

# GUJARAT TECHNOLOGICAL UNIVERSITY

## BIO MEDICAL ENGINEERING (31) ELECTRONIC SYSTEM DESIGN SUBJECT CODE: 2733103 SEMESTER: III

**Type of course:** Major Elective

**Prerequisite:** Basic knowledge of electronics systems and microcontrollers.

**Rationale:** To get knowledge about usage of electronic devices for communication and power supplies for application in biomedical systems.

### Teaching and Examination Scheme:

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

### Content:

Sr. No.	Topics	Teaching Hrs.	% Module Weightage
<b>1</b>	<b>INTRODUCTION TO RF DESIGN</b> RF behavior of passive components, Chip components and circuit board considerations, Review of transmission lines, Impedance and admittance transformation, Parallel and series connection of networks, ABCD and scattering parameters, Analysis of amplifier using scattering parameter. RF filter – Basic resonator and filter configurations – Butterworth and Chebyshev filters. Implementation of microstrip filters design. Band pass filter and cascading of band pass filter elements.	<b>10</b>	<b>20</b>
<b>2</b>	<b>RF TRANSISTOR AMPLIFIER DESIGN</b> Impedance matching using discrete components. Microstrip line matching networks. Amplifier classes of operation and biasing networks – Amplifier power gain, Unilateral design – Simple input and output matching networks – Bilateral design - Stability circle and conditional stability, Simultaneous conjugate matching for unconditionally stable transistors. Broadband amplifiers, High power amplifiers and multistage amplifiers.	<b>10</b>	<b>20</b>
<b>3</b>	<b>DESIGN OF POWER SUPPLIES</b> DC power supply design using transistors and SCRs, Design of crowbar and foldback protection circuits, Switched mode power supplies, Forward, flyback, buck and boost converters, Design of transformers and control circuits for SMPS.	<b>10</b>	<b>25</b>
<b>4</b>	<b>DESIGN OF DATA ACQUISITION SYSTEMS</b> Amplification of Low level signals, Grounding, Shielding and Guarding techniques, Dual slope, quad slope and high speed A/D converters, Microprocessors Compatible A/D converters, Multiplying A/D converters and Logarithmic A/D converters, Sample and Hold, Design of two and four	<b>10</b>	<b>20</b>

	wire transmitters.		
<b>5</b>	<b>DESIGN OF PRINTED CIRCUIT BOARDS</b> Introduction to technology of printed circuit boards (PCB), General lay out and rules and parameters, PCB design rules for Digital, High Frequency, Analog, Power Electronics and Microwave circuits, Computer Aided design of PCBs.	<b>12</b>	<b>15</b>

#### Reference Books:

1. Reinhold Luduig and Pavel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education, 2000
2. Sydney Soclof, “Applications of Analog Integrated Circuits”, Prentice Hall of India, 1990.
3. Walter C. Bosshart, “Printed circuit Boards – Design and Technology”, TATA McGraw-Hill, 1983.
4. Keith H. Billings, “Handbook of Switched Mode Supplies” McGraw-Hill Publishing Co., 1989.
5. Michael Jacob, “Applications and Design with Analog Integrated Circuits” Prentice Hall of India, 1991.
6. Otmar Kigenstein, “Switched Mode Power supplies in Practice”, John Wiley and Sons, 1989.
7. Muhammad H. Rashid, Power Electronics – Circuits, Devices and Applications, Prentice Hall of India, 2004.

#### Course Outcome:

Upon successful completion of this subject students should be able to:

1. Learn about RF component such as resonator, filter, transmission lines, etc...
2. Able to design RF amplifiers using transistors.
3. Understand the design of modern Power Supplies using SCR and SMPS technology
4. acquire knowledge about signal shielding & grounding techniques and study of A/D and D/A Converters.
5. Gain Design knowledge and will be able to fabricate PCBs using CAD.

**List of Experiments:** An experimental study should be used in conjunction with a theoretical approach in biomedical applications within the scope of this course. Suggested list of experiments are;

1. DC power supply design using buck - boost converters.  
Design the buck-boost converter for the given input voltage variation, load current and output voltage. Plot the regulation characteristics.
2. DC power supply design using fly back converter (Isolated type)  
Design the fly back converter using ferrite core transformer for the given input voltage variation load current and output voltage. Plot the regulation characteristics.
3. Design of a 4-20mA transmitter for a bridge type transducer.  
Design the Instrumentation amplifier with the bridge type transducer (Thermistor or any resistance variation transducers) and convert the amplified voltage from the instrumentation amplifier to 4 - 20 mA current using op-amp. Plot the variation of the temperature Vs output current.
4. Design of AC/DC voltage regulator using SCR  
Design a phase controlled voltage regulator using full wave rectifier and SCR, vary the

conduction angle and plot the output voltage.

5. Design of process control timer

Design a sequential timer to switch on & off at least 3 relays in a particular sequence using timer IC.

6. Design of AM / FM modulator / demodulator

ii. Design AM signal using multiplier IC for the given carrier frequency and modulation index and demodulate the AM signal using envelope detector.

iii. Design FM signal using VCO IC NE566 for the given carrier frequency and demodulate the same using PLL NE 565.

7. Design of Wireless data modem.

Design a FSK modulator using 555 and convert it to sine wave using filter and transmit the same using IR LED and demodulate the same PLL NE 565.

8. PCB layout design using CAD

Drawing the schematic of simple electronic circuit and design of PCB layout using CAD

9. Microcontroller based systems design

Design of microcontroller based system for simple applications like security systems combination lock etc. using 89c series flash micro controller.

10. DSP based system design

Design a DSP based system for simple applications like echo generation, etc. using TMS 320 DSP kit.

**Design based Problems (DP)/Open Ended Problem:** Student has to search and select (i) research paper from reputed conference or journal, or (ii) mini project, related to medical diagnostic application and has to implement the same using any tool/platform under the guidance of course instructor.

**Major Equipment:** advanced modelling and simulation software with advanced computational facilities.

**List of Open Source Software/learning website:** Students may visit the online research and publication and ongoing project information from research centers from the respective websites.

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.