Academic Quality Assurance Department

Course Syllabus Form

College	Engineering and Technology		
Department	Electrical Engineering		
Program			
Course Title	Sustainable Energy Technology 1	**Course Number:**	12150310
Year	2023-2024	**Semester:**	SUMMER
Prerequisite(s)	Thermodynamics and Power Applications & Power Electronics		
Instructor	Dr. Mahmoud Ismail		
Instructor's e-mail	m.ismail@ptuk.edu.ps ; mahmoud_kafa@yahoo.com		
Office Hours	*10:00-11:00 SUN,TUS,THU*		
Class Time	08:00-10:00 SUN, MON,TUE 08:00-10:00 WED as Discussion Lecture	**Class Room:**	H216
Course description	Introduction to energy systems : conventional and renewable energy resources ; Solar Spectrum, Solar Time and angles, day length, angle of incidence on tilted surface; Sun path diagram; Shadow angle protractor; Solar Radiation ; Extraterrestrial Radiation; Effect of earth atmosphere; Estimation of solar radiation on horizontal and tilted surfaces; Measurement of solar radiation; Solar radiation calculations. Photovoltaic fundamentals; Solar Cell Physics; The Photovoltaic Effect, Dark and illumination characteristics; Figure of merits of solar cell; Efficiency limits; Variation of efficiency with band-gap and temperature; Efficiency measurements; High efficiency cells. Equivalent Circuit of the Solar Cell, Analysis of PV Cells: Types of Solar cells. Solar Cell Fabrication Technology. Solar Photovoltaic System Design; Maximum tracking; Centralized and decentralized SPV systems; Stand alone, hybrid and, grid connected system. The Recent developments in Solar cells, Role of nano-technology in Solar cells. Wind speed analysis; Wind turbine energy, power, torque and speed characteristics. Solar heater systems: Design, amount of heat.		

Course Intended Learning Outcomes (CILOs)	**A) Knowledge and understanding** 1- Identify, explain & analyze the roles of key stakeholders in the Renewables sector. 2- Understand and apply mathematical knowledge to Renewables scenarios, and solve theoretical problems 3- Solve practical problems by applying knowledge and understanding of physical science and mathematics 4- Design aspects of renewable technology, including working models 5- Evaluate existing and future Renewables technologies, with regards to operational effectiveness, safety and environmental impact. 6- Explore legal restrictions in the Renewables sector, including government and EU legislation 7- Evaluate organizational structure and propose improvements **B) Intellectual/Cognitive skills** 1- Gather, record, process and analyze quantitative data, relevant to Renewables technologies 2- Gather, record, process and analyze qualitative data, relevant to the Renewables industry 3- Form reasoned arguments in Renewables scenarios 4- Form balance and supported arguments in Renewables scenarios, and form justified conclusions 5- Demonstrate openness to new technologies in Renewables, and assess their potential impact 6- Identify key areas of a problem in Renewables 7- Determine appropriate tools and methods to use in problem solving **C) Subject specialization and practical skills** 1- Address problems systematically and appreciate complexity 2- Act with autonomy when devising original designs, within guidelines 3- Act with autonomy when analyzing and evaluating Renewables technology, within guidelines 4- Operate ethically, with regards to environmental principles and legal obligations 5- Operate responsibly, with regards to the safety requirements, for example, of high-hazard industrial plants 6- Fulfil and enhance own role within an organization **D) General and transferable skills** 1- Work with fellow employees in the Renewables sector 2- Communicate in writing and comprehend complex technological ideas in the Renewables sector 3- Identify and reflect upon their own strengths and weaknesses 4- Identify and reflect upon opportunities to enhance their own career, through personal development 5- Write essays expressing ideas relevant to the energy industry and analyzing complex Renewables technologies 6- Apply mathematical skills to Renewables scenarios, including analysis of existing and emerging technologies 7- Use IT tools, including WORD and Excel, to complete complex assignments 8- Work effectively in a team of peers to produce presentations and posters concerning Renewables 9- Prepare, deliver and evaluate a presentation concerning a personal project in

