Maharashtra State Board of Technical Education, Mumbai

Teaching And Examination Scheme For Post S.S.C. Diploma Courses

Program Name : Diploma in Medical Electronics

Program Code : MU **With Effect From Academic Year: 2017 - 18**

Duration of Program : 6 Semesters **Duration : 16 Weeks**

Semester : Third **Scheme : I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory							Practical					
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Digital Techniques	DTE	22320	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
2	Electronics Instruments and Measurements	EIM	22331	4	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
3	Electronics Devices and Circuits	EDC	22346	3	-	4	7	3	70	28	30*	00	100	40	50@	20	50	20	100	40	200
4	Human Anatomy and Physiology	HAP	22347	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
5	Bio-Sensors	BIO	22348	3	2	2	7	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
6	Computer Hardware and Networking	CHN	22029	1	-	2	3	--	--	--	--	--	--	--	25@	10	25~	10	50	20	50
			Total	**19**	**2**	**14**	**35**	--	**350**	--	**150**	--	**500**	--	**175**	--	**175**	--	**350**	--	**850**

Student Contact Hours Per Week: **35 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks : **850**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Program Name : **Computer and Electronics Engineering Program Group**

Program Code : **CO/CM/CW/DE/EJ/ET/EN/EX/EQ/IE/IS/IC/MU**

Semester : **Third**

Course Title : **Digital Techniques**

Course Code : **22320**

1. RATIONALE

In the present scenario most of the electronic equipment like computers, mobiles, music systems, ATM, automation and control circuits and systems are based on digital circuits which the diploma electronic engineering passouts (also called technologists) have to test them. The knowledge of basic logic gates, combinational and sequential logic circuits using discrete gates as well as digital ICs will enable the students to interpret the working of equipment and maintain them. After completion of the course, students will be able to develop digital circuits based applications.

2. COMPETENCY

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

- **Build/ test digital logic circuits consist of digital ICs.**

3. COURSE OUTCOMES (COs)

The theory, 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 number system and codes for interpreting working of digital system.
b. Use Boolean expressions to realize logic circuits.
c. Build simple combinational circuits.
d. Build simple sequential circuits.
e. Test data converters and PLDs in digital electronics systems.

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	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***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 teaching 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.

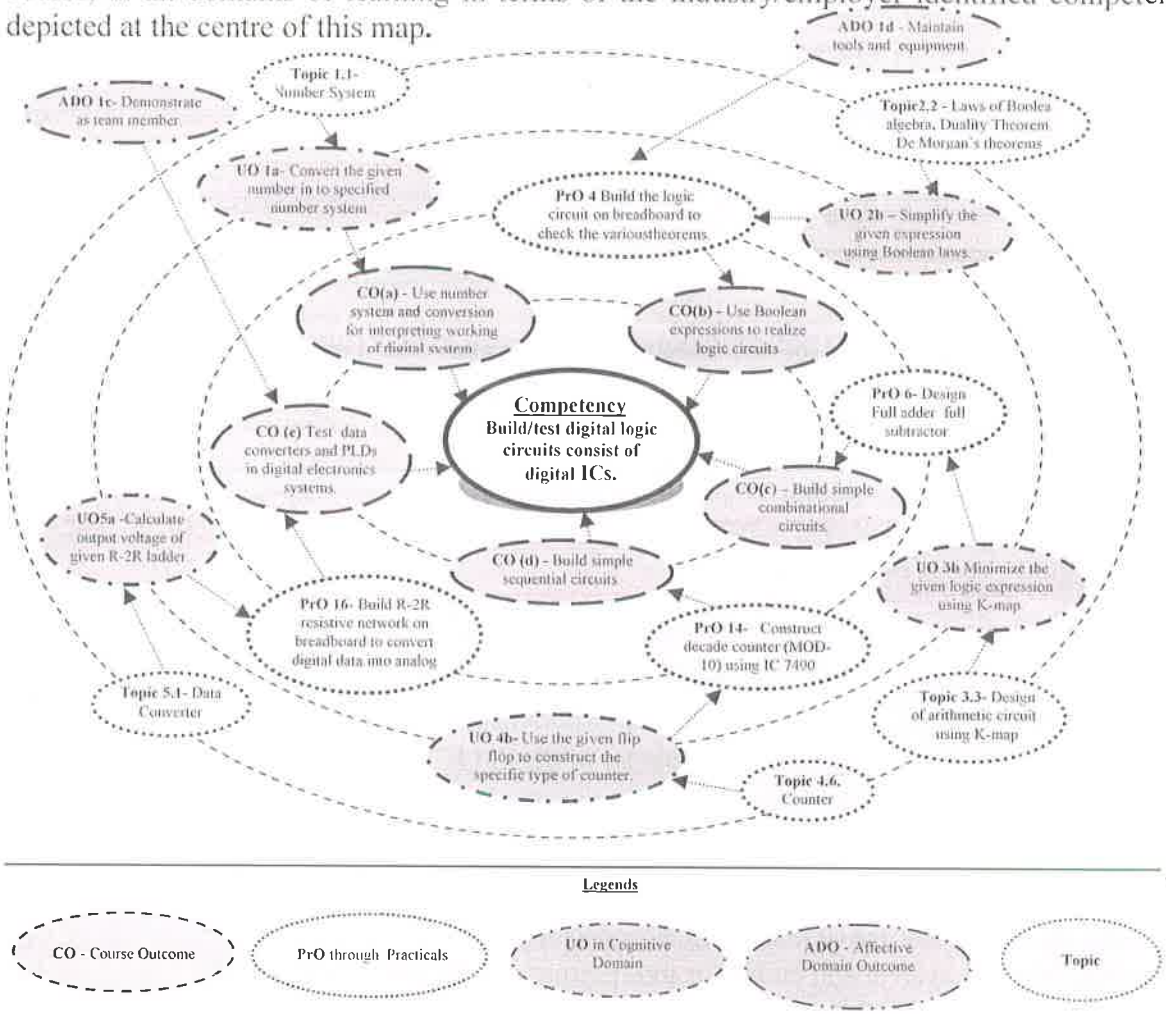

Figure 1 - Course Map

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)	Unit No.	Approx. Hrs. required
1	Test the functionality of specified logic gates using breadboard. (IC 7404, 7408, 7432, 7486)	II	02*
2	Test the functionality of NAND and NOR gate of using breadboard (IC 7400 and 7402)	II	02
3	Construct AND, OR, NOT gates using universal gates.	II	02
4	Build the logic circuit on breadboard to check the De Morgan's theorems.	II	02
5	Design Half adder and Half subtractor using Boolean expressions.	III	02*
6	Design Full adder and full subtractor.	III	02
7	Construct and test BCD to 7 segment decoder using IC 7447/ 7448.	III	02
8	Build / test function of MUX 74151/74153 any other equivalant.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
9	Build / test function of DEMUX 74155/74154/any other equivalant.	III	02
10	Build / test function of RS flip flop using NAND Gate.	IV	02*
11	Build / test function of MS JK flip flop using 7476.	IV	02
12	Use IC 7476 to construct and test the functionality of D and T flip flop.	IV	02
13	Implement 4 bit ripple counter using 7476.	IV	02
14	Use IC 7490 to construct decade counter (MOD-10).	IV	02
15	Implement 4 bit universal shift register.	IV	02
16	Build R-2R resistive network on breadboard to convert given digital data into analog.	V	02*
		Total	**32**

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 12 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 %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and conclusion	20
f.	Answer to sample questions	10
g.	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. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

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
- '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	Digital Multimeter: 3 and ½ digit with R, V, I measurements, diode and BJT testing.	All
2	CRO : Dual Channel, 4 Trace CRT / TFT based Bandwidth 20 MHz/30 MHz X10 magnification 20 ns max sweep rate, Alternate triggering Component tester and with optional features such as Digital Read out.	16
3	Pulse Generator: TTL pulse generator	10-15
4	DIGITAL IC tester: Tests a wide range of Analog and Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	1-15
5	Bread Board Development System: Bread Board system with DC power output 5V, +/-12V and 0-5V variable , digital voltmeter , ammeter, LED indicators 8 no, logic input switches 8 no, 7 segment display 2 no, clock generator, Manual pulser, Breadboard with about 1,600 points, Potentiometer, relay etc	1-15
6	Trainer kits for digital ICs: Trainer kit shall consists of digital ICs for logic gates, flop-flop, shift registers, counter along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	1-15
7	Regulated power supply: Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2 A Automatic Overload (Current Protection) Constant Voltage and Constant Current Operation Digital Display for Voltage and Current Adjustable Current Limiter Excellent Line and Load Regulation	1-16
8	Trainer kit for 4 bit Counter using Flip Flops: 4 bit ripple counter, Synchronous Counter, IC 7476 based circuit. Input given by switches and output indicated on LED. Facility to select MOD 8 or MOD 16 mode. Built in DC power supply and manual pulser with indicator.	13

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 Number System and Codes	1a. Convert the given number into the specified number system. 1b. Perform the binary arithmetic operation on the given binary numbers. 1c. Convert the given coded number into the other specified code.	1.1 Number System: base or radix of number system, binary, octal, decimal and hexadecimal number system. 1.2 Binary Arithmetic: Addition, subtraction, multiplication, division. 1.3 Subtraction using 1's complement and 2's complement. 1.4 Codes: BCD, Gray Code, Excess-3, and ASCII code.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	1d. Add the given two decimal numbers using BCD code.	1.5 BCD Arithmetic: BCD Addition
Unit – II Logic gates and logic families	2a. Develop the basic gates using the given NAND/NOR gate as universal gate. 2b. Simplify the given expression using Boolean laws. 2c. Develop logic circuits using the given Boolean expressions. 2d. Compare the salient characteristics of the given digital logic families.	2.1 **Logic gates**: Symbol, diode/ transistor switch circuit and logical expression , truth table of basic logic gates (AND, OR, NOT), Universal gates (NAND and NOR) and Special purpose gates (EX-OR, EX-NOR),Tristate logic 2.2 **Boolean algebra**: Laws of Boolean algebra, Duality Theorem, De-Morgan's theorems 2.3 **Logic Families**:Characteristics of logic families : Noise margin, Power dissipation, Figure of merit , Fan-in and fan-out, Speed of operation, Comparison of TTL, CMOS, types of TTL NAND gate
Unit– III Combinational Logic Circuits	3a. Develop logic circuits in standard SOP/ POS form for the given logical expression. 3b. Minimize the given logic expression using K-map. 3c. Use IC 7483 to design the given adder/ subtractor. 3d. Draw MUX/DEMUX tree for the given number of input and output lines. 3e. Write the specifications of the component for the given application. 3f. Develop the specified type of code converter.	3.1 **Standard Boolean representation:** Sum of Product (SOP) and Product of Sum(POS), Min-term and Max-term, conversion between SOP and POS forms, realization using NAND /NOR gates 3.2 **K-map reduction technique for the Boolean expression:** Minimization of Boolean functions up to 4 variables (SOP and POS form) 3.3 **Design of arithmetic circuits and code converter using K-map:** Half and full Adder, half and full Subtractor , gray to binary and binary to gray (up to 4 bits) 3.4 **Arithmetic circuits:** (IC 7483) Adder and Subtractor, BCD adder 3.5 **Encoder/Decoder:** Basics of encoder, decoder, comparison, (IC 7447) BCD to 7 segment decoder/driver 3.6 **Multiplexer and Demultiplexer:** working , truth table and applications of Multiplexers and Demultiplexures, MUX tree, IC 74151as MUX; DEMUX tree, DEMUX as decoder, IC 74155 as DEMUX 3.7 **Buffer:** Tristate logic, unidirectional and bidirectional buffer (74LS244,74LS245)

