Course Syllabus

1. Course number and name: 020ETCES1 Electrotechnics

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

3. Instructor's or course coordinator's name: Ragi GHOSN

4. Text book : Professor textbook and course material
    a. other supplemental materials: Slides

5. Specific course information
    a. brief description of the content of the course (catalog description)

        The aim of this course is the study of three-phase electrical networks in balanced and unbalanced steady-state sinusoidal operation as well as single-phase and three-phase transformers. The course covers the dielectrics, conductors, magnetic materials used in electrotechnics, the operating and modeling of linear and non-linear magnetic circuits without and with flux leakage and the effect of the airgap. It also covers the modeling of three-phase balanced and unbalanced electrical networks operating in a sinusoidal regime by the method of the single-phase star-equivalent scheme and the symmetrical components method. Finally, the principles of operation of single-phase and three-phase transformers are studied in order to establish their equivalent circuits and predetermine the values of the voltages, currents, powers, efficiency at no-load, short-circuit and load operations.

    b. prerequisites or co-requisites: 020EMENI3 Electromagnetism

    c. Required/Elective/Selected Elective: Required

6. Specific goals for the course
    a. specific outcomes of instruction,
        - Analyze linear and non-linear magnetic circuits, with or without airgap, while neglecting or taking into account the leakage flux.
        - Calculate the total core losses including the eddy currents loss and the hysteresis loss.
        - Analyze a three-phase AC electrical balanced circuit operating with sinusoidal waveforms by the method of the Wye equivalent one-phase circuit.
        - Analyze a three-phase AC electrical unbalanced circuit operating with sinusoidal waveforms by the symmetrical components method.
        - Define an ideal transformer and analyze its operation including impedance scaling. Explain the models of perfectly-coupled and imperfectly-coupled windings by the partial leakages method and the total leakages method.

Calculate the coupling factor and the inductive leakage factor or Heyland factor.

- Single phase transformer: Describe the construction – Determine an equivalent circuit in steady-state and calculate the values of its elements using no-load and short-circuit tests – Illustrate the phasor diagram – Predict the voltage drop and the efficiency at load operation – Describe the rated values and the short-circuit impedance – Interpret correctly the data on the transformer nameplate.
- Three phase transformer: Describe the construction – Explain primary and secondary winding connections and the vector group – Determine an equivalent circuit in steady-state and calculate the values of its elements using no-load and short-circuit tests – Illustrate the phasor diagram - Predict the voltage drop and the efficiency at load operation – Describe the rated values and the short-circuit impedance – Interpret correctly the data on the transformer nameplate.

b. KPIs addressed by the course.

KPI	a1	a2	b2	b3	k2
Covered	x	x	x	x	x
Assessed	x	x	x	x	x
Give Feedback	x	x	x	x	

7. Brief list of topics to be covered and approximate lecture hours :
   - Course introduction: 1 Lecture
   - Electromagnetism reminder, dielectrics, conductors, magnetic materials used in electrotechnics, operating and modeling of linear and non-linear magnetic circuits without and with flux leakage, effect of the airgap: 7 Lectures.
   - Problems on magnetic circuits: 3 Lectures.
   - Ideal transformer, magnetic coupling, flux leakage modeling, equivalent electric circuits, construction of a single phase transformer, equivalent circuits, phasor diagram, no-load, short-circuit and load operations, voltage regulation, rated values, nameplate, tests, efficiency: 7 Lectures.
   - Problems on single phase transformer: 4 Lectures.
   - Reminder on steady-state sinusoidal regime, balanced three-phase regime, wye and delta connections, power calculations and measurements, single-phase star equivalent circuit, unbalanced three-phase regime, symmetrical components method, examples: 7 Lectures.
   - Three-phase transformer: Construction of a three-phase transformer, windings connections, wye, delta, zig-zag, equivalent circuits, vector group, no-load, short-circuit and load operations, voltage regulation, rated values, nameplate, tests: 6 Lectures.
   - Problems on three-phase transformers: 3 Lectures.
   - Lab sessions on three-phase power measurements, single-phase transformers, three-phase transformers: Four sessions of 3 hours each, equivalent to 4 course lectures.