	Renewables.
Textbook(s)	A. Recommended Textbook(s): 1- Solar Energy Engineering-Processes and Systems (2nd Edition) by Kalogirou, Stories A. 2- Wind Power – The industry Grows Up by Busby, Rebecca L.
Other required material (References):	1-Handbook of Research on Solar Energy Systems and Technologies by Anwar, Sohiel; Efstathiadis, Harry; Qazi, Salahuddin.
Other Resources used (e.g. e-learning, field visits, periodicals, software, etc.)	A- Some Electronic resources, Websites related to the course: 1. http://global.kyocera.com/prdct/solar/spirit/about_solar/cell.html 2. http://www.greenrhinoenergy.com/renewable/wind/ 3. http://www.electrical4u.com/hydro-power-plant-construction-working-and-history-of-hydro-power-plant/ 4.http://www.waverlyutilities.com/environment/sustainable-energy-principles.aspx B- Field Visits to Solar Projects C- Shared Videos via MOODLE

Course Teaching Methods	
Teaching Method	**CILOs**
1-Lecturing	A1-A7
2- Presentation & Discussion	B1-B7; D1-D9
3- Discussion through field visits	C1-C6; D1-D9

Assessment Type	Details/Explanation of assessment in relation to CILOs	Weight	Date(s)
Midterm Exam	A1-A6	35-40	Week 4-6

	B1-B5; D1-D3 C1-C4; D1-D3		
Semester Work	A1-A6 B1-B5; D1-D3 C1-C4; D1-D3	15-20	During Semester
Final Exam	A1-A6 B1-B5; D1-D3 C1-C4; D1-D3	45	Announced by Registrar
Total		100%	

Course Intended Learning Outcomes (CILOs)										
CILOs	**Mapping to Program ILOs**									
On successful completion of the course, students will be able to:	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**I**	**j**
A) Knowledge and understanding										
1- Identify, explain & analyze the roles of key stakeholders in the Renewables sector.	X	X	X		X				X	
2- Understand and apply mathematical knowledge to Renewables scenarios, and solve theoretical problems	X	X	X		X				X	
3- Solve practical problems by applying knowledge and understanding of physical science and mathematics	X	X	X		X				X	
4- Design aspects of renewable technology, including working models	X	X	X		X				X	
5- Evaluate existing and future Renewables technologies, with regards to operational effectiveness, safety and environmental impact.									X	
6- Explore legal restrictions in the Renewables sector, including government and EU legislation						X	X	X	X	X
7- Evaluate organizational structure and propose improvements						X	X	X	X	X
B) Intellectual/Cognitive skills										
1- Gather, record, process and analyze quantitative data, relevant to Renewables technologies						X	X	X	X	X
2- Gather, record, process and analyze qualitative data, relevant to the Renewables industry						X	X	X	X	X
3- Form reasoned arguments in Renewables scenarios						X	X	X	X	X
4- Form balance and supported arguments in Renewables scenarios, and form justified conclusions						X	X	X	X	X
5- Demonstrate openness to new technologies						X	X	X	X	X

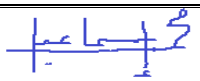
in Renewables, and assess their potential impact										
6- Identify key areas of a problem in Renewables						X	X	X	X	X
7- Determine appropriate tools and methods to use in problem solving						X	X	X	X	X
C) Subject specialization and practical skills										
1- Address problems systematically and appreciate complexity				X	X		X			
2- Act with autonomy when devising original designs, within guidelines				X	X		X			
3- Act with autonomy when analyzing and evaluating Renewables technology, within guidelines				X	X		X			
4- Operate ethically, with regards to environmental principles and legal obligations				X	X		X			
5- Operate responsibly, with regards to the safety requirements, for example, of high-hazard industrial plants				X	X		X			
6- Fulfill and enhance own role within an organization				X	X		X			
D) General and transferable skills										
1- Work with fellow employees in the Renewables sector				X	X		X	X		
2- Communicate in writing and comprehend complex technological ideas in the Renewables sector				X	X		X			
3- Identify and reflect upon their own strengths and weaknesses				X	X		X			
4- Identify and reflect upon opportunities to enhance their own career, through personal development				X	X		X			
5- Write essays expressing ideas relevant to the energy industry and analyzing complex Renewables technologies				X	X		X			
6- Apply mathematical skills to Renewables scenarios, including analysis of existing and emerging technologies				X	X		X			
7- Use IT tools, including WORD and Excel, to complete complex assignments				X	X		X			
8- Work effectively in a team of peers to produce presentations and posters concerning Renewables				X	X		X			
9- Prepare, deliver and evaluate a presentation concerning a personal project in Renewables				X	X		X			