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– IV Sequential Logic Circuit	4a. Use relevant triggering technique for the given digital circuit. 4b. Use the given flip-flop to construct the specific type of counter. 4c. Use excitation table of the given flip-flop to design synchronous counter. 4d. Design the specified modulo-N counter using IC7490. 4e. Construct ring/ twisted ring counter using the given flip-flop.	4.1 **Basic memory cell**: RS-latch using NAND and NOR 4.2 **Triggering Methods:** Edge trigger and level trigger 4.3 **SR Flip Flops**: SR-flip flop, clocked SR flip flop with preset and clear, drawbacks of SR flip flop 4.4 **JK Flip Flops**: Clocked JK Flip flop with preset and clear, race around condition in JK flip flop, Master slave JK flip flop, D and T type flip flop Excitation table of flip flops, Block schematic and function table of IC-7474, 7475 4.5 **Shift Register**: Logic diagram of 4-bit Shift registers – Serial Input Serial Output, Serial Input Parallel Output, Parallel Input Serial Output, Parallel Input Parallel Output, 4 Bit Universal Shift register **4.6 Counters:** Asynchronous counter: 4 bit Ripple counter, 4 bit up/down Counter, modulus of counter Synchronous counter: Design of 4 bit synchronous up/down counter Decade counter: Block schematic of IC 7490 Decade counter, IC 7490 as MOD-N Counter, Ring counter, Twisted ring counter
Unit– V Data Converters and PLDs	5a. Calculate the output voltage of the R-2R ladder for the given specified digital input. 5b. Calculate the output voltage of the weighted resistor DAC for the given specified digital input. 5c. Explain with sketches the working principle of the given type of ADC. 5d. Explain with sketches the working principle of the given types of memories. 5e. Explain with basic block diagram the working principle of the given type of programmable logic device.	5.1 **Data Converter**: DAC**:** Types, weighted resistor circuit and R-2R ladder circuit, DAC IC 0808 specifications ADC: Block Diagram, types, and working of Dual slope ADC, SAR ADC, ADC IC 0808/0809, specification 5.2 **Memory**: RAM and ROM basic building blocks, read and write operation ,types of semiconductor memories 5.3 **PLD:** Basic building blocks and types of PLDs. PLA, PAL, GAL 5.4 CPLD: Basic Building blocks, functionality.

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 QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Number System	06	2	2	4	08
II	Logic gates and logic families	10	4	4	4	12
III	Combinational Logic Circuits	16	4	6	8	18
IV	Sequential Logic Circuit	16	4	6	8	18
V	Data Converters and PLDs	16	4	4	6	14
Total		**64**	**18**	**22**	**30**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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 the survey report on the applications of different types of number system and code converters used in the design of digital system.
b. Compare technical specifications and applications of various types of memory, PLDs, CPLDs and Prepare report.
c. Test digital IC's using various testing equipment like digital IC tester, Digital multi-meter etc.
d. Give seminar on any course relevant topic.
e. Conduct library / internet survey regarding different data sheet and manuals.
f. Prepare power point presentation on digital circuits and their applications.
g. Undertake a market survey of different digital IC's required for different applications.
h. Search for video / animations / power point presentation on internet for complex topic related to the course and make a presentation.

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. PPTs/Animations may be used to explain the construction and working of electronic circuits.
g. Guide students for using data sheets / manuals.

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. Micro project report may be of four to five pages.

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

a. Build a Digital IC tester circuit.
b. Build a 4bit parity generator and parity checker circuit.
c. Build a circuit to implement 4 bit adder.
d. Build a circuit to test 7 segment display.
e. Build a circuit to implement debounce switch.
f. Build a circuit for LED flasher.
g. Build a circuit for LED BAR display
h. Design and analyze digital arithmetic circuit

Note: *Use general purpose PCB for making micro projects*

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009 ISBN: 9780070669116
2	Digital Circuits and Design	Salivahanan S.; Arivazhagan S.	Vikas Publishing House, New Delhi, 2013, ISBN: 9789325960411
3	Digital Electronics	Puri, V.K.	McGraw Hill , New Delhi, 2016, ISBN: 97800746331751
4	Digital Principles	Malvino, A.P.; Leach, D.P.; Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405
5	Digital Design	Mano, Morris; Ciletti, Michael D.	Pearson Education India, Delhi, 2007, ISBN: 9780131989245
6	Digital Electronics, Principles and Integrated Circuits	Maini, Anil K.	Wiley India, Delhi, 2007, ISBN: 9780470032145

S. No.	Title of Book	Author	Publication
7	Digital Fundamentals	Floyd, Thomas	Pearson Education India, Delhi, 2014, ISBN : 9780132737968

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.cse.yorku.ca/~mack/1011/01.NumberSystems.ppt
b. www.people.sju.edu/~ggrevera/arch/slides/binary-arithmetic.ppt
c. www.mathsisfun.com/binary-number-system.html
d. www.codesandtutorials.com/hardware/electronics/digital_codes-types.php
e. www.ee.surrey.ac.uk/Projects/Labview/gatesfunc/
f. www.ee.surrey.ac.uk/Projects/Labview/boolalgebra/
g. www.eng.auburn.edu/~strouce/class/elec2200/elec2200-8.pdf
h. www.maxwell.ict.griffith.edu.au/yg/teaching/dns/dns_module3_p3.pdf
i. www.scs.ryerson.ca/~aabhari/cps213Chapter5.ppt
j. www.eng.wayne.edu/~singhweb/seql.ppt
k. www.cs.sjsu.edu/faculty/lee/Ch2Problems2.ppt
l. www.rogtronics.net/files/datasheets/dac/SedraSmith.pdf
m. www-old.me.gatech.edu/mechatronics_course/ADC_F04.ppt
n. www.allaboutcircuits.com/vol_4/chpt_13/3.html
o. www.youtube.com/watch?v=5Wz5f3n5sjs
p. www.eee.metu.edu.tr/~cb/e447/Chapter%209%20-%20v2.0.pdf
q. www2.cs.siu.edu/~hexmoor/classes/CS315-S09/Chapter9-ROM.ppt
r. www.cms.gcg11.org/attachments/article/95/Memory2.ppt
s. www.cosc.brocku.ca/Offerings/3P92/seminars/Flash.ppt
t. www.webopedia.com/TERM/R/RAM.html
u. www.cs.sjsu.edu/~lee/cs147/Rahman.ppt

Program Name : **Digital Electronics, Medical Electronics and Instrumentation Engineering Program Group**

Program Code : **DE/IE/IS/IC/MU**

Semester : **Third**

Course Title : **Electronic Instruments and Measurement**

Course Code : **22331**

1. RATIONALE

Diploma pass outs (also called as technologists) should be able to measure various electrical and electronic parameters in industry using relevant instruments. This course is designed to provide the basic understanding about the concepts, principles and procedures of analog and digital electronic measuring instruments. Students will be able to use the various electronic measuring instruments for fault finding in the industry.

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 basic electrical and electronic instruments for measuring various parameters.**

3. COURSE OUTCOMES (COs)

The theory, 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 relevant type of measuring instruments for different applications.
b. Use analog meters to measure electrical parameters.
c. Use digital meters to measure electrical parameters.
d. Use CRO and signal generator to measure electrical parameters.
e. Use AC and DC bridges to measure electrical parameters.

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	-	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***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, TLOs 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.

