

Program Name : Diploma in Medical Electronics
Program Code : MU
Semester : Fifth
Course Title : Therapeutic Equipment
Course Code : 22546

1. RATIONALE

Therapeutic equipment is heart of physiotherapy department that are used not only in the hospitals, but also exclusively used in cosmetics, dermatology, and injuries occurred in sports. This therapy equipment are based on high frequency stimulations, heat radiations, ultrasound and laser. This course will aid the students to apply the knowledge to maintain the therapy equipment after graduation as biomedical engineers while serving in hospitals and industries.

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 the physiotherapy equipment.**

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:

- Interpret the specifications of physiotherapy equipment.
- Maintain ultrasound and diathermy machines.
- Maintain electrotherapy and cold therapy technique for pain relief.
- Use the different electrodes used in surgical unit.
- Follow general safety aspects and equipment safety in hospital environment.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				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 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 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.



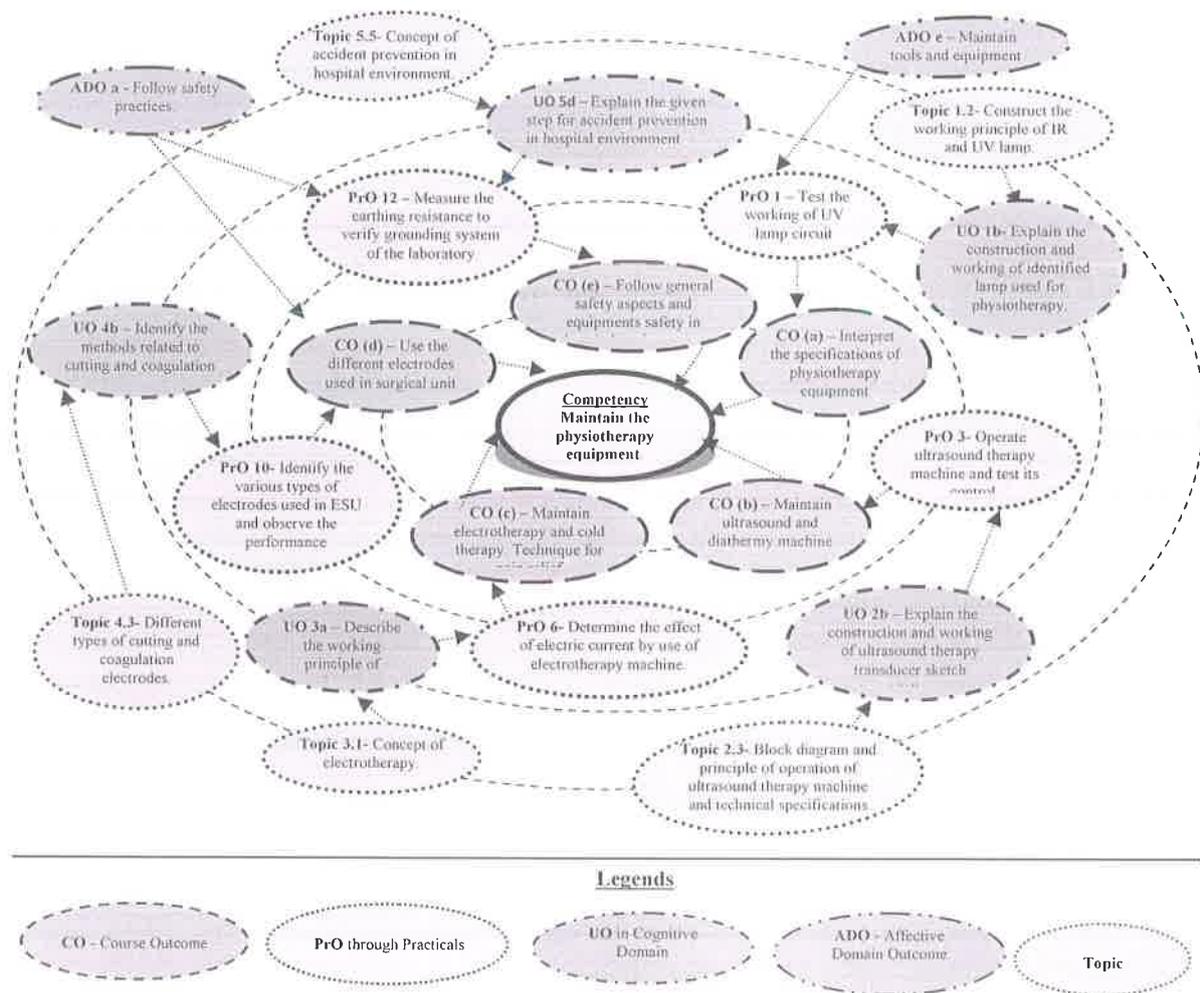


Figure 1 - Course Map

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	Test the working principle of UV lamp circuit.	I	02*
2	Test the working principle of IR lamp circuit.	I	02*
3	Operate ultrasound therapy machine and test its control.	II	02
4	Test the performance of short wave diathermy machine and various controls.	II	02
5	Use the capacitive and inductive method as application techniques of short wave diathermy.	II	02
6	Determine the effect of electric current by use of electrotherapy machine.	III	02
7	Draw the different types of waveforms of nerve- muscle stimulator using CRO.	III	02
8	Draw the different types of waveforms of nerve- muscle stimulator using analyzer.	III	02
9	Use different cold therapy techniques.	III	02*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
10	Identify the various types of electrodes used in electrosurgical unit and observe the performance.	IV	02
11	Operate the ESU machine in different modes of ESU and observe its waveforms.	IV	02*
12	Measure the earthing resistance to verify grounding system of the laboratory.	V	02
Total			24

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. Practice energy conservation.
