Northern Technical University
College of Oil & Gas Techniques Engineering/Kirkuk
Department of Renewable Energy Techniques Engineering

MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Renewable Energy systems**				
Module Type	**Core**		☒Theory ☐ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☒ Seminar		
Module Code	**RETE 302**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	3		Semester of Delivery	5	
Administration Department	RETE		College	College of Oil & Gas Techniques Engineering/Kirkuk	
Module Leader	Ali Qani Mohammed Saleh		e-mail	ali.alkurdi23@ntu.edu.iq	
Module Leader's Acad. Title	Lecturer		Module Leader's Qualification	MSc.	
Module Tutor	Name (if available)		e-mail		
Peer Reviewer Name			e-mail		
Scientific Committee Approval Date			Version Number	1	

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Relation with other Modules العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	RETE 207	Semester	Four
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. Comprehensive Understanding: The aim of this module is to provide students with a comprehensive understanding of various renewable energy systems, including solar, wind, hydropower, and biomass, enabling them to grasp the design, components, and operational principles of these systems. 2. Technical Proficiency: This module aims to equip students with the technical knowledge and skills necessary to analyze, evaluate, and design renewable energy systems. At the end of the module, students should be proficient in assessing the technical feasibility and performance of these systems. 3. Integration and Sustainability: Students will learn how to integrate renewable energy systems into the broader energy infrastructure and gain an appreciation for the role of these systems in achieving sustainability goals. They should be able to critically evaluate the environmental, economic, and social aspects of renewable energy technologies.
Module Learning Outcomes **مخرجات التعلم للمادة الدراسية**	(LO1). In-Depth Knowledge: Students will acquire in-depth knowledge of various renewable energy systems, including solar photovoltaic, wind, hydropower, and biomass, and understand their principles, components, and applications. (LO2). Technical Analysis: By the end of the course, students should be able to analyze the technical aspects of renewable energy systems, including system design, energy conversion processes, and efficiency considerations. (LO3). System Integration: Students will develop the skills to integrate renewable energy systems into existing energy infrastructures, including grid integration, storage solutions, and backup systems. (LO4). Performance Assessment: Students will be capable of assessing the performance and reliability of renewable energy systems, using key performance indicators and data analysis to evaluate their efficiency. (LO5). Environmental Impact Evaluation: Understanding the environmental implications of renewable energy technologies, students will be able to assess

	their positive and negative environmental impacts, contributing to more informed decision-making. (LO6). Economic Feasibility: Students will be able to conduct economic assessments of renewable energy projects, considering factors such as return on investment, cost-benefit analysis, and financial modeling. (LO7). Policy and Regulatory Awareness: Students should gain an understanding of the policy and regulatory frameworks related to renewable energy, allowing them to navigate the legal and administrative aspects of these technologies. (LO8). Innovation and Future Trends: Students will be aware of current innovations and emerging trends in renewable energy, preparing them for a dynamic and evolving field as they consider future opportunities and challenges.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. 1. Introduction to Renewable Energy • Definition and importance of renewable energy • Environmental and economic drivers for renewable energy 2. Solar Energy Systems • Solar photovoltaic (PV) technology • Solar thermal systems • Concentrated solar power (CSP) 3. Wind Energy Systems • Wind turbine technology • Wind resource assessment • Offshore wind energy 4. Hydropower Systems • Principles of hydropower generation • Types of hydropower systems (dam, run-of-river, tidal) • Environmental and social considerations 5. Biomass Energy Systems • Types of biomass sources (wood, crops, waste) • Biomass conversion processes (biogas, biofuels) • Cogeneration and combined heat and power (CHP) 6. Geothermal Energy Systems • Geothermal heat pumps • Geothermal power plants (flash, binary, dry steam) • Resource assessment and exploration 7. Integration and Grid Connection • Grid integration of renewable energy • Energy storage systems (batteries, pumped storage, etc.) • Backup power systems and grid stability 8. Energy Efficiency in Renewable Systems • Energy-efficient components and designs • Smart grids and demand-side management • Energy conservation measures 9. Environmental Impact and Sustainability • Life cycle assessment of renewable energy systems

