Module Information معلومات المادة الدراسية					
Module Title	**Design of Thermal System**			**Module Delivery**	
Module Type	**Core**			☒ **Theory** ☐ **Lecture** ☐ **Lab** ☒ **Tutorial** ☐ **Practical** ☐ **Seminar**	
Module Code	RE 403				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	4		**Semester of Delivery**	7	
Administering Department	PM		**College**	TEMO	
Module Leader	Nabeel Abdulrazzaq		**e-mail**	Nabil84m@ntu.edu.iq	
Module Leader's Acad. Title	Lec.		**Module Leader's Qualification**	Ph.D.	
Module Tutor			**e-mail**		
Peer Reviewer Name			**e-mail**		
Scientific Committee Approval Date			**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	
Module Objectives أهداف المادة الدراسية	1. Understand the fundamentals of thermodynamics and heat transfer principles. 2. Analyze different types of thermal systems and their components. 3. Evaluate the performance and efficiency of thermal systems. 4. Learn about heat exchangers and their design considerations. 5. Explore various energy sources and their utilization in thermal systems.

	6. Understand the principal design of pipe system. 7. Learn about renewable energy systems and their integration into thermal systems. 8. Explore the design considerations for solar thermal system. 9. Study the control and optimization of thermal systems for improved performance. 10. Analyze the environmental impact and sustainability aspects of thermal system design. 11. Develop skills in designing and sizing components of thermal systems, such as pumps, compressors, and turbines.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. Comprehensive knowledge of thermodynamics and heat transfer principles. 2. Understanding of different types of thermal systems and their components. 3. Ability to analyze and evaluate the performance and efficiency of thermal systems. 4. Proficiency in designing and sizing components of thermal systems, such as pipe system heat exchangers, and pumps. 5. Familiarity with various methods of heat transfer, including conduction, convection, and radiation. 6. Knowledge of fluid mechanics principles and their application in thermal systems. 7. Ability to design and optimize thermal systems for improved performance and energy efficiency. 8. Understanding of solar thermal system and thermal energy storage systems and their design considerations. 9. Proficiency in using computational tools and software for modeling and simulation of thermal systems. 10. Awareness of safety considerations and regulations relevant to thermal system design. 11. Ability to analyze case studies of real-world thermal systems and their design challenges. 12. Understanding of the environmental impact and sustainability aspects of thermal system design. 13. Development of critical thinking and problem-solving skills in the context of thermal system design. 14. Ability to communicate and present technical information related to thermal system design effectively.

Indicative Contents
المحتويات الإرشادية
	1. Introduction to Thermal Systems Design
	  ○ Overview of thermal systems and their significance
	  ○ Introduction to design methodologies and considerations
	2. Performance Analysis and Optimization
	  ○ Efficiency calculations and performance metrics
	  ○ Parametric analysis and optimization techniques
	  ○ Economic and environmental considerations
	3. Computational Tools and Simulation

	○ Introduction to software for thermal system modeling ○ Simulation of thermal systems and performance analysis 4. Case Studies and Design Projects ○ Analysis of real-world thermal systems and design challenges ○ Group projects involving the design of thermal systems 5. Sustainability and Environmental Impact ○ Environmental considerations in thermal system design ○ Energy conservation strategies and sustainable practices 6. Communication and Presentation Skills ○ Technical report writing ○ Oral presentation skills and effective communication

Learning and Teaching Strategies استراتيجيات التعلم والتعليم	
Strategies	1. Lectures: Traditional lectures can be used to introduce new concepts, explain theoretical principles, and provide an overall framework for the course content. Instructors can utilize visual aids, demonstrations, and examples to enhance understanding. 2. Problem-solving sessions: Conducting problem-solving sessions allows students to apply the concepts learned in lectures to solve real-world problems related to thermal system design. Instructors can present a variety of problem scenarios and guide students through the problem-solving process. 3. Case studies: Presenting case studies of actual thermal systems and their design challenges can help students understand the practical application of the concepts learned. Analyzing and discussing case studies can enhance critical thinking and problem-solving skills. 4. Group projects: Assigning group projects related to the design of thermal systems encourages collaboration and teamwork among students. These projects can involve designing and analyzing thermal systems, conducting simulations, or presenting feasibility studies. 5. Computer simulations: Utilizing computational tools and software for modeling and simulation of thermal systems enables students to analyze system performance, optimize designs, and simulate different operating conditions. 6. Field trips and industry visits: Organizing field trips or visits to thermal system facilities, power plants, or HVAC installations offers students a chance to observe and understand the practical implementation of thermal system design principles. 7. Discussions and debates: Engaging students in discussions and debates on controversial or emerging topics related to thermal system design

