

	Ministry of Higher Education and Scientific Research - Iraq University of Warith Al-Anbiyaa College of Advanced Technologies Department of Refrigeration and Air Conditioning Techniques Engineering	
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MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	Refrigeration Systems		Module Delivery
Module Type	C		☐ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar
Module Code	HVAC-405		
ECTS Credits	12		
SWL (hr/sem)	300		
Module Level	4	Semester of Delivery	
Administering Department	BSC-HVAC	College	Advanced Technologies
Module Leader	Rassol Hamed Rasheed	e-mail	rassol.ha@uowa.edu.iq
Module Leader's Acad. Title	Asst. Lect	Module Leader's Qualification	M.sc.
Module Tutor	None	e-mail	E-mail S
Peer Reviewer Name		e-mail	
Scientific Committee Approval Date	13 / 6/2026	Version Number	1.0

Relation with other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	MPAC205	Semester	L2,S1
Co-requisites module		Semester	

Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Aims	1. Enhance the students' knowledge of the principles of vapor compression refrigeration systems and its analysis. 2. Provide the students the basic design of all components for vapor refrigeration system 3. Studying types of refrigeration units and cryogenic refrigeration.
Module Learning Outcomes	Upon completion of the course, students should be able to: 1. To understand the principles of work of refrigeration systems, and main advantages, disadvantages and application of each them. 2. To investigate the general design of condenser, evaporator, expansion device and cooling tower 3. To understand the basic calculations of the all type of refrigeration systems.
Indicative Contents	Indicative content includes the following: Condensers and Evaporators: Condensers and evaporators as heat exchangers, overall heat transfer coefficients, heat transfer and pressure drop for the fluid flow in heat exchanger tubes and shell. Extended surfaces, Heat transfer and pressure drop for air side. Required condensing capacity, condensing coefficient, fouling factor, de-super heating, condenser design, Wilson plots, air and non-condensable gases. Evaporators, Boiling in the shell, boiling inside tube, evaporators performance, pressure drop in tubes, frost. [10 hrs] Expansion devices: Purpose and types of expansion devices, capillary tube, selection of capillary tube ,analytical computation of pressure drop in capillary tube, increment length, choked flow graphical method of capillary tube selection ,Constant pressure expansion valve, controlling of super-heating in thermostatic expansion valve [3 hrs] Vapor compression refrigeration system Analysis: balance point and system simulation, reciprocating compressors, condenser performance, condensing unit system mathematical and graphical analysis, evaporator performance, performance of complete

	system graphical and mathematical analysis, some performance trends, the expansion devices, sensitivity analysis. [5 hrs] Cooling towers and evaporative condensers: Heat rejected to atmosphere, cooling towers, analysis of counter flow cooling tower, stepwise integration, acceptance test, predicting outlet conditions from tower, air conditions through tower, evaporative condensers, when using a cooling tower and evaporative condensers. [4 hrs] Absorption refrigeration system: relation between vapour compression and absorption refrigeration units, the absorption refrigeration system, temperature and concentration properties of LiBr-water solution, calculations of mass flow rates in the absorption cycle, enthalpy of LiBr-water solutions, thermal analysis of simple cycle, absorption cycle with heat exchanger, crystallization, capacity control, aqua-ammonia system . [4 hrs] Adsorption system : the relation between adsorption and absorption, absorption and vapour compression cycle, the analysis of adsorption system, mathematical analysis of the adsorption system . Steam jet refrigeration: system components, analysis of steam jet refrigeration system, approximation analysis, equilibrium concentration. [5 hrs] Air refrigeration system : the working principle of the cycle, design considerations, atmosphere temperature, humidity and pressure, load calculation, refrigeration, heating, temperature control, ventilation, pressure control of zone, types of air system. [5 hrs] Thermoelectric refrigeration: working principle, types of thermoelectric refrigeration systems, electro-acoustic refrigeration, working principle, types. [5 hrs] Cryogenic and liquefaction of gases: Cryogenic, Joule-Thomson effect, air liquefaction by Hopson system (Joule-Thomson expansion). Temperature entropy diagram for air, calculation of work required for gas compression , Claude system, cascade system, general consideration for gas liquefaction, Hydrogen , Pre-Cooling system for air liquefaction, Helium [4 hrs] Vortex tube: Types and working principle. Heat Pipe: Types and working principle. [3 hrs]
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Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	Assessment is based on hand-in assignments, Written exam, Quizzes, Tutorial, Seminars, Reports.
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Student Workload (SWL)			
الحمل الدراسي للطالب			
Structured SWL (h/sem)	158	Structured SWL (h/w)	11
Unstructured SWL (h/sem)	92	Unstructured SWL (h/w)	10
Total SWL (h/sem)	250		