- d. Work as a leader/a team member.
- 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. No.
1	IR Lamp: power 200W, Voltage 110 or 220-230V, Frequency 50/60Hz, Cord-length 200cm	1
2	UV Lamp: Curing Width 50-1700mm, Lamp Housing: 300-1998mm, UV pulsing power: Up to 240W/cm, power of 15 W, wavelength of UV A spectrum (365 nm), length of 436 mm – Vilber or a corresponding one	1
3	Ultrasound Therapy machine: Frequency 1MHz and 3MHz, Therapy modes Continuous/Pulsed, Pulse Settings/Hz 9 settings/100 Hz, Output power -0-3W/cm ² , Timer-0-60mins	2
4	Nerve Muscle Stimulator: 4 Channel, 8 Electrodes; Modes: Continuous, Burst. Ramp. Wide Low Freq, Narrow Low Freq. Auto All; Pulse width: 50 - 350 μ S, (10 μ S/step); Pulse rate: 1 - 200 Hz; Contraction Time: 6 sec, 9 sec. Relaxation Time: 2 sec., 3 sec., 4 sec; Waveform: Symmetrical biphasic square pulse; Timer: 1 - 60 min. (1 min. / step)	3
5	Electrosurgical machine: Pure cut: 400W a 500 ohms Blend I : 230W at 300 ohms Blend II : 180W AT 300 ohms Blend III : 120W at 300 ohms Two Modes of Monopolar Coagulation Contact coagulation: 100 W at 300 ohms Spray coagulation: 80W at 500 ohms	4

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 Physiotherapy	1a. Explain the specified therapeutic effect of IR and UV radiations. 1b. Explain with sketches the construction and working of identified lamp used for physiotherapy. 1c. Describe with sketches the principle of given type of Laser used in biomedical field. 1d. Compare the feasibility of use of traction and CPM with reference to given application. 1e. Explain with sketches the use of given type of CPM.	1.1 Concept of IR and UV radiation and effects on human body 1.2 Construct the working principle of IR and UV lamp 1.3 Introduction of Laser used in biomedical field 1.4 Types of Laser as Pulsed ruby, Nd-YAG, He-Ne 1.5 Block diagram and principle of traction and continuous passive movement (CPM) 1.6 Types of CPM as knee and shoulder
Unit- II Ultrasound Therapy and Diathermy	2a. Describe with sketches the given ultrasound imaging technique used for visualization. 2b. Explain with sketches the construction and working of given type of transducer with sketch. 2c. Explain the specified	2.1 Concept of Ultrasound 2.2 Principle of ultrasound therapy transducer 2.3 Block diagram and principle of operation of ultrasound therapy machine and technical specifications 2.4 Concept of diathermy and effects on human body 2.5 Type of diathermy as a Shortwave

