Module Information
معلومات المادة الدراسية

Module Title	**Fundamentals of Air Conditioning and Refrigeration**	**Module Delivery**	
Module Type	**C**	☐**Theory** ☒**Lecture** ☒**Lab** ☐**Tutorial** ☐**Practical** ☐**Seminar**	
Module Code	UOMU021041		
ECTS Credits	**14**		
SWL (hr/sem)	**350**		

Module Level	2	**Semester of Delivery**	2
Administering Department	Mechanical Power Eng. Dep.	**College**	TCB
Module Leader	Dr. assam mohie	**e-mail**	assam.mohie@ uomus.edu.iq
Module Leader's Acad. Title	Lecturer	**Module Leader's Qualification**	Ph.D.
Module Tutor	Name (if available)	**e-mail**	E-mail
Peer Reviewer Name	Dr. assam mohie	**e-mail**	
Scientific Committee Approval Date	20 / 6/2023	**Version Number**	1.0

Relation with other Modules
العلاقة مع المواد الدراسية الأخرى

Prerequisite module	MPAC108	**Semester**	L1, S2
Co-requisites module		**Semester**	

Module Aims, Learning Outcomes and Indicative Contents أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Aims أهداف المادة الدراسية	1. Introduce the student to the basic processes of refrigeration and conditioning 2. Identifying the properties of air and the processes that take place on the moisture content of air. 3. Learn about the different cooling media and how to use their tables and curves. 4. Learn about the refrigeration compression system and its accessories
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1- The student will be able to complete basic operations calculations on the content of moisture air content 2- The student will be able to determine the internal and external conditions for the design of the air conditioning system according to the conditions of human comfort. 3- The student will be able to complete all the operations of the compression refrigeration system, its components and accessories.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. <u>Part A – Air Conditioning</u> The basic properties of a mixture of air and water vapor: components of atmospheric air, general equation of gases, Dalton's law of partial pressures, saturated vapor pressure, water vapor pressure in moist air, relative humidity, moisture content, humidification percentage, dew point, enthalpy, The psychometric scheme and adaptation processes: a general explanation of the psychometric chart and the basis for its construction. [15 hrs] Sensible cooling, sensible heating, dehumidification, humidification by water injection, adiabatic humidification, humidification efficiency, humidification by constant wet bulb temperature, contact factor, and bypass factor. [15 hrs] Humidification by steam injection, adiabatic air mixing, cooling, and dehumidification with reheating, preheating with humidification and reheat. [10 hrs]

	Air mixing and adiabatic humidification with reheating, summer cycle and winter cycle, practical applications for the case of summer, and practical applications for the case of winter. [15 hrs] Selection of supplied air conditions: removal of sensible heat, specific heat capacity of moisture air, removal of latent heat, inclination of the sensible heat ratio line, heat generated by fan motors, waste reheating, selection of appropriate air supply conditions [6 hrs] <u>Part B – Refrigeration cycle</u> Fundamentals Refrigerants, types of old and modern refrigerants, side effects of refrigerants on the ozone layer and global warming, secondary refrigerants, concept of refrigeration: uses of refrigeration and refrigeration methods, second law of thermodynamics, heat pump, reverse Carnot cycle, simple vapor compression cycle, simple vapor compression cycle parts.. [15 hrs] Mathematical analysis of the simple vapor compression cycle, the factors affecting the performance parameter of the vapor compression cycle (the impact of suction temperature, the impact of condensation temperature, the impact of sub-cooling, the impact of superheating, and the impact of pressure losses). Theoretical vapor compression cycle and its comparison with the real one, Improving the vapor compression cycle, Using flash tank, Supercooling of refrigerant.. [7 hrs] Multistage compression: flash gas removal, intercooler, one evaporator and one compressor, two evaporators and one compressor, two compressors and one evaporator. multi-stage compression: two compressors and evaporators, multi-stage compression with several types of inter-cooling (water intercooler, liquid flash intercooler, flash gas intercooler) [15 hrs] Vapor Compression refrigeration cycle components: compressors type, positive displacement compressors, reciprocating compressors, volumetric efficiency, mechanical efficiency, rotary compressors, screw compressors, scroll compressors, centrifugal compressors. Condensers, evaporators, and cooling towers Expansion tools, accessories for vapor compressor cooling system. [15 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, while at the same time refining and expanding their critical thinking skills. This will be achieved through classes, interactive tutorials and by considering type of simple experiments involving some sampling activities that are interesting to the students.