	can foster critical thinking, encourage different perspectives, and enhance communication skills. 8. Multimedia resources: Incorporating multimedia resources such as videos, animations, interactive simulations, and online resources can enhance student engagement and facilitate self-paced learning. 9. Assessments and feedback: Regular assessments, quizzes, exams, and assignments allow instructors to evaluate students' understanding and progress. Providing timely feedback helps students identify areas for improvement and reinforces learning.

Student Workload (SWL)
الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	63	**Structured SWL (h/w)** الحمل الدراسي المنتظم للطالب أسبوعيا	5
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	87	**Unstructured SWL (h/w)** الحمل الدراسي غير المنتظم للطالب أسبوعيا	6
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	**150**		

Module Evaluation
تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	**Quizzes**	2	10% (10)	5 and 10	LO #1 - #10
	Assignments	6	20% (10)	2,4,6,8,10 and 12	LO #1 - #12
	Projects	1	5% (5)	Continuous	All
	Siminar	1	5% (5)	Will be decided later	LO #13, #14 and #15
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 to Thermal Systems Design
	Overview of thermodynamics, fluid mechanics, and heat transfer principles
Week 2	Pipe sizing and hydraulic calculations: Flow rates, pressure drop, and pipe diameter selection
Week 3	Pump selection and performance analysis: Centrifugal pumps, pump curves, and system head calculations
Week4	Pipe material selection and characteristics
	Pipe layout and routing considerations
Week 5	Solar thermal system design principles
	Solar collectors and system components
Week 6	Solar thermal system sizing and performance analysis
	Integration of solar thermal systems in thermal designs
Week 7	Heat exchanger fundamentals and types
	Design considerations for heat exchangers
Week 8	Heat exchanger sizing and performance analysis
	Heat exchanger selection and optimization
Week 9	Cost estimation in thermal system design
Week 10	Economic analysis and evaluation methods
Week11	Computational tools and software for thermal system simulation
	Introduction to simulation software (e.g., MATLAB, ANSYS, Starccm)
Week12	Simulation of thermal systems using software tools
	Performance analysis and optimization through simulations
Week13	Advanced optimization techniques for thermal system design
	Parameter optimization and sensitivity analysis
Week14	Case studies: Real-world applications and design challenges
Week15	Analysis and discussion of case studies related to thermal system design
Week 16	**Preparatory week before the final Exam**

Learning and Teaching Resources مصادر التعلم والتدريس		
	Text	**Available in the Library?**
Required Texts	"Design of Thermal Systems" by Wilbert F. Stoecker and J. W. Jones	Yes
Recommended Texts	"Thermal Systems Design" by W. P. Jones "Thermal Systems Engineering: Thermodynamics, Fluid Mechanics, and Heat Transfer" by Michael J. Moran, Howard N. Shapiro, Bruce R. Munson, and David P. DeWitt	No
Websites	NA	

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.

Module 1

Code	Course/Module Title	ECTS	Semester
RE 403	**Thermal Systems Design**	**6**	**7**
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/sem)**
3	**1**	**63**	**87**

The Design of Thermal Systems course is a comprehensive exploration of the principles and practices involved in creating efficient and effective thermal systems. This course delves into the design considerations and methodologies necessary for designing systems that involve heat transfer, thermodynamics, fluid mechanics, and energy conversion.

Students will learn how to analyze and optimize thermal systems by examining factors such as heat generation, heat transfer mechanisms, and energy efficiency. They will study the design of components like heat exchangers, boilers, turbines, compressors, and refrigeration systems. Through case studies, simulations, and hands-on projects, students will gain practical experience in sizing, performance analysis, and material selection for thermal systems.

Furthermore, the course will cover system integration, control strategies, and the assessment of environmental impacts. Students will develop the skills to address real-world challenges in various industries, including power generation, HVAC, automotive, and aerospace.

By the end of the course, students will possess the knowledge and tools needed to design and optimize thermal systems, making them well-equipped for careers as thermal system engineers, energy consultants, or researchers in the field of thermal sciences