Program : **Diploma in Electronics Engineering / Electronics and Communication Engineering**	
Course Code : **6049A**	Course Title: **Medical Electronics Lab**
Semester :**6**	Credits: **1.5**
Course Category: **Program Elective**	
Periods per week: **3 (L:0, T:0, P:3)**	Periods per semester:**45**

Course Objectives:

- To provide hands-on experience in circuit design.
- To equip students to design and set up the circuits used in the medical instruments.
- To lay foundation for developing skills in maintenance and servicing of medical equipment.

Course Prerequisites:

Topic	Course code	Course name	Semester
Transistor based circuit design	3041	Electronic circuits	3
Operational amplifier based circuits	4043	Linear Integrated Circuits	4

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO1	Make use of the op-amp based circuits to design and implement front end circuits in medical instruments.	11	Applying
CO2	Implement circuits for signal processing in biopotential recorders	10	Applying
CO3	Implement circuits for output section in medical instruments	9	Applying
CO4	Experiment with ICs for implementing medical electronic circuits.	9	Applying
	Lab Exam	6	

CO – PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3		3	3			
CO2	3			3			
CO3	3			3			
CO4	3	3	3	3		2	2

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Make use of the op-amp based circuits to design and implement front end circuits inmedical instruments.**		
M1.01	Design and implement a Bio-amplifier circuit using op-amp and find out CMRR.	2	Applying
M1.02	Design and implement a Notch filter circuit using op-amp and (i) plot frequency response (ii) measure the band reject frequency.	2	Applying
M1.03	Design and implement a second order low pass filter circuit using op-amp and (i) plot frequency response (ii) measure the upper cut off frequency.	2	Applying
M1.04	Design and implement a second order high pass filter circuit using op-amp and (i) plot frequency response (ii) measure the lower cut off frequency.	2	Applying
M1.05	Design and implement a Band pass filter and (i) plot the frequency response (ii) measure bandwidth.	3	Applying
CO2	I**mplement circuits for signal processing in biopotential recorder**s.		
M2.01	Setup Half wave and Full wave Precision rectifier circuits using op-amp and plot the input and output waveforms.	3	Applying
M2.03	Setup a Threshold detector using op-amp for a given voltage level.	2	Applying
M2.04	Implement a Phase detector circuit using PLL IC and observe the phase difference between	3	Applying

	input and output.		
M2.05	Set up a Sample and hold circuit using op-amp.	2	Applying
	Lab Exam – I	3	
CO3	**Implement circuits for the output section in medical instruments.**		
M3.01	Implement the circuit that drives the Power amplifier for stylus movement.	3	Applying
M3.02	Implement the Chart drive circuit for biosignal recorders.	3	Applying
M3.03	Implement the automatic gain control circuit for biosignal recorders	3	Applying
CO4	**Experiment with ICs for implementing medical electronic circuits.**		
M4.01	Demonstrate the working IC 4051 and verify the output.	2	Understanding
M4.02	Demonstrate the working IC7107 and verify the output.	3	Understanding
M4.03	Open Ended experiments**	4	Applying
	Lab Exam – II	3	

**** - Suggested Open Ended Projects**

(Not for End Semester Examination but compulsory to be included in Continuous Internal Evaluation. Students can do open ended experiments as a group of 4-5. There is no duplication in experiments between groups. Open ended experiments should include the concepts of circuit design and application)

1) Implement simple circuits that form part of medical instruments in breadboard/simulation software/PCB (examples of experiments)
    - ECG Telemetry system
    - Digital BP meter
    - Heart rate monitor
    - QRS detector
    - Pulse sensor

Text / Reference:

T/R	Book Title/Author
T1	A.K. Sawhney A Course in Electronic Measurements and Instrumentation Dhanpat Rai & Co. (P) Limited 2015
R1	R S Khandpur- Handbook of Biomedical instrumentation- McGraw Hill Education; Third edition (4 August 2014)
R2	Ramakant A Gayakwad- Op - Amps and Linear Integrated Circuits Prentice Hall India Learning Private Limited 2002

Online Resources:

Sl.No	Website Link
1	www.nptel.ac.in
2	www.allaboutcircuits.com
3	www.electronicscircuits.com