Course Syllabus

1. Course number and name: 020ERNES5 – Renewable Energy

2. Credits and contact hours: 6 credits, 3x1:15 course hours per week

3. Instructor's or course coordinator's name: Chantal MAATOUK

4. Text book :
    a. other supplemental materials:
    Professor text book and other supplemental materials

5. Specific course information
    a. catalog description :
    This course provides an overview of the latest technologies and developments in renewable energies, as well as the diversity of their applications. It aims to make students aware of the potentials and specificities of renewable energies in terms of electricity generation. What are these energy resources? How to capture and transform them? In what form they can be used?
    In this course are examined: the current state of renewable energies in the world and future prospects. Energy cycle on earth. Solar energy; Availability conversion and applications of solar energy, thermal and photovoltaic sensors. Wind power; Availability and development. Hydroelectric power; Conversion methods, types of hydraulic turbines. Biomass; Sources, conversion methods. Geothermal energy; Geothermal energy level, type of systems. Energy storage; Fuel cells, hydraulic ponds. Socio-economic analysis and lifecycle analysis of renewable energy systems.

    b. prerequisites: None

    c. Required/Elective/Selected Elective: Required for EE program

6. Specific goals for the course
    a. specific outcomes of instruction,
    - Analyze and identify the main renewable energy sources and their operating modes;
    - Determine the basic energy balances of the renewable energies conversion systems;
    - List and describe the primary renewable energy resources and technologies;
    - Design and model renewable energy conversion systems

b. KPIs addressed by the course.

KPI	e1	e2	j1
Covered	x	x	x
Assessed	x	x	x
Give Feedback	x		x

7. Brief list of topics to be covered and approximate lecture hours :
   - Course introduction, (1 Lecture)
   - Hydro-electric: Principle of operation of hydraulic energy into electricity. Main turbine technologies i.e: Pelton, Francis and Kaplan. Component design and performance of hydro-electric power plant. Applications, (7 lectures)
   - Wind energy: History on the use of wind energy; Power in the wind ; Wind turbine site assessment basics; Basics of wind turbine design; Wind turbine blade design; Wind turbine alternator design ;Wind turbine control systems; Balance of system; Wind turbine towers; Wind turbine monitoring; Diagnosis and prognosis of wind turbine failure, (7 lectures)
   - Solar energy: Photovoltaic solar cells. The sunlight. Physics of Photovoltaics: Fundamentals of energy conversion in photovoltaic solar cells. Solar spectrum, effect of geometry, atmospheric attenuation. Main photovoltaic technologies. Design of Stand-alone PV Systems; Hybrid Systems. Specific Purpose Photovoltaic Applications. Calculating the Cost of PV Systems. Life cycle analysis, (11 lectures)
   - Thermal Solar systems: Development of solar thermal energy uses. Different technologies of solar thermal panels for domestic hot water production: Unglazed collectors, flat plate collectors, evacuated tube collector. Operating conditions and design. Efficiency and performance, (3 lectures)
   - Biomass and environment. Resources and characteristics of different types of biomass. Biomass to renewable energy processes: Chemical process (hydrolysis, liquefaction, pyrolysis, and gasification), Thermochemical process (methanation), and Biological process (compost). Sustainability & Resilience. Bioenergy & Environment, Criteria Pollutants, Carbon Footprint, (7 lectures).
   - Geothermal Energy: Geothermal resources. Geothermal heating and air conditioning applications. Low-temperature geothermal applications for heat generation. High-temperature geothermal power production: Natural or flash-based geothermal installations. Design and calculation of geothermal processes, (2 lectures)
   - Energy storage. Fuel cells, super capacitors, compressed air, flywheels, chemical batteries, hydraulic storage. Principle of operation. Existing technologies. Efficiency and performance, (4 lectures)