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	application techniques of diathermy. 2d. Differentiate between ultrasound and shortwave diathermy with respect to given aspects. 2e. List the technical specifications of the given equipment used for ultrasound therapy /SWD.	diathermy(SWD) 2.6 Application techniques of SWD as capacitive and inductive field 2.7 Block diagram and principle of operation of SWD and technical specifications 2.8 Installation and maintenance of diathermy equipment
Unit-III Electrotherapy and Cold therapy	3a. Describe with sketches the working principle of specified therapy technique. 3b. Explain with sketches the working of the given stimulator. 3c. List the technical specification of the given stimulator. 3d. Explain the specified cold therapy physiological effect. 3e. Differentiate between electrotherapy and cold therapy with respect to given aspect.	3.1 Concept of Electrotherapy 3.2 Effects of Electric current on nerve and muscles of human body 3.3 Block diagram and principle of operation of nerve and muscle stimulator 3.4 Technical specification and application technique of nerve and muscle stimulator 3.5 Concept of cold therapy 3.6 Physiological effects of cold therapy on human body and their uses 3.7 Contra-indications of cold therapy on human body
Unit –IV Electrosurgical Unit	4a. Explain with sketches the electro-surgery and the specified mode. 4b. Identify the methods related to cutting and coagulation. 4c. Explain with sketches the given solid-state cautery machine. 4d. Describe the safety precautions while handling ESU. 4e. List the technical specifications of specified electro-surgical machine.	4.1 Effect of electric current on human tissue 4.2 Concept of electro-surgery and modes as a uni-polar and bipolar 4.3 Different types of cutting and coagulation electrodes 4.4 Methods of cutting and coagulation 4.5 Block diagram, principle of operation and technical specifications of solid-state cautery machine 4.6 Patient safety in cautery machine 4.7 Maintenance of electrosurgical unit(ESU)
Unit-V Safety Instrumentation	5a. Describe the specified effect of electric shock on human body. 5b. Explain the specified electric hazard in hospital environment. 5c. Describe the specified step for testing the grounding system. 5d. Explain the given step for accident prevention in hospital environment.	5.1 Physiological effects of electric shock as a micro and macro on human body 5.2 Electric hazard in hospital environment and leakage current through equipment 5.3 Testing of proper grounding system in patient care area in hospitals 5.4 Concept of electro static discharge(ESD) 5.5 Concept of accident prevention in hospital environment

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	Physiotherapy	10	04	05	07	16
II	Ultrasound Therapy and Diathermy	10	04	05	07	16
III	Electrotherapy and Cold Therapy	08	03	03	06	12
IV	Electrosurgical Unit	10	04	04	08	16
V	Safety Instrumentation	10	03	03	04	10
Total		48	18	20	32	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) Identify the various types of electrodes use in electrosurgical unit and develop a chart.
- b) Visit a nearby hospital and prepare the report on following basis;
 - i) Location of the physiotherapy department and equipment.
 - ii) Problems frequently encountered in therapeutic equipment.
 - iii) Name of the equipment, manufacturer, cost, technical specifications of equipment.
- c) Prepare a troubleshooting chart of diathermy machine.
- d) Prepare a presentation of ultrasound therapy with its new trends and technologies.
- e) Prepare the chart of different transducer and electrodes in therapy machines.
- f) Prepare the chart for different electrodes related to Electro-surgical unit.
- g) Prepare a presentation on accident prevention.
- h) Use different method of accident preventions.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

- a) Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- b) '*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) Correlate subtopics with power system utility and electrical equipments.
- g) Use proper equivalent analogy to explain different concepts.
- h) Use Flash/Animations to explain various theorems in circuit analysis.
- i) Use open source PSpice/Matlab models to explain different concepts of electric circuit.
- j) Use the tutorial time period for micro projects, students suggested activities.

12. SUGGESTED MICRO-PROJECTS

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

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

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

- a) Design a circuit for IR Lamp and test it, and visit to the nearest hospital and compare the safety parameters which are use by them.
- b) Design a circuit for UV lamp and test it, and visit to the nearest hospital and compare the safety parameters which are use by them.
- c) Design the nerve - muscle stimulator circuit.
- d) Test for proper earthing/grounding in labs and prepare a report of it.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Handbook of Biomedical Instrumentation	Khandpur, R.S.	Tata McGraw-Hill publishing company Ltd, New Delhi, Third Edition, ISBN: 9789339205430
2	Clayton's Electrotherapy	Nigel , Angela Forster	Bailliere Tindall , London ,Eighth Edition, ISBN: 9780702009020
3	Biomedical Instrumentation and Measurement	Anandnatrajan, R.	Prentice Hall of India pvt. Ltd, ISBN: 9788120352155

14. SOFTWARE/LEARNING WEBSITES

- a) <https://www.healthline.com/health/diathermy#risks5>
- b) <http://www.sportsinjuryclinic.net/treatments-therapies/electrotherapy/ultrasound-therapy>
- c) <http://physioworks.com.au/>