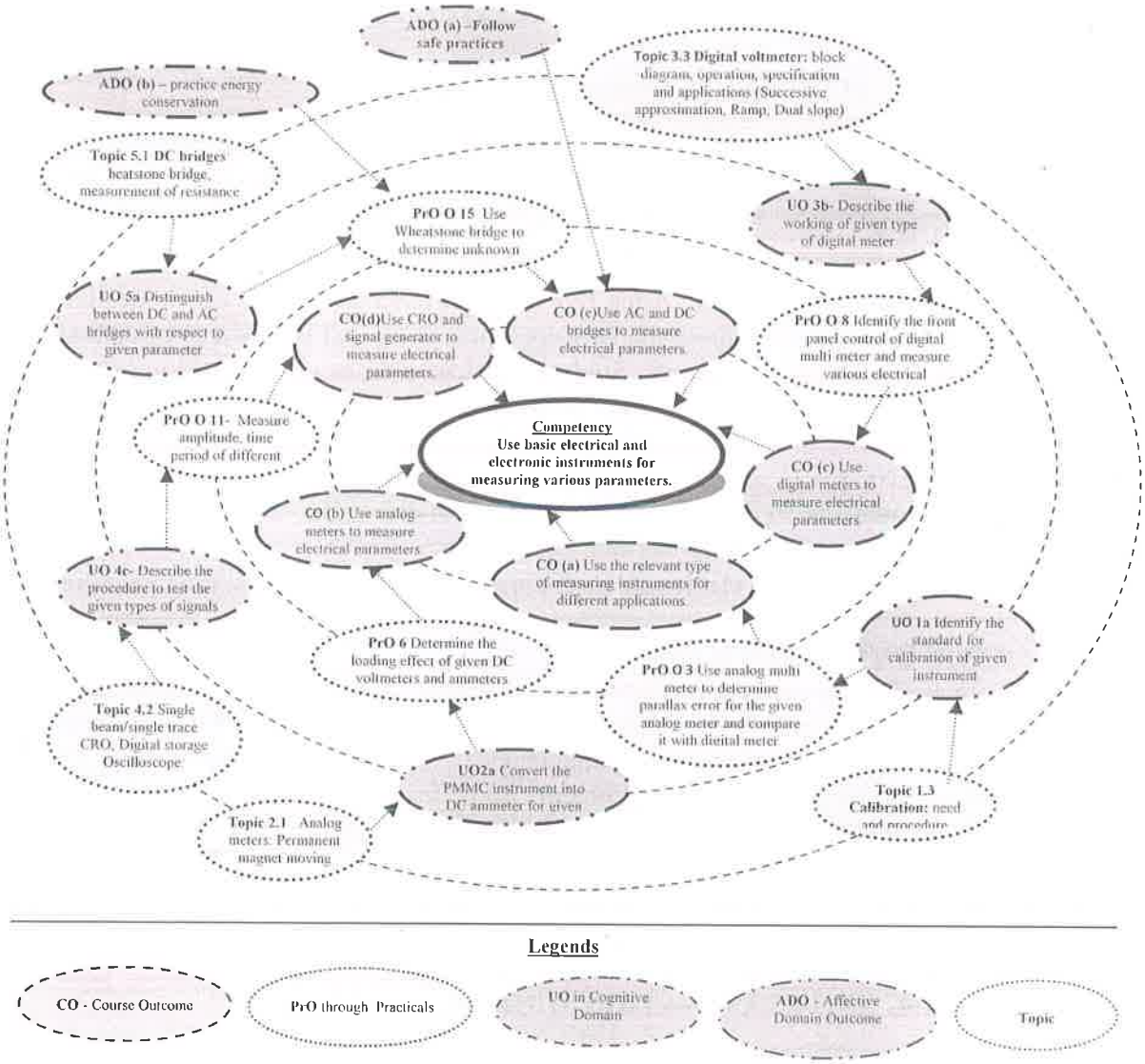

Figure 1 - Course Map

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)	Unit No.	Approx. Hrs. Required
1	Use analog multi meter to determine accuracy, resolution and hysteresis.	I	02*
2	Calibrate the analog multi meter by comparing with given standard instrument.	I	02
3	Use analog multi meter to determine parallax error for the given analog meter and compare it with digital meter	I	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
4	Convert basic PMMC movement of 1mA into DC voltmeter for measuring 5V, 10V, 15V.	II	02
5	Convert basic PMMC movement of 1mA into DC ammeter for measuring 10mA, 50mA, 100mA	II	02*
6	Determine the loading effect of given DC voltmeters and ammeters	II	02
7	Use LCR meter to calculate the value of resistance, Inductance, capacitance and compare those with component codes.	III	02
8	Identify the front panel control of digital multi meter and measure various electrical parameters using DMM	III	02*
9	Use analog multi meter to determine accuracy, resolution and hysteresis loop of given digital meter.	III	02
10	Identify the front panel control of logic Analyzer and Test the given digital circuit	III	02
11	Measure amplitude, time period of different signals generated by function generator using CRO.	IV	02*
12	Measure unknown frequency and phase difference with respect to given signal using Lissajous pattern	IV	02
13	Identify the front panel control of DSO and measure various parameters of applied signal	IV	02
14	Identify the front panel control of Spectrum Analyzer and determine frequency content of given signal.	IV	02
15	Use Wheatstone bridge to determine unknown resistance	V	02*
16	Use Maxwell Bridge to determine unknown inductance.	V	02
17	Use Schering Bridge to determine unknown capacitance.	V	02
18	Measure intensity of bulb available in the laboratory using Lux meter.	III	02
	Total		**36**

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 12 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.	Preparation of experimental setup	20
2.	Setting and operation	20
3.	Safety measures	10
4.	Observation and recording	10
5.	Interpretation of result and conclusion	20
6.	Answer to sample questions	10
7.	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. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

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
- '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 authorities concerned.

S. No.	Equipment Name with Broad Specifications	Pro.S. No.
1	Analog multi meter 1mA, 500 ohms.	1,2,3
2	Digital Multi meter 4 ½ digit display	2,3,8,9
3	Voltmeter 0-10V,0-50V,0-100V,0-300V	3,4,6
4	Ammeter 0-100mA, 0-50μA,0-1mA	3,5
5	LCR meter 20Hz – 2MHz	5
6	Cathode ray Oscilloscope single beam dual trace 0-30 MHz	11,12
7	Function generator 0-2MHz, 0-3MHz	11,12, 14,16, 17
8	Digital Storage Oscilloscope 60 MHz bandwidth	13
9	Logic Analyzer: 32 channel	10
10	Spectrum Analyzer: Heterodyne type 3GHz	14
11	Lux Meter range 400.0/4000 lux sensor diameter 2 to 2 inch, Accuracy 5%, memory 16000 reading, resolution 100 lux, foot candle resolution 0.1 fc. Display type- numeric	18

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 Fundamentals of measure	1a. Identify the standard for calibration of the given instrument with justification. 1b. Classify the given measuring instruments.	1.1 Measurement: Concept , units of measurement of fundamental quantities, standard and their classification, Static and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
ments	1c. Determine static and dynamic characteristics of the measuring instruments with the given data. 1d. Explain with sketches the generalized procedure for calibration of the given device.	dynamic characteristics, types of errors 1.2 Classification of instruments: (i) absolute and secondary instruments, (ii) analog and digital instruments, (iii) mechanical, electrical and electronic instruments 1.3 Calibration: need and procedure
Unit– II Analog meters	2a. Explain with sketches the construction and working principle of the given permanent magnet moving coil (PMMC) instrument with sketches. 2b. Describe with sketches the procedure to convert the PMMC instrument into DC ammeter for the given range. 2c. Describe with sketches the procedure to convert the PMMC instrument into DC voltmeter for the given range. 2d. Explain with sketches the working of given type of ohm meter. 2e. Explain with sketches the working of given type of AC voltmeter. 2f. Prepare specification for given analog meters.	2.1 Permanent magnet moving coil (PMMC) and Permanent magnet moving iron (PMMI) meter their construction, principle, working, salient features 2.2 DC Ammeter: Basic, Multi range, Universal shunt/Ayrton, simple numerical based on R_{sh} 2.3 DC Voltmeter: Basic, Multi range, simple numerical based on R_s, concept of loading effect and sensitivity 2.4 Ohm meter: Series and shunt 2.5 AC voltmeter: Rectifier type (half wave and full wave)
Unit– III Digital Meters	3a. Determine resolution, sensitivity and accuracy of the given digital display. 3b. Explain with sketches the working of given type of digital meter. 3c. Explain with sketches the construction and working of the given types of digital meters. 3d. Describe with sketches the procedure to measure the given electric parameter using the relevant type of digital meter. 3e. Describe with sketches the procedure to test the given digital circuits using logic analyser. 3f. Prepare specification for given digital instrument.	3.1 Resolution, sensitivity and accuracy of digital Instruments. 3.2 Digital frequency meter, Digital multi meter, LCR-Meter, Lux Meter, Logic Analyser: block diagram, operation, specification and applications 3.3 Digital voltmeter: block diagram, operation, specification and applications (Successive approximation, Ramp, Dual slope)
Unit-IV CRO and signal generato	4a. Describe the given blocks and working of given type of oscilloscope with sketches. 4b. Describe with sketches the procedure to measure the given parameter using the	4.1 Single beam/single trace CRO, Digital storage Oscilloscope: Basic block diagram, working, Cathode ray tube, electrostatic deflection, vertical amplifier,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
rs	CRO. 4c. Describe with sketches the working of given type of type of signal/function generator with sketches. 4d. Describe with sketches the procedure to test the given type of signal using the relevant type of function generator/signal generator/CRO. 4e. Select CRO/ DSO, Spectrum analyzer and function generator for the given application. 4f. Prepare specification for given instrument.	time base generator, horizontal amplifier, attenuator, delay line and specifications. 4.2 CRO Measurements: voltage, time period, frequency, phase angle, Lissajous pattern. 4.3 Signal generator: need, working and Basic block diagram 4.4 Function generator: need. working and basic block diagram and specifications. 4.5 Spectrum analyzer: Basic block diagram, operation , specification and applications.
Unit –V DC and AC bridges	5a. Explain with sketches the the working of the given type of bridge with sketches. 5b. Describe with sketches the procedure to measure given unknown resistance using the relevant type of bridge with sketches 5c. Describe with sketches the procedure to measure given unknown capacitance using relevant type of bridge with sketches. 5d. Describe with sketches the procedure to measure given unknown inductance value using relevant type of bridge with sketches.	5.1 DC bridges: Wheatstone bridge, measurement of resistance 5.2 AC bridges: Use of Schering bridge, Maxwell bridge, Hays bridge

***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 QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of measurements	08	02	02	04	08
II	Analog meters	16	04	06	08	18
III	Digital meters	14	02	06	10	18
IV	CRO and Signal generator	18	02	06	10	18
V	DC and AC bridges	08	02	02	04	08
Total		**64**	**12**	**22**	**36**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*

***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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. Compile broad specification of DSO, LCR meter, logic analyzer, Spectrum analyser using data sheets and handbook.
b. Develop a report after performing market survey of electronic instruments used in the laboratory.
c. Prepare a chart of static and dynamic characteristics of the instrument/equipment available in the laboratory.
d. Prepare chart to display types of Units.
e. Prepare chart to display front panel control of DSO, LCR meter, Logic analyser and Spectrum analyser
f. Visit nearby institutes, exhibition and industries to collect information about electronic instruments.
g. Assist to the technicians who are doing repair or maintenance work of electronic instruments.
h. Prepare instruction chart for safe handling of electronic instruments

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. Video programs/YouTube may be used to teach various topics and sub topics.
g. Demonstrate set-up arrangement to the students thoroughly before they start doing the practical.
h. Encourage students to refer different book and websites to have deeper understanding of the subject.
i. Observe continuously and monitor the performance of students in Lab.
j. Encourage students to use front/rear panel control of electronic instruments.
k. Encourage students to visit nearby electronic instruments repair workshop units or manufacturing industries.

l. Instruct students to safety concern of handling electronic instruments and also to avoid any damage to the electronic instruments.

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. Prepare a report on market survey of Dual beam CRO, Dual trace CRO, Sampling Oscilloscope, DSO, function generator, logic analyzer and LCR meter.(technical specification and manufacturers).
b. Build and test given power supply using CRO and DMM.
c. Build, test and commission Wheatstone bridge using LDR / thermistor / RTD / potentiometer.
d. Find the fault in the given laboratory electronic measuring instrument.
e. Build, test and commission Schering Bridge using LDR / thermistor / RTD / potentiometer.
f. Build the circuit of LED bulb using white LED arrays and measure its intensity using lux meter.
g. Take two similar circuit board. One is faulty another is in working condition. Test both circuit boards using component test function on CRO/DSO and find out the faulty component in faulty circuit.
h. Take laminated copper wire and construct inductor and measure inductance using LCR meter. Now change the number of turns and test different inductors.
i. Take copper clad and form capacitor by etching copper clad and measure the capacitance using LCR meter.
j. Construct voltage Doubler /trippler circuit and measure voltage at every capacitor using CRO.
k. Build and test function generator using IC (eg.ICL8038, MAX038, XR2206 etc.).

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electronic Instrumentation	Kalsi, H.S.	Mc Graw Hill Education, New Delhi, 2010 ISBN:9780070702066
2	Electronic Measurement and instrumentation	Sedha, R.S.	S Chand and Company, New Delhi , 2012 ISBN: 9788121997751
3	Electronic instruments and	Anand, M.M.S.	PHI Learning., New Delhi.2004

S. No.	Title of Book	Author	Publication
	instrumentation Technology		ISBN: 9788120324541
4	A course in electrical and electronic measurement and instrumentation	Sawhney, A.K.	Dhanpat Rai and Company, New Delhi, 2005 ISBN-13: 978-8177000160
5	Electronic Measurement and instrumentation	Rajput, R.K.	S Chand and Company, New Delhi , 2008 ISBN: 9788121929172
6	Electronic instrumentation and Measurement	Khurana, Rohit.	Vikas Publications House. New Delhi, ISBN: 9789325990203
7	Electronic instrumentation and Measurement	Bell, David A.	Oxford University Press, New Delhi, 2013; ISBN: 9780195696141
8	Elements of electronic instrumentation and measurements	Carr, Joseph J.	Pearson Education ,New Delhi, 2003 ISBN: 9788131712115

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.nptel.iitg.ernet.in/courses/Elec.engg/IIT%20Bombay/electrical/%20and
b. www.electrical4u.com/permanent-magnet-moving-coil-instrument/
c. www.electrical4u.com/digital-frequency-meter/
d. www.electrical4u.com/digital-multimeter/
e. www.electrical4u.com/wheatstone-bridge-circuit-theory-and-principle/
f. www.electrical4u.com/maxwell-bridge-inductance-capacitance-bridge/
g. www.electrical4u.com/hays-bridge-circuit-theory-phasor-diagram-advantages-applications/
h. www.electrical4u.com/schering-bridge-measurement-of-capacitance-using-schering-bridge/
i. www.electrical4u.com/cathode-ray-oscilloscope-cro/
j. www.nprcet.org/eee/document/MI.pdf
k. web.mst.edu/~cottrell/ME240/Resources/basic_inst/Basic_Instrumentation.pdf

Program Name : **Diploma in Medical Electronics**

Program Code : **MU**

Semester : **Third**

Course Title : **Electronic Devices and Circuits**

Course Code : **22346**

1. RATIONALE

The past decades have witnessed several exciting technological developments in the field of medical electronics. Large numbers of solid state devices have been used to design various circuits in medical electronics. For learners this course imparts a sound understanding of electronic devices and circuits like amplifiers, oscillators, regulators and plays a vital role in developing skills needed to become a medical electronics professional in healthcare industry.

