

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ELECTRONICS & COMMUNICATION (EMBEDDED SYSTEM) (54)

ELECTRONIC SYSTEM DESIGN

**SUBJECT CODE: 2715403**

SEMESTER: I

**Type of course:** Integrated Circuits and Designing of PCB

**Prerequisite:** Fundamental knowledge of Op-Amp , ADC and Logic Families

**Rationale:** Students will possess a good understanding of important parameters of an Op-Amp. To design any system student must have knowledge of about DAC and ADC and its basic parameters for proper selection. EMC regulation and PCB designing according to it is a necessary requirement.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2	2	5	70	30	20	10	20	0	150

**Content:**

Sr. No.	Contents	Total Hrs.	% Weightage
<b>1</b>	Passive components: Understanding and interpreting data sheets and specifications of various passive and active components, non-ideal behavior of passive components.	4	10
<b>2</b>	Op amps: DC performance of op amps: Bias, offset and drift, AC Performance of operational amplifiers: band width, slew rate and noise, Properties of a high quality instrumentation amplifier, Design issues affecting dc accuracy & error budget analysis in instrumentation amplifier applications, Isolation amplifier basics and Active filters: design of low pass, high pass and band pass filters.	5	10
<b>3</b>	ADCs and DACs: Characteristics and performance parameters of ADC & DAC, interfacing to microcontrollers, selecting proper ADC and DAC.	5	10
<b>4</b>	Power supplies: Characteristics, design of full wave bridge regulated power supply. Circuit layout and grounding in mixed signal system.	5	10
<b>5</b>	Practical Logic Circuit Design Issues and Techniques: Understanding and interpreting data sheets, specifications of various CMOS & BiCMOS family Logic devices, Electrical behaviour (steady state & dynamic) of CMOS& BiCMOS family logic devices, Benefits and issues on migration of 5-volt and 3.3 volt logic to lower voltage supplies.	5	10

<b>6</b>	Electromagnetic Compatibility: Designing for EMC, EMC regulations, typical noise path, methods of noise coupling and methods of reducing interference in electronic systems.	5	10
<b>7</b>	Grounding of Electronic Systems: Safety grounds, signal grounds, single-point ground systems, multipoint-point ground systems, hybrid grounds, functional ground layout, practical low frequency grounding, hardware grounds, grounding of cable shields ground loops, shield grounding at high frequencies Power line filtering, power supply decoupling, decoupling filters, high frequency filtering and system bandwidth.	5	20
<b>8</b>	Protection Against Electrostatic Discharges (ESD): Static generation, human body model, static discharge, ESD protection in equipment design, software and ESD protection, ESD versus EMC.	4	10
<b>9</b>	Packaging & Enclosures of Electronic System: Effect of environmental factors on electronic system, nature of environment and safety measure, Packaging's influence and its factors.	4	10

#### Reference Books:

1. Electronic Instrument Design, First edition; Author: Kim R.Fowler; Publisher: Oxford University Press.
2. Noise Reduction Techniques in Electronic Systems, Second edition, Author: Henry Ott, Publisher: John Wiley & Sons.
3. Digital Design Principles & Practices, Third edition, Author: John F. Wakerly; Publisher: Prentice Hall International, Inc.
4. Operational Amplifiers and linear integrated circuits, Third edition, Author: Robert F. Coughlin; Publisher: Prentice Hall International, Inc
5. Intuitive Analog circuit design, Second Edition, Author: Marc T Thompson; Published by Elsevier
6. The Art of Electronics, Second Edition, Author: Paul Horowitz, Winfield Hill, Cambridge University Press.
7. Printed Circuit Boards - Design & Technology, 1st edition; by: W Bosshart; Tata McGraw Hill.
8. A Designer's Guide to Instrumentation Amplifiers; by: Charles Kitchin and Lew Counts; Seminar Materials @ <http://www.analog.com>
9. Errors and Error Budget Analysis in Instrumentation Amplifier Applications; by: Eamon Nash; Application note AN-539@ <http://www.analog.com>
10. Practical Analog Design Techniques; by: Adolfo Garcia and Wes Freeman; Seminar Materials@ <http://www.analog.com>
11. Selecting An A/D Converter; by:Larry Gaddy; Application bulletin @ <http://www.Ti.com>
12. Benefits and issues on migration of 5-volt and 3.3 volt logic to lower voltage supplies; Application note SDAA011A@ <http://www.Ti.com>
13. JTAG/IEEE 1149.1 designs considerations; Application note SCTA029@ <http://www.Ti.com>
14. Live Insertion; Application note SDYA012@ <http://www.Ti.com>
15. PCB Design Guidelines For Reduced EMI; Application note SZZA009@ <http://www.Ti.com>

**Course Outcome:**

1. DC and AC performances of an Op-Amp and how to measure different parameters and how to alleviate issues related to these parameters using different circuits.
2. Active filter design and comparative analysis of different ADCs and DACs.
3. Analysis, Comparison and Study of advanced digital logic families.
4. Describe the general concepts in EMC Standards and Regulations.
5. Application of the general EMC diagnostic and design approaches to reduce EMI.

**List of Experiments:**

1. To study and Perform calculation of input offset voltage.
2. To study and perform calculation of  $I_{b+}$ ,  $I_{b-}$ , Slew-Rate for op amp.
3. To Study and Perform Working of Instrumentation Amplifier.
4. To Study and Perform Working of Low pass, High Pass Filter.
5. To Study and Perform Working of Band Pass and Band Reject Active Filter.
6. To Study and Perform different filters on ASLK Pro KIT and Universal Active Filter UAF42.
7. To study and perform LCD interfacing and calculator interfacing on 8051.
8. To Study and Perform ADC interfacing with microcontroller 8051.
9. To study and perform Temperature Sensor interfacing with 8051 microcontroller.
10. Introduction about layout making process for PCB in Proteus software.
11. To separate out DC and AC parts from a signal and show them.

**Open Ended Problems**

1. Design a temperature sensor system using Instrumentation IC, Temperature Sensor, ADC and Microcontroller.
2. Design of Low Electro Magnetic Interference (EMI) PCB with the help of Proteus Software.
3. Design and Implementation of CMOS to TTL converter.
4. Design an instrumentation amplifier to read differential pressure signal with full scale voltage as 10 mV.
5. Design signal conditioning circuit such that the 0 to 10 mV is converted in -2.5V to 2.5V

**Major Equipments:**

- i. ALSKPRO kit from Texas Instruments
- ii. Function Generator
- iii. Oscilloscope
- iv. Digital Multi-meter
- v. DC Power Supply (0-30 V)

**List of Software:** Multisim, PSPice, NGspice (**Open Source Software**), Proteus

**Learning website:**

[www.nptel.ac.in](http://www.nptel.ac.in)