Identification	**Subject**	CHE 490 Renewable Energy, 6 ECTS
	Department	Mechanical Engineering
	Program	Undergraduate
	Term	Fall, 2025
	Instructor	Dr. Mehdi Kiyasatfar
	E-mail:	mkiyasatfar@khazar.org
	Phone:	
	Classroom/hours	
	Office hours	
Prerequisites		
Language	English	
Compulsory/Elective	Compulsory	
Required textbooks and course materials	1- Messenger, Roger A. *Photovoltaic systems engineering*. CRC press, 2018. 2- Duffie, John A., and William A. Beckman. *Solar engineering of thermal processes*. John Wiley & Sons, 2013. 3- El-Sharkawi, Mohamed A. *Wind energy: an introduction*. CRC Press, 2015.	
Course website		
Course outline	This course provides a comprehensive introduction to renewable energy systems, covering key sources like solar, wind, hydro, and biomass. The curriculum explores the scientific, technical, and economic aspects of these technologies, with a strong emphasis on their role in addressing global energy challenges and mitigating climate change. Students will learn to critically evaluate energy conversion technologies, understand grid integration, and analyze the environmental and societal impacts of these systems, equipping them with the knowledge to contribute to discussions on sustainable energy practices.	
Course objectives	• Understanding basic characteristics of renewable sources of energy and technologies for their utilization • To give review on utilization trends of renewable sources of energy • To give review on legislative and regulatory rules related to utilization of renewable sources of energy	
Learning outcomes	Upon successful completion of this course, the student will be able: • Define basic properties of different renewable sources of energy and technologies for their utilization, • to understand the role of solar energy in the context of regional and global energy systems, its economic, social, and environmental connotations, and the impact of technology on a local and global context. • to understand the physical principles of the photovoltaic (PV) solar cell and what are its sources of losses. • to know the most important characteristics of the elements within a PV system and how they work: battery and charge controller, DC/DC converter, DC/AC converter (inverter) and loads. • to list the relevant organizations, major projects at the international level, the main sources of information and regulations related to solar photovoltaic technology. • to carry out a basic engineering project related to energy supply using solar photovoltaic technology. • to know the main lines of research in the field of solar energy. • to bring innovative ideas in the field of solar photovoltaic energy. • Understand the equations used to convert the air kinetic energy into mechanical	

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<tr><td></td><td colspan="3">energy,
• Understand the main components of wind energy system and its functions,
• Understand rotor aerodynamics,
• Be able to know how to design wind energy system by software,
• Understand the first attempts of electrical power generation from wind,
• Able to deal with residential, commercial, and industrial applications,
• Be able to deal with water heating applications for heating and cooling the buildings,</td></tr>
<tr><td rowspan="3">Teaching methods</td><td colspan="2">Lecture</td><td>x</td></tr>
<tr><td colspan="2">Group discussion</td><td>x</td></tr>
<tr><td colspan="2">Case analysis</td><td>x</td></tr>
<tr><td rowspan="7">Evaluation</td><td>Methods</td><td>Date/deadlines</td><td>Percentage (%)</td></tr>
<tr><td>Midterm Exam</td><td></td><td>25</td></tr>
<tr><td>Participation</td><td>At each lesson</td><td>5</td></tr>
<tr><td>Seminar</td><td>During the semester</td><td>10</td></tr>
<tr><td>Project</td><td>During the semester</td><td>20</td></tr>
<tr><td>Final Exam</td><td></td><td>40</td></tr>
<tr><td>Total</td><td></td><td>100</td></tr>
<tr><td>Policy</td><td colspan="3">▪ Ethics
Copy of other students' work is highly discouraged. All assignments must be handled by the student himself. This is a university policy and violators will be reprimanded accordingly.
▪ Preparation for class
The structure of this course demands your individual effort outside the classroom for extra practice of many problems within the textbook. After each session, every student needs to put sufficient time to practice and finish the assignments by the predetermined date.
• Withdrawal (pass/fail)
This course strictly follows the grading policy of the School of Engineering. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year.
▪ Cheating/plagiarism
Cheating or other plagiarism in handling the assignments, Mid-term and Final Examinations will lead to course failure. In this case, the student will automatically get zero (0), without any considerations.
▪ Professional behavior guidelines
The students shall behave in a way to create a favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly discouraged.
▪ Attendance
Students who attend the whole classes will get 5 marks. for three absence student loses 1 mark.

▪ Seminar
Each student will be required to choose and present on a recent or emerging topic in renewable energy. The evaluation will be based on the clarity and depth of your presentation, the quality of your research, and the effective use of visual aids to support your arguments.
▪ Project
Throughout the semester, students will complete two design projects, each worth 10 points. Both projects will require students to design and analyze systems based on two different renewable energy sources .In each project, students will apply the principles learned in the course to create practical solutions, considering both technical and environmental factors. For each project, students will be required to submit a detailed report that includes the design process, assumptions, calculations,</td></tr>
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	analysis, and conclusions. The projects will be evaluated based on the clarity and accuracy of the design, creativity, depth of analysis, and the ability to apply renewable energy concepts to real-world challenges.

Tentative Schedule

Week	Date/Day (tentative)	Topics	Textbook/Assignments
1		Introduction to renewable energy and historical overview of solar cells, Functioning of the photovoltaic cells and Efficiency of solar cells	Textbook-1 Chapter 1
2		Types of solar photovoltaic cells and Energy depreciation of photovoltaic cells, Photovoltaic system types, conversion, and specifications	Textbook-1 Chapter 2-3
3		Charge regulators, Power factor Energy, Network-connected photovoltaic systems (on-grid)	Textbook-1 Chapter 2-3-4
4		Standalone systems (off-grid) or isolated systems, Hybrid systems, Independent, systems for economic purposes	Textbook-1 Chapter 4-5
5		Project	
6		Introduction of solar thermal energy, residential, commercial, and industrial applications	Textbook-2 Chapter 1-2
7		Solar radiation, heat transfer, Solar thermal power	Textbook-2 Chapter 3-4-5
8		Review **Midterm**	
9		Plane and concentrated collectors, water heating applications, heating and cooling the buildings, Thermal industrial applications, Water desalination, Solar thermal energy system,	Textbook-2 Chapter 10-12-13-14
10		Project	
11		History of the Wind Energy Development and Aerodynamics of Wind Turbines	Textbook-3 Chapter 1-2
12		Generators.	Textbook-3 Chapter 6-7
13		Physical principles of Wind Energy Conversion, Wind Turbine system.	Textbook-3 Chapter 8-9
14		Estimating Wind Turbine average power and energy production	Textbook-2 Chapter 2-4
15		Project	
16		**Final Exam/ Delivery of assignments**	

This syllabus is a guide for the course and any modifications to it will be announced in advance.