MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information معلومات المادة الدراسية					
Module Title	**Solar Energy Engineering**				
Module Type	**Core**		☒Theory ☐ Lecture ☒ Lab ☒ Tutorial ☐ Practical ☐ Seminar		
Module Code	**RETE 305**				
ECTS Credits	**6**				
SWL (hr/sem)	**150**				
Module Level	3		Semester of Delivery	6	
Administration Department	RETE		College	College of Oil and Gas Techniques Engineering - Kirkuk	
Module Leader	Afrah Turki Awad		e-mail	afrah.turki@ntu.edu.iq	
Module Leader's Acad. Title	Lecturer		Module Leader's Qualification	PhD	
Module Tutor			e-mail		
Peer Reviewer Name			e-mail		
Scientific Committee Approval Date			Version Number		

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 Aims **أهداف المادة الدراسية**	The course content is designed to provide comprehensive knowledge on solar radiation, analysis of solar radiation data, fundamentals of the solar thermal and photovoltaic system along with storage of energy required for effective design of efficient solar energy conversion devices. The concepts will be illustrated with practical examples, schematics and block diagrams wherever required. A sufficient number of numerical problems with solutions will be discussed in the course. This course is specifically designed for undergraduate and postgraduate students of Energy Engineering and Technology. Further, the course will be very much useful for students and researchers from varied academic backgrounds for the synthesis of novel energy conversion devices and processes.
Module Learning Outcomes **مخرجات التعلم للمادة الدراسية**	• Basic principles of Solar Power (Solar Photovoltaic, Solar Thermal, Dish Type, Solar Tower) • Design features of Solar Photovoltaic and Solar thermal equipment • Manufacturing process for Solar Photovoltaic and Solar thermal equipment • Quality assurance aspects of Solar Photovoltaic and Solar thermal equipment • Erection, Commissioning and Testing aspects of Solar Photovoltaic and Solar thermal equipment • Operation & Maintenance aspects of Solar Photovoltaic and Solar thermal equipment • Feasibility study & Economics of Solar Photovoltaic and Solar thermal power project, • How to prepare Feasibility Report / Detailed Project Report for Solar Photovoltaic and Solar thermal power project • Techno-Commercial appraisal of Solar Photovoltaic and Solar thermal power project from lenders perspective • Salient features of various Financing / Loan Agreements. • Financing options in the development of Solar Photovoltaic and Solar thermal power project • Tariff calculation of Solar Photovoltaic and Solar thermal power project and calculation of IRR, Payback period, etc. • Regulatory aspects/provisions in development of Solar Photovoltaic and thermal power project.
Indicative Contents المحتويات الإرشادية	The undergraduate Solar Energy course covers a comprehensive range of topics to equip students with a fundamental understanding of renewable energy principles and solar technology applications. The course begins with an introduction to renewable energy sources, emphasizing the significance of solar energy in the global energy landscape. Students delve into the fundamentals of solar radiation, learning about solar geometry, radiation measurement, and influencing factors. The curriculum includes in-depth explorations of solar photovoltaic (PV) technology, covering semiconductor physics, various types of

	solar cells, module construction, and electrical basics for PV systems. Solar thermal systems, including solar water heating and concentrating solar power, are studied extensively, with a focus on system components and thermal energy storage methods. Practical aspects of PV system design, such as sizing, layout, and efficiency analysis, are explored, preparing students to design both grid-connected and off-grid solar installations. Additionally, the course delves into the economic aspects of solar energy projects, including policy analysis, incentives, and financial evaluations. Environmental sustainability, project development, and emerging solar technologies are also integral components, allowing students to grasp the holistic aspects of solar energy engineering. Laboratory sessions and hands-on projects complement theoretical learning, providing students with practical skills and insights into solar energy applications. This comprehensive approach enables students to develop a strong foundation in solar energy, fostering their ability to contribute effectively to the renewable energy sector and sustainable development initiatives.

Learning and Teaching Strategies
استراتيجيات التعلم والتعليم

Strategies	Teaching Method 1 – Lectures Description: Attendance Recorded: Yes Teaching Method 2 – Asynchronous online course materials Description: Podcasts, videos, and articles on Renewable Energy 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	78	Structured SWL (h/w) الحمل الدراسي المنتظم للطالب أسبوعيا	5.2
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	72	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطالب أسبوعيا	4.8

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	2	10% (10)	5, 10	LO #5 and 8
	Seminar	2	10% (10)	Continuous	All
	Lab Report	2	20% (20)	6, 13	LO # 2, 9
Summative assessment	Mid Term exam	2 hr	10% (10)	10	LO # 1-11
	Final Exam	3 hr	50% (50)	16	All
100% (100 Marks)					

Delivery Plan (Weekly Syllabus)
المنهاج الأسبوعي النظري

Week 1	Energy Scenario, overview of solar energy conversion devices and applications, physics of propagation of solar radiation from the sun to earth
Weeks 2	Sun-Earth Geometry, Extra-Terrestrial and Terrestrial Radiation, Solar energy measuring instruments
Weeks 3	Estimation of solar radiation under different climatic conditions, Estimation of total radiation
Week 4	Fundamentals of solar PV cells, principles and performance analysis, modules, arrays, theoretical maximum power generation from PV cells.
Week 5	PV standalone system components, Standalone PV-system design.
Week 6	Components of grid-connected PV system, solar power plant design and performance analysis.
Week 7	Fundamentals of solar collectors, Snails law, Bougers law, Physical significance of Transmissivity – absorptivity product.
Week 8	Performance anlaysis of Liquid flat plate collectors and testing
Week 9	Performance anlaysis of Solar Air heaters and testing
Week 10	Mid-Term Exam

Week 11	Solar thermal power generation (Solar concentrators).
Week 12	Thermal Energy Storage (sensible, latent and thermochemical) and solar pond
Weeks (13-14)	Applications: Solar Refrigeration, Passive architecture,solar distillation, and ermeging technologies.
Week 15	Preparing for the final Exam

Learning and Teaching Resources
مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.	No
	S. P. Sukhatme and J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill, 2006.	No

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.