MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Thermodynamics-2**			**Module Delivery**	
Module Type	**C**			☒ **Theory** ☒ **Lecture** ☒ **Lab** ☒ **Tutorial** ☒ **Practical** ☐ **Seminar**	
Module Code	**UOMU0206042**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	2		**Semester of Delivery**	4	
Administering Department	**Fuel and Energy Techniques Engineering**		**College**	**Technical Engineering College**	
Module Leader	Hussein Kadhim Halwas		**e-mail**	hussein.kadhim@uomus.edu.iq	
Module Leader's Acad. Title	Lecturer		**Module Leader's Qualification**	PhD in Mechanical Engineering	
Module Tutor			**e-mail**		
Peer Reviewer Name			**e-mail**		
Scientific Committee Approval Date			**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. To discuss the study of Power cycles; Refrigeration and liquefaction process 2. To analyze Theory and application of solution thermodynamics ;Vapor/liquid equilibrium in both 3. To explain binary and multicomponents; Ideal and non-ideal solutions are discussed using Raoult's and modified 4. To explain Raoult's law; Fugacity and fugacity coefficient definitions; Chemical reaction equilibriumand 1. To explain Thermodynamic analysis of processes.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Ability to discuss the study of Power cycles; Refrigeration and liquefaction process 2. Ability to analyze Theory and application of solution thermodynamics ;Vapor/liquid equilibrium in both 3. Ability to explain binary and multicomponents; Ideal and non-ideal solutions are discussed using Raoult's and modified 4. Ability to explain Raoult's law; Fugacity and fugacity coefficient definitions; Chemical reaction equilibriumand 5. Ability to To explain Thermodynamic analysis of processes.
Indicative Contents المحتويات الإرشادية	**Properties of Solutions** Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, gibbs-duhem equation [12 hrs.] **Phase Equilibria** Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity [10 hrs.] **Correlation of Phase Equilibria** Activity coefficient-composition models, thermodynamic consistency of phase equilibria [10 hrs.] **Chemical Reaction Equilibria** The reaction coordinate, standard Gibbs-energy change, equilibrium constant, effect of temperature on equilibrium constant [12 hrs.]

	Cycle Carnot refrigeration cycle; air refrigeration cycle; vapor compression cycles; comparison of refrigeration cycles absorption refrigeration, [8 hrs.]

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	Type something like: The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises are 1. Teamwork 2. Visualization 3. Inquiry-Based Teaching 4. Student-led Classroom 5. Implementing Technology in the Classroom 6. Auditory strategies 7. Reading & Writing

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	74	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	106	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	7
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	180		

Module Evaluation

تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5, 10	LO #1, 2, 10 and 11
	Assignments	2	10% (10)	2, 12	LO # 3, 4, 6 and 7
	Projects / Lab.	1	10% (10)	Continuous	
	Report	1	10% (10)	13	LO # 5, 8 and 10
Summative assessment	Midterm Exam	2 hr	10% (10)	7	LO # 1-7
	Final Exam	2hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered
Week 1	fugacity and fugacity coefficients of real gases standard states definition and choice,
Week 2	Properties of Solutions Partial molar properties ideal and non-ideal solutions
Week 3	gibbs-duhem equation excess properties of mixtures
Week 4	Phase Equilibria Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity
Week 5	application of phase rule vapor-liquid equilibrium,
Week 6	phase diagrams for homogeneous systems and for systems with a miscibility gap effect of temperature and pressure on azeotrope composition
Week 7	liquid-liquid equilibrium ternary liquid-liquid equilibrium.
Week 8	Correlation of Phase Equilibria Activity coefficient-composition models, thermodynamic consistency of phase equilibria, application of the correlation and prediction of phase equilibria in systems of engineering
Week 9	interest particularly to distillation and liquid extraction processes.
Week 10	Chemical Reaction Equilibria The reaction coordinate

	standard Gibbs-energy change
Week 11	equilibrium constant effect of temperature on equilibrium constant,
Week 12	relation of equilibrium constants to composition(gas phase reaction and liquid phase), equilibrium conversion, multireaction equilibria
Week 13	Cycle Carnot refrigeration cycle air refrigeration cycle
Week 14	vapor compression cycles comparison of refrigeration cycles absorption refrigeration
Week 15	heat pump liquefaction processes.
Week 16	Preparatory week before the final Exam

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Specific heat of water
Week 2	Specific heat of metal
Week 3	Heat pump
Week 4	Chemical Reaction Equilibrium
Week 5&6	Refrigeration
Week 7	

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	[1] Abbott, Michael M., Joseph M. Smith, and Hendrick C. Van Ness. "Introduction to chemical engineering thermodynamics." McGraw-Hill. [2] Elliott, J. Richard, and Carl T. Lira. "Introductory chemical engineering thermodynamics". Upper Saddle River, NJ: Prentice	yse

	Hall PTR. [3] Narayanan, K. V.A chemical engineering thermodynamics. PHI Learning Pvt. Ltd..	
Recommended Texts		
Websites		

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.