Program Name : **Diploma in Digital Electronics Engineering**

Program Code : **DE**

Semester : **Third**

Course Title : **Electronics Simulation Software Practices**

Course Code : **22025**

1. RATIONALE

Industry expects a Diploma Engineer (technologist) to use modern day Electronic Design Automation (EDA) tool for analyzing, designing, and real time testing of analog, digital, Microcontroller(MCU), and mixed electronic circuits and their PCB layouts. These operations are useful in developing, fabricating and testing new prototype circuits. Using basic features of EDA tool prepares student for learning advanced aspects of the modern EDA tool such as using the simulation software for design of complex circuits.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use different EDA tools to maintain the functioning of the basic analog and digital circuits.**

3. COURSE OUTCOMES (COs)

Student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Select relevant EDA tools.
b. Use EDA tools to analyze DC and AC circuit for various parameters.
c. Interpret time domain waveforms at various test points.
d. Use EDA tools to analyze digital circuit.
e. Use EDA tools to analyze Data acquisition system and power control devices.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
-	-	4	4	--	--	--	--	--	--	--	25@	10	25~	10	50	20	

*(~[2]): For the **practical only courses,** the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.*

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

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

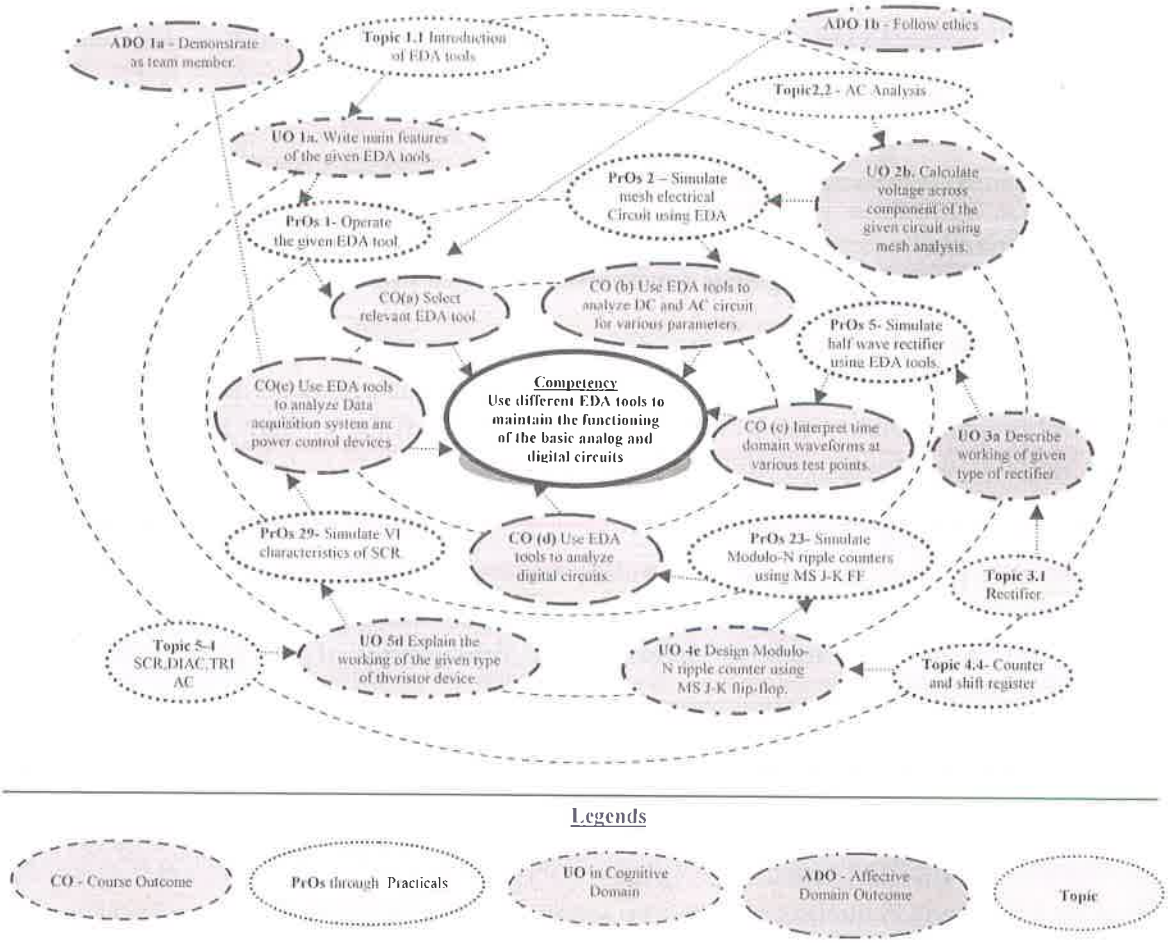

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Exercises(PrOs)	Unit No.	Approx. Hrs. required
1	Operate the given EDA tool.	I	2*
2	Simulate the mesh electrical circuit using EDA tool.	II	2*
3	Simulate the nodal electrical circuit using EDA tool.	II	2
4	Simulate resonance characteristics of the given R-L-C circuit by varying L and C.	II	2
5	Simulate the half wave rectifier without filter using EDA tool.	III	2*
6	Simulate the half wave rectifier with filter using EDA tool.	III	2
7	Simulate the full wave centre tap/bridge rectifier without filter using EDA tool.	III	2
8	Simulate the full wave centre tap/bridge rectifier with filter using EDA tool.	III	2
9	Simulate the single stage amplifier using BJT to observe the frequency response using EDA tool.	III	2

