Program Name : **Diploma in Medical Electronics**

Program Code : **MU**

Semester : **Fourth**

Course Title : **Simulation Software**

Course Code : 22038

1. RATIONALE

Recent development in technology has put a lot of emphasis on awareness of available analytical tools. Number of application software as analytical tools are available which are helpful in designing, testing and simulating electronic circuits with ease. The ready to use library functions available in different simulation software enable the user to design circuits without knowing the complex mathematical details. Under this course students will be taught use of software like Scilab/MATLAB and LabVIEW that are commonly used by electronics engineers, worldwide. This practical only course uses the concepts and other details learnt in other courses of earlier semesters.

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 simulation tools for relevant medical applications.**

3. COURSE OUTCOMES (COs)

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Use various library functions available in the software.
b. Construct given circuit diagram using these library functions.
c. Simulate the circuit and observe its working for various inputs.
d. Simulate various biomedical systems to analyze medical parameters.
e. Perform simulation of different waveforms using software tools.

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	--	--	--	--	--	--	--	50@	20	50~	20	100	40	

*(~): 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, **'#':** No Theory Examination*

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.

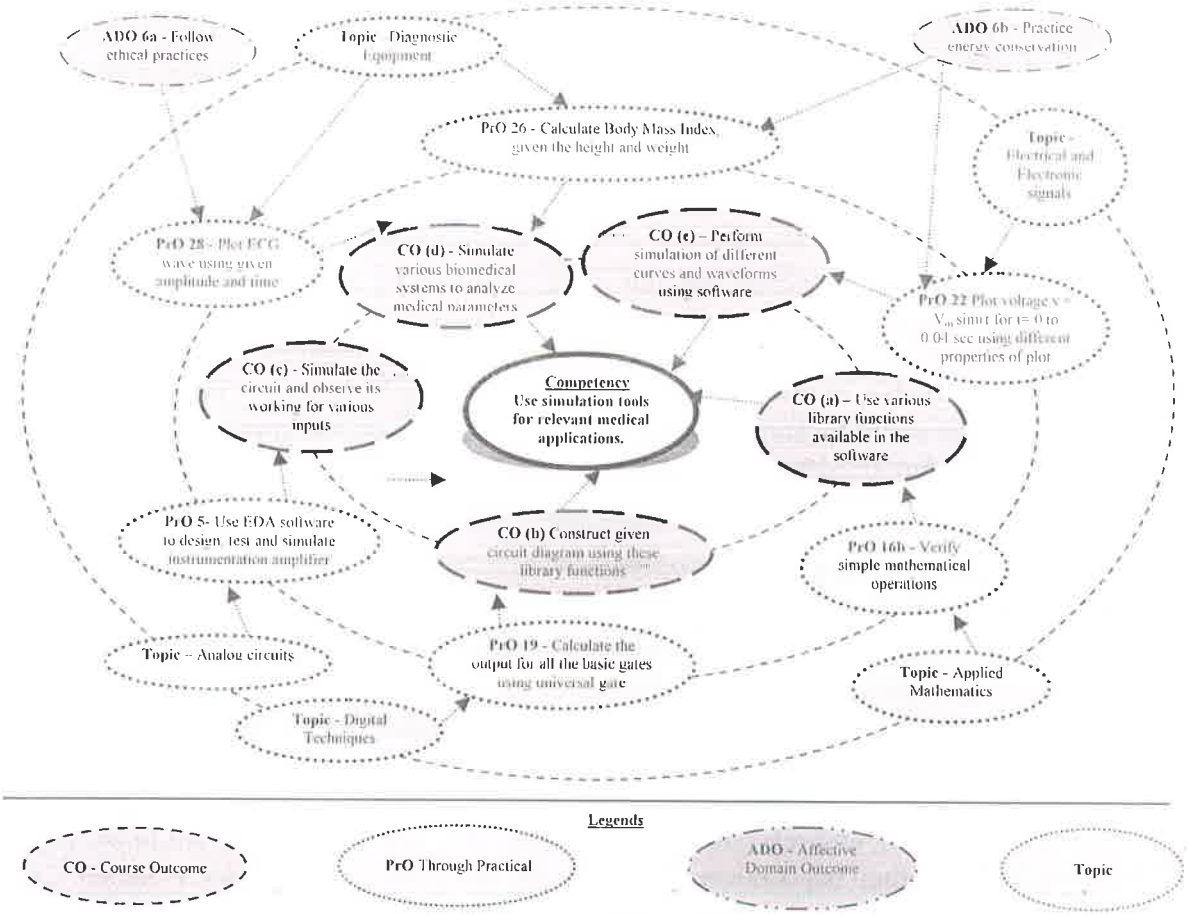

Figure 1 - Course Map

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 Outcomes (PrOs)	Approx. Hrs. Required
1	Identify the various components and facilities available in the simulation software.	02
2	Use the library functions of available simulation software.	02*
3	Use EDA software to test and simulate half wave rectifier (HWR).	02
4	Use EDA software to design, test and simulate full wave rectifier (FWR) and bridge rectifier.	02
5	Use EDA software to design, test and simulate capacitor filter and π filter.	02*
6	Use EDA software to design, test and simulate clipper and clamper circuit.	02
