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

MODULE DESCRIPTOR FORM
نموذج وصف المادة الدراسية

Module Information
معلومات المادة الدراسية

Module Title	Thermodynamics II	**Module Delivery**	
Module Type	CORE	**Theory** **Lab** **Tutorial**	
Module Code	AIE233		
ECTS Credits	5		
SWL (hr/sem)	125		
Module Level	2	**Semester of Delivery**	3
Administering Department	Aircraft Engineering	**College**	Engineering
Module Leader	Basim Sachit Atiyah	**e-mail**	basim.sa@uowa.edu.iq
Module Leader's Acad. Title	Asst. Lec.	**Module Leader's Qualification**	MSc
Module Tutor	None	**e-mail**	None
Peer Reviewer Name		**e-mail**	
Review Committee Approval	01/06/2024	**Version Number**	2024

Relation With Other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	AIE114	**Semester**	1
Co-requisites module	None	**Semester**	

Module Aims, Learning Outcomes and Indicative Contents
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Aims أهداف المادة الدراسية	Definition of the second stage students in the Mechanical Engineering Department concepts of science thermodynamic. 1. To develop rules for determining gas mixture properties from knowledge of mixture composition and the properties of the individual components. 2. To define the quantities used to describe the composition of a mixture such as mass fraction, molar fraction, and volume fraction. 3. To understand the concept of pure substance and phase; the process of steam generation and properties of steam; analysis the process of steam; determination of dryness fraction of wet steam and apply the accounts as well as the use of steam and steam schemes. 4. To perform analysis of thermodynamic steam and gas cycles (e.g., Carnot, Rankine, and Brayton cycles). 5. To perform psychrometric analysis for heating/cooling processes. 6. To explain the working and calculations of single and multi-stage reciprocating compressor; clearance volume; volumetric efficiency.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Able to understand the concept of mole and mass fraction; partial pressure; Daltons law of partial pressure, and to setup the relation between partial pressure, mole fraction and volume fraction; the relations for gas constant, molecular mass, specific heats, and entropy of the gas mixture. 2. Able to use steam tables and charts as well as tables and charts cooling. Also, how to work the accounts of steam and use steam schemes. 3. Able to identify the components or parts of steam and gas stations . 4. Able to identify the application of the equations for the flow of energy to the stable parts of the plant steam. 5. Able to know the basic thermodynamic calculations on steam and gas cycles. 6. Able to perform psychrometric analysis for heating/cooling processes.

	7. Able to identify all parts of reciprocating air compressors and rotary as well as the accounts.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. Part A - **Mixtures of gases** Physical mixing of pure substances, Avogadro's hypothesis, The mole and the molecular properties, Dalton's law of partial pressures Gibbs-Dalton law of apparent properties of mixture (u,h,s), Volumetric analysis, Gravimetric analysis, Average properties of mixture. [12hrs] Part B - **Two-Phase system** Phase change process, Basic definitions, Property diagram and tables Fundamentals - **Processes on Two-Phase system:** Constant volume process, Constant pressure process, Constant temperature process, Polytropic process, Isentropic process. [4hrs] - **Steady flow devices**: Boiler and Condenser, Nozzle and Diffuser, Turbine and Compressor, Mixing chamber. [4hrs] - **Throttling:** Throttling process, Measurement of steam quality, Separating and throttling calorimeters, Combined calorimeter. [5hrs] Part C - **Power production cycle by Vapour** Concept of heat engine and Criteria of cycle performance, Carnot cycle for a vapour. [4hrs] **Simple Rankine steam power cycle**, Deviation of actual Rankine steam power Cycle from Idealized One. [10hrs] Part D - **Air standard cycles** Configuration of reciprocating engine, Air standard approximation, Carnot power cycle, Otto standard cycle, Diesel standard cycle, Dual (Mixed) standard cycle, Mean effective pressure, Simple gas turbine cycle (Joule-Brayton cycle), Deviation of actual gas-turbine cycle from idealized one. [14hrs] Part E - **Psychrometrics:** Gas-vapour mixtures, Characteristics of humid air, Adiabatic saturation, Psychrometric chart. [7hrs] Part F - **Reciprocating air compressors:** Description of reciprocating components, Indicated power input, Condition of minimum work and Isothermal efficiency, Effect of clearance volume and volumetric efficiency, Actual indicator diagram, Inter-cooling in multi-stage compressor, Steady flow analysis of a compressor. [14hrs]

