# Course Description Form

| 1. Course Name: |
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| Renewable energy |
| 2. Course Code: |
| MPAC407 |
| 3. Semester / Year: |
| Annual (2024–2025) |
| 4. Description Preparation Date: |
| Beginning of the academic calendar (2024–2025) |
| 5. Available Attendance Forms: |
| Lectures + Lab |
| 6. Number of Credit Hours (Total) / Number of Units (Total) |
| Theoretical (60) – Practical (30) / 5 Units |
| 7. Course administrator's name (mention all, if more than one name) |
| Name: Hassan Talib Hashem<br><br>Email: hasanth2030@uowa.edu.iq |
| 8. Course Objectives |

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| **Course Objectives** | **1. Expanding the student's knowledge through his introduction to new sources of energy other than traditional sources. The primary objective of the course lies in the importance of renewable energy and its applications, which has become one of the most important fields proposed in the twenty-first century for economic and environmental reasons, and in the importance of obtaining renewable (sustainable) and clean energy as a guarantee for the present and security for the future.**<br>**2. Getting to know renewable energy sources and how to benefit from them to obtain energy and learn about the various application systems associated with those sources.**<br>**3. Students can benefit from this course in their field of work as engineers in the field of refrigeration and air conditioning and include** |

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| | **in general education curricula concepts about preserving the environment and using clean and renewable energy.**<br>**4. Studying traditional energy sources, sources of energy consumption, the world's energy needs, as well as environmental problems related to the use of traditional energies and studying ways and methods to reduce energy consumption.**<br>**5. Knowledge of the basics of various renewable energy sources and the technologies required for associated energy systems.**<br>**6. Studying the types of renewable energy, its working principle, properties, applications, development prospects, and explaining the importance of using such energies from an environmental and economic perspective.**<br>**7. Providing students with scientific and applied research skills.** |

## 9. Teaching and Learning Strategies

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| **Strategy** | **1. Theoretical lectures**<br>**2. Practical application and laboratory experiments**<br>**3. Discussions, workshops and seminars**<br>**4. Using modern presentation and teaching methods**<br>**5. Field visits and professional training**<br>**6. Review the latest published research in the field of renewable energy**<br>**7. Self-education** |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
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| 1 | 3 | Knowledge of renewable energy sources and their applications, and identification of environmental problems resulting from the use of traditional fuels | General introduction to renewable energy<br>Renewable energy sources and applications<br>Renewable Energy and environmental problems (Acid rain, Ozone layer depletion, Global climate change, Nuclear hazards) | 1. Theoretical lectures<br>2. Practical application and laboratory experiments<br>3. Discussions, workshops and seminars<br>4. Using modern presentation | ● Daily and oral tests<br>● Monthly tests<br>● Practical tests<br>● Reports<br>● Extracurricular activities<br>● Projects<br>● Annual tests |
| 2 | 3 | How to calculate solar time equation | The sun<br>Reckoning of time (the equation of time | | |

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| | | | and longitude correction) | and teaching methods<br>5. Field visits and professional training<br>6. Review the latest published research in the field of renewable energy<br>7. Self-education | |
| 3 | 3 | Calculating solar angles required for solar energy applications | Solar angles (declination, hour angle, solar altitude angle, solar azimuth angle, Sunrise and sunset times and day length, incidence angle) | | |
| 4 | 3 | Calculating solar radiation incident on different surfaces | Extraterrestrial solar radiation, Atmospheric attenuation, Terrestrial irradiation, Total radiation on tilted surfaces. | | |
| 5 | 3 | Knowing the types and characteristics of fixed solar collectors | SE collectors Stationary collectors (Flat-Plate Collectors, Compound Parabolic Collectors, Evacuated Tube Collectors) | | |
| 6 | 3 | Knowing the types and characteristics of tracking solar collectors | Sun-tracking concentrating collectors (Parabolic Trough Collectors, Fresnel collectors, Parabolic Dish Reflectors, Heliostat Field Collectors) | | |
| 7 | 3 | Learn about the characteristics and advantages of solar heating systems | Solar water heating systems Passive systems (Thermosiphon systems, Integrated collector storage) | | |
| 8 | 3 | Know the characteristics of features Direct and indirect heating systems | Active systems (Direct Circulation Systems, Indirect Water Heating Systems, Pool Heating Systems) | | |
| 9 | 3 | Learn about renewable energy storage systems | Heat storage systems (Air System Thermal Storage, Liquid System Thermal Storage, and | | |

