Electrical Drives

Academic Year: (2020 / 2021) **Review date: 12-11-2020**

Department assigned to the subject: Department of Electrical Engineering

Coordinating teacher: MONTILLA D'JESUS, MIGUEL EDUARDO

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

STUDENTS ARE EXPECTED TO HAVE COMPLETED

-Magnetic circuits and transformers
-Control Engineering
-AC Electric machines

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

-Ability to selection, analysis, and size of electric drives.

-To know the schemes of the electric motors speed control

-Ability to control an electric drive and simulate dynamic response

DESCRIPTION OF CONTENTS: PROGRAMME

LESSON 1. Introduction to electric drives and mechanical system
1.1) Introduction, Law of Motion for electric drives.
1.2) Basic principles of mechanics (moment-of-inertia, angular acceleration, gearbox, pulleys and flexible mechanical system)
LESSON 2. Introduction to DC machines and DC-DC converters
2.1) Principle of operation of the separately excited and series DC motors
2.2) Speed control of the separately excited and series DC motors (steady-state study)
2.2.1) Principles of speed control by varying applied voltage.
2.2.2) Principles of speed control by varying excitation flux.
2.3) Rectifier AC-DC power, controlled and uncontrolled.
2.4) Step-Down (Buck) and Step-up (Boost) converters
LESSON 3. DC Motor Drives
3.1) Operating principles in DC-motor drives (torque control, speed control, and flux control).
3.2) Speed control in the separately excited DC motor.
3.3) Dynamic Model of the DC motor
LESSON 4. AC Motor Drives (inverter)
4.1) Introduction to frond-end Inverter, Definition of Space vectors, Clarke transformation, and Park transformation. Inverter model in Stator Reference Frame.
4.2) Operating Principles of frond-end Inverter
4.3) Controller design for Inverter (space vector PWM)
4.4) Limits of the Inverter.
LESSON 5. Dynamic model of the induction motor and Scalar Speed Control
5.1) Dynamic model of the induction motor (cage rotor)
5.2) Scalar control of induction motors
LESSON 6. Vector control systems for induction motors
6.1) Introduction
6.2) Transformation of the dynamic model of the machine for vector control
6.2.1) Field Orientation Principle. Torque Control. Rotor flux Control.
6.2.2) Torque-speed characteristics for vector control. Rotor flux orientation.
6.2.3) Direct and indirect vector control
6.3) Direct vector control induction motor fed by converter which operates as a current source (torque, speed and flux control)
6.4) Direct vector control induction motor fed by converter which operates as a voltage source (torque, speed and flux control)

LEARNING ACTIVITIES AND METHODOLOGY

-The development of the course will be based on master classes with previous comprehensive reading of texts on some of the topics to be developed, individual tutorials. (3 ECTS credits).

-Lab practices. On the other hand, classes will be taught in the computer lab for students to develop through computer models (MATLAB / Simulink) all knowledge acquired on the DC and AC electric drives. Group and individual tutoring (3 ECTS credits)

ASSESSMENT SYSTEM

A. ORDINARY SESSION
1.- Continuous assessment (EvC)
- Computer Test (50 %)
- Homework's notes in small group (37,5%)
- Note of laboratory practice (12,5 %)

2.- Ordinary assessment (EvO)
3.- Final Note
-If the student PRESENTS ALL assigned homework (small group) with AVERAGE TOTAL NOTE ABOVE 3 and he/she is SUITABLE in the lab practices:
FINAL NOTE = 0,4*EvC + 0,6*EvO (if EvO is greater or equal to 3,5)
FINAL NOTE = 0,4*EvC (if EvO is less than 3,5)
-If the student DOES NOT PRESENTS ALL assigned homework (small group) with AVERAGE TOTAL NOTE ABOVE 3 and he/she is NOT SUITABLE in the lab practices:
FINAL NOTE = 0,6*EvC

B. EXTRAORDINARY ASSESSMENT
1.- Continuous assessment (EvC)
- Computer Test (50 %)
- Homework's notes in small group (37,5%)
- Note of laboratory practice (12,5 %)

2.- Extraordinary assessment (EvE)
3.- Final Note (Maximum score obtained according to the following points a and b)
a) FINAL NOTE = EVE + Test lab additional if you did not attend any or all of the practices (EPLA)
b) Criteria to consider continuous assessment (EvC)
-If the student PRESENTS ALL assigned homework (small group) with AVERAGE TOTAL NOTE ABOVE 3 and he/she is SUITABLE in the lab practices:
FINAL NOTE = 0,4*EvC + 0,6*EvE (if EvE is greater or equal to 3,5) + EPLA
FINAL NOTE = 0,4*EvC (if EvE is less than 3,5) + EPLA
-If the student DOES NOT PRESENTS ALL assigned homework (small group) with AVERAGE TOTAL NOTE ABOVE 3 and he/she is NOT SUITABLE in the lab practices:
FINAL NOTE = 0,6*EvE + EPLA

In either calls the conditions to pass the subject:
FINAL NOTE = > 5 (greater than or equal to 5)

(*) Marks obtained in the laboratory for the course for subsequent courses will not be saved. In the ordinary call, the note of practices will be greater than 5.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Chapman Stephen J , Máquinas Eléctricas, McGraw Hill.
- Fitzgerald Arthur Eugene, Máquinas Eléctricas. , McGraw Hill.
- Fraile Mora Jesús , Máquinas Eléctricas. , McGraw Hill.
- Krause Paul C, Analysis of Electric Machinery., IEEE.
- Leonhard Werner, Control of Electrical Drives., Springer.
- Mohan Ned, Power Electronic: converter, application and design. , John Wiley & Sons.

ADDITIONAL BIBLIOGRAPHY

- Theodore Wildi Máquinas Eléctricas y Sistemas de Potencia, Prentice Hall, 2007

- Trzynadlowski, Andrzej M. The Field Orientation Principle in Control of Induction Motors, Kluwer Academic Publishers, 1994