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

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	63	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	62	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.2
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	125		

Module Evaluation
تقييم المادة الدراسية

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

Delivery Plan (Weekly Syllabus) المنهاج الاسبوعي النظري	
	Material Covered
Week 1	**Mixtures of gases:** Physical mixing of pure substances, Avogadro's hypothesis, The mole and the molecular properties, Dalton's law of partial pressures
Week 2	Gibbs-Dalton law of apparent properties of mixture (u,h,s), Volumetric analysis, Gravimetric analysis, Average properties of mixture
Week 3	**Two-Phase system:** Phase change process, Basic definitions, Property diagram and tables
Week 4	**Processes on Two-Phase system:** Constant volume process**,** Constant pressure process**,** Constant temperature process**,** Polytropic process**,** Isentropic process
Week 5	**Steady and unsteady flow processes:** Application of steady unsteady flow energy equation: **Steady flow devices**: Boiler and Condenser, Nozzle and Diffuser, Turbine and Compressor, Mixing chamber
Week 6	**Throttling:** Throttling process, Measurement of steam quality**,** Separating and throttling calorimeters, Combined calorimeter
Week 7	**Power production cycle by Vapour:** Concept of heat engine and Criteria of cycle performance, Carnot cycle for a vapour.
Week 8	**Simple Rankine steam power cycle**, Deviation of actual Rankine steam power Cycle from Idealized One
Week 9	**Air standard cycles:** Configuration of reciprocating engine, Air standard approximation, Carnot power cycle.
Week 10	Otto standard cycle.
Week 11	Diesel standard cycle, Dual (Mixed) standard cycle, Mean effective pressure.
Week 12	Simple gas turbine cycle (Joule-Brayton cycle), Deviation of actual gas-turbine cycle from idealized one
Week 13	**Psychrometrics:** Gas-vapour mixtures, Characteristics of humid air, Adiabatic saturation, Psychrometric chart.
Week 14	**Reciprocating air compressors:** Description of reciprocating components, Indicated power input, Condition of minimum work and Isothermal efficiency.
Week 15	Effect of clearance volume and volumetric efficiency, Actual indicator diagram, Inter-cooling in multi-stage compressor, Steady flow analysis of a compressor.
Week 16	**Final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Exp. 1: Thermodynamic relation between the saturation pressure and temperature for the pure water.
Week 2	Exp. 2: Measuring the dryness fraction for wet steam.

Week 3	Exp. 3: Study the performance of the steam power plant. Part-1.
Week 4	Exp. 4: Study the performance of the steam power plant. Part-2.
Week 5	Exp. 5: Energy balance of two-stage reciprocating air compressor.
Week 6	Exp. 6:
Week 7	Exp. 7:

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	➢ Yunus A. Cengel Michael A. Boles, "Thermodynamics An Engineering Approach" Fifth Edition, 2006.	Yes
	➢ Rajput, R. K. A textbook of engineering thermodynamics. Laxmi Publications, 2005.	Yes
Recommended Texts	➢ Estop T. and McConckyA., "Applied thermodynamics for engineering technologists", 2009. ➢ Roger's & Mayhew, "Engineering thermodynamics work and heat transfer", 4th Edition, 1992. ➢ Michael J. Moran, Howard N. Shapiro, Daisie D. Buettner, Margaret B. Bailey, "Fundamentals of Engineering Thermodynamics", 5th Edition, 2006.	Yes
Websites		

APPENDIX:

GRADING SCHEME
مخطط الدرجات

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.