

Program Name : Diploma in Medical Electronics
Program Code : MU
Semester : Fifth
Course Title : Rehabilitation Engineering
Course Code : 22545

1. RATIONALE

Rehabilitation engineering involves the design and development of innovative technologies and techniques that can help disabled persons to regain physical or cognitive functions so that they are integrated into society. This course primarily consists of basics, applications of rehabilitation engineering, orthotics and prosthetics aids. This course will help to develop the skills related with rehabilitating persons with disabilities.

2. COMPETENCY

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

- Apply Rehabilitation engineering techniques for various disabilities.

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:

- Select the relevant rehabilitation concepts for various disabilities.
- Interpret the Gait cycle.
- Develop orthotics and prosthetics.
- Select mobility aids for various disabilities.
- Apply advanced applications of rehabilitation engineering.

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	-	5	3	70	28	30*	00	100	40	--	--	--	--	--	--

(*): 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.

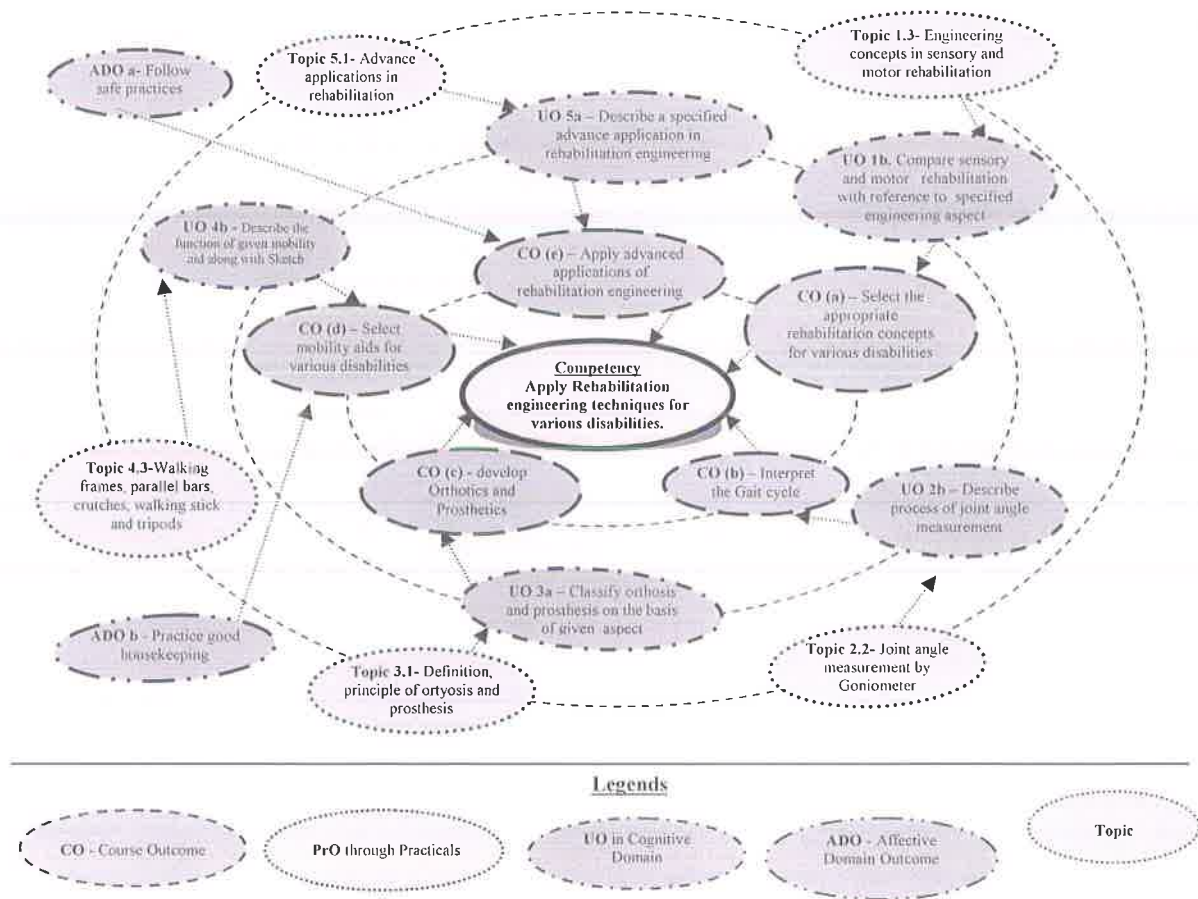


Figure 1 - Course Map

6. 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 Rehabilitation	1a. Explain the given concept of rehabilitation. 1b. Compare sensory and motor rehabilitation with reference to specified engineering aspect. 1c. Describe functions of identified rehabilitation team member. 1d. List different approaches for delivering the specified rehabilitation care.	1.1 Fundamentals of rehabilitation 1.2 Concepts and goals of rehabilitation 1.3 Engineering concepts in sensory and motor rehabilitation 1.4 Rehabilitation team 1.5 Delivery of rehabilitation care
Unit– II Gait analysis	2a. Interpret the given Gait cycle. 2b. Describe with sketches process of the specified joint angle measurement. 2c. Describe function of given Gait measurement device.	2.1 Gait cycle, anatomical lever system, 2.2 Joint angle measurement by Goniometer 2.3 Measurement devices-foot switches, walkway



