NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING
MECHANICAL-ELECTRICAL ENGINEERING PROGRAM

ML214 – STATIC ELECTRICAL MACHINES

I. GENERAL INFORMATION:

Course Code	: ML214 Static Electrical Machines
Semester	: 6
Credits	: 4
Hours per week	: 6 (4 Theory – 2 Practice)
Pre requisites	: ML-115
Condition	: Mandatory

II. SUMMARY:

Students, at the end of the course will be able to apply the concepts of magnetic circuits with ferromagnetic core, excited with alternating current, solve circuit models of power transformers in single-phase and three-phase; describing its constitution, explaining its operation and correctly determining its electrical parameters.

III. COMPETENCES:

The student:

1. Explain and determine the parameters of current magnetic circuits DC and AC power.
2. Constructs models of single-phase transformers and autotransformers of power.
3. Understand and apply the concepts of three-phase power transformers/
4. Types of connections. Open delta connection.
5. Solve problems involved with transformers connected in parallel.

IV. LEARNING UNITS

1. FUNDAMENTAL PRINCIPLES OF MAGNETOSTICS. EXCITATION OF FERROMAGNETIC STRUCTURES WITH CONTINUOUS CURRENT (6 HOURS)

Magnetic flux / Magnetic field and magnetic circuit / Magnetic properties of materials / Magnetization of substances / Permeability and magnetic susceptibility of a substance / Ampere law

in material media / Ferromagnetic materials / Ferromagnetic circuits of rectangular section with and without air gap.

2. FUNDAMENTAL PRINCIPLES OF ELECTROMAGNETIC INDUCTION. EXCITATION OF FERROMAGNETIC STRUCTURES WITH ALTERNATIVE CURRENT (6 HOURS)

Faraday's Law of Electromagnetic Induction / Sinusoidal applied voltage ratio, Induced f.e.m. and magnetic flux / Magnetic field energy of a coil / Energy losses in ferromagnetic cores / separation losses / Excitation current of a coil with ferromagnetic core / Graphical representation and mathematical representation / Equivalent electric circuit of the reactor / Determination of the Reactor parameters.

3. THE MONOPHASIC POWER TRANSFORMER (8 HOURS)

Basic characteristics of construction and operation / The exact equivalent circuit / Approximate equivalent circuit / Real-time single-phase transformer phasor diagram operating on vacuum and with load / Reduction of the parameters to one of its sides / Determination of equivalent circuit parameters using tests / The unitary method of calculation and its application to transformers.

4. REGULATION AND EFFICIENCY OF A MONOPHASIC POWER TRANSFORMER (8 HOURS)

Regulation of a single phase transformer / Analytical determination of the regulation / Maximum efficiency performance conditions / Economic study of the transformers.

5. SINGLE-PHASE AUTOTRANSFORMERS (6 HOURS)

The single phase transformer used as autotransformer / type of connections and equivalent circuits / regulation and efficiency of the auto transformer for the different types of connections / Advantages and disadvantages of the autotransformers.

6. THREE-PHASE CONNECTIONS OF SINGLE-PHASE TRANSFORMERS AND
7. THREE-PHASE TRANSFORMERS (12 HOURS)

Table of three-phase connections / The connection in open delta or in V / v / The three-phase transformers tests of vacuum and short circuit of a three-phase transformer / equivalent circuit of a three-phase transformer.

8. PARALLEL OPERATION OF TRANSFORMERS (10 HOURS)

Parallel operation of single-phase transformers / Conditions for parallel operation / Influence of the internal impedance of the transformers in the distribution of the load / Effect of the difference in the ratio of transformation on the parallel operation of two single-phase / parallel three-phase transformers.

V. METHODOLOGY

The course is developed in sessions of theory and practice. In theory sessions, the teacher presents concepts and applications using the operating principles and circuit models of static electric machines. At the end of the course the student must present an integrative real work project in teams. In all the sessions the active participation of the student is promoted.

VI. EVALUATION

Evaluation system "F".

Calculation of the final average: PF = (1EP + 2EF + 1PP) / 4

EP = Midterm Exam

EF = Final Exam

PP = Quizzes averages, there will be 3 quizzes

VII. BIBLIOGRAPHY:

1. Kingsley, Kusko and Fitzgerald. Theory and Analysis of Electrical Machines.6 Edition 2004.Mc Graw Hill.

2.- GURU-HIZIROGLU- "Electric machines and transformers" - 3rd Edition,

Oxford University Press. 2002