S. No.	Practical Exercises(PrOs)	Unit No.	Approx. Hrs. required
10	Simulate the single stage amplifier using FET to observe the frequency response using EDA tool.	III	2
11	Simulate the single stage amplifier using MOSFET to observe the frequency response using EDA tool.	III	2
12	Interpret dc and transient analysis of two stage RC coupled/transformer coupled/ dc coupled amplifier using BJT/ JFET/MOSFET. Observe frequency response using virtual spectrum analyzer.	III	2
13	Interpret dc and transient analysis of two stage RC coupled/transformer coupled/ dc coupled amplifier using JFET. Observe frequency response using virtual spectrum analyzer.	III	2
14	Interpret dc and transient analysis of two stage RC coupled/transformer coupled/ dc coupled amplifier using MOSFET. Observe frequency response using virtual spectrum analyzer.	III	2
15	Interpret transient analysis of phase shift oscillator.	III	2
16	Interpret transient analysis of Wien bridge oscillator.	III	2
17	Interpret transient analysis of Colpitts oscillator.	III	2
18	Interpret transient analysis of Hartley oscillator.	III	2
19	Realize given Boolean expression using logic gates and verify its truth table by simulation software.	IV	2*
20	Simulate adder/subtractor and verify its truth table.	IV	2
21	Simulate multiplexer, demultiplexer/decoder and verify its truth table.	IV	2
22	Simulate R-S/J-K/MS J-K/D/T flip-flops and observe output on virtual logic analyzer,	IV	2
23	Simulate Modulo-N ripple counters using MS J-K FF and verify output using virtual logic analyzer.	IV	2
24	Simulate Modulo-N synchronous counters using MS J-K FF and verify output using virtual logic analyzer.	IV	2
25	Simulate four-bit shift universal register and verify output using virtual logic analyzer.	IV	2
26	Simulate R-2R resistive network DAC to convert given digital data into analog.	V	2
27	Measure temperature and display on 7 segment display.	V	2
28	Simulate Pressure to current converter for 4 to 20 mA	V	2*
29	Simulate VI characteristics of SCR	V	2
30	Simulate and control intensity of bulb using suitable Control rectifier .	V	2
31	Simulate VI characteristics of DIAC	V	2
32	Simulate VI characteristics of TRIAC	V	2
	Total		**64**

Note

*i. A suggestive list of **PrOs** is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 24 or more practical need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student*

reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S. No.	Performance Indicators	Weightage in %
1.	Draw schematic circuit	20
2.	Neatness and appearances of drawing	10
3.	Answers to practical related questions	20
4.	Prepare journal report for all simulated practicals.	40
5.	Attendance and punctuality	10
TOTAL		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices.
b. Practice good housekeeping.
c. Function as a team member.
d. Function as a team leader.
e. Follow ethics.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year and
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will use in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	PrO. S.No.
1.	EDA tools like: eSim/ LTSPICE /TINA/OrCAD/MultiSim/SPICE/ /EasyEDA/ CircuitLogix/MicroCap /Scilab	All
2.	Personal Computer, 4GB RAM, 500GB HDD , i7 or higher Processor	All
3.	Laser Jet Printer.	All

