

	Ministry of Higher Education and Scientific Research - Iraq University of Warith Al-Anbiyaa College of Advanced Technologies Department of Refrigeration and Air Conditioning Techniques Engineering	
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MODULE DESCRIPTION FORM

نموذج وصف المادة الدراسية

Module Information			
معلومات المادة الدراسية			
Module Title	Renewable Energy		Module Delivery
Module Type	C		☐ Theory ☒ Lecture ☒ Lab ☐ Tutorial ☐ Practical ☐ Seminar
Module Code	HVAC406		
ECTS Credits	10		
SWL (hr/sem)	250		
Module Level	4	Semester of Delivery	
Administering Department	BSc-HVAC	College	Advanced Technologies
Module Leader	Mohammed Hassan Aboud	e-mail	mohammed.hassan@uowa.edu.iq
Module Leader's Acad. Title	Assist Professor.Dr	Module Leader's Qualification	Ph.D.
Module Tutor	Name (if available)	e-mail	E-mail
Peer Reviewer Name		e-mail	
Scientific Committee Approval Date	31-8-2026	Version Number	1.0

Relation with other Modules

العلاقة مع المواد الدراسية الأخرى

Prerequisite module	MPAC203	Semester	2
Co-requisites module		Semester	

Module Aims, Learning Outcomes and Indicative Contents

أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية

Module Aims أهداف المادة الدراسية	1. Provide the students the basic knowledge of all sources of renewable energies. 2. Provide the students with the fundamentals of the different power generation systems working based on renewable energies. 3. Provide the students the experimental training about the different renewable energy systems.
Module Learning Outcomes مخرجات التعلم للمادة الدراسية	1. To understand the sources of renewable energies and the main advantages and disadvantages of each of them. 2. To understand the effects of renewable energy on the environment. 3. To understand the principles of work of renewable energy systems. 4. To investigate the general design of renewable energy systems. 5. To understand the basic calculations of renewable energy sources and systems.
Indicative Contents المحتويات الإرشادية	Indicative content includes the following. <u>Part 1 – Solar energy</u> The principles of solar energy with the solar systems of solar water heating, solar air heating, solar thermal power plants, solar water desalination, and solar dryer. [30 hrs] <u>Part 2 - Photovoltaic</u> Principles of solar cells and photovoltaic modules. Effects of solar radiation and ambient temperature on the photovoltaic systems. Types of photovoltaic systems with different applications. Power outputs of the photovoltaic systems. [30 hrs] <u>Part 3 – Wind energy</u> Wind energy and wind turbines. Classifications and types of wind turbines. Components of wind turbines. Types of wind farms and performance of the wind turbines. [10 hrs] <u>Part 4- Water energy</u> Hydro energy with hydro turbines. Types of hydro power plant. Ocean energy with different power plants. Tidal energy and tidal power plants. [10 hrs] <u>Part 5- Geothermal energy</u>

	Types and applications of geothermal energy, geothermal heating systems, and geothermal power plants. [10 hrs] <u>Part 6 – Bioenergy</u> Types and applications of bioenergy, biomass biogas and biofuel. [10 hrs]
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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.
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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 أسبوعياً	11
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	106	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطالب أسبوعياً	10
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	250		

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, 4
	Assignments	2	10% (10)	2, 12	LO # 3, 5
	Projects / Lab. Report	1	10% (10)	Continuous	
		1	10% (10)	13	LO # 1, 2m 3, 4, 5
Summative assessment	Midterm Exam	2 hr	10% (10)	7	LO # 1-3
	Final Exam	2hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)

