Employability Skills in Electronics Design(304208)

Teaching Scheme:
Lectures:2Hrs/ Week
Practical: 2Hrs/Week

Examination Scheme:
In Semester Assessment:
Phase I : NIL
End Semester Examination:
Phase III: 50

Course Objectives:

- To teach the student , the art of applying basic concepts for designing electronic systems
- To imbibe good design practices for robust design of electronic systems
- To highlight the importance and significance of customer specifications/requirements
- To teach electronic circuit function verification with an EDA tool
- To create an interest in the field of electronic design as a prospective career option

Course Outcomes:

After successfully completing the course students will be able to

- Shall be able to understand and interpret the specifications
- Shall be able to select optimal design topologies
- Shall be able to interpret datasheets and thus select appropriate components and devices
- Shall be able to use an EDA tool for circuit schematic and simulation
- Shall be able to design an electronic system/sub-system and validate its performance by simulating the same

Unit I : Design of Linear Power Supply 6L

Typical specifications, Concept of ideal power supply & Voltage regulation, Rectifier and filter design, Basic shunt regulator design, Series pass transistorized regulator, Variable output voltage regulator, Protection circuits for critical devices in regulator circuits (Short-circuit, over-voltage protection circuits), Heat-sink selection, Three terminal IC regulator, Design examples of IC based power supplies.

Unit II : Design of Data Acquisition Systems 10L

Generalized control system, Concept of set point and error, Typical control mechanisms, Role of data acquisition system, Transducers, sensor and actuator, Active and passive transducers, Transfer characteristics and non-linearities of transducers, Resolution, accuracy and precision, Characteristics of an ideal transducer, Instrumentation Amplifiers(IA), Characteristics of an ideal IA, Selection criteria of IA, Tradeoffs with practical IA, Signal conditioning circuits, Need of signal conditioners, Design of signal conditioning circuits, Span-zero circuit, Overview of Analog to Digital Converters, Types of ADCs, Parameters of ADC devices, Selection criteria for ADC, Overview of Microcontrollers, Types of microcontrollers, Characteristics of microcontrollers, Examples of MCU devices, Selection criteria for MCU, Overview of Interface

devices and storage, RS-232 interface, RTC, I2C EEPROM, LCD, Keyboard interface, DC motor driver, relay driver interface.

Unit III : Design of Switched Mode Power Supply 8L

Advantages of SMPS, Basic concept of switching regulator, Basic topologies, Step down converter, Step up converter, Polarity inverter, Characteristics of components, Switching element, BJT, MOSFET, IGBT, Switching diode, Filter capacitor and inductor, PWM circuit, General block diagram of SMPS, High frequency transformer design (steps only),Practical topologies of SMPS, Flyback design, Pushpull Design, Start up circuit design, PWM control circuit, Isolation circuit.

Unit IV : Design of Active Filters 4L

Design of various filter types , Low-pass filter (second order),High-pass filter (second order), Band-pass filter , Band-reject Filter , All-pass filter, State variable filter design, Selection of components , Sensitivity analysis.

List of Assignments:

[Note: 1. Students are expected to complete FOUR assignments during the semester.

2. Paper design should be functionally verified with an appropriate EDA tool (NI Multisim/OrcadPspice etc).
3. Specifications should be different for different group of students.
4. Documentation shall consist of :
    - Problem statement
    - Specifications
    - Block Diagram
    - Detailed circuit diagram (separate sheet Imperial /Half Imperial size)
    - Calculations
    - Component selection
    - Calculations using the selected component values
    - Simulation results (partial simulations , in the case where models are not available)
    - Component List
    - Conclusion
    - Datasheets]

Assignment 1: Design of Linear Power Supply:

- Single Polarity (Variable/Fixed, Display)
- Dual Polarity (Variable/Fixed, Display)
- Dual Polarity (tracking, display)

Note:

- Protection circuits are also expected to be included
- Heat-sink design is mandatory wherever necessary
- Transformer design steps are expected

Assignment 2: Design of Data Acquisition System

- Multi-channel data acquisition systems
  - Serial communication/ EEPROM storage/SD card storage
  - RTC interface, LCD display, Push-button /Matrix Keyboard
  - DC motor driver, relay driver

Note:

- Sub-circuit designs are also expected except for power supply sub-system
- Micro-controller programming is expected (cross-compiler/assembly language)

Assignment 3: Design of Switched Mode Power Supply

- Single polarity , multiple outputs (Flyback/ Push-pull)
- Dual polarity output (Flyback/ Push-pull)

Note:

- Protection and isolation circuits are also expected to be included
- Heat-sink design is mandatory wherever necessary
- High frequency transformer design steps are expected
- Sub-systems like start-up circuit are expected to be designed

Assignment 4: Design of Active Filter

- Second-order LPF/HPF/BRF/BPF
- State variable filter design/ Biquad

Note:

- Sensitivity analysis should be provided

Reference Books:

1. Practical design of power supplies" , Ron Lenk, John Wiley & Sons, 2005, ISBN: 978-0-08-097138-4
2. "Intuitive Analog Circuit Design A Problem-Solving Approach using Design Case Studies", Marc T. Thompson, Elsevier Inc, 2006,ISBN-10: 0-7506-7786-4
3. "Linear Circuit Design Handbook", Hank Zumbahlen, Elsevier Inc, 2008 , ISBN 978-0-7506-8703-4
4. "The Circuit Designer's Companion", Peter Wilson, Elsevier Ltd, 2012
5. "Switching Power Supply Design ,"3E, Abraham I. Pressman et. al, The McGraw-Hill Companies, 2009
6. "Measurement, Instrumentation, and Sensors Handbook", John G. Webster, CRC Press, 1999
7. "Electronic Filter Design Handbook",4E, Arthur Williams, Fred Taylor, McGraw-Hill ,2006