

Syllabus – Renewable Energy and Technology

Course Code: ENGR
Instructor: Prof. Sen Nieh

Credits: 3
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DESCRIPTION: This is a 3-credit, summer intensive, dual-level technical elective course for Mechanical and other Engineering upperclassmen and graduate students. It reviews traditional and alternative energy sources, and their usage and problems. It introduces various emerging and/or promising renewable energies and associated engineering technologies/systems, including solar thermal/photovoltaic, biomass/biofuels/Waste-to-Energy, wind power, hydro power, geothermal, ocean thermal/tidal/current energy, hydrogen/fuel cells, and various direct energy converters. It gives a broad, practical view and quantitative analysis of renewable energies for sustainable use.

INSTRUCTOR: Dr. Sen Nieh, Professor and Chairman, Department of Mechanical Engineering, The Catholic University of America; (Tel) +1-202-319-5170(U.S.); +886-979-434-857(Taiwan); nieh@cua.edu

CLASS MEET: Engr. Rm xxx, 9am-12, 1:30-4:30pm, July-August 2017 (2- or 3-Week Course)
TEXTBOOK: Fundamentals of Renewable Energy Processes, by Aldo V. da Rosa, 3rd ed., 884 pages, 18 chapters, Academic Press, MA, 2013 (ISBN-978-0-12-397219-4).
(Or a Relevant Textbook from Taiwan's Book Market)

COURSE CONTENT:

1. Introduction to Renewable & Traditional Energy, and Energy Systems
2. Problems of Traditional Energy: Air Pollution, Acid Precipitation, Smog, HAPs
3. Ozone Depletion, Global Warming, Climate Changes & Natural Disasters
4. Renewable Energy/Technology - 1: Solar Energy and Wind Power
5. Renewable Energy/Technology - 2: Bio Energy and Geothermal Energy
6. Renewable Energy/Technology - 3: Hydro Power and Ocean Energy
7. Renewable Energy/Technology - 4: H₂, Fuel Cell; New Nuclear P, Comb. Icy CH₄....
8. Status and Outlook of Renewable Energy/Technology in the World & Taiwan

PREREQUISITE: Undergraduate Thermodynamics; Upperclassmen in Engr. or Graduate Students

HOMEWORK: Four homework problem sets with some open-ended design problems will be given and graded for every two lecturing days.

EXAMINATION: Mid-term and final exams will be given.

GRADING: **The final grade will be based on (100%):**

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| o Homework, Attendance, Power Plant Tour | 30% |
| o Mid-Term Exam | 30% |
| o Final Exam | 40% |

| (Three-Week Course), July 2017 | | | | | | |
|---------------------------------------|--|-----|--|--|-----|-----|
| SUN | MON | TUE | WED | THUR | FRI | SAT |
| 7/09 | 7/10 (day1) 09:00-12:00 13:30-16:30 | 11 | 7/12 (day2) 09:00-12:00 13:30-16:30 | 7/13 (day3) 09:00-12:00 13:30-16:30 | 14 | 15 |
| 16 | 7/17 (day4) 09:00-12:00 13:30-16:30 | 18 | 7/19 (day5) 09:00-12:00 13:30-16:30 | 7/20 (day6) 09:00-12:00 13:30-16:30 | 21 | 22 |
| 23 | 7/24 (day7) 09:00-12:00 13:30-16:30 | 25 | 7/26 (day8) 09:00-12:00 13:30-16:30 | 7/27 (day9) 09:00-12:00 13:30-16:30 | 28 | 29 |

- Day 1-1: Orientation, Syllabus, Textbook, Grade Policy; Intro to Renewable Energy/Tech; Materials, Phase Triangle, Energy Form/Types (PPTs Presentation) ---HW#1 Given
- Day 1-2: Energy System; Energy Law, Conversion Process; Energy Overview - USA/World, Traditional E: Coal, Oil, NG, Nuclear, Hydro (PPTs Presentation)
- Day 2-1: Renewable Energy, New Energy, Green Energy, Sustainable Energy; Resources Solar, Wind, Hydro, Ocean, Geoth, BioE, Adv.E (PPTs Presentation)
- Day 2-2: ES Problem-1, Air Pollution from Burning of HC Fuels-- Coal, Oil, NG; MSW PM-10, PM-2.5, SO_x, NO_x, CO, VOCs, Pb/Mg, ---HW#2 Given
- Day 3-1: ES Problem-2, Acid Precipitation, Dust Plague; Photochemical Smog; Indoor Air Quality/Th Comfortness; HAPs --- HW#1 Due
- Day 3-2: ES Problem-3, O₃ Depletion from HVAC/Refri. -- CFCs/HCFs/Cl; Alternative Refrigerants; Solar Radia./Spectrum; Atmosph. Structure, O₃ Depletion/Holes
- Day 4-1: ES Problem-4, Global Warming -- Carbon/CO₂/CO Emissions/Capture; Earth Energy Balance; Greenhouse Gas/Warming Impacts/Potential (PPTs Presentation)
- Day 4-2: ES Problem-5, Climate Change & Natural Disasters: Intensity, Frequency, Scale, Uncertainty, Casualties; GCC Summit, Review Exam (PPTs Present) --- HW#2 Due
- Day 5-1: **Q&As and *****Mid-Term Exam******* ---HW#3 Given
- Day 5-2: Renewable E-1, Solar E – Thermal Collectors, Solar Tower; Photovoltaic Panels Solar Farm; Technology/Application, World/Taiwan Outlook
- Day 6-1: Renewable E-2, Wind E – Wind Distribution, Windmill/Turbine, Aerody. Blades; Offshore Power, Outlook; Return Graded Exam & Status Report
- Day 6-2: Renewable E-3, Geothermal E – Geothermal Heat/Cooling/Power/Cogeneration; Hot Dry Rock; Volcano-related Sources; Technology/Example ---HW#4 Given
- Day 7-1: Renewable E-4, Bio E – Biomass, Solar Battery, Waste Residue, MSW, Bio-/Blended-Fuel; Animal Power, Bio Farm; Technology/Example --- HW#3 Due
- Day 7-2: Renewable E-5, Water E – Hydroelectric PPs, Water Cycle, Resources, Power Small-Scale Hydro Power; Technology/Example/Outlook
- Day 8-1: Renewable E-6, Ocean E – Ocean Thermal P, Tidal Power, Tidal Barrage/Lagoon, Ocean Current P, Fresh-Salty H₂O, Ocean Farm; Technology/Example
- Day 8-2: Renewable E-7, New E – Hydrogen Power, Fuel Cells & Reform; New Nuclear P, TEs/Thermionic P; MHD, DECS, Combustible Icy CH₄, Review Exam --- HW#4 Due
- Day 9-1: Adv. Topics of Renewable E/Tech; World/Taiwan Outlook; Concluding Remarks
- Day 9-2: **Q&As, *****Final Examination***** , Grades Submission**