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| | | | Thermal Analysis of Storage Systems). | | |
| 10 | 3 | Learning how to design the module and array and know the auxiliary devices and equipment in renewable energy systems | Module and array design (module design, and array Design)<br>Differential temperature controller, Placement of Sensors | | |
| 11 | 3 | Calculating the amount of hot water required and knowing the practical requirements for renewable energy systems | Hot water demand<br>Practical considerations (pipes, supports, insulation, pumps, valves, and instrumentation). | | |
| 12 | 3 | Calculating the heating and cooling load of buildings | Solar Space Heating and Cooling<br>Calculation of heat load | | |
| 13 | 3 | Heating and cooling buildings with solar energy | Solar space heating and cooling (Space heating and service hot water, Air systems, Water systems, Location of auxiliary heater, Heat pump systems)<br>Solar cooling (Adsorption units, Absorption units)<br>Solar cooling with absorption refrigeration | | |
| 14 | 3 | Learn about solar heating processes for industrial purposes | Industrial Process Heat (Solar industrial air and water systems, Solar steam generation systems)<br>Chemistry Applications (Reforming of fuels, Fuel cells, Materials processing, Solar detoxification) | | |
| 15 | 3 | Knowing the types, features and characteristics of | Solar Dryers (Active Solar Energy Dryers, Passive Solar Energy Dryers | | |

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| | | solar dryers and greenhouses | Greenhouses and Greenhouse materials. | | |
| 16 | 3 | Knowledge of the types, features and characteristics of water desalination systems and solar desalination processes | Solar Desalination Systems, Desalination processes Direct collection systems (Classification of Solar Distillation Systems, Performance of Solar Stills) | | |
| 17 | 3 | Learn about solar cells, their working principle, and the components of the solar electrical generation system | Solar cells, Structure of Photovoltaic PV System | | |
| 18-19 | 3 | Knowledge of the components and characteristics of the solar generation system and the hybrid system | Design of PV system Hybrid PV/T systems and applications | | |
| 20 | 3 | Knowledge of the components, characteristics and working principle of solar thermal electricity generation systems | Solar Thermal Power Systems (Parabolic trough collector systems, Power tower systems) | | |
| 21 | 3 | Knowledge of the components, characteristics and working principles of dish collector systems and solar ponds | Solar Thermal Power Systems (Dish systems, Solar ponds) | | |
| 22 | 3 | Learn about the basics of wind energy, wind turbines, and the aerodynamics of rotors and wind turbines | Introduction to Wind Energy Power available in the WE Wind turbine WT power and torque Classification of WTs (Horizontal axis WTs, Vertical axis WTs) | | |

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| | | | Characteristics of wind rotors<br>Aerodynamics of WTs (Airfoil, Aerodynamic theories) | | |
| 23 | 3 | Know how to design a wind turbine rotor and how to analyze wind data | Rotor design - Rotor performance<br>Analysis of wind data | | |
| 24 | 3 | Learn the characteristics and advantages of wind conversion systems and wind generators | Wind energy conversion systems<br>Wind electric generators (Tower, Rotor, Gear box, Power regulation, Safety brakes, Generator)<br>Wind farms, Offshore wind farms<br>Wind pumps - Wind water heater | | |
| 25 | 3 | Know the characteristics of wind energy conversion, power curve, and capacity factor in wind energy | Performance of wind energy conversion system<br>Power curve of wind turbine<br>Capacity factor | | |
| 26 | 3 | Learn about power generation from water and water turbines | Introduction, Water Cycle<br>Water Turbines | | |
| 27 | 3 | Identify the characteristics, features and working principle of hydropower stations | Hydropower Plants (Run - of - River Power Plants, Storage Power Plants, Pumped - Storage Power Plants)<br>system design | | |
| 28 | 3 | Knowledge of bioenergy and its use in heat and electricity generation plants | Tidal Power Plants, Wave Power Plants | | |
| 29 | 3 | Learn about geothermal power plants, their characteristics and | Introduction to bioenergy (biomass, biogas, biofuel) | | |

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| | | the principle of their operation | Biomass Heating (Wood as a Fuel, Fireplaces and Closed Wood burning Stoves, Wood Pellet Heating) Biomass Heat and Power Plants | | |
| 30 | 3 | Identify tidal energy and wave energy, their characteristics, and their principle of operation | Introduction to geothermal energy Geothermal Plants (Geothermal Heat Plants, Geothermal Power Plants), Geothermal Heat pump | | |

## 11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

## 12. Learning and Teaching Resources

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| Required textbooks (curricular books, if any) | 1- Soteris Kalogirou , 2009 " solar energy engineering – processes and systems " 1st Ed. Elsevier Inc. ., USA<br>2- Sathyajith Mathew, 2006 , " Wind Energy , Fundamentals , Resource Analysis and Economics ", Springer , Netherlands .<br>3- Volker Quaschning , 2010 ," Renewal energy and climate change " John Wiley a Sons, Ltd. |
| Main references (sources) | |
| Recommended books and references (scientific journals, reports…) | |
| Electronic References, Websites | |