Course Syllabus

1. Course number and name: 020PENES4 – Power Generation

2. Credits and contact hours: 4 credits, 2x1:15 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.
    Conversion d'énergie par turbomachines. Michel Pluviose. Collection Ellipses.

5. Specific course information
    a. catalog description : In this course, we examine the basic concepts of conventional energy conversion processes for power generation, as well as the characterization and forecasting of electrical energy demand.
    In this course, after a brief overview of the world energy situation and projections for the medium term, the respective share foreseen for energy systems is shown. Then, the modes of production and transfer of heat, in order to produce electrical energy, will be studied. This will lead us to study thermodynamic systems, means of production of mechanical energy.
    This mechanical energy can be recovered from renewable sources such as water, wind and sun, and of course from the fossil and fissile fuels used to supply the hot source of thermodynamic cycles: steam turbine power stations, Gas turbines, combined cycles, nuclear power plants, etc. It will be necessary to study the operating principles of these power plants at their nominal points but also at partial loads. The economic and environmental aspects will also be discussed.

    b. prerequisites : Fluid mechanics

    c. Required/Elective/Selected Elective: Selected Elective

6. Specific goals for the course
    a. specific outcomes of instruction,
    - Apply the fundamental principles of thermodynamics to study thermal power plants for the production of electric energy from different sources of fossil fuels.
    - Analyze, design and optimize the thermal power plants by applying their knowledge developed on the main mature technologies.
    - Develop mathematical models to design and optimize conventional electricity generation systems, conduct technical, economic and environmental analysis and interpret the results.

b. KPIs addressed by the course.

KPI	a2	h1			
Covered	x	x			
Assessed	x				
Give Feedback					

7. Brief list of topics to be covered and approximate lecture hours :
   - Course introduction- World energy situation. Energy forecasts and world reserves. Forms of energy and mode of conversion. Power generation by turbo-machinery. Economic and environmental aspects. Electricity sector: load curve, annual monotonous curve, (2 lectures).
   - Chapter 2 - Fundamentals of Energy Conversion and Heat Transfer. Principles of Heat generation and Transfer; How can we produce heat? What are the modes of heat transfer? Fundamentals of thermodynamics; First law, Second law, Carnot cycle. Basic Principles of Fluid Mechanics; mass conservation, Bernouilli equation, Compressible fluids, (5 lectures).
   - Chapter 3 - Steam Power Plants. Introduction of the steam power cycles; Carnot cycle, Role of working fluid, Rankine cycle, superheat cycles, supercritical cycles, cycles efficiency. Hirn's Cycle; Theoretical and real. Ideal and real Regenerative Cycle. Reheat Cycle. Condensation of steam, (6 lectures).
   - Chapter 4 - Multi-stage Turbines. Impulse turbines. Reaction turbines. Multiple casing turbine. Non - condensable fluid turbines. Pressure-flow characteristics, (3 lectures).
   - Chapter 5 – Regulation of Steam Turbine. Steam turbine steam control device. Power regulation by total rolling; partial injection; sliding pressure. Consumption in partial injection mode, (1 lecture).
   - Chapter 6- Gas power cycle. Analysis of the ideal and real gas power cycle. Calculation of a gas turbine performance at nominal and partial loads. Improvement; Gas turbines with regeneration, intercooled compression and reheating, (5 lectures)..
   - Chapter 7- Combined gas-vapor power cycles. Principle of operation of a combined cycle. Thermodynamic analysis. Recovery boiler. Performance at partial loads, (3 lectures).
   - Chapter 8- Internal combustion engines. The sliding crank mechanism. Lenoir Cycle. Otto Cycle. Alternative engine efficiency. Ignition controlled. Ignition by compression or diesel cycle. Comparison between Otto and Diesel cycles. Performance of a diesel engine (3 lectures).