



Course Specification

(Bachelor)

Course Title: : Renewable Energy
Course Code: ME4245
Program: Mechanical Engineering
Department: Mechanical Engineering Department
College: College of Engineering and Architecture
Institution: Umm Al-Qura University
Version: 1
Last Revision Date: 1 January 2025

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)

2. Course type

- A. ☐ University ☐ College ☐ Department ☐ Track ☐ Others
- B. ☒ Required ☐ Elective

3. Level/year at which this course is offered: (9)

4. Course General Description:

The course concentrates on solar energy technologies (photovoltaics and solar thermal systems), wind turbines, geothermal technologies, biomass energy, and ocean energy (tidal energy). Providing the students with the required knowledge to be able to understand and design small systems based on recent renewable technologies. Further, understand the quantity of the CO₂ level replaced by these technologies.

5. Pre-requirements for this course (if any):

ME4232- Heat Transfer Equipment

6. Co-requisites for this course (if any):

7. Course Main Objective(s):

- To give sufficient knowledge about the promising new and renewable sources of energy
- To equip students in working with projects and to take up research work in connected areas.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom		80
2	E-learning		10
3	Hybrid Traditional classroom		



No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		10

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	Lectures	20
2.	Laboratory/Studio	30
3.	Field	
4.	Tutorial	
5.	Others (specify)	
Total		50

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Figure out a comprehensive knowledge and critical understanding of the main subjects of the subject matter or specialization, including the main concepts, principles, theories and their current applications in the field of academic research specializing in mechanical engineering.	K1	Figure out a comprehensive knowledge and critical understanding of the main subjects of the subject matter or specialization, including the main concepts, principles, theories and their current applications in the field of academic research specializing in mechanical engineering.	1.1
1.2	Understand deeply one or more areas of specific specialization in relation to the latest theories, research and professional practice in mechanical engineering.	K1	Understand deeply one or more areas of specific specialization in relation to the latest theories, research and professional practice	1.2



Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
			in mechanical engineering.	
...		...		...
2.0	Skills			
2.1	Apply continuously theoretical and practical knowledge in dealing with a variety of contexts, new and unexpected scientific, and provide authentic and innovative responses to problems and issues. Make convincing and informed judgments in situations where complete or consistent information is not available.	S2	Apply continuously theoretical and practical knowledge in dealing with a variety of contexts, new and unexpected scientific, and provide authentic and innovative responses to problems and issues. Make convincing and informed judgments in situations where complete or consistent information is not available.	2.1
2.2	Plan and execute large projects or part of scientific research independently, applying his theoretical and practical knowledge and using research methods to arrive at valuable conclusions that lead to important additions to current knowledge or professional practices.	S1	Plan and execute large projects or part of scientific research independently, applying his theoretical and practical knowledge and using research methods to arrive at valuable conclusions that lead to important additions to current knowledge or professional practices.	2.2
...		...		...
3.0				





Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.1	Initiate the identification and creative handling of complex issues and problems in academic contexts. Act independently, when additional information or skills are needed, by searching for and applying the required information and skills.	V3	Initiate the identification and creative handling of complex issues and problems in academic contexts. Act independently, when additional information or skills are needed, by searching for and applying the required information and skills.	3.1
3.2	Take fully responsibilities for his work and cooperate fully and constructively with others when addressing issues and problems, demonstrating official and non-official leadership skills whenever necessary. Act in ways that always stimulate the effectiveness of the group as a whole in collective situations.	V1	Take fully responsibilities for his work and cooperate fully and constructively with others when addressing issues and problems, demonstrating official and non-official leadership skills whenever necessary. Act in ways that always stimulate the effectiveness of the group as a whole in collective situations.	3.2
3.3	Deals permanently and sensitively with complex ethical issues in academic or professional positions. Issue sound, fair and informed judgments based on well-known principles and values in cases that have not been thoroughly	V1	Deals permanently and sensitively with complex ethical issues in academic or professional positions. Issue sound, fair and informed judgments based on well-known principles and values in cases	3.3



Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	addressed in ethical standards, codes of practice or regulations. Issues fair and sound judgments based on informed knowledge and based on established principles and values. Points out the shortcomings in existing standards and practice to try to revise and reform them.		that have not been thoroughly addressed in ethical standards, codes of practice or regulations. Issues fair and sound judgments based on informed knowledge and based on established principles and values. Points out the shortcomings in existing standards and practice to try to revise and reform them.	

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction: Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources	5
2.	Solar thermal systems: Introduction, Solar Constant, Basic Sun-Earth Angles, Measurement of Solar Radiation Data – Pyranometer and Pyrliometer. Principle of Conversion of Solar Radiation into Heat, – Solar thermal collectors – General description and characteristics – Flat plate collectors – Heat transfer processes – Solar concentrators (parabolic trough, parabolic dish, Central Tower Collector) –performance evaluation.	15
3.	Solar electric systems: Solar Thermal Electric Power Generation –; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems – stand-alone and grid connected; Applications –Street lighting, Domestic lighting and Solar Water pumping systems.	5
4.	Energy from ocean: Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Advantages and Limitations of TPP. Ocean Thermal Energy Conversion (OTEC): Principle	5



	of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Site-selection criteria, Biofouling, Advantages & Limitations of OTEC.	
5.	Wind energy: Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Advantages and Disadvantages of WECS and types of turbines – Design and selection considerations.	10
6.	Biomass energy: Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants. Small hydro power: Classification as micro, mini and small hydro projects - Basic concepts.	5
7.	Geothermal Energy: Geothermal resources. Geothermal heating and air conditioning applications. Low- temperature geothermal applications for heat generation. High temperature geothermal power production: Natural or flashbased geothermal installations. Design and calculation of geothermal processes,	5
Total		50

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Oral Quiz-1		5%
2.	Midterm exam		40%
3.	Oral Quiz-2		5%
4.	Final exam		50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Abbasi S. A. and N. Abbasi, <i>Renewable Energy Sources and Their Environmental Impact</i>, Prentice Hall of India, 2001 • G.N. Tiwari: <i>Solar Energy-Fundamentals, Design, Modelling and Applications</i>, Narosa Publishers, 2002 • Khan B. H., <i>Non-Conventional Energy Resources</i>, Tata McGraw Hill, 2009
Supportive References	Gotsmann, Kreis and Kreider, "Solar Energy Engineering", Taylor





	& Francis, 2000.
Electronic Materials	
Other Learning Materials	Lab. Facilities

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classroom
Technology equipment (projector, smart board, software)	Data show
Other equipment (depending on the nature of the specialty)	Lab. Facilities of instrumentations and systems

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	indirect
Effectiveness of Students assessment	Faculty	direct
Quality of learning resources	Students and faculty	indirect
The extent to which CLOs have been achieved		
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify))

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	1- Prof. Adel Abdeen, coordinator 2- Dr. Abdullah AlZahrani 3- Dr. Bander Fadhl 4- Dr. Basem Makhdoom 5- Dr. Kamel Guedri 6- Prof. Abdulmajeed Alghamdi 7- Dr. Mowffaq Oreijah 8- Dr. Abdulmannan Saati
REFERENCE NO.	
DATE	1/1/2025