2. COMPETENCY

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

- **Maintain regulated power supplies, amplifiers and oscillator circuits.**

3. COURSE OUTCOMES (COs)

The theory, 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. Select the relevant configuration of transistor.
b. Use the relevant biasing circuit in the transistorised amplifier circuit.
c. Use transistor(s) for amplification of signals
d. Troubleshoot oscillator/ amplifier circuits.
e. Build various wave shaping circuits.
f. Troubleshoot voltage regulator circuits.

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
3	-	4	7	3	70	28	30*	00	100	40	50@	20	50	20	100	40

(*): 10 marks of theory PA is for micro-project assessment to facilitate attainment of COs and the remaining 10 marks for tests and assignments given by the teacher.

***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.

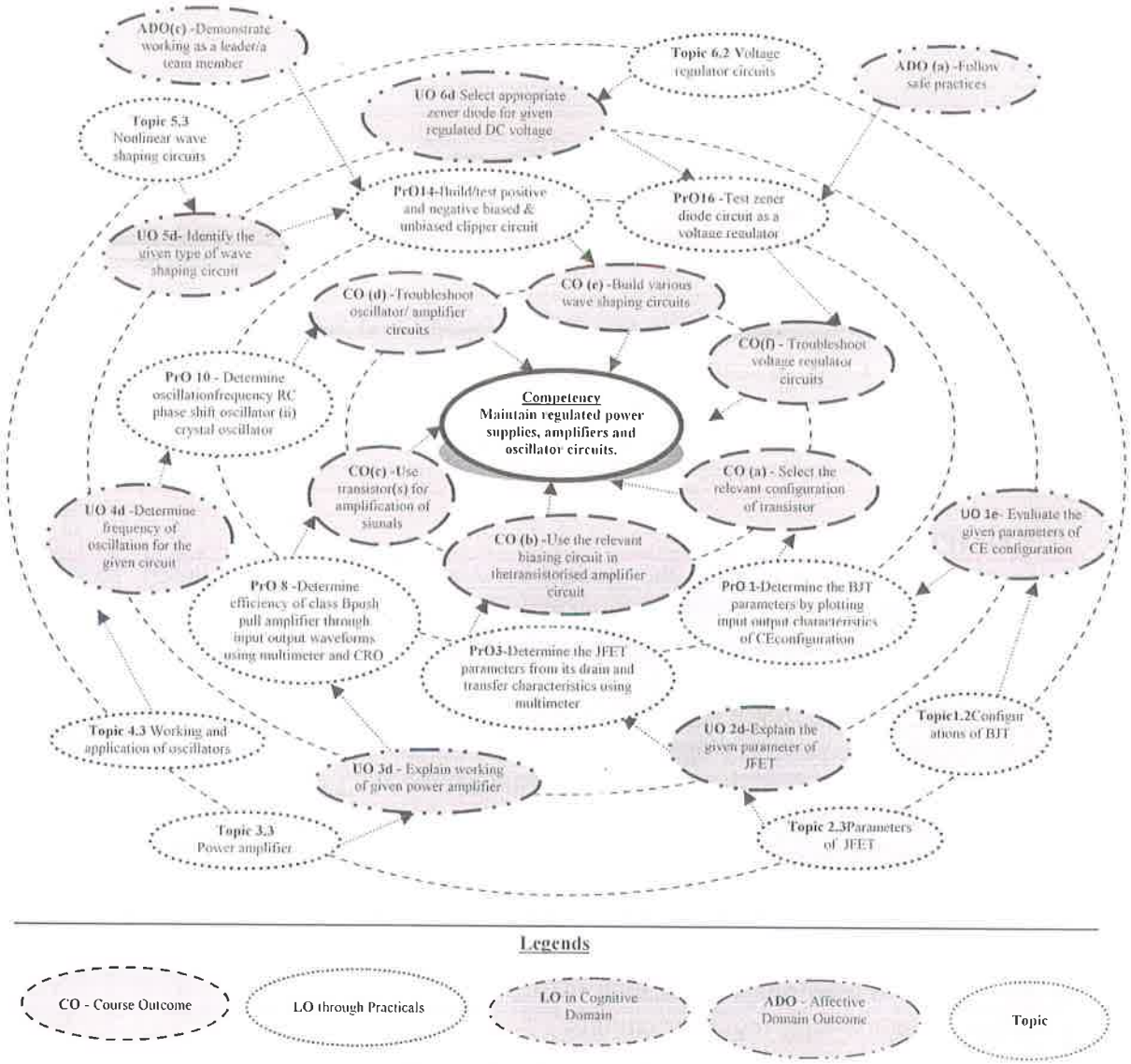

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

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

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Determine the BJT parameters by plotting input output characteristics of common emitter configuration – Part I	I	02*
2	Determine the BJT parameters by plotting input output characteristics of common emitter configuration.– Part II	I	02
3	Use BJT as a switch to turn on/off LED.	I	02
4	Determine the JFET parameters from its drain and transfer characteristics using multimeter. – Part I	II	02*
5	Determine the JFET parameters from its drain and transfer characteristics using multimeter. – Part II	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
6	Determine the EMOSFET parameters from its drain and transfer characteristics using multimeter. – Part I	II	02*
7	Determine the EMOSFET parameters from its drain and transfer characteristics using multimeter. – Part II	II	02
8	Identify the negative resistance region by plotting V-I characteristics of UJT using multimeter.	II	02
9	Determine gain and bandwidth of amplifier by plotting frequency response of single stage CE amplifier using CRO and function generator.– Part I	III	02*
10	Determine gain and bandwidth of amplifier by plotting frequency response of single stage CE amplifier using CRO and function generator. – Part II	III	02
11	Use CRO and function generator to Determine gain and bandwidth of two stage RC coupled BJT amplifier from its frequency response. – Part I	III	02
12	Use CRO and function generator to Determine gain and bandwidth of two stage RC coupled BJT amplifier from its frequency response.– Part II	III	02
13	Usemultimeter and CRO to Determine efficiency of class B push pull amplifier through input and output waveforms. – Part I	III	02
14	Usemultimeter and CRO Determine efficiency of class B push pull amplifier through input and output waveforms. – Part II	III	02
15	UseCRO and function generatorto Compare bandwidth of amplifier with and without negative feedback from frequency response. – Part I	IV	02*
16	UseCRO and function generatorto Compare bandwidth of amplifier with and without negative feedback from frequency response. – Part II	IV	02
17	Determine oscillation frequency practically of (i) RC phase shift oscillator (ii) crystal oscillator and compare with theoretical value.	IV	02*
18	Determine frequency of UJT relaxation oscillator to verify with theoretical value.	IV	02
19	Build/test RC Integrator circuit for square wave input. – Part I	V	02*
20	Build/test RC Differentiator circuit for square wave input. – Part II	V	02
21	Build/Test positive and negative biased and unbiased clipper circuit.– Part I	V	02*
22	Build/Test positive and negative biased and unbiased clipper circuit.– Part II	V	02
23	Build/Test positive and negative biased and unbiased clamper circuit.– Part I	V	02*
24	Build/Test positive and negative biased and unbiased clamper circuit. – Part II	V	02
25	Test zener diode circuit as a voltage regulator. – Part I	VI	02*
26	Test zener diode circuit as a voltage regulator. – Part II	VI	02
27	Determine the line and load regulation of series voltage regulator	VI	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	using multimeter. – Part I		
28	Determine the line and load regulation of series voltage regulator using multimeter. – Part II	VI	02
29	Check Load and Line regulation characteristics of fixed regulator circuit using IC 78XX. – Part I	VI	02*
30	Check Load and Line regulation characteristics of fixed regulator circuit using IC 78XX. – Part II	VI	02
31	Build dual voltage regulator and test input-output voltage. – Part I	VI	02*
32	Build dual voltage regulator and test input-output voltage. – Part II	VI	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 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.	Selection of suitable component(s), device(s) and instrument(s)	10
2.	Preparation of experimental set up	20
3.	Setting and operation	20
4.	Observations and Recording	10
5.	Interpretation of result and Conclusion	20
6.	Answer to sample questions	10
7.	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. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain equipment and designed circuits.
e. Follow ethical practices.

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
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

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	Digital multimeter: 3 1/2 digit display, 9999 counts, measures: V_{ac},V_{dc} (1000V max), A_{dc}, A_{ac}(10 amp max),Hz, resistance (0 - 100 MΩ) , capacitance and temperature	1,2,3,4,5, 8, 16, 17, 18 and 19
2	Variable DC power supply: 0- 30V, 2A, short circuit protection, display for voltage and current	1 to11and 14 to19
3	Cathode Ray Oscilloscope: Dual Trace 20 MHz, 1 megaohm input impedance	2 and 6 to 15
4	Function Generator: 0-2 MHz with sine, square and triangular output with variable frequency and voltage	2, 6,7,8,9,12,13, 14and15
5	Electronic Test Bench: Bread Board 840 -1000 contact points, positive and negative power rails on opposite side of the board, 0-30 V, 2 Amp variable DC power supply, Function Generator 0-2 MHz, CRO 0-30 MHz, digital multimeter	All

8. UNDERPINNING THEORY COMPONENTS

The following topicsare to betaught 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 Bipolar Junction Transistor	1a. Identify terminals of the given BJTfigure with justification. 1b. Compare different configurations of BJT with respect to circuit diagram, and amplification factor. 1c. Evaluate the given parameter of CE configuration. 1d. Select thebiasing circuit of BJT forthe given application with justification. 1e. Determine numerically current amplification factor for the given data of the amplifier.	1.1 Fundamentals of BJT:Types of BJT, construction, symbol and operation 1.2 Configurations of BJT: CB,CE ,CC and their current amplification factors,input output characteristics of CE with their parameters, BJT as switch 1.3 BJT biasing: DC loadline, biasing, stabilization,thermal runaway,biasing circuits: i. Fixed bias ii. Voltage divider bias