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	2d. Describe with sketches specified technique for motion analysis.	2.4 Motion analysis-Interrupted light photography, film/video, selspot
Unit-III Orthotics and prosthetics	3a. Classify orthosis and prosthesis on the basis of given aspect. 3b. Describe with sketches the specified contraindication of orthosis. 3c. Explain with sketches the given type of orthosis and prosthesis. 3d. Describe the role of given component of prosthesis. 3e. Describe with sketch the specified application aid of orthosis/ prosthesis.	3.1 principle of orthosis and prosthesis, Orthosis classification on the basis of function and anatomical area 3.2 Contraindications of orthosis 3.3 Lower limb orthosis (Hip-Knee ankle foot), Upper limb orthosis (Thoraco lumbar sacral, cervical) 3.4 Concept of Functional Electrical Stimulation 3.5 Prosthesis-Definition and classifications based on construction design , materials and power system used 3.6 Basic Components of Prosthesis 3.7 Lower prosthesis (knee joint, Jaipur foot), Upper prosthesis (Myoelectric prosthesis)
Unit –IV Mobility aids	4a. Explain the concept and criteria for selection of a specified mobility aid. 4b. Describe with sketches the function of given mobility aid along with sketch. 4c. Describe with sketches the functions of given part of wheelchair. 4d. Describe the maintenance steps of the specified mobility aid.	4.1 Concept of mobility aids and functions 4.2 Wheel chair's parts and their functioning, powered wheel chair 4.3 Walking frames, parallel bars, crutches, walking stick and tripods
Unit-V Advance applications of rehabilitati ons	5a. Describe with sketches the specified advance application in rehabilitation engineering. 5b. Describe with sketches an intelligent prosthetic knee. 5c. Explain with sketches prosthetic hand. 5d. Describe with sketches self alighting orthotic knee joint	5.1 Advance applications in rehabilitation engineering 5.2 Intelligent prosthetic knee 5.3 Hierarchically controlled prosthetic hand 5.4 Self alighting orthotic knee joint

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



Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Rehabilitation	07	02	04	04	10
II	Gait Analysis	10	04	06	06	16
III	Orthotics and Prosthetics	16	04	06	08	18
IV	Mobility Aids	08	04	04	06	14
V	Advance Applications of Rehabilitation	07	04	04	04	12
Total		48	18	24	28	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:

- Visit to orthopedic hospital and prepare the report on the various disabilities and related orthopedic treatments.
- Visit to rehabilitation center and prepare a report of manufacturing of various orthotics and prosthetics.
- Prepare chart on Gait cycle analysis.
- Do internet survey on various human disabilities.
- Prepare a chart on roles of rehabilitation team.
- Prepare power point presentation on given intelligent orthotics and prosthetics.

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:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- '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.
- 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).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Guide student(s) in undertaking micro-projects.
- Correlate subtopics with power system utility and electrical equipment.
- Use proper equivalent analogy to explain different concepts.
- 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 hours to clarify doubts, complete the micro-project and suggested student 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.

Suggestive lists of micro-projects are given here. Similar micro-projects could be added by the concerned faculty.

- a) Measure and compare any five subjects/ gait cycle with standard measures.
- b) Prepare a model of given mobility aid.
- c) Prepare a mould of prosthetics and orthotics for given human body extremities.
- d) Visit to nearby rehabilitation center and observe the process of making prosthesis and orthosis. Prepare a report of it.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Textbook of Rehabilitation	Sunder S.	Jaypee Publishers, 3 rd edition, New Delhi, 2010, ISBN: 978-81-8448-711-4
2	The Biomedical Engineering Handbook	Bronzino, Joseph D.	CRC Press, LLC, 3 rd edition, 2006, ISBN: 978-0849321214
3	Essentials of Prosthetics and Orthotics	Agarwal, A.K	Jaypee Publishers, 1 st edition, New Delhi, 2013, ISBN: 978-93-5090-473-4
4	Essentials of Rehabilitation for Orthopedic Surgeons	Ebnezar, John	Jaypee Publishers, 1 st edition, New Delhi, 2006, ISBN: 81-8061-271-6

14. SOFTWARE/LEARNING WEBSITES

- a) www.nibib.nih.gov/science-education/science-topics/rehabilitation-engineering
- b) www.humantechpando.com/whats-the-difference-between-orthotics-and-prosthetics/
- c) www.orthobullets.com/foot-and-ankle/7001/gait-cycle
- d) www.rehab.research.va.gov/jour/78/15/2/farmer.pdf