Academic Quality Assurance Department

Course Syllabus Form

Course Weekly Breakdown					
Week	**Date**	**Topics Covered**	**CILOs**	**Lab Activities**	**Assessment**
1	21/7	Introduction: 1.1 Palestine & World energy consumption & Demand 1.2 Renewable vs fossil energy sources 1.3 Future outlook Overview of renewable energy technologies: 2.1 Renewable energy sources 2.2 Advantages and benefits 2.3 Available technologies and challenges	A1-A7 B1-B7; C1-C6; D1-D9		In MIDTERM EXAM, FINAL, and ASSIGNMENTS
2	28/7	Load analysis and Tariff Systems 3.1 Load Curve Terminologies and Calculations 3.2 Tariff Systems in conventional power systems 3.3 Tariff systems in Renewable Energy systems Solar energy: 4.1 Sun and its Energy: Basics of Solar Energy 4.2 Solar angles and Radiation	A1-A7 B1-B7;C1-C6; D1-D9		In MIDTERM EXAM, FINAL, and ASSIGNMENTS
3	4/8	Solar energy: 5.1 Radiation on tilted surfaces. Photovoltaic Systems 6.1 Solar Photovoltaics Definition , features , and applications 6.2 Solar cell physics and technology	A1-A7 B1-B7; C1-C6; D1-D9		In MIDTERM EXAM, FINAL, and ASSIGNMENTS
4	11/8	Photovoltaic Systems 7.1 Photovoltaic Panels 7.2 Related Equipment (Batteries; Inverters; Charge controllers; Peak-power trackers) Photovoltaic Systems 8.1 Photovoltaic Applications (Direct-coupled PV system; Stand-alone applications; Grid-connected system; Hybrid connected system)	A1-A7 B1-B7; C1-C6; D1-D9		In MIDTERM EXAM, FINAL, and ASSIGNMENTS
5	18/8	Photovoltaic Systems 9.1 Design of PV systems (Electrical loads; Absorbed solar radiation; Cell temperature; Sizing of PV systems; Tilt angle and yield; Concentrating PV) Photovoltaic Systems 10.1 Degradation in PV Systems 10.2 Solar Tracking Systems. 10.3 Distance between rows	A1-A7 B1-B7; C1-C6; D1-D9		In MIDTERM EXAM, FINAL, and ASSIGNMENTS

6	25/8	Photovoltaic Systems 11.1 Losses Analysis of PV Systems 11.2 Bypass and Blocking Diodes 11.3 Recent Developments in Solar cells, Role of Nano-technology in Solar Cells Solar Thermal Energy 12.1 Solar Thermal Energy (Solar energy collectors; Thermal analysis of Solar Collectors; Performance of Solar Collectors).	A1-A7 B1-B7; C1-C6; D1-D9		IN FINAL EXAM, and ASSIGNMENTS
7	1/9	Solar Thermal Energy 13.1 Solar Thermal Power Systems (Parabolic trough collector systems; Power tower systems; Dish systems) Wind Energy Systems 14.1 Introduction (How the sun produces wind; Capturing and using the wind's energy) 14.2 Today's Wind Energy Systems (Sizes; Designs; Benefits; Challenges) 14.3 Wind characteristics (Wind speed profiles; Wind speed variation with time;	A1-A7 B1-B7; C1-C6; D1-D9		IN FINAL EXAM,
8	8/9	FINALS			

Prepared by:	**Dr. Mahmoud Ismail**	**Signature**	
Head of Department	**Dr. NABEEL TANNAH**	**Signature**	
Date	**20-7-2024**		