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– II FET and UJT	2a. Compare the given parmenters/features of the BJT with FET 2b. Describe with sketches the construction of agiven type of FET. 2c. Explain with sketches the working principle of the given type of transistor. 2d. Explain with sketches the given parameter of the JFET. 2e. Use the relevant FET biasing circuit for the given application. 2f. Explain with sketches the working principle of the given transistor in order to understand its application.	2.1 Field Effect Transistors:Types,construction and applications 2.2 Working principle and characteristics of: JFET,EMOSFET, DMOSFET, ISFET and UJT 2.3 Parameters of JFET:DC drain resistance.amplification factor,transconductance 2.4 FET biasing : i. Self-bias ii. Voltage divider bias
Unit– III Amplifier	3a. Explain with sketches operation of the given type of transistor as small signal amplifier. 3b. Explain with sketches working of the given type of power amplifier. 3c. Determine the gain and bandwidth of thegiven type amplifier circuit from the frequency response. 3d. Identify the relevant type of amplifier for the given use with justification.	3.1 Small signal amplifier: Amplifier concept, single stage BJT CE amplifier, FET CS amplifier,frequency response 3.2 Multistage amplifier: Types of coupling:RC coupling, Transformer coupling, Direct coupling 3.3 Power amplifiers:Class A,class B, class AB and class C 3.4 Operation: Class A transformer coupled amplifier,class B push pull amplifier
Unit-IV Feedback Amplifiers and Oscillators	4a. Identify the type of feedback connections for the given circuit with justification. 4b. Derive the gain expression for the given feedback amplifier. 4c. Select a particular type of oscillator for the given application with justification. 4d. Determinefrequency of oscillation for the given circuit.	4.1 Types of feedback: Gain expression with block diagram 4.2 Types of feedback connections:Voltage shunt,voltage series, current shunt and current series 4.3 Oscillator concept: Barkhausen's criteria for sustained oscillation 4.4 Working and application: RC phase shift oscillator, crystal oscillator(using BJT),UJT relaxation oscillator.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit –V Wave Shaping Circuit	5a. Design the circuit to generate the desired waveform. 5b. Compare the salient features of the given type ofintegrator anddifferentiator. 5c. Identify the given type ofwave shaping circuit in the given figure with justification. 5d. Sketch the output waveform of wave shaping circuit for the given input.	5.1 Wave shaping circuits: Need,comparison between linear and non-linear circuits 5.2 Linear wave shaping circuits: RC integrator and differentiator 5.3 Non linear wave shaping circuits: clippers and clampers
Unit-VI DC Voltage Regulator	6a. Select relevantzenerdiode for the given regulated DC voltage. 6b. Distinguish between transistorised shunt and series voltage regulator on the basis of given criteria. 6c. Design the regulated power supply using using IC 78XX and 79XX for a given value of voltage. 6d. Design zener diode as a voltage regulator for the given value of voltage.	6.1 Regulators:Block diagram of regulated power supply,load and line regulation 6.2 Voltage regulator circuits: Zener diode as voltage regulator, transistorised shunt and series voltage regulator 6.3 Regulator ICs: Fixed and variable DC voltage regulators using IC 78XX and 79XX

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

9. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Bipolar Junction Transistor	10	04	06	04	14
II	FET and UJT	08	02	04	04	10
III	Amplifier	10	02	04	08	14
IV	Feedback Amplifiers and Oscillators	06	02	04	04	10
V	Wave Shaping Circuit	08	02	04	06	12
VI	DC Voltage Regulator	06	02	04	04	10
Total		48	**14**	**26**	**30**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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 power point presentation or animation showing working of transistors, amplifiers, oscillators and regulators.
b. Simulate simple amplifier, oscillator and regulator circuits using open source software.
c. Undertake a market survey of different devices covered in curriculum based on the following points:
    i. Manufacturer
    ii. Specifications/ratings
    iii. Salient features
    iv. Applications

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES

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

a. Encourage students to refer different websites to have deeper understanding of the course.
b. Observe continuously and monitor the performance of students in Lab.
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. Use animations to explain the construction and working ofelectronic devices.
e. In respect of item no.10 above, the teachers need to create opportunities and pursue students for the effectiveness of such co-curricular activities.
f. MOOCs (Massive Open Online Courses) may be used to teach various topics and sub-topics.

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. Prepare an Electronic device board with specifications of each.

b. Build and Testan audio amplifier circuit.
c. Build automatic darkness detector circuit using LDR sensor and BJT as a switch
d. Build a basic remote tester using transistor and IR sensor.
e. Design and build dual voltage regulator for different voltage range.
f. Build a simple touch switch/ touch alarm /rain alarm sensor.

For the micro-project undertaken, the student should also simulate and develop the PCB layout in any open source software like evaluation versionof Multisim, Microcap, and Proteus etc. during building and testing of the circuit. This will also help him/her to develop competence in using CAD tools.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	A Textbook of Applied Electronics	Sedha, R.S.	S.Chand Publishing, New Delhi, 2014, ISBN: 978-8121927833
2	A Textbook of Electrical Technology	Theraja,B.L ; Theraja, A.K.	S.Chand Publishing, New Delhi, 2015, ISBN:978-8121926676
3	Electronics Devices and Circuit Theory	Boylestead, Robert L.;Neshelsky, Louis	Pearson, 11th edition, 2012, New Delhi, ISBN: 978-0132622264
4	Basic Electronics	Mandal,Soumitra Kumar	Mc Graw Hill,New Delhi,2013,ISBN: 978-1259006586
5	Fundamentals of Electronic Devices and Circuits	Bell, David	Oxford University Press, New Delhi, 2015, ISBN: 978-0195425239

14. SUGGESTED SOFTWARES/LEARNING WEBSITES

a. www.en.m.wikipedia.org/wiki/ISFET
b. www.nptel.ac.in/courses/117103063/
c. www.electronics-tutorials.ws/category/amplifier
d. www.electronics-tutorials.ws/category/transistor
e. www.ni.com/multisim/try/
f. www.labcenter.com/downloads/
g. www.spectrum-soft.com/download.shtm

Program Name : **Diploma in Medical Electronics**

Program Code : **MU**

Semester : **Third**

Course Title : **Human Anatomy and Physiology**

Course Code : **22346**

1. RATIONALE

Human anatomy and physiology is a core course that deals with normal structure, shape, size and location and functions of various organs of human body. By studying this course, students will be able to become familiar with anatomical and physiological terms, understand general anatomy of major systems, their importance in design of biomedical devices and correlate the knowledge of anatomy and functionality of human body systems in operating medical instruments. This course is a prerequisite for all courses of Medical Electronics, thereby vital for their career in Medical Electronics Field.

2. COMPETENCY

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

- **Correlate the use of medical instruments with respect to human body organ functions.**

3. COURSE OUTCOMES (COs)

The theory, 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. Interpret the functioning of the cell, tissues and skeleton system of the body.
b. Choose the equipment relevant to cardiac disease.
c. Relate the instrument to measure the respiratory parameters.
d. Select the equipment related to digestive & urinary system.
e. Interpret the effect of hormones on human body.
f. Identify the instruments related to function of nervous systems parts and special senses in human body.

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	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA is for micro-project assessment to facilitate attainment of COs and the remaining 20 marks is for tests and assignments given by the teacher.

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, POs, UOs, ALAs 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.

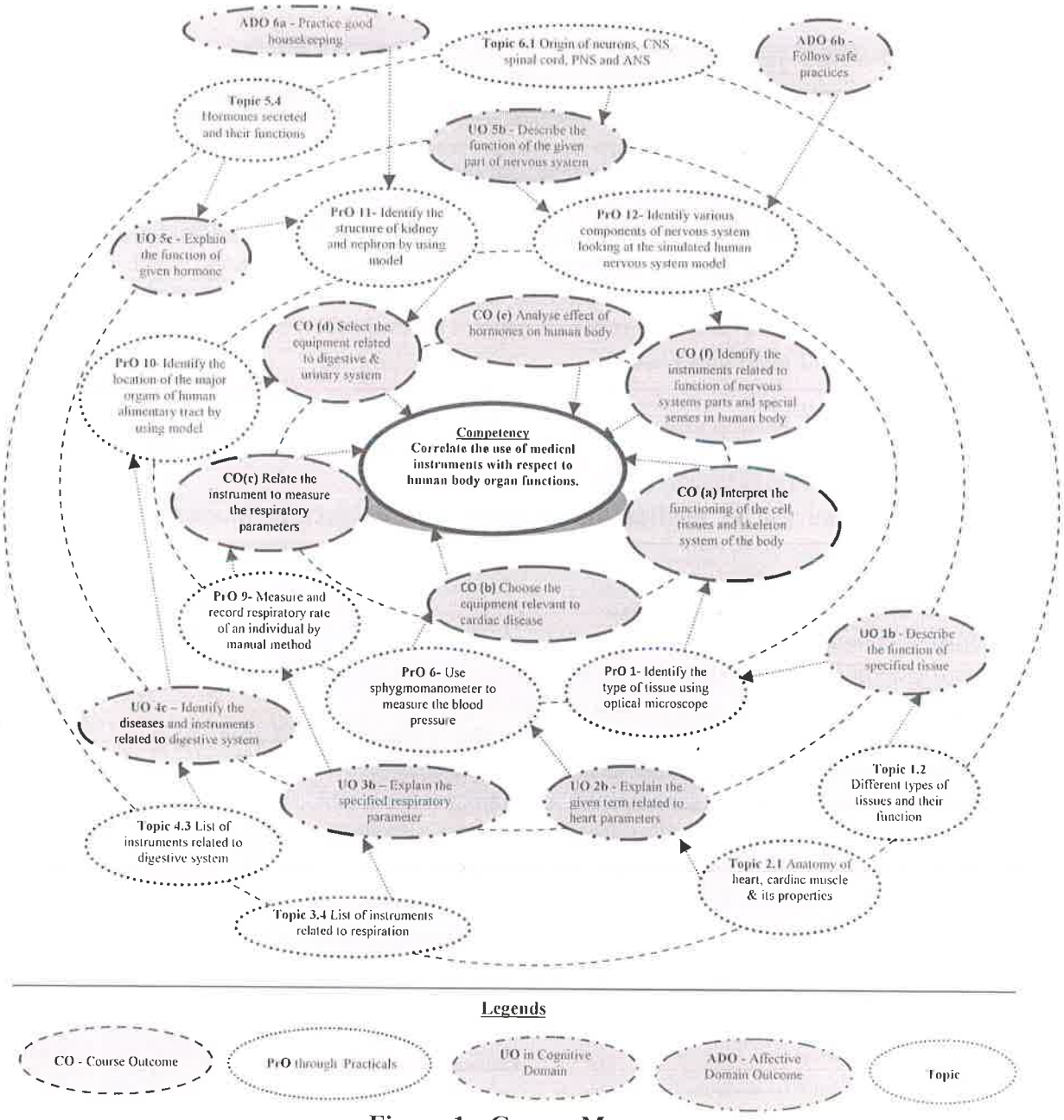

Figure 1 - Course Map

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)	Unit No.	Approx. Hrs. Required
1	Identify the type of tissue using optical microscope	I	02

2	Identify the blood group of given blood sample. – Part I	I	02*
3	Identify the blood group of given blood sample. – Part II	I	02
4	Determine haemoglobin content of the given blood sample. – Part I	I	02*
5	Determine haemoglobin content of the given blood sample. – Part II	I	02
6	Determine the bleeding time of a patient.	I	02
7	Determine the clotting time of the given blood sample.	I	02
8	Use sphygmomanometer to measure the blood pressure. – Part I	II	02*
9	Use sphygmomanometer to measure the blood pressure. – Part II	II	02
10	Identify heart sound using stethoscope.	II	02*
11	Determine pulse rate by manual method using radial pulse and carotid pulse. – Part I	II	02*
12	Determine pulse rate by manual method using radial pulse and carotid pulse. – Part II	II	02
13	Measure and record respiratory rate of an individual by manual method.	III	02*
14	Identify the location of the major organs of human alimentary tract by using model.	IV	02*
15	Identify the structure of kidney and nephron by using model.	IV	02
16	Identify various components of nervous system looking at the simulated human nervous system model.	VI	02
17	Identify various components of special senses looking at the simulated special senses model. – Part I	VI	02*
18	Identify various components of special senses looking at the simulated special senses model. – Part II	VI	02
Total			**36**

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 12 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	Preparation of experimental set-up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	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. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Follow ethical practices.

