GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

Course Title: Circuit Design Tools

(Code: 3341106)

Diploma Programme/s in which this course is offered	**Semester in which offered**
Diploma in Electronics & Communication	4th Semester

1. RATIONALE

In the era of miniature electronic gadgets and automation, it is required to have electronic circuit simulation for better design and cost effective PCB layout for better performance. This course aims to teach students about how to simulate the electronic circuit and how to design PCB layout of given circuit using available circuit simulation and PCB layout design tools (free or licensed). This course helps the student to simulate the circuit and develop complete hardware circuit on PCB.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- Simulate and test the Electronic circuit using Circuit Simulation Tools.
- Design PCB Layout and develop an electronic circuit using PCB Layout Design Tools.

3. COURSE OUTCOMES

1. Compare different circuit simulation and PCB layout design software.
2. Analyze and simulate the electronic circuit using circuit simulation tools .
3. Transfer an electronic circuit from circuit simulation tool to PCB Layout design tool.
4. Design and develop layout of PCB using PCB layout design tool with fabrication .

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			**Total Credits (L+T+P)**	**Examination Scheme**				
				Theory Marks		**Practical Marks**		**Total Marks**
L	**T**	**P**	**C**	**ESE**	**PA**	**ESE**	**PA**	**100**
0	0	4	4	0	0	40	60	

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit **ESE** - End Semester Examination; **PA** - Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I Introduction to circuit simulation and PCB design software	1a. Discuss different circuit simulation tools (Open source or licensed) used for electronic circuit simulation.	1.1 Demonstration of circuit simulation software.
	1b. List different PCB layout design tools (Open source or License) used for PCB layout design.	1.2 Demonstration of PCB layout design software.
Unit – II Schematic design of electronic circuits using software	2a. Define the general terms wire, bus, junction, probe, voltage source, current source, and ground etc. used in circuit simulation software.	2.1 Wire, bus, junction, probe, voltage source, current source, and ground etc. used in circuit simulation software.
	2b. Create and save new project, design and schematic file using circuit simulation software.	2.2 Create new project, design and schematic file.
	2c. Search, add and create new electronic part using circuit simulation software.	2.3 Search, add and create new electronic part.
	2d. Connect or wire the different electronic parts and make a circuit using circuit simulation software.	2.4 Edit, Connect or wire the circuit.
Unit – III Simulation of electronic circuits	3a. Simulate and test the RC, LC, or RLC based electronic circuit using circuit simulation software.	3.1 Test RC, LC or RLC based electronic circuit.
	3b. Simulate and test the diode, transistor or MOSFET based electronic circuit using circuit simulation software.	3.2 Test diode, transistor or MOSFET based electronic circuit.
	3c. Simulate and test the analog or digital IC based electronic circuit using circuit simulation software.	3.3 Test analog/digital IC based electronic circuit.
	3e. Find the transient analysis of RC, LC, or RLC based circuit using circuit simulation software.	3.4 Transient analysis of RC, LC, or RLC based electronic circuit.
	3f. Find the bias point analysis of diode, transistor or MOSFET based circuit using circuit simulation software.	3.5 Bias point analysis or characteristic curve of diode, transistor or MOSFET based electronic circuit.

Unit	Major Learning Outcomes	Topics and Sub-topics
	3g. Find the transient analysis of diode, transistor or MOSFET etc. based circuit using circuit simulation software.	3.6 Transient analysis of diode, transistor or MOSFET etc. based electronic circuit.
	3h. Find the frequency response (AC Analysis) of RC, diode, transistor etc. based electronic circuit using simulation software.	3.7 Frequency response (AC Analysis) of RC, diode, and transistor etc. based electronic circuit.
	3i. Find the frequency response (AC Analysis) of analog/ digital IC based circuit using simulation software.	3.8 Frequency response (AC Analysis) analog/ digital IC based electronic circuit.
Unit – IV PCB layout design using software	4a. Identify the terms netlist file, back annotation, bill of material, foot print, PTH, track width, mil , etc. used in PCB layout design software.	4.1 Netlist file, back annotation, bill of material, foot print, PTH, track width, mil, etc.
	4b. Transfer an electronic circuit to PCB layout design software.	4.2 Transfer circuit to PCB layout
	4c. Search, add and create footprint of different electronic components used in PCB layout design software.	4.3 Search, add and create footprint
	4d. Place, route and generate the layout of given circuit using manual or auto routing using PCB layout design software.	4.4 Place, route and generate PCB Layout
Unit – V PCB fabrication techniques	5a. Demonstrate the PCB manufacturing steps.	5.1 Drawing and printing layout on board, photo etching process, masking process, etc.
	5b. Demonstrate Different PCB manufacturing techniques.	5.2 PCB manufacturing techniques

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS

Unit No.	Unit Title	Laboratory Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to circuit simulation and PCB design software	06				
II	Schematic design of electronic circuits using software	14				

