	Ministry of Higher Education and Scientific Research - Iraq University of Warith Al-Anbiyaa College of Engineering Aircraft Engineering Department	

MODULE DESCRIPTOR FORM

Module Information

Module Title	Thermodynamics I		**Module Delivery**	
Module Type	CORE			**Theory** **Lab** **Tutorial**
Module Code	ENG114			
ECTS Credits	7			
SWL (hr/sem)	175			
Module Level	1	**Semester of Delivery**	1	
Administering Department	**Aircraft Engineering**	**College**	**Engineering**	
Module Leader	Basim Sachit Attiya	**e-mail**	basim.sa@uowa.edu.iq	
Module Leader's Acad. Title	Assist. Lec.	**Module Leader's Qualification**	MSc.	
Module Tutor		**e-mail**		
Peer Reviewer Name		**e-mail**		
Review Committee Approval	26/09/2024	**Version Number**	2024	

Relation With Other Modules

Prerequisite module	None	**Semester**	
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents

Module Aims	1. This course deals with the fundamentals of Thermodynamics including thermodynamic systems and properties, and relationships among the thermos-physical properties. 2. Description of the substance and phases including the theories dealing with the analytical formulation of their properties. 3. Description of the thermal system and its surroundings with interaction characteristics between them. 4. Awareness of units and dimensions in standard systems of units. 5. Definition of Energy and its forms, transformation means and tools. 6. Mathematical formulation of the First and Second laws of thermodynamics, their limitations and applications of these basic laws in thermodynamic systems. 7. Application of the physical and mathematical concepts to thermodynamic processes and evaluating their impacts on performance and developing techniques.
Module Learning Outcomes	1. Identify fundamental concepts relevant to thermodynamics. 2. Students will know the definition of adiabatic, isobaric, isothermal and isometric processes. 3. Students will be familiar with the concept of a reversible engine and the Carnot cycle. 3. To understand and analyze the influence of fluid properties on the behaviour of engineering systems and to be able to analyze systems using the concepts of conservation of mass and energy. 4. Students will be able to find the maximum possible efficiency of heat engines and calculate the maximum coefficient of performance of a heat pump or refrigerator. 5. On successful completion of the module, students should be able to show experience and enhancement of discipline-specific practical skills in using appropriate modelling and analytical methods to solve thermodynamics problems. 6. To understand the thermodynamic behaviour of different fluids and their importance in a heat pump or a refrigerator. 7. An understanding of the everyday implications of the laws of thermodynamics and an ability to communicate these implications to a lay audience.
Indicative Contents	Indicative content includes the following: **<u>Part A - Basic concepts</u>** **- Systems of units & dimensions**. Force, Pressure. Mass, volume, sp. volume & density. **- Thermodynamic equilibrium.** Conditions of equilibrium, Temperature and the Zeroth law of thermodynamics.

Thermometers and Temperature scales. [4hrs]

- Energy:
Types of thermodynamic system.
Conventional and renewable sources of energy.Stored and transported energy. Internal energy. Potential and kinetic energy. Elastic energy (springs). [8hrs]
Heat energy and the Specific heat capacity. Work energy and Power.
Equivalent forms of work.Sign convention of heat & work.[8hrs]

- Properties of working substance:
Intensive & extensive properties. Single-phase system (Ideal gas), Equation of state for ideal gases, Real gas behavior.[4hrs]

Part B- First law of thermodynamics:
Conservation of energy principle, Statements of first law, Energy as system property, Non-flow energy equation, Practical applications of First law of thermodynamics. [4 hrs]

- Thermodynamic processes in closed system:
State function & path function. Constant volume process. Constant pressure process. Constant temperature process. Adiabatic &Polytropic process. [4hrs]
Flow systems:
Energy equation of flow systems. Steady & unsteady process.Boiler & condenser. Compressor & turbine. [8hrs]
Nozzle & diffuser.Throttling valves. [9hrs]
Reversible & irreversible process for flow systems (Frection, Temperature difference Free unrestrained explantion… etc.). [8hrs]

- Entropy:
Entropy & energy degradation, Entropy as system property.
Fundamental entropy equations. [8hrs]
Construction of (T – s) diagram for gases, Carnot cycle on (T – s) diagram.
General entropy equations for gases. [8hrs]
Entropy change in reversible processes.Entropy change in irreversible processes. [12hrs]

Part C- Second law of thermodynamics:
Relation between first & second laws, Statements of the second law.
Heat engine & thermal efficiency, Carnot power cycle, Work & efficiency in Carnot power cycle, Reversed heat engine & COP., Reversed Carnot cycle for cooling (Work and COP in Carnot cooling cycle).[12hrs]

