Northern Technical University
College of Oil & Gas Techniques Engineering/Kirkuk
Department of Renewable Energy Techniques Engineering

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية				
Module Title	**Thermodynamics**			
Module Type	**Core**		☒Theory ☐ Lecture ☒ Lab ☒ Tutorial ☐ Practical ☐ Seminar	
Module Code	**RETE 104**			
ECTS Credits	**9**			
SWL (hr/sem)	**225**			
Module Level	1	Semester of Delivery	2	
Administration Department	RETE	College	College of Oil & Gas Techniques Engineering/Kirkuk	
Module Leader	Naseer Tawfeeq Alwan	e-mail	naseer.t.alwan@ntu.edu.iq	
Module Leader's Acad. Title	Lecturer	Module Leader's Qualification	PhD	
Module Tutor	Name (if available)	e-mail		
Peer Reviewer Name		e-mail		
Scientific Committee Approval Date	14/09/2023	Version Number	1	

Relation with other Modules
العلاقة مع المواد الدراسية الأخرى

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

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

Module Aims **أهداف المادة الدراسية**	1. Understanding energy and its transformation: Thermodynamics deals with the study of energy and its conversion from one form to another. By studying thermodynamics, engineers gain a fundamental understanding of how energy behaves and can be manipulated. 2. Analyzing and optimizing energy systems: Engineers use thermodynamics to analyze and optimize the performance of energy systems, such as power plants, engines, refrigeration systems, and HVAC systems. They can determine the efficiency, energy transfer rates, and overall performance of these systems, leading to improvements in design and operation. 3. Designing and improving energy-related devices: Thermodynamics provides engineers with the knowledge necessary to design and improve energy-related devices, including combustion engines, turbines, heat exchangers, and renewable energy systems. By understanding the principles of thermodynamics, engineers can enhance the efficiency, reliability, and sustainability of these devices.
Module Learning Outcomes **مخرجات التعلم للمادة الدراسية**	(LO1) describe basic concepts of Thermodynamics • restate definition of system, surrounding, closed and open system, extensive and intensive properties. • calculate absolute and gage pressure, and absolute temperature. • calculate changes in kinetic, potential, enthalpy and internal energy. (LO2) arrange the ideal and real gas equations of state. (LO3) formulate the first law of thermodynamics for a closed systems and arrange the change in energy in the closed systems via heat and work transfer. (LO4) apply first law of thermodynamics for closed systems and construct conservation of mass and energy equations.

	(LO5) formulate the first law of thermodynamics for a closed systems and arrange the change in energy in the closed systems via heat and work transfer. (LO6) apply the first law of thermodynamics to the open systems. • describe steady-flow open system. • apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow. (LO7) judge the properties of pure substances • judge the state of the pure substances such as compressed liquid, saturated liquid-vapor mixture and superheated vapor using property diagrams and tables. (LO7) assess thermodynamic applications using second law of thermodynamics. • calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps. • restate perpetual-motion machines, reversible and irreversible processes. (LO8) On successful completion of the module, students should be able to show experience and enhancement of discipline-specific practical skills in carrying out Level 1 practical exercises in Thermodynamics following instruction, using test and measurement equipment and techniques, collecting and recording data, estimating accuracy, assessing errors, and using safe systems of work. (LO9) Problem solving skills (LO10) Numeracy (LO11) Communication skills (LO12) IT skills
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. • Conservation of Energy: The total energy of an isolated system remains constant over time. The energy may change its form or be transferred between different components of the system, but the total energy within the system remains constant. • The ideal gas is a theoretical model that simplifies the behavior of gases under certain conditions. While real gases deviate from ideal behavior at high pressures and low temperatures, the ideal gas concept provides a useful framework for understanding gas properties • Ideal Gas Law: The ideal gas law is an equation that relates the pressure (P), volume (V), temperature (T), and number of moles (n) of an ideal gas. It can be expressed as PV = nRT, where R is the ideal gas constant. This equation shows that, at a constant temperature, the product of pressure and volume is proportional to the number of moles of gas.