	• Environmental benefits and challenges • Sustainability considerations 10. Economic Analysis and Financing • Economic evaluation of renewable energy projects • Financial modeling and cost-benefit analysis • Financing options and incentives 11. Regulation and Policy Framework • Regulatory challenges and incentives • Government policies and support mechanisms • International agreements and targets 12. Emerging Technologies and Trends • Exploration of cutting-edge renewable energy technologies • Market trends, innovation, and future prospects • The role of research and development 13. Practical Applications and Case Studies • Real-world case studies of successful renewable energy projects • Hands-on experience with renewable energy systems • Field trips and site visits (if applicable) 14. Group Projects and Student Presentations • Collaborative projects on renewable energy system design or analysis • Student presentations and discussions 15. Examinations and Assessment • Final examinations or assessments • Evaluation of student understanding and application of course content

Learning and Teaching Strategies **استراتيجيات التعلم والتعليم**	
Strategies	Teaching Method 1 – Lectures Description: Attendance Recorded: Yes Teaching Method 2 – Asynchronous on-line course materials Description: Podcasts, videos and articles in thermodynamics Attendance Recorded: No Unscheduled Directed Student Hours (time spent away from the timetabled sessions but directed by the teaching staff). Teaching Method 3 - Tutorials Description: Attendance Recorded: Yes

	Teaching Method 4 - Practical Description: Practical homework assignments Attendance Recorded: No Unscheduled Directed Student Hours (time spent away from the timetabled sessions but directed by the teaching staff).

Student Workload (SWL)
الحمل الدراسي للطالب

Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	63	Structured SWL (h/w) الحمل الدراسي المنتظم للطالب أسبوعيا	4.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	87	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطالب أسبوعيا	5.8
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	5	10% (10)	3,5,7,9,11 and 15	LO #2, #3,#5,#7,#9 and #11
	Assignments	5	10% (10)	2,6,8 and 12	LO #1, #4, #6and #10
	Projects / Lab.	4	20% (10)	Continuous	All
	Report				
Summative assessment	Midterm Exam	2 hr	10%(10)	7	LO #1 - #5
	Final Exam	3 hr	50%(50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)
المنهاج الاسبوعي النظري

Week 1	Introduction to Renewable Energy - Overview of the course, Importance of renewable energy, Environmental and economic drivers

Week2	Solar Energy Systems - Solar photovoltaic (PV) technology, Solar thermal systems, Solar resource assessment
Week3	Wind Energy Systems - Wind turbine technology, Wind resource assessment, Offshore wind energy
Week4	Hydropower Systems - Principles of hydropower generation, Types of hydropower systems, Environmental and social considerations
Week5	Biomass Energy Systems - Types of biomass sources, Biomass conversion processes, Cogeneration and combined heat and power (CHP)
Week6	Geothermal Energy Systems - Geothermal heat pumps, Geothermal power plants, Resource assessment and exploration
Week7	Integration and Grid Connection - Grid integration of renewable energy, Energy storage systems, Backup power systems and grid stability
Week8	Energy Efficiency in Renewable Systems - Energy-efficient components and designs, Smart grids and demand-side management, Energy conservation measures
Week9	Environmental Impact and Sustainability - Life cycle assessment of renewable energy systems, Environmental benefits and challenges, Sustainability considerations
Week 10	Economic Analysis and Financing - Economic evaluation of renewable energy projects, Financial modeling and cost-benefit analysis, Financing options and incentives
Week 11	Regulation and Policy Framework - Regulatory challenges and incentives, Government policies and support mechanisms, International agreements and targets
Week 12	Emerging Technologies and Trends - Cutting-edge renewable energy technologies, Market trends, innovation, and future prospects, The role of research and development
Week 13	Practical Applications and Case Studies - Real-world case studies of successful renewable energy projects, Hands-on experience with renewable energy systems, Field trips and site visits (if applicable)
Week 14	Group Projects and Student Presentations - Collaborative projects on renewable energy system design or analysis, Student presentations and discussions
Week 15	Final Examinations and Assessment - Final examinations or assessments, Evaluation of student understanding and application of course content

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	Renewable Energy: Technology, Economics, and Environment by Martin Kaltschmitt, Wolfgang Streicher, and Andreas Wiese	No
Recommended Texts	Sustainable Energy: Choosing Among Options by Jefferson W. Tester, Elisabeth M. Drake, Michael J. Driscoll, et al.	No
	Renewable Energy: Power for a Sustainable Future by Godfrey Boyle	No

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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.