7	Use EDA software to design, test and simulate high pass filter. Observe waveform on CRO.	02
8	Use EDA software to design, test and simulate instrumentation amplifier using opamp.	02*
9	Use EDA software to design, test and simulate Counter.	02
10	Use EDA software to assemble astable multivibrator using IC 555.	02

S. No.	Practical Outcomes (PrOs)	Approx. Hrs. Required
	Observe waveform on CRO.	
11	Use EDA software to design, test and simulate 1:8 multiplexer.	02
12	Use EDA software to design, test and simulate 8:1 de-multiplexer by using 4:1 de-multiplexer.	02
13	Use EDA software to test Kirchhoff's voltage law and Kirchhoff's current law.	02*
14	Use EDA software to test maximum power transfer theorem.	02
15	Use EDA software to find the equivalent resistance current, voltage using thevenins theorem Verify the same using Norton's theorem.	02
16	a. Find the determinant, inverse and transpose of the given 2 X 2 matrix. b. Verify following simple mathematical operations of all elements in row/column vector using Scilab/MATLAB. a. Sum b. Mean c. Length d. Max e. Min f. Prod g. Sign h. Round i. Sort j. Fix 2	02*
17	Use commands to (for any two of the following) a. Convert Centigrade to Fahrenheit. b. Convert Kilograms to Pounds. c. Convert Meter to Feet. d. Given the radius of circle. Find the circumference and its area.	02
18	Write a Scilab/ MATLAB program to specify the resistance values and tolerance using given colour codes.	02*
19	a. Calculate the output for all the basic gates using universal gate. OR b. Calculate the output for all condition of A, B, C, for decade counter.	02
20	Calculate the natural frequency of oscillators for the given RLC circuit. Assume L=0.01mH, R=100Ω and C varying from 0.1 to 0.5 in steps of 0.1 μf using following equation. $F = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{4C^2}}$	02
21	A series R-L-C circuit connected across 100V peak, 50 Hz supply, consists of R=10Ω, L=0.2H, C=100μF. Write a Scilab/MATLAB script to determine the resonant frequency and current at resonance. Hint: $F = \frac{1}{2\pi\sqrt{LC}}$, $I = \frac{V}{R}$, $Vrms = \frac{Vpp}{\sqrt{2}}$	02*
22	Plot voltage v = V_m sinwt for t= 0 to 0.04 sec using different properties of plot.	02
23	Plot the voltage v = 5sinwt and current i = 2sin(wt-ϕ) flowing through circuit on the common axis X.	02