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics

Unit– I EDA tool and File operation	1a. Write main features of the given EDA tool. 1b. Explain use of different windows to perform various operations of the given EDA tool. 1c. Explain procedure to perform the given file operation. 1d. Describe procedure to perform the given operation on schematic design windows of EDA tool.	1.1 EDA tools- eSim, Cadence, synopsis, spice, tina, scilab, lab view, multisim, orcad 1.2 Features of electronic design software. 1.3 Different editing windows 1.4 Different file operation 1.5 Drawing and editing schematic files
Unit– II Circuit Analysis	2a. Calculate current through component of the given circuit using Mesh analysis to verify the same through EDA simulation tool. 2b. Calculate voltage across component of the given circuit using Mesh analysis to verify the same through EDA simulation tool. 2c. Calculate current through and voltage across component of the given circuit using Nodal analysis to verify through EDA simulation tool. 2d. Calculate current through and voltage across component of the given RLC in ac circuit to verify the same through EDA tool.	2.1 DC analysis-Loop/ Mesh and Nodal 2.2 AC analysis-RL, RC and RLC circuit, peak value, rms value along with phase value.
Unit– III Transient Analysis of Analog Circuit	3a. Explain with sketches the working of the given type of rectifier. 3b. Explain with sketches the rectification of the given rectifiers circuit with and without filter. 3c. Select clipper or clamper for obtaining the given waveform with justification. 3d. Interpret the transient behavior of single/two stage RC coupled amplifier using the given transistor. 3e. Explain with sketches the frequency response of the given amplifier. 3f. Interpret the transient behavior of the given oscillator.	3.1 Rectifier:half wave rectifier, full wave rectifiers 3.2 Clipper and clamper circuits. 3.3 Single stage and multistage amplifier using BJT/JFET/MOSFET 3.4 Audio frequency and radio frequency oscillator.
Unit– IV Digital circuit	4a. Develop the given Boolean expression using logic gates and verify its truth table by simulation software. 4b. Draw MUX/DEMUX tree for the given number of input and output lines. 4c. Design the given simple flip-flops to verify output using virtual logic analyzer 4d. Use the given flip-flop to construct the specific type of counter. 4e. Use the given flip-flop to construct the	4.1 Combinational circuit-Logic gate, Boolean expressions. 4.2 Adder, subtractor, multiplexer, decoder, demultiplexer 4.3 Sequential circuit- Latch , flip-flops 4.4 Counters and shift register

	specific type of counter.	
Unit– V Measurement and power devices	5a. Explain with sketches the function of the given data converter. 5b. Explain with sketches the working principles of given temperature transducers. 5c. Explain with sketches the functions of the given components of Data acquisition system. 5d. Explain with sketches the working of the given type of thyristor device. 5e. Identify various power electronic devices for the specified application with justification.	5.1 ADC, DAC 5.2 Temperature transducers 5.3 Data acquisition system 5.4 SCR,DIAC,TRIAC

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR (INTERNAL) QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	EDA tool and File operation	03	--	--	02	02
II	Circuit Analysis	03	--	--	02	02
III	Transient Analysis of Analog Circuit	04	--	--	02	02
IV	Digital circuit	03	--	--	02	02
V	Measurement and power devices	03	--	--	02	02
Total		**16***	--	--	**10**	**10#**

**The hours utilize in conducting practical itself*

#PA = 50 (assesssment of pratical-20, microproject-20, internal theory test-10)

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare work diary based on simulated practicals performed in laboratory. Work diary consists of use of EDA tool, circuit drawing, simulated results, and date of performance with teacher signature.
b. Prepare journals consisting printouts of circuit diagram. Write simulation results of each practical in journal and precautions to be taken while using tools.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Arrange visit to nearby industries involved in research design and development of electronics hardware at circuit level.
g. Show video/animation films explaining application of simulation software.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Build Circuit for D.C. motor to rotate in clockwise and anticlock wise direction using transistor.
b. Build on general purpose PCB to test circuit using opto-coupler for turn ON/OFF fan /light.
c. Build circuit using diodes and resistors to display numerals from 0 to 9 on seven segment display.
d. Build circuit to count 10 objects (pulses) for five times.
e. Build digital code lock using 16:1 MUX a digital code Switch turn on when input key code is 3,7,9,12 at output connect solenoid to operate the door.
f. Simulate and build circuit for water level controller using logic gates.
g. Simulate simple emergency light system using any EDA tool.
h. Simulate speed control of fan using TRIAC low power DC flasher using SCR.
i. Simulate pressure measurement system using appropriate EDA tool.
j. Simulate temperature measurement system using appropriate EDA tool.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Network Analysis and Synthesis	Ghosh, S.P.; Chakrabarti, A.K	McGraw Hill Education, New Delhi, 2010. ISBN: 978-0070144781
2	Electronics Devices and Circuit Theory	Boylestad, Robert L.	Pearson Publication, New Delhi, 2015. ISBN: 978-8131727003
3	Modern Digital Electronics	Jain, R.P.	McGraw Hill Education, New Delhi, 2009. ISBN: 978-0070669116
4	Power Electronics	Bimbhra, P.S.	KhannaPublishers, New Delhi, 2004, ISBN NO.81-7409-056-8
5	Power Electronics	Bimbhra, P.S.	Khanna Publishers, New Delhi ,2012 ISBN: 978-81-7409-279-3
6	Electrical & Electronics Measurement	Sawhney, A. H.	Dhanpat Rai and Sons, New Delhi, 2012, ISBN: 978-817001006

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.scilab.org
b. www.esim.fossee.in/
c. www.esim.fossee.in/resources/tutorials/KiCad
d. www.esim.fossee.in/resources/tutorials/Ngspice
e. www.spoken-tutorial.org/tutorial-search/?search_foss=Oscadandsearch language= English
f. www.linear.com/designtools/software/#LTspice
g. www.orcad.com/
h. www.linear.com/
i. www.easyeda.com/
j. www.circuitlogix.com/
k. www.spectrum-soft.com/
l. http://esim.fossee.in/resource/book/esimusermanual.pdf