



## MODULE DESCRIPTION FORM

### نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	Refrigeration & Air Conditioning		Module Delivery
Module Type	Core	<input checked="" type="checkbox"/> Theory <input type="checkbox"/> Lecture <input checked="" type="checkbox"/> Lab <input checked="" type="checkbox"/> Tutorial <input type="checkbox"/> Practical <input type="checkbox"/> Seminar	
Module Code	RAC 301		
ECTS Credits	8		
SWL (hr/sem)	200		
Module Level	Three		
Administering Department	Power Mechanics - Ref. & AC (RAC)	College	TEMO
Module Leader	Ayad Suleiman Abdullah	e-mail	Ayad.selman@ntu.edu.iq
Module Leader's Acad. Title	Lecture	Module Leader's Qualification	Ph.D.
Module Tutor	available	e-mail	E-mail
Peer Reviewer Name	Name	e-mail	E-mail
Scientific Committee Approval Date	01/6/2023	Version Number	1.0

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

<p><b>Module Objectives</b> أهداف المادة الدراسية</p>	<ol style="list-style-type: none"> <li>1. Introduce the student to the groups used in refrigeration and to know their composition and how they work.</li> <li>2. Introduce the student to selecting and connecting all special pipes and accessories.</li> <li>3. Introducing the student to the parts of the summer and winter air conditioning cycle, their applications, and load estimation thermal in the field of air conditioning.</li> <li>4. Introducing students to connecting air-conditioning systems in terms of designing cooling pipes and ducts according to</li> <li>5. System type of air or water cooling.</li> <li>6. Introducing students to how to design refrigerated rooms.</li> <li>7. Introducing the student to the ailments that accompany the process of freezing food.</li> <li>8. Providing the student with practical and technical experience in calculating free loads and choosing the air conditioning system occasion.</li> </ol>
<p><b>Module Learning Outcomes</b> مخرجات التعلم للمادة الدراسية</p>	<p>Important: Write at least 6 Learning Outcomes, better to be equal to the number of study weeks.</p> <ol style="list-style-type: none"> <li>1. Show the student's ability to use knowledge to prepare scientific and applied research.</li> <li>2. The ability to use electronic programs to solve the problems of air conditioning systems.</li> <li>3. The ability to think to extract engineering solutions to problems related to air conditioning systems.</li> <li>4. The ability to keep pace with scientific and technical modernity.</li> <li>5. Teaching leadership skills, the value of commitment, love of work and devotion to it.</li> <li>6. The ability to calculate thermal loads in summer and winter.</li> <li>7. The ability to design the connecting pipes between the air conditioning system and the rooms.</li> <li>8. The ability to design refrigerated rooms for use in food preservation.</li> <li>9. The ability to provide comfortable conditions inside the room without problems such as noise and others.</li> <li>10. The ability to use experiments and obtain and analyze results.</li> </ol>
<p><b>Indicative Contents</b> المحتويات الإرشادية</p>	<p>Indicative content includes the following.</p> <ul style="list-style-type: none"> <li>• BUILDING SURVEY</li> </ul> <p>space characteristics and heat load sources [10 hrs]  air conditioning load estimate, outdoor loads, internal loads [15 hrs]  heat transfer topics, single layered wall, multi layered wall [15 hrs]</p>



	<ul style="list-style-type: none"> <li>• COOLING LOAD ESTIMATION</li> </ul> <p>External Heat Gain, Solar Heat gain Glass, Solar transmission window and door, Solar and Transmission Gain- Walls, and Transmission Gain Roofs and Floors. [15 hrs]</p> <ul style="list-style-type: none"> <li>• HEATING LOAD ESTIMATION</li> </ul> <p>HEAT LOSS- GLASS AND DOORS – HEAT LOSS – WALLS, AND ROOFS, HEAT LOSS -FLOORS elements, Heat Transmission Partition [15 hrs]</p> <ul style="list-style-type: none"> <li>• DUCT DESIGN</li> </ul> <p>BERNOULLI EQUATION, HEAD AND PRESSURE, FLUID RESISTANCE, DUCT DESIGN METHODS [15 hrs]</p>
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<b>Learning and Teaching Strategies</b> استراتيجيات التعلم والتعليم	
<b>Strategies</b>	<p>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 types of simple experiments involving some sampling activities that are interesting to the students.</p>

<b>Student Workload (SWL)</b> الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
<b>Structured SWL (h/sem)</b> الحمل الدراسي المنتظم للطالب خلال الفصل	108	<b>Structured SWL (h/w)</b> الحمل الدراسي المنتظم للطالب أسبوعيا	7
<b>Unstructured SWL (h/sem)</b> الحمل الدراسي غير المنتظم للطالب خلال الفصل	92	<b>Unstructured SWL (h/w)</b> الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
<b>Total SWL (h/sem)</b> الحمل الدراسي الكلي للطالب خلال الفصل	<b>200</b>		



