

Electronic System Design (404202)

Teaching Scheme:

Lectures: 3 Hrs/ Week

Examination Scheme:

In Semester Assessment:

Phase I : 30

End Semester Examination:

Phase II: 70

Course Objectives:

- To understand the stages of system (hardware/ software) design and development.
- To learn the different considerations of analog, digital and mixed circuit design.
- To be acquainted with methods of PCB design and different tools used for PCB Design.
- To understand the importance of testing in product design cycle.
- To understand the processes and importance of documentation.

Course Outcomes:

After successfully completing the course students will be able to

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- Understand various stages of hardware, software and PCB design.
- Importance of product test & test specifications.
- Special design considerations and importance of documentation.

Unit I : Introduction

7L

Stages in product design- Market survey, Product Specifications (Electrical, Mechanical, Environmental), R&D and Engineering Prototypes, Pilot Production Batch, Environmental testing, Documentation, Manufacturing. Electronic Products Classification: Consumer, Industrial and Military. Their peculiarities in terms of Cost/performance ratio and Reliability. Case study of a typical Industrial Product. Reliability: Bath tub curve, Measures taken (at Component and Product level and various soldering techniques including Surface Mount Technology) to improve reliability.

Unit II : Hardware Design- Analog

7L

Analog Signal Conditioning: Factors affecting choice of Op-Amps in signal conditioning, applications, Need for Instrumentation Amplifiers- Case study. Error budget analysis with Case study. ADCs: Interpretation of ADC specifications from design view point, considerations in selecting references (V_{ref} for ADC). DACs: Interpretation of DAC specifications from design view point.

Unit III :Hardware Design- Digital

6L

Interface examples for LED, HB LED, LCD, Keyboard, Relays (Electromagnetic and Solid State). Microcontrollers: Comparative study of different Microcontroller architectures, Factors affecting choice of Microcontroller for particular application with case study of one application. Introduction to buses and protocols used in Electronic products- I2C, SPI, CAN, Lin, Flexray

Unit IV : Software Design and Testing for Electronic Product

6L

Different approaches to development of application software for Electronic Product. Assemblers, Factors affecting choice between Assembly language and High level languages like C and C++. Documentation practices and templates for above software. Debugging tools and techniques for software- Features of Simulators, ICE, IDE.

Unit V : PCB Design and EMI/EMC

6L

PCB Design practices for Analog and Mixed signal circuits: Ground Loops, Precision circuits, shielding and guarding. PCB Design Practices for High speed digital circuits
Signal integrity and EMC, EMI/EMC testing standards and compliance

Unit VI : Fault Finding and Testing

7L

Analyses- DC/ Operating Point Analysis, AC (Frequency Response), Transient, Sensitivity, Monte Carlo. Debugging/ Fault finding- Features and limitations of Analog CRO, DSO, Logic Analyzer and Mixed Signal Oscilloscopes in finding hardware/software faults. Environmental Testing: Need for Environmental Testing. Temperature, Humidity, Vibration and Shock tests. Introduction to EMI/EMC testing standards and compliance.

Text Books

1. Bernhard E. Bürdek, *_History, Theory and Practice of Product Design_*, Springer Science, 2005
2. Paul Horowitz, *_Art of Electronics_*, Cambridge University Press

Reference Books

1. Howard Johnson, Martin Graham, *_High-speed Digital design- A Handbook of Black Magic_*, Prentice Hall Publication
2. G. Pahl and W. Beitz J. Feldhusen and K.-H. Grote, *Engineering Design - A Systematic Approach_*, Springer,2007
3. Tim Williams, *_EMC for Product Designers_*, Elsevier, Fourth edition 2007
4. Jerry C Whitaker, *_The Electronics Handbook_*, CRC Press, IEEE Press, ISBN 0-8493-8345-5

5. David Bailey, *_Practical Radio Engineering and Telemetry for Industry_*, Elsevier, ISBN 07506 58037
6. Pressman , *_Software Engineering - A Practitioner's Approach_*
7. David Bailey, *_Practical Radio Engineering & Telemetry for Industry_*, Elsevier, ISBN 07506 58037
8. Domine Leenaerts , Johan van der Tang , Cicero S. Vaucher , *Circuit Design for RF Transceivers*, Kluwer Academic Publishers, 2003