Student Workload (SWL) الحمل الدراسي للطالب			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	144	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	10
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	206	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	11
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	350		

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	The basic properties of a mixture of air and water vapor: components of atmospheric air, general equation of gases, Dalton's law of partial pressures, saturated vapor pressure, water vapor pressure in moist air, relative humidity, moisture content, humidification percentage, dew point, enthalpy, The psychometric scheme and adaptation processes: a general explanation of the psychometric chart and the basis for its construction
Week 2	Sensible cooling, sensible heating, dehumidification, humidification by water injection, adiabatic humidification, humidification efficiency, humidification by constant wet bulb temperature, contact factor, and bypass factor.
Week 3	Humidification by steam injection, adiabatic air mixing, cooling and dehumidification with reheating, preheating with humidification and reheat.
Week 4	Air mixing and adiabatic humidification with reheating, summer cycle and winter cycle, practical applications for the case of summer, and practical applications for the case of winter.
Week 5	Comfort and internal conditions: Metabolism and human comfort, body mechanics in heat transfer and thermoregulation, metabolic rate, clothing, the effect of the environment on human comfort, other factors affecting human comfort, and selection of internal conditions.
Week 6	Climate and external conditions: climate, wind, local winds, dew formation, seasonal temperature change, seasonal humidity change, meteorological measurements, seasonal change of the psychometric condition of the external outdoor conditions, selection of external conditions (the three methods).
Week 7	Selection of supplied air conditions: removal of sensible heat, specific heat capacity of moisture air, removal of latent heat, inclination of the sensible heat ratio line, heat generated by fan motors, waste reheating, selection of appropriate air supply conditions
Week 8	Refrigerants, types of old and modern refrigerants, side effects of refrigerants on the ozone layer and global warming, secondary refrigerants, concept of refrigeration: uses of refrigeration and refrigeration methods, second law of thermodynamics, heat pump, reverse Carnot cycle, simple vapor compression cycle, simple vapor compression cycle parts.
Week 9	Mathematical analysis of the simple vapor compression cycle, the factors affecting the performance parameter of the vapor compression cycle (the impact of suction temperature, the impact of condensation temperature, the impact of sub-cooling, the impact of superheating, and the impact of pressure losses).

Week 10	Theoretical vapor compression cycle and its comparison with the real one, Improving the vapor compression cycle, Using flash tank, Supercooling of refrigerant.
Week 11	Multistage compression: flash gas removal, intercooler, one evaporator and one compressor, two evaporators and one compressor, two compressors and one evaporator.
Week 12	Multi-stage compression: two compressors and evaporators, multi-stage compression with several types of intercooling (water intercooler, liquid flash intercooler, flash gas intercooler)
Week 13	Vapor Compression refrigeration cycle components: compressors type, positive displacement compressors, reciprocating compressors, volumetric efficiency, mechanical efficiency, rotary compressors, screw compressors, scroll compressors, centrifugal compressors.
Week 14	Condensers, evaporators, and cooling towers
Week 15	Expansion tools, accessories for vapor compressor cooling system.
Week 16	**The preparatory week before the final Exam**

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر	
	Material Covered
Week 1	Air velocity measuring devices - measuring air velocity using a Petot tube and a manometer.
Week 2	Applications to the air properties Psychometric Chart.
Week 3	Sensible cooling
Week 4	Sensible heating
Week 5	Dehumidification process
Week 6	Air Humidification by Direct Injection of Water Drops
Week 7	Humidify the air with a jet of steam
Week 8	Air mixing process
Week 9	Cooling and dehumidifying with reheating
Week 10	Preheating, cooling and dehumidifying with reheating
Week 11	Mixing and adiabatic saturation with reheating

Week 12	Theoretical calculations for compressor performance
Week 13	Condenser calculations for vapor compression cycle
Week 14	Calculations of capacity and performance factor for vapor compression cycle
Week 15	Calculations of the coefficient of performance for the real vapor comprssion cycle

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	***Jan F. Kreider, Peter S. Curtiss " Heating and cooling of Building" Mc Graw Hill, 2000*** ***ASHRAE, Fundamental . 1997.***	Yes
Recommended Texts	***Sapali, S.N., 2009."Refrigeration and air conditioning". PHI Learning Pvt. Ltd.***	No
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 is 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.