	• Boyle's Law: Boyle's law describes the relationship between the pressure and volume of an ideal gas at constant temperature. It states that the pressure of an ideal gas is inversely proportional to its volume: P1V1 = P2V2. • Charles's Law: Charles's law relates the volume and temperature of an ideal gas at constant pressure. It states that the volume of an ideal gas is directly proportional to its absolute temperature: V1/T1 = V2/T2. • Avogadro's Law: Avogadro's law states that equal volumes of different gases, at the same temperature and pressure, contain an equal number of molecules. It implies that the volume of an ideal gas is directly proportional to the number of moles of the gas: V1/n1 = V2/n2. • Energy Conservation Equation: The first law can be mathematically expressed using the energy conservation equation. It states that the change in internal energy of a system is equal to the heat added to the system minus the work done by the system: ΔU = Q - W, where ΔU represents the change in internal energy, Q represents the heat added to the system, and W represents the work done by the system. • The second law of thermodynamics is a fundamental principle in thermodynamics that governs the direction and limitations of energy transfer and conversion. • The second law sets an upper limit on the efficiency of heat engines, which are devices that convert heat energy into mechanical work. The Carnot efficiency represents the maximum efficiency that can be achieved by an ideal heat engine operating between two temperature extremes. It depends only on the temperatures of the heat source and heat sink and is given by (T1 - T2) / T1, where T1 is the temperature of the heat source and T2 is the temperature of the heat sink.

Learning and Teaching Strategies **استراتيجيات التعلم والتعليم**	
Strategies	Teaching Method 1 – Lectures Description: Attendance Recorded: Yes Teaching Method 2 – Asynchronous on-line course materials Description: Podcasts, videos and articles in thermodynamics Attendance Recorded: No Unscheduled Directed Student Hours (time spent away from the timetabled sessions but directed by the teaching staff). Teaching Method 3 - Tutorials

	Description: Attendance Recorded: Yes Teaching Method 4 - Practical Description: Practical homework assignments Attendance Recorded: No Unscheduled Directed Student Hours (time spent away from the timetabled sessions but directed by the teaching staff).

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	108	Structured SWL (h/w) الحمل الدراسي المنتظم للطالب أسبوعيا	7.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	117	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطالب أسبوعيا	7.8
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	225		

Module Evaluation
تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	5	10% (10)	3,5,7,9,11 and 15	LO #2, #3,#5,#7,#9 and #11
	Assignments	5	10% (10)	2,6,8 and 12	LO #1, #4, #6and #10
	Projects / Lab.	4	20% (10)	Continuous	All
	Report				
Summative assessment	Midterm Exam	2 hr	10%(10)	7	LO #1 - #5
	Final Exam	3 hr	50%(50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

Week 1	Definition of energy – kinetic & potential energies –work – power flow & internal energy – enthalpy- energy diagram
Week2	Definition of state – property, process – property diagrams -1st law of thermo dynamic, (P- V) diagram.
Week3	Ideal gases – ideal gasses laws (boyle , Charles , Gaylosic), gas constant – Avogadro law specific heat at constant volume &pressure
Week4	Energy analysis of closed system , particular closed system processes – constant volume , constant pressure and constant temperature process.
Week5	Particular closed system processes – adiabatic and polytrophic processes
Week6	Mass and energy analysis of control systems
Week7	Properties of pure substances and Phase change process of pure substances
Week8	Steam formation process, Dryness fraction ,Liquid line ,Steam line and Wet steam
Week9	Calculation of steam ,steam table
Week 10	Steam process with drawing each processes on (P-V)diagram
Week 11	Second law of thermodynamic Statement of (Kelvin, Planck & Clausius statement)
Week 12	Heat engine , Refrigerator and Heat pump
Week 13	Carnot and reverse Carnot cycle
Week 14	Entropy , Entropy change of ideal gases and isentropic process
Week 15	Entropy change of pure substances and Isentropic efficiencies of steady-flow devices

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Applied Thermodynamics for engineering technology By T.D. EASTOP	Yes
Recommended Texts	Thermodynamics An engineering approach By Yunus A. Cengel	Yes
	Fundamentals of engineering thermodynamics By Michael J. Moran	No

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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	راسب (قيد المعالجة)	45-49	More work required but credit awarded
	F – Fail	راسب	0-44	Considerable amount of work required

Note: Marks 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.