Module Evaluation					
تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	4	20% (20)	3,7,9,13	LO #1-13
	Assignments	1	10% (10)	7	LO # 5,12
	Seminar	2	10% (10)	4,11	LO # 10,12
Summative assessment	Midterm Exam	2 hr	10% (10)	7	LO # 1-7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الأسبوعي النظري محتوى كل أسبوع يجب ان يغطي الوقت المحدد

	Material Covered
Week 1	Condensers and Evaporators: Condensers and evaporators as heat exchangers, overall heat transfer coefficients, heat transfer and pressure drop for the fluid flow in heat exchanger tubes and shell.
Week 2	Extended surfaces, Heat transfer and pressure drop for air side. Required condensing capacity, condensing coefficient, fouling factor, de-super heating, condenser design, Wilson plots, air and non-condensable gases
Week 3	Evaporators, Boiling in the shell, boiling inside tube, evaporators performance, pressure drop in tubes, frost.
Week 4	Expansion devices: Purpose and types of expansion devices, capillary tube, selection of capillary tube ,analytical computation of pressure drop in capillary tube, increment length, choked flow graphical method of capillary tube selection ,Constant pressure expansion valve, controlling of super-heating in thermostatic expansion valve
Week 5	Vapor compression refrigeration system Analysis: balance point and system simulation, reciprocating compressors, condenser performance, condensing unit system mathematical and graphical analysis, evaporator performance, performance of complete system graphical and mathematical analysis, some performance trends, the expansion devices, sensitivity analysis.
Week 6	Cooling towers and evaporative condensers: Heat rejected to atmosphere, cooling towers, analysis of counter flow cooling tower, stepwise integration, acceptance test, predicting outlet conditions from tower, air conditions through tower, evaporative condensers, when using a cooling tower and evaporative condensers.
Week 7	Absorption refrigeration system: relation between vapour compression and absorption refrigeration units, the absorption refrigeration system, temperature and concentration properties of LiBr-water solution, calculations of mass flow rates in the absorption cycle, enthalpy of LiBr-water solutions, thermal analysis of simple cycle, absorption cycle with heat exchanger, crystallization, capacity control, aqua-ammonia system .

Week 8	Adsorption system : the relation between adsorption and absorption, absorption and vapour compression cycle, the analysis of adsorption system, mathematical analysis of the adsorption system .
Week 9	Steam jet refrigeration: system components, analysis of steam jet refrigeration system, approximation analysis, equilibrium concentration.
Week 10	Air refrigeration system : the working principle of the cycle, design considerations, atmosphere temperature, humidity and pressure, load calculation, refrigeration, heating, temperature control, ventilation, pressure control of zone, types of air system.
Week 11	Thermoelectric refrigeration: working principle, types of thermoelectric refrigeration systems, electro-acoustic refrigeration, working principle, types.
Week 12	Cryogenic and liquefaction of gases: Cryogenic, Joule-Thomson effect, air liquefaction by Hopson system (Joule-Thomson expansion)
Week 13	Temperature entropy diagram for air, calculation of work required for gas compression , Claude system, cascade system, general consideration for gas liquefaction, Hydrogen , Pre-Cooling system for air liquefaction, Helium
Week 14	Vortex tube: Types and working principle.
Week 15	Heat Pipe: Types and working principle.

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الأسبوعي للمختبر

	Material Covered
Week 1-15	Project

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?

Required Texts	➤ Refrigeration and air condition, second edition , W. F. Stocker and J. W. Jones ➤ REFRIGERATION AND AIR CONDITIONING --- Ramesh Chandra Arora ➤ A textbook of refrigeration and air condition, R. S. Khurmi and J. K. Gupta	yes
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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.

العميد : ا.م.د. علي باسم




استاذ المادة: م.م. رسول حمد رشيد

التاريخ: 31-8-2026

رئيس القسم: ا.م.د. محمد حسن عبود

التاريخ : 31-8-2026