

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**COURSE CURRICULUM  
COURSE TITLE: REHABILITATION ENGINEERING  
(COURSE CODE: 3360302)**

<b>Diploma Programmes in which this course is offered</b>	<b>Semester in which offered</b>
Biomedical Engineering	Sixth

**1. RATIONALE**

Rehabilitation engineers design and build devices and systems to meet a wide range of needs that can assist individuals with mobility, communication, hearing, vision, and cognition. These tools help people with day-to-day activities and tasks related to employment, independent living, and education. This course is important and emerging field in biomedical engineering.

**2. COMPETENCY**

The course content should be taught and implemented with the aim to develop required skills so that students are able to acquire following competency:

- i. Develop orthotics and prosthetics.**
- ii. Maintain the sensory/motor rehabilitation systems.**

**3. COURSE OUTCOMES (COs)**

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes:

- i. Select the appropriate rehabilitation concept for various disabilities.
- ii. Compare the different methods of orthopedic prosthetics and orthotics for rehabilitation.
- iii. Repair and maintain power wheel chair.
- iv. Design and develop orthotic and prosthetic.
- v. Select proper sensory augmentation and substitution.

**4. TEACHING AND EXAMINATION SCHEME**

<b>Teaching Scheme (In Hours)</b>			<b>Total Credits (L+T+P)</b>	<b>Examination Scheme</b>				
				<b>Theory Marks</b>		<b>Practical Marks</b>		<b>Total Marks</b>
<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>ESE</b>	<b>PA</b>	<b>ESE</b>	<b>PA</b>	
4	0	2	06	70	30	20	30	

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit ESE - End Semester Examination; PA - Progressive Assessment.

## 5. COURSE DETAILS

Unit	Major Learning Outcomes ( In Cognitive Domain)	Topics and Sub-topics
<b>Unit – I Rehabilitation Fundamentals</b>	1a. Describe the rehabilitation engineering. 1b. Explain engineering concepts in sensory rehabilitation. 1c. Describe engineering concepts in motor rehabilitation.	1.1 Rehabilitation concepts 1.2 Engineering concepts in sensory rehabilitation 1.3 Engineering concepts in motor rehabilitation 1.4 Future of engineering in Rehabilitation
<b>Unit– II Orthopedic Prosthetics and Orthotics in Rehabilitation</b>	2a. Describe intelligent prosthetic knee. 2b. Explain functional electrical stimulation. 2c. Describe hybrid assistive system in brief. 2d. Describe computer application in rehabilitation engineering. 2e. Describe myoelectric hand. 2f. Describe the prosthetic hand and its applications. 2g. Elaborate orthotic knee joint.	2.1 Computer aided engineering in component design, Intelligent prosthetic knee 2.2 Hierchically controlled prosthetic hand, myoelectric hand 2.3 Orthotic knee joint 2.4 Externally powered and controlled orthoses and prosthesis: <ol style="list-style-type: none"> <li>i. FES systems-restoration of hand, restoration of standing and walking</li> <li>ii. HAS-hybrid assistive system for walking</li> </ol>
<b>Unit– III Wheeled Mobility: Wheel Chair</b>	3a. Describe features of wheelchair. 3b. Explain structure of wheelchair. 3c. Compare the manual and power wheel chair in detail. 3d. Describe the parts of powered wheel chair. 3e. Describe the maintenance procedure of power wheel chair.	3.1 Wheelchairs: Categories, functions 3.2 Wheelchair structure and component design <ol style="list-style-type: none"> <li>i. Materials</li> <li>ii. Frame and design</li> <li>iii. Wheels and casters</li> </ol> 3.3 Power wheelchair electrical system
<b>Unit – IV Active Prosthesis and Electronic Travel Applications</b>	4a. Describe the salient features of the myoelectric hand. 4b. Explain principle of laser cane. 4c. Describe the different types of active prostheses. 4d. Classify various disabilities.	4.1 Active prostheses: active above-knee prostheses, myoelectric hand and arm prostheses 4.2 Laser cane 4.3 Ultrasonic blind detector 4.4 Ultrasonic binaural sensing 4.5 Disabilities.
<b>Unit – V Sensory Augmentation and</b>	5a. Describe visual augmentation. 5b. Explain the principle of substitutory devices used for auditory vision substitution.	5.1 Visual systems <ol style="list-style-type: none"> <li>i. Visual augmentation</li> <li>ii. Tactual vision substitution</li> <li>iii. Auditory vision substitution</li> </ol>

Unit	Major Learning Outcomes ( In Cognitive Domain)	Topics and Sub-topics
<b>Substitution</b>	5c. Describe tactual vision substitution. 5d. Describe auditory augmentation. 5e. Describe devices used for visual auditor substitution 5f. Describe devices used for tactual auditory substitution 5g. Elucidate tactual augmentation. 5h. Explain tactual augmentation. 5i. Describe methods to prevent visual impairment. 5j. Describe braille, optacon, optical character recognition.	5.2 Auditory system i. Auditory augmentation ii. Visual auditory substitution iii. Tactual auditory substitution 5.3 Tactual system i. Tactual augmentation ii. Tactual augmentation