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
- '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	Stethoscope: Diaphragm diameter 2.0"(51cm), diaphragm material: polyurethane –coated silicon, Length 27"(69cm)	1
2	Sphygmomanometer: Measuring range 0-300mm Hg, mercury type, Accuracy 3mm Hg, Glass tube 3.5 to 4.0mm	2
3	Microscope: Eyepiece Magnification 10X, Illuminator 50W halogen & 130W mercury, Magnification range 10X to 1500X	1

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 Cell, Tissues and Skeleton System	1a. Explain with sketches the structure and function of the given cell organelle. 1b. Describe with sketches the function of the specified tissue. 1c. Explain with sketches the functions of blood and its' given components. 1d. Identify the type of joint in the specified body location with justification.	1.1 Structure and function of cell organelles 1.2 Different types of tissues and their function 1.3 Composition of blood, cellular contents, blood function, blood groups 1.4 Classification of bone, joints and muscles, function of bone, joints and skeletal muscle
Unit – II Cardiovascular System	2a. Describe with sketches the function of the specified part of the conduction system of heart. 2b. Explain with sketches the given term related to heart parameters.	2.1 Anatomy of heart, cardiac muscle and its properties 2.2 Blood vessels and circulation of blood, conduction system 2.3 Blood pressure, blood flow, cardiac

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2c. Identify the parts of the cardiovascular system with justification. 2d. Select the relevant instrument for the given application with justification.	output, heart rate and pulse rate 2.4 Diseases related to cardiovascular system 2.4 Instruments related to heart
Unit – III Respiratory System	3a. Describe with sketches the function of the given part of respiratory system. 3b. Explain with sketches the features of the specified respiratory parameter. 3c. Describe the systems of the specified disease related to the respiratory system and the instruments related to it. 3d. Select the relevant type of instrument required for the respiratory system with justification.	3.1 Anatomy of respiratory system, nose, pharynx, larynx, trachea, bronchi and lungs 3.2 Mechanism of respiration, gases exchange, respiratory parameters: lung volumes and capacities 3.3 Diseases related to respiratory system 3.4 Instruments related to respiration
Unit – IV Digestive and Excretory System	4a. Explain with sketches the function of given digestive organ. 4b. Identify the diseases and instruments related to the given body system. 4c. Identify the diseases related to the given excretory system with justification. 4d. Explain with sketches the structure of skin.	4.1 Organs of digestive system, juices secreted by various digestive organs and their functions 4.2 Diseases related digestive system 4.3 Instruments related to digestive system and urinary system 4.4 Anatomy of urinary system –kidney, ureter, urinary bladder, urethra, formation of urine & function of kidney 4.5 Diseases related to urinary system 4.6 Structure and function of skin
Unit– V Reproductive System and endocrine system	5a. Describe with sketches the function of the specified part of male/female reproductive system. 5b. Identify the hormones secreted by male/female reproductive system. 5c. Describe the function of the given type of hormone. 5d. Identify the location of the specified gland with justification. 5e. Correlate the given endocrine	5.1 Male reproductive system 5.2 Hormones secreted by male reproductive system and their functions 5.3 Female reproductive system 5.4 Hormones secreted by female reproductive system and their functions 5.5 Structure, position and function of endocrine glands

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	gland with the hormones in human body.	
Unit-VI Nervous System and special senses	6a. Describe with sketches the function of the given part of the nervous system along with labelled sketch. 6b. Identify the diseases and instruments related to the given body system. 6c. Describe with sketches the mechanism of a human being. 6d. Identify the specified part of eye along with its function	6.1 Origin neurons, central nervous system (CNS), brain, spinal cord, peripheral nervous system (PNS), autonomic nervous system (ANS) 6.2 Diseases related to nervous system, instruments related to nervous system 6.3 Anatomy of ear and its function, hearing mechanism 6.4 Anatomy of eye and its function, image formation

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Cell, Tissues and Skeleton System	11	04	02	04	10
II	Cardiovascular System	10	02	04	04	10
III	Respiratory System	10	02	04	04	10
IV	Digestive and Excretory System	12	02	08	04	14
V	Reproductive System and Endocrine System	08	04	02	04	10
VI	Nervous System and Special Senses	13	02	08	06	16
Total		**64**	**16**	**28**	**26**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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 a presentation on functions of Cell/tissues/blood/kidney.
b. Prepare a chart of organ system of human body.
c. Collect information of instruments related to human body.

d. Collect the videos or animation to give presentation of given human system.
e. Visit a genetic lab and prepare a report.

11. 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. Demonstrate students thoroughly before they start doing the practice.
f. Encourage students to refer different websites to have deeper understanding of the course.
g. Use flash/animations to explain the structure and function of human body organs.
h. Guide students to develop interesting micro projects.

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. Prepare a model of circulatory system.
b. Prepare a chart to demonstrate respiratory system.
c. Prepare a model of digestive/ urinary system.
d. Prepare a brief report to analyse the effect of endocrine glands on human body.
e. Prepare a report on market survey of medical instruments, with respect to aspects like manufacturing company, advancements, cost, technical specification and applications.
f. Prepare a report containing details on heart.
g. Prepare a report on vitamins and classification with its importance.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Ross and Wilson Anatomy and Physiology in Health and Illness	Waugh Anne; Grant Allison	Churchil Livingstone Elsevier, U.K, 12th Edition, 2014, ISBN:978-0702032288
2	Essentials of Human Anatomy and Physiology	Marieb Elaine N.	Pearson International Edition, 11th Edition, 2014, ISBN:0321919009
3	Biology	Campbell Neil; Reece Jane	Pearson Education, 7th Edition, ISBN: 978-8131724095
4	Human Anatomy and Physiology and Health Education	Jayaveera K.N.; Vrushabendra Swamy B.M.	S. Chand, 1st Edition, 2010 ISBN: 978-8121933575

14. SUGGESTED SOFTWARE AND LEARNING WEBSITES

a. www.innerbody.com
b. www.getbodysmart.com
c. www.visiblebody.com
d. www.argosymedical.com

Program Name : **Diploma in Medical Electronics**

Program Code : **MU**

Semester : **Third**

Course Title : **Biosensors**

Course Code : **22348**

1. RATIONALE

Human body generates different physiological signals. These signals are further electronically processed for diagnosis, monitoring or therapeutic patient management. This course deals with the acquisition of bio-signals from human body using various transducers/ sensors and processing of these signals. Biosensor is the pre-requisite for all the courses related to patient's management in the respect of diagnosis, monitoring and therapy.

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 relevant transducers to measure bio-signals.**

3. COURSE OUTCOMES (COs)

The theory, 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. Identify sensors and transducers for different medical applications.
b. Use displacement and pressure transducers for biomedical applications.
c. Use temperature, optical and radiation transducers for biomedical applications.
d. Select flow and electrochemical transducers for different biomedical applications.
e. Use bio- potential electrodes for medical applications.

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
3	2	2	7	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA; Out of 30 marks, 10 marks of theory PA is for micro-project assessment to facilitate attainment of COs and the remaining 20 marks is for tests and assignments given by the teacher.

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.