Learning and Teaching Strategies	
Strategies	• Teaching Method 1 – Lectures (Description: Attendance Recorded: Yes) • Teaching Method 2 – Tutorials (Description: Attendance Recorded: Yes) • Teaching Method 3 – Practical (Description: Practical homework assignments. Attendance Recorded: No) • Teaching Method 4 – Unscheduled Directed Student Hours (time spent away from the timetabled sessions but directed by the teaching staff). • Teaching Method 5- Laboratory sessions(Providing experimental supplementary to promote the engineering sense of students)

Student Workload (SWL)			
Structured SWL (h/sem)	78	**Structured SWL (h/w)**	5
Unstructured SWL (h/sem)	97	**Unstructured SWL (h/w)**	6.5
Total SWL (h/sem)	175		

Module Evaluation					
		Time/ Number	**Weight (Marks)**	**Week Due**	**Relevant Learning Outcome**
Formative assessment	**Quizzes**	4	20% (20)	3, 6, 9, 12	LO #1-7
	Assignments	2	10% (10)	5, 10	LO #1-7
	Projects / Lab.	Lab. 5	10% (10)	Continuous	LO #1, 2, 3, 4, 5, 6
	Report	-	-	-	-
Summative assessment	**Midterm Exam**	2 hrs.	10% (10)	7	LO #1-7
	Final Exam	3 hrs.	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)	
	Material Covered
Week 1	**Basic concepts**: **Systems of units & dimensions**: Force, Pressure,Mass, volume, sp. volume & density.**Thermodynamic equilibrium**: Conditions of equilibrium, Temperature and the

	Zeroth law of thermodynamics, Thermometers and Temperature scales.
Week 2	**Energy:** Types of thermodynamic system, Conventional and renewable sources of energy, Stored and transported energy, Internal energy, Potential and kinetic energy, Elastic energy (springs).
Week 3	Heat energy and the Specific heat capacity,Work energy and Power, Equivalent forms of work, Sign convention of heat & work.
Week 4	**Properties of working substance:** Intensive & extensive properties, Single-phase system (Ideal gas), Equation of state for ideal gases, Real gas behavior.
Week 5	**First law of thermodynamics:** Conservation of energy principle, Statements of first law, Energy as system property, Non-flow energy equation, Practical applications of First law of thermodynamics.
Week 6	**Thermodynamic processes in closed system:** State function & path function, Constant volume process, Constant pressure process.
Week 7	Constant temperature process, Adiabatic &Polytropic process.
Week 8	**Flow systems:** Energy equation of flow systems, Steady & unsteady process, Boiler & condenser, Compressor & turbine.
Week 9	Nozzle & diffuser, Throttling valves, Reversible & irreversible process for flow systems (Friction, Temperature difference, Free unrestrained expansion… etc.).
Week 10	**Entropy:** Entropy & energy degradation, Entropy as system property, Fundamental entropy equations.
Week 11	Construction of (T – s) diagram for gases, Carnot cycle on (T – s) diagram, General entropy equations for gases.
Week 12	Entropy change in reversible processes, Entropy change in irreversible processes.
Week 13	**Second law of thermodynamics:** Relation between first & second laws, Statements of the second law, Heat engine & thermal efficiency.
Week 14	Carnot power cycle, Work & efficiency in Carnot power cycle.
Week 15	Reversed heat engine & COP, Reversed Carnot cycle for cooling (Work and COP in Carnot cooling cycle).
Week 16	**Preparatory week before the Final Exam**

Delivery Plan (Weekly Lab. Syllabus)	
	Material Covered
Week 1	Exp. 1: Boyle's Law
Week 2	Exp. 2: Gas thermometer
Week 3	Exp. 3: Specific Heat
Week 4	Exp. 4: Ratio of specific heat

Week 5	Exp. 5: Reversed heat engine
Week 6	Exp. 6: Calorific value of gaseous fuel
Week 7	Exp. 7:

Learning and Teaching Resources

	Text	Available in the Library?
Required Texts	Yuns A. and Michael A. Boles and Mehmet Kanoğlu, "Thermodynamics: An Engineering Approach", 10th Edition., 2024, ISBN 978-1-266-15211-5	Yes
	Rajput, R. K. A textbook of engineering thermodynamics. Laxmi Publications, 2005.	Yes
Recommended Texts	Estop T. and McConckyA., "Applied thermodynamics for engineering technologists", 2008.	Yes
Websites	--	

APPENDIX:

GRADING SCHEME				
Group	**Grade**	التقدير	**Marks (%)**	**Definition**
Success Group (50 - 100)	**A** - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	**FX** – Fail	مقبول بقرار	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required

Note:

NB Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.