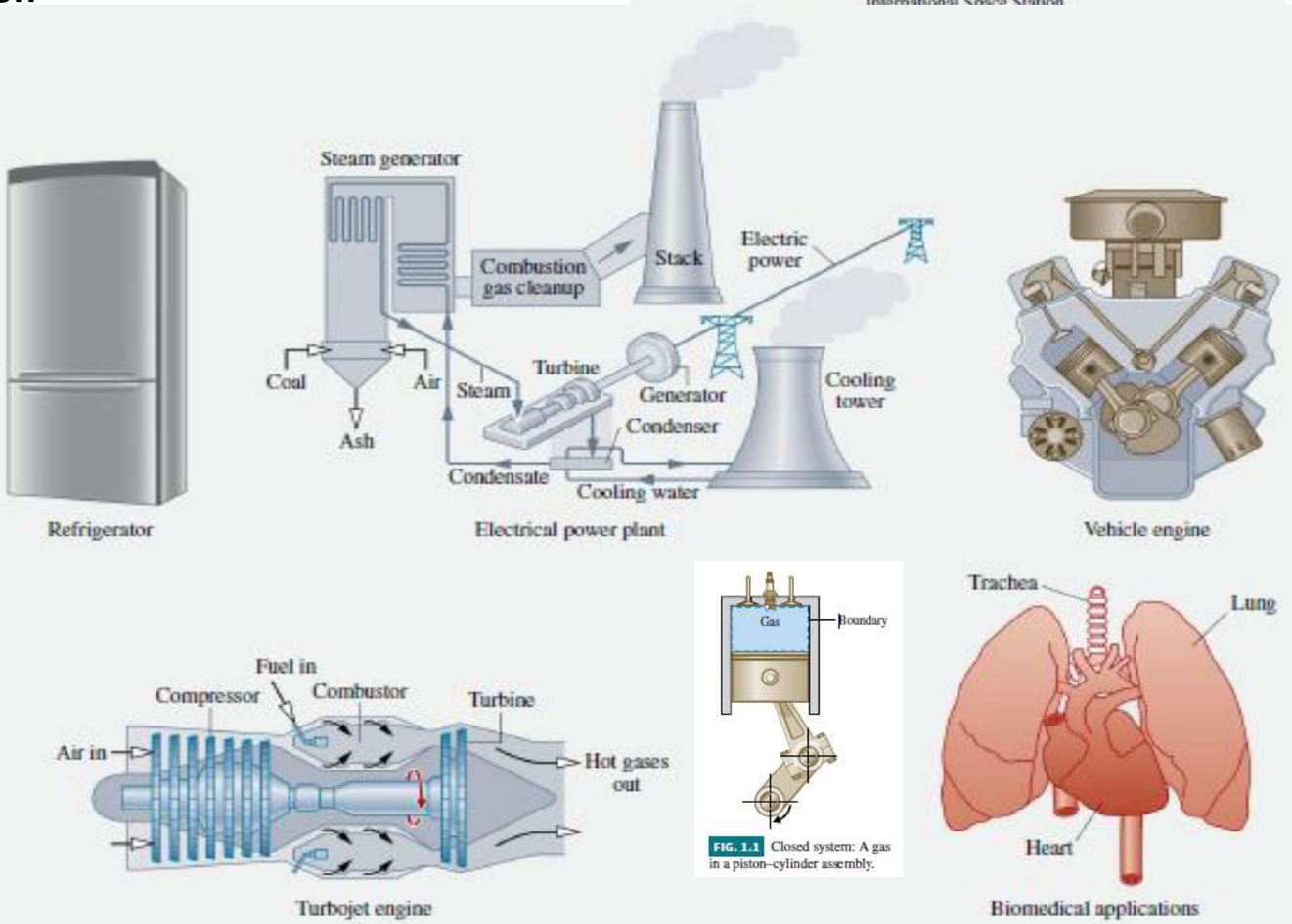
Energy and energy transformations, including power production, refrigeration, and relationships between the properties of matter.

Engineering thermodynamics is the subject that deals with the study of the science of thermodynamics and the usefulness of this science in the engineering design of processes, devices, and systems involving the effective utilization of energy and matter for the benefit of humankind.

1.3 Applications of Engineering Thermodynamics

Aircraft and rocket propulsion
Alternative energy systems
Fuel cells
Geothermal systems
Magnetohydrodynamic (MHD) converters
Ocean thermal, wave, and tidal power generation
Solar-activated heating, cooling, and power generation
Thermoelectric and thermionic devices
Wind turbines
Automobile engines
Bioengineering applications
Biomedical applications
Combustion systems
Compressors, pumps
Cooling of electronic equipment
Cryogenic systems, gas separation, and liquefaction
Fossil and nuclear-fueled power stations
Heating, ventilating, and air-conditioning systems
Absorption refrigeration and heat pumps
Vapor-compression refrigeration and heat pumps
Steam and gas turbines
Power production
Propulsion





1.4 Definition of thermodynamics

Thermodynamics may be defined as follows:

Thermodynamics is a clear science that deals with the relations between heat, work, and properties of systems that are in equilibrium. It describes the state and change in the state of a physical system.

Thermodynamics is *the science that deals with the interaction between energy and material systems.*

Thermodynamics basically includes four laws: Zeroth, First, Second, and Third law of thermodynamics.

❖ **The *First law* throws light on the concept of internal energy**

القانون الاول يلقي الضوء على الطاقة الداخلية

- **The Zeroth law deals with thermal equilibrium and establishes a concept of temperature**

يتعامل القانون الصفري مع التوازن الحراري ويؤسس مفهوم درجة الحرارة

- **The Second law indicates the limit of converting heat into work and introduces the principle of increase of entropy.**

يشير القانون الثاني الى حد تحويل الحرارة الى عمل ويقدم مبدأ زيادة الأنتروبيا

- **The Third law defines the absolute zero entropy.**

يحدد القانون الثالث أنتروبيا الصفر المطلق

These laws are based on experimental observations and have no mathematical proof. Like all physical laws, these laws are based on logical reasoning.

تستند هذه القوانين الى الملاحظات التجريبية وليس لها دليل رياضي، مثل جميع القوانين الفيزيائية تستند هذه القوانين الى التفكير المنطقي.