## 6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
<b>I</b>	Rehabilitation Fundamentals	04	06	04	00	10
<b>II</b>	Orthopedic Prosthetics and Orthotics in Rehabilitation	10	08	08	05	21
<b>III</b>	Wheeled Mobility : Wheel Chair	14	04	04	04	12
<b>IV</b>	Active Prosthesis and Electronic Travel Applications	14	02	04	06	12
<b>V</b>	Sensory Augmentation and Substitution	14	06	04	05	15
	<b>Total</b>	56	26	24	20	70

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

**Note:** This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

## 7. SUGGESTED EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes mainly in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

*Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.*

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Approx. Hours required
1	I	Use engineering concept in sensory & motor rehabilitation.	02
2	II	Demonstration of intelligent prosthetic knee, prosthetic hand.	02
3	II	Demonstration of externally powered and controlled orthotics and prosthetics-FES.	02
4	II	Demonstration of intelligent hand prosthesis (MARCUS).	02
5	III	Operate wheel chair.	02
6	III	Find centre of gravity of wheel chair.	02
7	III	Demonstrate Braille printing system.	02
8	III	Assembling power wheel chair.	02
9	III	Maintain power wheel chair.	02
10	III	Use computer application in rehabilitation engineering.	02
11	IV	Demonstrate the performance of path sounder.	02
12	IV	Demonstrate the performance of laser cane.	02
13	IV	Maintain laser cane.	02
14	IV	Demonstrate the performance of polarized ultrasonic travel aid.	02
15	V	Demonstrate the performance of assistive devices for the visually impaired.	02
16	V	Demonstrate the performance of sleeping aids.	02
17	V	Demonstrate the performance of walking & postural aids.	02
18	V	Design circuit of hearing aids.	02
19	V	Maintain circuit of hearing aids.	02
20	V	Measure hearing deficiency of patient.	02
21	V	Assembling cochlea using model.	02
<b>Total</b>			<b>42</b>
<b>Note:</b> Perform any of the practical exercises from above list for total of minimum 28 hours depending upon the availability of resources so that skills matching with the most of the outcomes of every unit are included.			

## 8. SUGGESTED STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- i. Visit any nearby reputed hospitals/diagnostic centers.
- ii. Visit paraplegia center and rehabilitation center.
- iii. Explore internet and websites/suppliers of reputed manufacturers of rehabilitation aids to collect specifications and details of their products and prepare a comparative report of instruments.

## 9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Show video/animation to explain the concepts.
- ii. Ask students (in group of three-four) to prepare a mini project on a particular rehabilitation aid and present in Seminar/Symposium
- iii. Ask students to contact someone using a rehabilitation aid and take his/her interview about effectiveness of that device and suggestions for further improvement in it.
- iv. Arrange expert lectures
- v. Arrange visit to Hospital & Reputed rehabilitation Centre/supplier of aids.
- vi. Show on films of working, production and maintenance of prosthetic and orthotics

## 10. SUGGESTED LEARNING RESOURCES

### A) Books

S. No.	Title of Book	Author	Publication
1.	Handbook of Biomedical Engineering, second edition – Volume II	Bronzino Joseph D.	CRC press,2010
2.	An Introduction to Rehabilitation	Cooper Rory A.	Taylor and Francis, London, 2012
3.	Textbook of Rehabilitation	Sunder S.	Jaypee,2012

### B) Major Equipment/ Instrument with Broad Specifications

- i. Power wheel chair
- ii. Prosthetic hand
- iii. Prosthetic knee
- iv. Laser cane
- v. Ultrasound blind detector
- vi. Myoelectric hand
- vii. Ear model with cochlear implant
- viii. Braille system

### B) Software/Learning Websites

- i. <http://www.gpamdavadbme.hpage.com>
- ii. <http://www.gpgbiomedical.hpage.com>

## 11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### Faculty Members from Polytechnics

- **Prof. M. H. Dave** ,Lecturer ,Dept of Biomedical engineering, G.P.Gandhinagar.
- **Prof. S. S. Malkan** ,Lecturer ,Dept of Biomedical engineering, G.G.P.Ahmedabad
- **Prof. A. K .Bula** ,Lecturer ,Dept of Instrumentation engineering, G.P.Gandhinagar
- **Prof. N. D. Makwana** ,Lecturer ,Dept of Biomedical engineering, G.P.Gandhinagar
- **Prof. V. V. Makwana**, Lecturer, Dept of Biomedical engineering, A.V.P.T.I,Rajkot

### Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. (Mrs.) Susan S. Mathew**, Associate Professor, Dept. of Electrical and Electronics Engineering.
- **Dr. Shashi Kant Gupta**, Professor and Coordinator for State of Gujarat