Unit No.	Unit Title	Laboratory Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
III	Simulation of circuits	14				
IV	PCB layout design using software	14				
V	PCB fabrication techniques	08				
	Total	**56**				

Legends: R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

7. SUGGESTED LIST OF EXERCISES/PRACTICALS

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1	I	Evaluate different Circuit simulation tools for Circuit Simulation (Presentation)	02
2	I	List and compare different PCB layout design tools used for PCB Layout Design (Presentation)	02
3	II	Create and save new schematic file with Project using circuit simulation software.	02
4	II	Use different options like wire, bus, junction, AC and DC voltage source, current source, probe, pulse generator, ground, and probe etc. used in circuit simulation software library.	02
5	II	Search, create and add the electronic component to the schematic file from the library used in circuit simulation software.	02
6	II	Connect the electronic circuit using Place and route method used in circuit simulation software.	02
7	II	Connect, simulate and test the RC, LC, and RLC based electronic circuit using circuit simulation software.	02
8	II	Connect, simulate and test the Diode, Transistor, MOSFET based electronic circuit using circuit simulation software.	02
9	II	Connect, simulate and test IC based electronic circuit using circuit simulation software.	02
10	III	Calculate the Bias point and verify V- I characteristic (DC Analysis) curve of given diode or transistor based circuitry using circuit simulation software.	02
11	III	Draw the Transient analysis curve of a given diode circuit using circuit simulation software.	02
12	III	Draw the Transient analysis curve of a given transistorized electronic using circuit simulation software.	02
13	III	Draw the Transient analysis curve of a given Analog IC based electronic circuit using circuit simulation software.	02
14	III	Draw the Frequency response (AC Analysis) curve to check the functionality of RC, LC and RLC based circuit using circuit	02

		simulation software.	
15	III	Draw the Frequency response (AC Analysis) curve to check the functionality of Transistorized based circuit using circuit simulation software.	02
16	III	Draw the Frequency response (AC Analysis) curve to check the functionality of analog IC based circuit using circuit simulation software.	02
17	III	Use the following options: netlist file, back annotation, Bill of material, single layer PCB, double layer PCB, PTH, footprint, track width, mil, etc. and develop a complete project file.	04
18	IV	Synthesize and Transfer an electronic circuit using circuit simulation software to the PCB layout design software.	02
19	IV	Search, create and add footprint of different electronic components to the PCB layout design file.	02
20	IV	Synthesize the PCB Layout of the given RC, RLC, diode or transistor based electronic circuit with manual and auto routing technique using PCB design software.	02
21	IV	Synthesize the PCB Layout of given analog or digital IC based electronic circuit with manual and auto routing technique using PCB design software.	06
22	V	Synthesize complete PCB for a given electronic circuit (mini project)	04
23	V	Synthesize complete PCB through Fabrication Techniques step by step.	06
Total			**58**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- Prepare PCB layout of a given circuit on butter paper (Mini Project).
- Transfer the layout from Butter paper to Copper cladded board. (Paper Phenolic or glass epoxy material etc.)
- Industrial Visit to any PCB manufacturing Industry.
- Prepare PCB layout using circuit simulation software/PCB layout software.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- Expert Lecture from PCB manufacturing industry personal.
- Videos of PCB making steps and different PCB making Techniques.

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book/user manual	Author	Publication
1.	Printed Circuit Boards: Design and Technology	Bosshart	TMH 2008 or latest edition

2.	Multisim user manual	National Instruments	**www.ni.com**
3.	Ultiboard user manual	National Instruments	**www.ni.com**
4.	Orcad online manual	Cadence	**www.cadence.com**

B) List of Major Equipment/ Instrument/Software with Broad Specifications

- NI Multisim (Academic Version or Licensed Version)
- NI UltiBoard (Academic Version or Licensed Version)
- Cadence Orcade (Student Version or Licensed Version)
- Express PCB (Free Version or Licensed Version)
- Circuit Maker (Free Version or Licensed Version)
- Tinapro (Free Version or Licensed Version)
- CadSoft Eagle PCBDesignSoftwae (Free Version or Licensed Version)
- freePCB (Free Version)

C) List of Software/Learning Websites

- **www.ni.com (Multisim and Ultiboard - Academic version)**
- **www.cadence.com (OrCAD - Student version)**
- **www.cadsoftusa.com (EAGLE – Free version)**
- **www.youtube.com (PCB Manufacturing Videos)**

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- Prof. S. N. Sampat, I/C Head (EC) Government Polytechnic, Gandhinagar.
- Prof. K. J. Pithadiya, Lecturer (EC), BBIT, Vallabh Vidhyanagar
- Prof. G. V. Parmar, Lecturer (EC), Government Polytechnic, Jamnagar
- Prof. K. V. Chhaniyara, Lecturer (EC), AVPTI Rajkot.

Coordinator and Faculty Members from NITTTR Bhopal

Dr. (Mrs.)Anjali potnis ,Assistant Professor , DEEE, NITTTR, Bhopal