المنهاج الأسبوعي النظري

	Material Covered
Week 1	General introduction to Energy. Introduction to renewable energy. Renewable energy resources and application. Renewable energy and environmental problems (Acid rain, Ozone layer depletion, Global climate change, Nuclear hazards).
Week 2	The sun. Reckoning of time (the equation of time and longitude correction). Solar angles (declination, hour angle, solar altitude angle, solar azimuth angle, sunrise and sunset times and day length, incidence angle). Calculations of solar radiation (Extraterrestrial solar radiation, Atmospheric attenuation. Terrestrial irradiation. Total radiation on the surface).
Week 3	Solar energy collectors. Stationary collectors (Flat plate collectors, Compound parabolic collectors, Evacuated tube collectors). Sun-tracking concentrating collectors (Parabolic trough collectors, Fresnel collectors, Parabolic dish reflectors, Heliostat field collectors).
Week 4	Solar water heating systems. Passive systems (Thermo siphon systems, Integrated collector storage). Active systems (Direct circulation systems, Indirect water heating systems, Pool heating systems).
Week 5	Heat storage systems (Air system thermal storage, Liquid system thermal storage, and thermal analysis of storage systems). Module and array design. Differential temperature controller, Placement of sensors.
Week 6	Heat storage systems (Air system thermal storage, Liquid system thermal storage, and thermal analysis of storage systems). Module and array design. Differential temperature controller, Placement of sensors.
Week 7	Industrial process heat (Solar industrial air and water systems, Solar steam generation systems). Chemistry applications (Reforming of fuels, Fuel cells, Materials processing, Solar detoxification). Solar dryers (Active solar energy dryers, Passive solar energy dryers. Greenhouses and greenhouse materials.
Week 8	Solar desalination systems. Desalination processes. Direct collection systems. Classification of solar water desalination systems. Performance of solar stills. Solar cells, Structure of photovoltaic System, Design of photovoltaic system. Hybrid photovoltaic /thermal systems and applications.
Week 9	Solar Thermal Power Systems (Parabolic trough collector systems, Power tower systems, Dish systems, Solar ponds).
Week 10	Introduction to wind energy. Power available in the energy. Wind turbine power and torque. Classification of Wind turbine (Horizontal axis Wind turbine, Vertical axis Wind turbine).

	Aerodynamics of Wind turbine (Airfoil, Aerodynamic theories). Characteristics of wind rotors (Rotor design, Rotor performance). Analysis of wind data
Week 11	Wind energy conversion systems. Wind electric generators (Tower, Rotor, Gearbox, Power regulation, Safety brakes, Generator). Wind farms, Offshore wind farms. Wind pumps. Wind water heater. Performance of wind energy conversion system. Power curve of wind turbine. Capacity factor.
Week 12	Introduction to water cycle. Water turbines. Hydropower plants (Run - of - River power plants, Storage power plants, Pumped - storage power plants).
Week 13	Introduction to bioenergy (biomass, biogas, biofuel). Biomass heating (Wood as a fuel, Fireplaces and closed wood burning stoves, Wood pellet heating). Biomass heat and power plants.
Week 14	Introduction to geothermal energy. Geothermal plants (Geothermal heat plants, Geothermal power plants), Geothermal heat pumps.
Week 15	Tidal energy. Tidal power plants. Wave energy. Wave power plants.
Week 16	The preparatory week before the final Exam

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الأسبوعي للمختبر

	Material Covered
Week 1	Measurement devices and safety tools
Week 2	Solar angles
Week 3	Sun path and shading
Week 4	Solar simulators
Week 5	solar water heating systems
Week 6	solar air heating system
Week 7	Solar dryer
Week 8	Solar water desalination
Week 9	Solar concentrators
Week 10	Performance of photovoltaic modules
Week 11	Performance of photovoltaic systems
Week 12	Performance of photovoltaic thermal system
Week 13	Wind turbines
Week 14	Hydro energy

Week 15	Geothermal systems			
Learning and Teaching Resources مصادر التعلم والتدريس				
	Text			Available in the Library?
Required Texts	Solar energy engineering processes and systems, Second edition. Soteris A. Kalogirou. Wind energy: fundamentals, resource analysis and economics. Sathyajith Mathew. Introduction to geothermal power. Val Pierce. Introduction to renewable energy. Vaughn Nelson.			Yes
Recommended Texts	Solar Energy Thermal Processes, fourth edition. Duffie, John A			Yes
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.				

العميد: ا.م.د علي باسم

رئيس القسم: ا.م.د محمد حسن عبد

التاريخ : 31-8-2026

استاذ المادة

التاريخ: 31-8-2026