S. No.	Practical Outcomes (PrOs)	Approx. Hrs. Required
24	a. Perform simulation of amplitude modulation for different modulation index. b. Perform simulation of frequency modulation for different modulation index.	02*
25	Design a low pass filter with R= 1 KΩ and C = 0.1 μF and calculate the cut off frequency.	02
26	Calculate Body Mass Index (BMI), given the height and weight.	02
27	Given the Heart Rate and display whether the person is having tachycardia and bradycardia.	02
28	Plot ECG wave using given amplitude and time. Part - I	02*
29	Create a VI that produces a sine wave with a specified frequency and displays the data on a waveform chart until stopped by the user. Part - II	02*
30	Create a VI that produces a sine wave with a specified frequency and displays the data on a waveform chart until stopped by the user. Part - I	02*
31	Create a VI that produces a sine wave with a specified frequency and displays the data on a waveform chart until stopped by the user. Part - II	02*
32	Create a VI to connect three sine wave sources of given amplitude and frequency but with a phase shift of 0, $2\pi/3$, and - $2\pi/3$ to a 3X1 multiplexer and observe the waveforms on scope. Also, demultiplex these waveforms and observe on the scope.	02
	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 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	Write algorithm and draw flow chart.	20
2	Use Scilab/MATLAB software tool for programming to create, edit and compile the programs/applications.	40
3	Debug, test and execute the programs/applications.	20
4	Able to answer oral questions.	10
5	Submission of report in time.	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. Demonstrate working as a leader/a team member
b. Maintain software tools and equipment.
c. Handle console/command environment.
d. Follow ethical practices.
e. Practice energy conservation.

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 usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Hardware: Personal computer, (i3-i5 preferable), RAM minimum 2 GB onwards.	For all Practicals
2	Operating system: Windows XP/Windows 7/LINUX onwards.	For all Practicals
3	Software: Scilab /MATLAB/ LabVIEW. Any other equivalent open source software can also be used.	14 to 28
4	Software: MultiSIM /TINA/iCircuit , Any other equivalent open source software can also be used.	1 to 13

8. UNDERPINNING THEORY COMPONENTS

-Not applicable-

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

-Not applicable-

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 journals based on practical performed in laboratory.
b. Give seminar on relevant topic.
c. Library/E-Book survey regarding use of different 'simulation software' in biomedical field.
d. Prepare power point presentation or animation for showing different applications of simulation software.
e. Visit a hospital/diagnostic scan centers to learn about various image grabbing software and prepare a report.
f. Undertake a market survey of different 'simulation software' and compare with respect to following points.
   i. Available applications.
   ii. Application profile.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. 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 LOs/COs through classroom presentations (see implementation guideline for details).
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. Guide student(s) in undertaking micro-projects.
e. No. of practical's selection to be performed should cover all units.

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 are given here. Similar micro-projects could be added by the concerned faculty:

a. Design a scope for patient monitoring with at least four different parameters and observe the waveform by changing these parameters.
b. Simulate pre-amplifier circuit for ECG.
c. Simulate pre-amplifier circuit for EEG.
d. Simulate bio-potential amplifier.
e. Simulate electroencephalogram signal.
f. Simulate electromyogram signal.
g. Generate waveform of spirogram for different pressure.
h. Simulate cardiac acoustic mapping system which displays phonocardiogram.
i. Simulate ECG pulse missing detector.

13. SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Programming in Scilab 4.1	Das, Vinu V.	New Age Publication, New Delhi, 2014, ISBN: 9788122424713
2	Modeling and Simulation using MATLAB	Jain, Shailendra	Wiley India Pvt. Ltd., New Delhi, 2014, ISBN: 9788126551972
3	Virtual Instrumentation LabVIEW	Gupta, Sanjay; John, Joseph	Mc Graw Hill Education, New Delhi, 2014, ISBN: 9780070700284
4	Virtual Instrumentation	Jerome, Jovitha	PHI Learning New Delhi, 2014;

S.No.	Title of Book	Author	Publication
	Using LabVIEW		ISBN: 9788120340305

14. SUGGESTED SOFTWARE/LEARNING WEBSITE

a. http://www.mathworks.com
b. http://coep.vlab.co.in/?sub=25
c. http://scilab.in/lab_migration_run/download_code
d. http://www.ni.com/download-labview/
e. http://www.ti.com/tool/tina-ti/
f. http://www.ni.com/multisim/


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