Course Specification
(Bachelor)

Course Title:	Renewable Energy Systems
Course Code:	EVS 1476
Program:	Bachelor of Science in Environmental Science
Department:	Biology
College:	Science
Institution:	Imam Mohammed Ibn Saud Islamic University
Version:	1
Last Revision Date:	-

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 3 (2 Lectures + 2 Lab)

2. Course type

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

3. Level/year at which this course is offered: (Level 7 /4th Year)

4. Course General Description:

This course offers an introductory exploration into renewable energy systems, focusing primarily on solar, water, and wind energy technologies. Its goal is to provide students with a fundamental understanding of the potential and practical applications of solar, wind, hydroelectric, biomass, and geothermal energy. The course will cover the design, operation, and integration of renewable energy systems into existing energy infrastructure, as well as the environmental, economic, and social implications of renewable energy arrangement. Students will explore the advantages, limitations, and potential of various energy sources including wind, solar, small-scale hydro, ground-source heat pumps, combined heat and power, biofuels, fuel cells, and other emerging technologies. Through the course, students will gain insight into the strategies and cost-benefit analyses used by energy analysts to fulfill energy demand through clean energy production. Additionally, students will undertake a study and develop a proposal for their own renewable energy project.

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

EVS 1110 / EVS 1114

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

None

7. Course Main Objective(s):

Familiarizing students with renewable energy resources as viable alternatives to finite sources. The course also aims to equip students with a comprehensive understanding of renewable energy sources, including their utilization for electricity generation, system components, characteristics, sizing, and applications in both centralized and decentralized electrical power supply systems, spanning small-scale to large-scale implementations Providing insight into the current and future global and national energy demands in relation to available renewable energy resources, enabling analysis and understanding. Offering a concise overview of the fundamentals of solar energy and photovoltaic cells. Explore the different technologies and components involved in harnessing renewable energy, including solar photovoltaics, wind turbines, hydroelectric generators, biomass conversion systems, and geothermal heat pumps. Learn about the design considerations, performance characteristics, and operational principles of renewable energy systems.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	√	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning	-	-
4	Distance learning	-	-

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	30
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)**	0
Total		60

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

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Identify Energy Production Systems and Sustainable Energy Conversion Processes	K1	Lecture and take-home research assignment	Quizzes, midterm exam and final exam
1.2	Discuss Solar Radiation and Characteristics of Photovoltaic Systems	K2	Lecture and take-home research assignment	Quizzes, midterm exam and final exam

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.3	State Wind Power and Technologies for Energy Conversion	K3	Lecture and take-home research assignment	Quizzes, midterm exam and final exam
2.0	**Skills**			
2.1	Show proficiency in utilizing critical thinking and problem-solving skills to assess business energy usage, and determine appropriate applications of renewable energy solutions	S1	Lecture and take-home research assignment	Quizzes, midterm exam and final exam
2.2	Analyze and comprehend the challenges associated with the integration of renewable energy systems, and effectively evaluate potential obstacles to implementation.	S2	-Tutorials	-Presentations -Assignments -written exams
2.3	Evaluate the benefits, drawbacks, and potential of various clean energy sources tailored to the needs of buildings and businesses, and demonstrating a comprehensive	S3	-Tutorials	-Presentations -Assignments -written exams

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	understanding of their suitability and efficacy.			
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrate understanding and awareness of the regulatory frameworks governing renewable energy projects, including compliance requirements and permitting processes.	V1	Laboratory and take-home research assignment	Lab reports and Lab exam
3.2	Show accountability in presenting a comprehensive proposal for a clean energy project, integrating knowledge of technical, financial, regulatory, and policy aspects to offer a feasible and compelling plan.	V2	Laboratory and take-home research assignment	Lab reports and Lab exam
3.3	Share actively in specialized activities	V3	Laboratory and take-home research assignment	Lab reports and Lab exam

C. Course Content

No	List of Topics (Lectures)	Contact Hours
1.	**Principles of Renewable Energy** • Introduction to renewable energy • Energy and sustainable development • Scientific principles of renewable energy	**4**
2.	**Fundamentals of Solar Energy** • Introduction • Radiation Fundamentals • Radiative Properties • Solar Radiation • Estimation of Solar Radiation	**4**
3.	**Solar Energy Applications** • Introduction • Flat-plate solar collector • Evacuated Tube collectors • Concentrating Solar collector	**4**
4.	**Water Energy** • Hydropower Systems • Turbines • Micro-hydro Systems • Environmental Impacts and Mitigation	**4**
5.	**Wind Energy** • Wind energy fundamentals and resource assessment • Wind turbine technology and design considerations • Wind farm siting and optimization	**2**
6.	**Biomass Energy** • Biomass Resources • Bioenergy production pathways (biogas, biofuels, biomass combustion) • Biomass resources and sustainability considerations	**2**

7.	**Integration of Renewable Energy Systems** • Grid integration challenges and solutions • Energy storage technologies (batteries, pumped hydro, thermal storage) • Smart grids and demand-side management • Hybrid renewable energy systems and microgrids	**2**
8.	**Renewable Energy Economics** • Levelized cost of energy analysis • Financial modelling and project financing • Economic evaluation methods • Risk assessment and mitigation strategies	**2**
9.	**Emerging Trends and Future Directions** • Advanced renewable energy technologies • Energy transition pathways and scenarios • Innovation in renewable energy research and development • Socioeconomic implications and societal acceptance of renewable energy	**2**
10.	**General revision-I**	**2**
11.	**General revision-II**	**2**
Total		**30**

No	List of Topics (Lab)	Contact Hours
1.	The components of solar flat plate collector	4
2.	The components of tube solar thermal system	4
3.	The components of the solar dryer system	4
4.	Quantify heat output, maximum power, and power output efficiency of solar energy systems.	4
5.	Construct or disassemble horizontal axis small wind turbines.	2
6.	Construct or disassemble vertical axis small wind turbines.	2
7.	Quantify the power output generated by the turbine	2
8.	Construct a hydropower system	2
9.	Quantify the power output generated by the hydropower system	2
10.	Construct a biogas system	2
11.	Quantify the power output generated by a biogas system	2
Total		30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm 1	Around 4th - 5th week	15%
2.	Midterm 2	Around 7th - 8th week	15%
3.	Quizzes, Participation, Assignments, Attendance	During the semester	10%
4.	Lab reports	During the semester	5%
5.	Lab Exam	15th week	15%
6.	Final Exam	16th week	40%
Total			100%

*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	1 Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala. Fundamentals and Applications of Renewable Energy. McGraw Hill; 2nd edition (July 21, 2023). ISBN-13 : 978-1265079659 2 John Twidell and Tony Weir. Renewable Energy Resources. 2015, Routledge is an imprint of the Taylor & Francis Group, an informa business
Supportive References	Felix A Farret and M. Godoy Simoes. Integration of Renewable Sources of Energy, 2nd Edition, , Wiley, 2018, ISBN: 978-1-11-913737-5
Electronic Materials	None
Other Learning Materials	None

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms and Laboratories
Technology equipment (projector, smart board, software)	Projector and Smartboard
Other equipment (depending on the nature of the speciality)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct
Effectiveness of Students assessment	Program Leader	Direct
Quality of learning resources	Faculty	Indirect
The extent to which CLOs have been achieved	Program Leader	Direct
Other	-	-

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

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**Head of Biology Department**
REFERENCE NO.	
DATE	