Module Evaluation					
تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	4	10% (10)	2, 4, 6, 9 and 13	LO #1, #2, #5, #8 and #10
	Assignments	3	10% (10)	3,5 and 12	LO #3, #4, #6, #7 and #9
	Projects / Lab.	10	20% (20)	Continuous	All
	Report				
Summative assessment	Midterm Exam	2hr	10% (10)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)	
المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Introduction - Building Survey -Space Characteristics And Heat Load Sources -
Week 2	Air Conditioning Load Estimate, Outdoor Loads, Internal Loads, Heat Transfer Topics, Single Layered Wall, Multi Layered Wall, Heat Gain Through Wall, Equivalent Temperature Difference,
Week 3	Cooling Load Estimation, External Heat Gain, Solar Heat Gain Glass, Solar Transmission Window And Door, Solar And Transmission Gain- Walls, Solar And Transmission Gain Roofs And Floors
Week 4	Internal Heat Gain, Heat Transmission Partition, Heat Gain People, Heat Gain Lights, Heat Gain – Appliances, Heat Gain From Electric Motors, And Infiltration:
Week 5	Heating Load Estimation
Week 6	Duct Design, Bernoulli Equation, Head And Pressure, Fluid Resistance, Friction Losses, Dynamic Losses, Duct Design Methods, Equal Friction Method.
Week 7	Fans, Types of Fans, Fan Laws, Fan Characteristic
Week 8	Water Piping Systems Design, Water Piping Classification, Water Piping System Return Arrangements, Pipe Sizing, Water Piping For Cooling Tower System
Week 9	Pumps, Pump Laws, Pump Sizing, Absolute And Gauge Pressure, Pump Performance Curve



<b>Week 10</b>	Frozen-Food Properties, Thermal Properties Of Frozen Food, Ice Fraction ,
<b>Week 11</b>	Enthalpy, Unfrozen Food, Frozen Food
<b>Week 12</b>	Thermal Conductivity
<b>Week 13</b>	Freezing Time Of Food, Plank's Equation
<b>Week 14</b>	Calculation The Internal Dimension Of Freezer Storage
<b>Week 15</b>	Racking Arrangement , Pallets Arrangement
<b>Week 16</b>	Preparatory week before the final Exam

<b>Delivery Plan (Weekly Lab. Syllabus)</b> المنهاج الاسبوعي للمختبر	
	<b>Material Covered</b>
<b>Week 1</b>	Lab 1: Calculation the Capacity of Condenser for Heat Pump
<b>Week 2</b>	Lab 2: Calculating the Cooling Effect in The Heat Pump.
<b>Week 3</b>	Lab 3: Effect of The Types of Expansion Devices on The C.O.P. In The Refrigeration System
<b>Week 4</b>	Lab 4: Cooling Tower
<b>Week 5</b>	Lab 5: Calculation of chilled water refrigeration capacity, With studying the sensible cooling process
<b>Week 6</b>	Lab 6: Study the pressure drop in ducting system accessories
<b>Week 7</b>	Lab 7: Actual refrigeration cycle
<b>Week 8</b>	Lab 8: Processes of Air Conditioned
<b>Week 9</b>	Lab 9: Parallel & Series pumps connection, and the relation between the heads and their flow
<b>Week 10</b>	Lab 10: Calculation of Chiller Load water pump on and off
<b>Week 11</b>	Lab 11: Air Cooler
<b>Week 12</b>	Lab 12: Performance of Air Conditioning Unit with Varies Expansion Devices
<b>Week 13</b>	Lab 13: Sensible heating and cooling
<b>Week 14</b>	Lab 14: Dehumidification of air
<b>Week 15</b>	Lab 15: Type of Fan

<b>Learning and Teaching Resources</b> مصادر التعلم والتدريس		
	<b>Text</b>	<b>Available in the Library?</b>
<b>Required Texts</b>	ASHRAE 2017 (FUNDAMENTALS)	Yes
<b>Recommended Texts</b>	Howell, R. H., Coad, W. J., & Sauer, H. J. (2013). Principles of heating, ventilating and air conditioning. Atlanta, Ga.:	No



	American Society of Heating, Refrigerating and Air-Conditioning Engineers	
Websites	<a href="http://www.BookFi.org">www.BookFi.org</a> , <a href="http://www.ashrae.org">www.ashrae.org</a>	

Grading Scheme مخطط الدرجات				
Group	Grade	التقدير	Marks %	Definition
<b>Success Group</b> (50 - 100)	<b>A</b> - Excellent	امتياز	90 - 100	Outstanding Performance
	<b>B</b> - Very Good	جيد جدا	80 - 89	Above average with some errors
	<b>C</b> - Good	جيد	70 - 79	Sound work with notable errors
	<b>D</b> - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	<b>E</b> - Sufficient	مقبول	50 - 59	Work meets minimum criteria
<b>Fail Group</b> (0 – 49)	<b>FX</b> – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	<b>F</b> – Fail	راسب	(0-44)	Considerable amount of work required
<b>Note:</b> 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.				



## Undergraduate Courses 2023-2024

Code	Course/Module Title	ECTS	Semester
RAC 301	Refrigeration & Air Conditioning	8	5
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
4	3	108	92
Description			
<p>This subject focuses on HVAC &amp; Refrigeration Systems, covering equipment like piping, ducting, fans, pumps, etc. It includes thermal load estimation and food preservation. By the end of the course, students will:</p> <ul style="list-style-type: none"><li>Review refrigeration storage considerations.</li><li>Understand heat transfer for maintaining comfortable conditions in heating systems.</li><li>Understand heat transfer for maintaining comfortable conditions in cooling systems.</li><li>Estimate cooling capacity for rooms, buildings, and cooling coils.</li><li>Describe the functions of an Air Handling Unit (AHU).</li><li>Discuss the importance of studying air transmission in air conditioning.</li><li>Learn about airflow, fan laws, and the interaction between fans and ducts.</li><li>Understand balance points and general rules for duct design.</li><li>Classify duct and pipe systems.</li><li>Familiarize with duct and pipe design methods.</li></ul> <p>This course equips students with the necessary knowledge to comprehend and work with HVAC &amp; Refrigeration Systems, enabling them to analyze and design systems effectively.</p>			