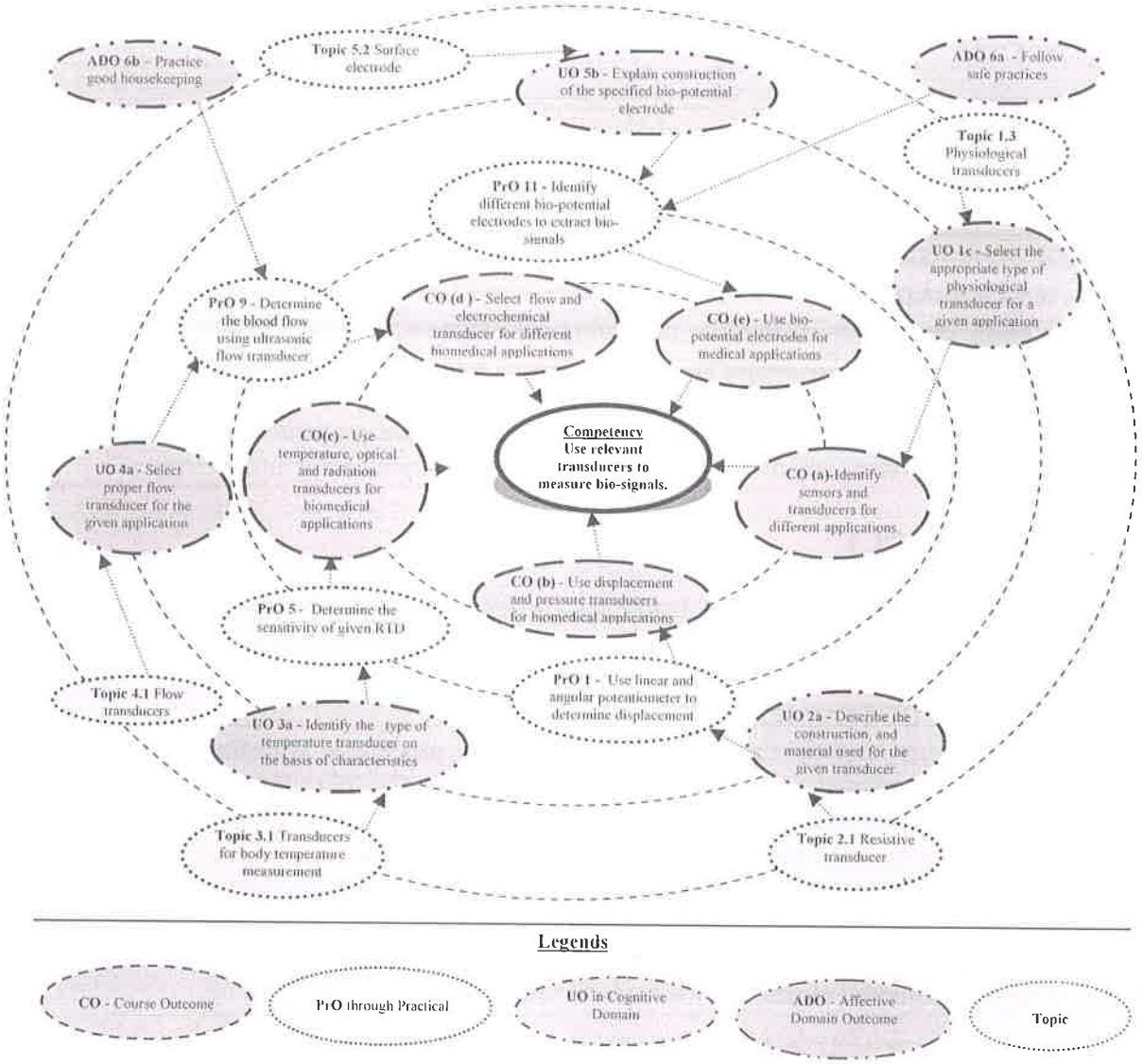

Figure 1 - Course Map

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 Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Use linear and angular potentiometer to determine displacement. - Part I	II	02*
2	Use linear and angular potentiometer to determine displacement. - Part II	II	02
3	Use given LVDT to determine linear displacement.	II	02
4	Use strain gauge to determine the weight of unknown object.	II	02*
5	Use strain gauge to determine the weight of unknown object. - Part II	II	02
6	Measure the pressure by using Burdon tube.	II	02
7	Measure the pressure by using Bellows.	II	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
8	Measure the pressure by using piezoelectric transducer.	II	02*
9	Identify the type of thermister and determine its' sensitivity.	III	02*
10	Determine the sensitivity of given RTD.	III	02
11	Identify the type of thermocouple and determine its sensitivity. - Part I	III	02
12	Identify the type of thermocouple and determine its sensitivity. - Part II	III	02
13	Calibrate the given PH electrode and measure the pH level of the given solution. - Part I	IV	02*
14	Calibrate the given PH electrode and measure the pH level of the given solution. - Part II	IV	02
15	Measure blood glucose level by using glucometer.	IV	02*
16	Determine the blood flow using ultrasonic flow transducer. - Part I	IV	02
17	Determine the blood flow using ultrasonic flow transducer. - Part II	IV	02
18	Identify and connect the different types of bio-potential electrode to extract the bio-signals and suggest application area. - Part I	V	02*
19	Identify and connect the different types of bio-potential electrode to extract the bio-signals and suggest application area. - Part II	V	02
Total			**38**

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 12 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	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	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. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.

e. Follow ethical practices.

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
- 'Organizing Level' in 2nd year
- 'Characterizing 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	Digital multimeter : 3 1/2 digit display, 9999 counts digital millimeter measures: V_{ac}, V_{dc} (1000V max), A_{dc}, A_{ac} (10 amp max) , Hz , Resistance (0 - 100 MΩ) , capacitance and temperature	1, 2, 3, 4, 5, 6,11
2	Linear and angular potentiometer set-up: Linear Rheostat from 25 Ω to 50 Ω; Angular Potentiometer of different values from 10K Ω to 100K Ω	1
3	LVDT set- up trainer kit consists of industrial grade: LVDT of +/- 20 mm with instrumentation, Micrometer with resolution of 0.1 mm, Digital indicator in terms of voltage, Built in Excitation signal, DC regulated power supply, facility to vary excitation frequency and amplitude	2
4	Strain gauge set-up, trainer kit consisting of Wheatstone bridge, cantilever type loading arrangement on which strain gauges are mounted, weights up to 2Kg, DC amplifier, digital indicator in terms of grams, facility to select quarter and half bridge mode, inbuilt DC regulated power supply	3
5	Temperature measurement set- up trainer kit suitable to measure the temperature using K type Cr-Al Thermocouple housed in S.S. type industrial housing, heater which can go up to 200 deg C with facility to vary heater power, 3 1/2 digit digital indicator of temperature, in built DC regulated power supply etc.	6
6	Trainer kit suitable to measure the temperature using thermister set up should be provided with Heater which can go up to 200 deg C with facility to vary heater power, constant current source with amplifier, 3 ½ digit digital indicator of temperature, In built DC regulated power supply etc.	4
7	Trainer kit suitable to measure the temperature using PT 100 type R.T.D. housed in S.S. type industrial housing. Set up should be provided with Heater which can go up to 200 deg C with facility to vary heater power, constant current source with amplifier, 3½ digit digital indicator of temperature, In built DC regulated power supply	5
8	pH meter: pH electrode with at least three different buffer solutions	7
9	Glucose-meter : Digital type, high data storage around 400 measurements , sample volume 1.2 µL, Time to glucose result 5 s, connectivity, Battery	8

S. No.	Equipment Name with Broad Specifications	Pro. S. No.
	specification..3V lithium button battery	
10	Ultrasonic flow transducer: 1MHz /5 MHz ultrasonic sensor	9
11	Pressure measurement set- up : 1 MHz piezoelectric crystal with measuring accessories, Bourdon tube pressure measurement setup Bellows pressure measurement setup	10
12	Different biomedical electrodes	11

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 Medical Instrumentation System and Introduction to Physiological Transducers	1a. Identify the use of a given physiological biomedical signal with justification. 1b. Explain with sketches the function of specified component of Man Instrumentation System. 1c. Select the appropriate type of physiological transducer for a given application with justification. 1d. Identify the type of the specified transducer on the basis of the given performance characteristics with justification.	1.1 Overview of physiological biomedical signals 1.2 Block diagram and specifications of Man Instrumentation System (MIS), General constraints in design of MIS 1.3 Physiological transducers, classification of transducers: active and passive transducers, primary and secondary transducers based on process used, based on physical or chemical principle used, based on applications, Performance characteristics of transducers, static characteristics, dynamic characteristics
Unit– II Displacement and Pressure Transducers	2a. Describe with sketches the construction, and material used for the given type of transducer. 2b. Explain with sketches the working principle of the specified transducer. 2c. Identify the type of the specified displacement/ pressure transducers on the basis of the characteristics with justification. 2d. Select relevant displacement/ pressure transducer for the given application with justification. 2e. Calculate different parameters	2.1 Resistive transducer - Linear and angular potentiometers, bonded and unbounded strain gauge 2.2 Inductive transducers- Linear Variable Differential Transformer (LVDT) 2.3 Capacitive transducers, Piezoelectric transducers 2.4 Pressure transducers Diaphragm - Flat, corrugated, capsule, Bellows, Bourdon tube - C shape, spiral, helical, Twisted

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	on the basis of formulae for the given transducers.	
Unit– III Temperature, Optical and Radiation Transducers	3a. Identify the type of temperature transducer on the basis of the characteristics with justification. 3b. Explain with sketches construction and material used for the given temperature transducers. 3c. Identify the type of optical transducers on the basis of the characteristics with justification. 3d. Select relevant radiation transducer for the given application with justification.	3.1 Transducers for body temperature measurement : Thermistor, thermocouple, RTD 3.2 Optical transducers: Fiber optic sensors, photomultiplier tube 3.3 Radiation thermometry
Unit-IV Flow and Electro Chemical Transducers	4a. Select proper flow transducer for the given application with justification. 4b. Identify the type of chemical transducer with justification. 4c. Describe with sketches the construction along with its principle of operation of the specified flow transducer. 4d. Explain with sketches the operating principle of the given electrochemical transducer along with sketches. 4e. Select the relevant electrochemical transducer for the given application with justification.	4.1 Flow transducers: Plethysmography, ultrasonic flow transducers, electromagnetic transducers, flow measurement by indicator dilution, flow measurement by thermal convection 4.2 Chemical transducers: Reference electrode, pH electrode, PO_2 electrode, PCO_2 electrode, blood glucose sensor
Unit –V Bio-potential electrodes and advanced biosensors	5a. Compare polarizable and non-polarizable electrodes using concept of electrode electrolyte interference. 5b. Explain with sketches the construction of the specified bio-potential electrode. 5c. Identify electrodes for the given biomedical operation with justification. 5d. Explain with sketches the concept of carbon	5.1 Electrode electrolyte interference, polarizable and non-polarizable electrodes, electrode and skin interface, motion artifact, classification of electrodes 5.2 Surface electrodes: Metal plate electrode, metal disc disposable, suction electrode, floating electrodes, flexible electrode 5.3 Internal electrode-Needle electrodes, wire electrodes 5.4 Micro electrodes: Metal

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Nanotube as a biosensor with reference to the specified application. 5e. Describe with sketches the given application for the given Bio-MEMS.	microelectrodes, supported microelectrodes, micropipette 5.5 Advanced biosensor: Carbon nanotube biosensor, fiber optic biosensor, wireless biosensor network, Bio MEMS-Biomedical Micro Electro Mechanical Systems.

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

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Medical Instrumentation System and Introduction to Physiological Transducers	08	02	04	04	10
II	Displacement and Pressure Transducers	10	04	04	06	14
III	Temperature, Optical and Radiation Transducers	10	02	08	08	18
IV	Flow and Electro Chemical Transducers	10	02	08	08	18
V	Bio Potential Electrodes and advanced biosensors	10	02	04	04	10
Total		**48**	**12**	**28**	**30**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

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 chart of different electronic transducer based on their construction, working, specifications and application.
b. Collect and understand datasheets of different types of transducers.
c. Give seminar on any relevant topic to this course.
e. Prepare display chart of different types of advance biosensors.
d. Prepare power point presentation animation for showing different types transducers.

e. Develop a report after undertaking a market survey of different transducers and electrodes on the following points.
   i. Construction
   ii. Properties
   iii. Applications

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. Use Flash/Animations to explain the construction and working of different transducers.

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. Build a bridge circuit using RTD and measure the output by varying the temperature.
b. Build a bridge circuit using thermister and measure the output by varying the temperature.
c. Build a simple application based on load cell.
d. Design digital thermometer to measure body temperature.
e. Design and construct LVDT for displacement measurement.
f. Market survey of different types of biomedical electrodes and prepare a report.
g. Prepare report on applications of different biosensors by visiting hospital/diagnostic center/pathology lab.

h. Make a display using available pressure measuring transducers from different sources and prepare a report.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Medical Instrumentation Application and Design	Webster John G.	Wiley India, Fourth Edition, ISBN 13 : 978-81265553792
2	A Handbook of Biomedical Instrumentation	Khandpur R.S.	Mc Graw Hill Education, Third Edition, ISBN: 978-9339205430
3	Biomedical Instrumentation and Measurements	Cromwell Leslie, Weibell Fred J., Pfeiffer Erich A.	PHI learning Pvt. Ltd. Second Edition; ISBN 13: 978-0130764485
4	Biomedical Instrumentation and Measurements	Ananadnatarajan R.	PHI learning Pvt. Ltd. ISBN 13: 978-8120342279

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. www.transducersdirect.com/DSLibrary.asp
b. www.multitrode.com/assets/datasheets/mtpt-pressure-transducer-datasheet.pdf
c. www.d-flow.com/sites/default/files/media/transducer_data_sheet.pdf
d. www.journals.elsevier.com/biosensors-and-bioelectronics
e. www.medcraveonline.com/IJBSBE/
f. www.Bio-MEMS/Wikipedia.html

Program Name : **Diploma in Medical Electronics**

Program Code : **MU**

Semester : **Third**

Course Title : **Computer Hardware and Networking**

Course Code : **22029**

1. RATIONALE

Medical electronics diploma engineers have to deal with computers and with current trends of development in medical electronics field, this is only going to increase. Skills to use and maintain computers especially with reference to its various areas of applications such as networking, networking components and various peripherals are essential. Emphasis on practical approach while undergoing this course will help in diagnosing and troubleshooting computer along with peripheral related problems in medical electronics domain. The course will help the students understand various protocols required to set up and configure the basic network as well as troubleshoot connectivity problems.

