Electromagnetic compatible design

Academic Year: (2022 / 2023) **Review date: 29/01/2023 14:30:41**

Department assigned to the subject: Electronic Technology Department

Coordinating teacher: BARRADO BAUTISTA, ANDRES

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

An introductory course on Digital, Analog and Power Electronics

OBJECTIVES

COMPETENCES (CG2, CE3, CE8, CE10, CG1, CE11, CG4)
Capacity to design and test an electronic system on a specific application.
Capacity to handle advanced techniques for system electronic design.
Capacity to resolve real problems of interferences to get electromagnetic compatibility on equipment and systems.
Capacity to apply techniques for the development of electronic circuits and devices, like PCB and EMI filter design.
Capacity to make clear documentation explaining the development, design and application of complex electronic systems.
Capacity to make data searching related to the technology state of the art.
To be able to work in a collaborative group.

LEARNING RESULTS
The student learns basic concepts about EMI, EMC, conducted and radiated emissions, coupling types, surges etc.
The student learns to resolve real problems related to the electromagnetic interaction between electronic equipment and systems, and how to apply the standards to these cases.
The course allows acquiring design techniques that complement others needed to reach its functionality.
There are specific techniques to reduce electromagnetic EMI noise on PCB, cables, cardcages and boxes. Also, how to protect from conducted and radiated internal/external surges, including power supply network, electrostatic discharges, lightning transitory etc..
These techniques apply to any type of electric/electronic devices, and to applications based on microprocessors, FPGA, analog or power electronics. It also can be used for system design of vehicles, aircrafts, military equipment, distribution and power systems, robots, etc..

DESCRIPTION OF CONTENTS: PROGRAMME

Part 1: Introduction
EMI & EMC: Electromagnetic Interference & Compatibility
- Relevance of interferences for EMC
- The problem of equipment non-compliance
- EMC Integrated Design Process
- References and Links

Types of Interferences and Couplings
- Conducted and Radiated emissions
- EM fields: Near and Far field
- Frequency spectrum of emissions
- Capacitive Coupling
- Inductive Coupling
- Common impedance Coupling

- Common & Diferential Modes

Part 2: Design Criteria
- System Partitioning
- PCB Layout
  - Power bus distribution
  - Decoupling
- Protections
  - Filters
  - Overvoltage limiters: Transzorb, Varistors, Dischargers, etc.
- Mixed signal board design example
- PCB design for High Speed.
  - High Speed in a PCB
  - Transmission lines on PCBs
  - Impedance mismatch
  - Differential signal transmission

Part 3: Standards
- Directives and Standards: CE mark
- Standards EU, FCC, MIL, RTCA.

Part 4: EMC Laboratory Measures
EMC Laboratory
- Main items

Measure of radiated EMI
- PC main board

Measure of conducted EMI
- Switched Mode Power Supply (SMPS)

Other tests
- Surface Transfer Impedance STI of shielded cables
- EMI Susceptibility
- Shielding Effectiveness of boxes & shelters

LEARNING ACTIVITIES AND METHODOLOGY

Theory sessions
Practice sessions
Theoretical-practical sessions
Individual guided sessions
Grouped guided sessions

METHODOLOGY
The teacher explains in sessions with presentations based on slides.
Some real problems are presented to the students.
These problems are exposed and discussed in the sessions.
There is also a final work that each student group must elaborate at the end of the course.

ASSESSMENT SYSTEM

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

The course includes a written assessment valued 40%, and a collaborative work valued 60% of the final mark. A minimum mark will be required in the written assessment.

In the extraordinary examination either continuous assessment or 100% final exam could be applied.

BASIC BIBLIOGRAPHY

- Alain Charoy Parásitos y perturbaciones en electrónica, Ed. Paraninfo, 1996

- Clayton R. Paul Introduction to Electromagnetic Compatibility, second ed. Wiley InterScience, 2006

- Henry W. Ott Electromagnetic Compatibility Engineering, John Wyley & Sons, 2009

- Tim Williams EMC for product designers, 3rd. ed. Elsevier, 2001