2. COMPETENCY

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

- **Maintain computer hardware and networking devices.**

3. COURSE OUTCOMES (COs)

The theory, 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. Assemble/Disassemble a computer.
b. Perform hard disk management operations.
c. Maintain computer peripherals.
d. Maintain the computer networks in laboratory environment.
e. Troubleshoot computer networks.

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
1	-	2	3	--	--	--	--	--	--	--	25@	10	25~	10	50	20

*(#): No theory Exam; (~): 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. 15 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e. 10 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.

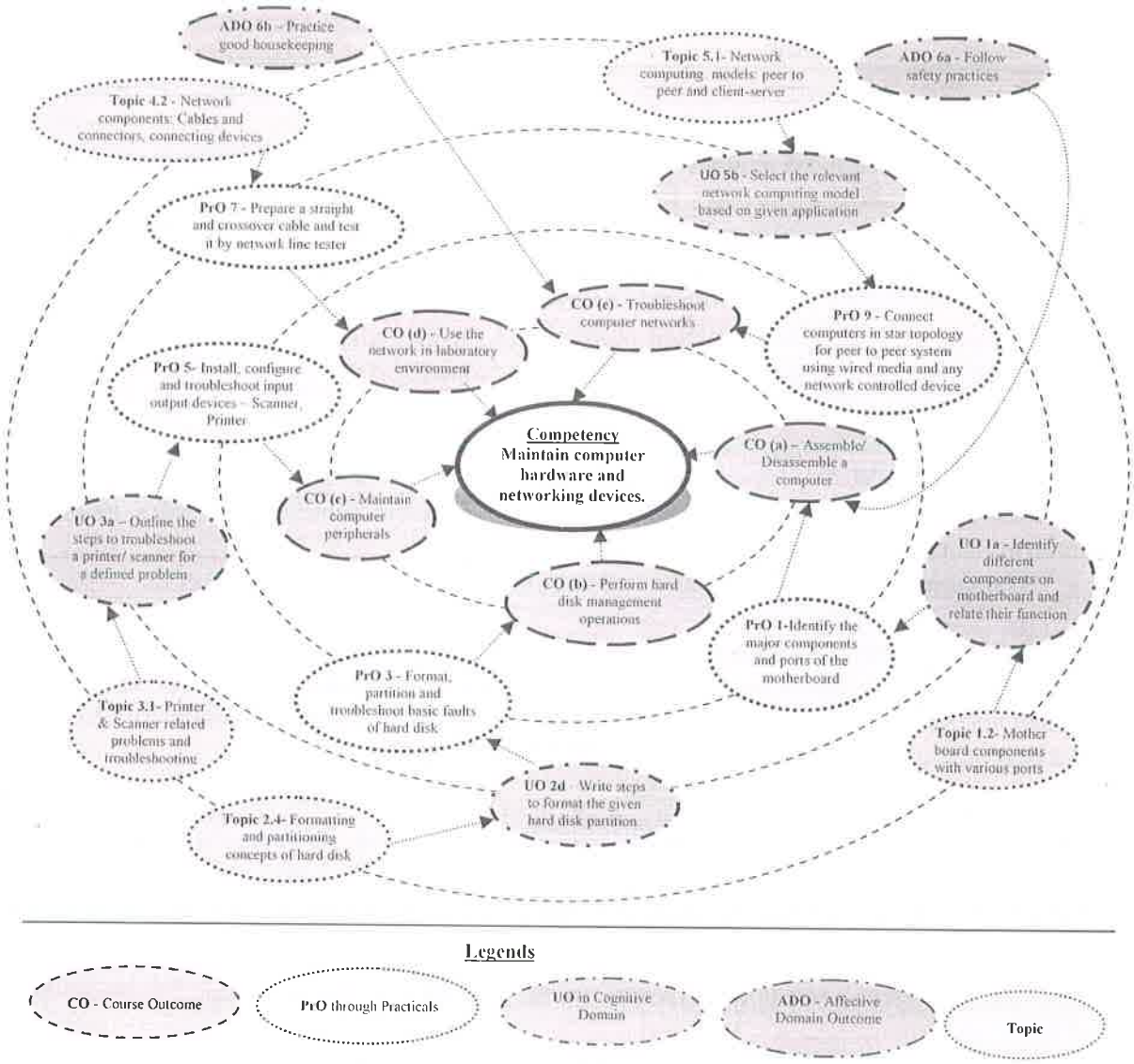

Figure 1 - Course Map

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 Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Identify the major components and ports of the motherboard.	I	02*
2	Dismantle a computer system.	I	02*
3	Configure various BIOS settings.	I	02
4	Format, partition and troubleshoot basic faults of hard disk. – Part I	II	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
5	Format, partition and troubleshoot basic faults of hard disk. – Part I	II	02
6	Install, configure and troubleshoot input output devices – Scanner, Printer.	III	02*
7	Install, configure and troubleshoot input output devices – Scanner, Printer.	III	02
8	Backup and restore files and settings using backup utility.	III	02
9	Identify various networking cables.	IV	02*
10	Prepare a straight and crossover cable and test it by network line tester.	IV	02*
11	Configure IP related properties.	V	02*
12	Configure IP related properties.	V	02
13	Connect computers in star topology for peer to peer system using wired media and any network controlled device.	V	02*
14	Connect computers in star topology for peer to peer system using wired media and any network controlled device.	V	02
15	Share printer and folder in network.	IV	02
16	Troubleshoot the network using basic TCP/IP network commands and utility software.	V	02*
17	Troubleshoot the network using basic TCP/IP network commands and utility software.	V	02
18	Form a Piconet using Bluetooth devices and transfer data.	V	02
	Total		**36**

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 12 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	Ability to perform practical using appropriate tools	30
2	Complete the practical in stipulated time	30
3	Quality of output achieved	10
4	Answer to oral questions	20
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. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Ensure tools are in proper working conditions.

e. Follow ethical practices.

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
- '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	Exp. No.
1	Motherboard of a Desktop Computer	1
2	Desktop Computer (Intel core i3/ i7/ RAM 16 GB/ HDD)	All except 1,6,7,12
3	Crimping tool, Cables –UTP, Connectors –RJ45, Network Line tester	7,9
4	Scanner –A4 size	4
5	Printer – LaserJet 30 ppm, 16 MB RAM, 1200 dpi or equivalent	4
6	Ethernet Hub/Switch - 8/16/24 port	9
7	Bluetooth enabled devices like laptop, mobile.	12

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 Motherboard and major components	1a. Identify the given component on motherboard and relate its function. 1b. Describe with sketches the construction of specified peripheral. 1c. Illustrate with sketches the working of specified peripheral with its connection to computer. 1d. Describe with sketches the configuration of BIOS setting for the given functionality aspect.	1.1 Computer system and its peripherals 1.2 Mother board components with various ports 1.3 Motherboard configuration and assembling a computer 1.4 BIOS basics
Unit– II Storage Devices	2a. Describe with sketches the construction and working of specified type of hard disk. 2b. Write steps to connect the given type of hard disk to a computer.	2.1 Concept and use of cache memory 2.2 Construction, working of hard disk 2.3 Types of hard disks – SATA,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2c. Write steps to partition a hard disk as per given specification. 2d. Write steps to format the given hard disk partition.	PATA, USB and their connection to computer 2.4 Formatting, Partitioning concepts of hard disk
Unit– III Troubleshooting and Maintenance	3a. Describe with sketches the steps to troubleshoot a printer/scanner for a defined problem. 3b. Write steps to perform a specified maintenance procedure of PC. 3c. Write major steps to perform the maintenance of specified peripheral device used in medical application. 3d. Write steps to create a specified type of backup/restoration of files.	3.1 Printer & Scanner related problems and Troubleshooting 3.2 PC and peripheral maintenance, active maintenance, passive maintenance 3.3 Backup utility – Types of backups and their application: full, incremental, differential backups,concept of driver
Unit-IV Basic Network Concepts	4a. Describe the steps to perform sharing of a specified resource in a network. 4b. Describe with sketches the salient features of a given type of network cable. 4c. Describe with sketches the salient features of given network connecting device. 4d. Explain with sketches the characteristics of given network topology.	4.1 Objective of networking: Managing resources- printer share and folder, device share 4.2 Network components: Cables and connectors, connecting devices 4.3 Network topology-Star, Bus, Ring, Mesh
Unit-V Networking Devices and Reference Models	5a. Describe with sketches the procedure to configure IP address of computer/network device as per the required type of IP protocol. 5b. Select the relevant network computing model based on given application with justication. 5c. Outline the steps for creating blue tooth connection for data transfer between two devices. 5d. Outline the troubleshooting steps for a given network problem. 5e. Write steps to perform given type of security settings using firewall	5.1 TCP/IP fundamentals, TCP/IP addressing – IP addresses, IPv4, IPv6 5.2 Network computing models: peer to peer and client-server 5.3 Ethernet(IEEE 802.3),Wireless(802.11) 5.4 Ad-hoc network using Blue tooth 5.5 Troubleshooting and maintaining the network – using TCP/IP commands 5.6 Network Security: Firewalls and proxies

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

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. Identify the different beep codes generated while assembling and troubleshooting.
b. Collect information about various probes used in medical field and its interfaces.
c. Collect specification of the latest computer and its advanced features.
d. Prepare a network diagram of your laboratory and list its specifications & features.
e. Collect Information regarding the IP addressing and sub-netting in the laboratory.
f. Prepare a presentation showing the concept of cache memory and its types.

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. Guide the students in undertaking micro-projects.
b. Arrange video sessions to demonstrate the various procedures for maintenance and troubleshooting computers and networks.
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. Arrange group discussion of students on use of networking in medical field.
e. Guide the students to prepare and present the micro-project through PPT. They should also submit a report which is limited to 4-5 pages.
f. Take quiz/MCQ on various topics.
g. MOOCs (Massive Open Online Courses) may be used to teach various topics and sub-topics.

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. Assemble a computer using given components.
b. Partition and format the hard disk into logical drives as C:, D:, E:, in the percentage of 40%, 40% and 20%. Install operating system, Antivirus software, update and report a summary.
c. Select a computerized system in your institute such as admission system, payroll system, student record keeping or any other. Develop a backup plan. Create following type of backup of the selected system:
    i. Daily Backup at specified time
    ii. Incremental backup
    iii. Differential backup
d. Configure and use VoIP to communicate with people at different location.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Upgrading and Repairing PCs	Mueller, Scott	Pearson Education, Inc. U.S., 2011, ISBN: 978-0789747105
2	The Complete PC Upgrade and Maintenance Guide	Minasi, Mark	Willey Publication, U.S. , 2005, ISBN: 978-8126506279
3	Managing and Troubleshooting Networks	Meyers, Mike	Tata McGraw Hill Education Private Limited, New Delhi, 2009, ISBN: 978-0070677272
4	Data Communications and Networks	Godbole, Achyut; Kahate, Atul	McGraw Hill Education, New Delhi, 2011, ISBN: 978-0071077705

14. SUGGESTED SOFTWARE/ LEARNING WEBSITES

a. www.tutorialspoint.com/computer_fundamentals/computer_hardware.htm
b. www.techiwarehouse.com/engine/3b8fc18b/Basics-of-Computer-Hardware-Maintenance
c. www.bleepingcomputer.com/tutorials/hardware
d. www.windowsnetworking.com/articles-tutorials