

## In the Name of Good

**Islamic Republic of Iran**  
**Ministry of Health and Medical Education**  
**Deputy Ministry of Education**

## **Biomedical Engineering (Medical Robotics)**

**Degree: Doctor of Philosophy (PhD)**

### **Total Course Credits**

- Core: 11
- Non-core (Elective): 9
- Dissertation: 22
- Compensatory: It varies for the students based on their MSc degrees

### **Program Description**

The field of Medical Robotics is a branch of the Biomedical Engineering on the application of Robotic Sciences and Mechatronics in Medicine. In the last ten years this field, as an interdisciplinary program, has progressed impressively in human health systems by top universities all around the world.

Training medical robotic experts would certainly affect the healthcare system by implementing new ideas and techniques in clinical diagnosis and therapeutic systems.

As a branch of Biomedical Engineering, Medical Robotics is the integration of basic sciences, engineering and medicine, which applies engineering technology in medicine to promote medical services according to scientific principles. In other words, Medical Robotics is specifically the application of Robotics Science and Mechatronics in medicine in both clinical diagnosis and therapy, using robotic devices.

The aim of the PhD program in Biomedical Engineering (Medical Robotics) is to educate new multidisciplinary researchers to meet the growing engineering and medical demands for advanced education and research in robotics concerning the design of new robotic devices and systems applicable in community health.

Considering the continuous research and applied work in Medical Robotics in Iran in the last decade to the level of designing smart robotic surgery systems, assistive, surgical and rehabilitative robots and also testing remote robotic surgery on animals, the Islamic Republic of Iran would be among the top countries offering this program in training the most committed, knowledgeable and competent graduates in Medical Robotics.

## Admission Requirements

1- Doctor of Medicine degree or M.Sc. degree in one of the following fields awarded by one the home or foreign universities approved by Iran's Ministry of Health, Treatment and Medical Education

| M.Sc. Degree                          | M.Sc. Degree                                     |
|---------------------------------------|--|
| Biomedical Engineering (all branches) | Mechanical Engineering (all branches)            |
| Mechatronic Engineering               | Electrical Engineering (all branches)            |
| Robotic Engineering                   | Computer Sciences and Engineering (all branches) |
| Prostheses and Assistive Devices      | Medical Informatics                              |
| Health Information Technology         | Sports Physiotherapy                             |
| Physiotherapy                         | Occupational Therapy                             |
| Ergonomics                            |  |

2-Acceptance in specialized entrance exam including the subjects in the following table:

| No | Subjects of Entrance Exam                           | Weight |
|----|---|--------|
| 1  | Robotics and Biomechanics                           | 3      |
| 2  | Medical Image Processing                            | 2      |
| 3  | Medical Bioinstrumentations                         | 2      |
| 4  | Engineering Mathematic , Probability and Statistics | 3      |
|    |   |        |

\*N.B.: These general conditions do not necessarily exclude specific conditions of each institute or university.

## Expected Competencies at the End of the Program

### General Competencies\*

### Specific Competencies and Skills

At the end of the program learners will be competent in the following skills:

- Making use of robotic sensors and actuators
- Developing human/machine interfaces
- Working in professional environments, using specialized instruments and interpreting the acquired clinical data
- Managing clinical robotic engineering centers in hospitals
- Managing and performing theoretical and practical research in general biomedical and Robotic Engineering fields
- Designing and developing new techniques, methods and devices in special areas of Robotic Engineering Technology
- Teaching basic and new Robotic Engineering technologies to medical, biomedical engineering and basic sciences students in engineering, and medical schools and also medical staffs in hospitals and health centers
- Keeping the physical and psychological environment as well as the workplace healthy

## Educational Strategies, Methods and Techniques

### Student Assessment (Methods and Types)

- Formative (Quizzes and Midterm Exam)
- Summative (Final Exam)
- Comprehensive Exam
- Methods of assessment: oral, written, OSLE, and Logbook

### Ethical Considerations\*

\*Note: The related document(s) can be found at <http://hcmep.behdasht.gov.ir/>

## Tables of the Courses

**Table 1. Compensatory Courses**

| No. | Course Title                                   | Credits |           |       | Teaching Hours |           |       |
|-----|--|---------|-----------|-------|----------------|-----------|-------|
|     |  | Theory  | Practical | Total | Theory         | Practical | Total |
| 1   | Medical Information Systems*                   | 0.5     | 0.5       | 1     | 9              | 17        | 26    |
| 2   | Medical Imaging Systems                        | 2       | 1         | 3     | 34             | 34        | 68    |
| 3   | Medical Images Processing                      | 3       | 0         | 3     | 51             | 0         | 51    |
| 4   | Anatomy and Physiology                         | 3       | 0         | 3     | 51             | 0         | 51    |
| 5   | Biomechanics of Musculoskeletal System         | 3       | 0         | 3     | 51             | 0         | 51    |
| 6   | Kinematics and Dynamics of Robots              | 3       | 0         | 3     | 51             | 0         | 51    |
| 7   | Advanced Mathematical and Engineering Analysis | 3       | 0         | 3     | 51             | 0         | 51    |
|     | Total  | 19      |           |       |                |           |       |

\*This course is obligatory for those who have not completed it before.

**Table 2. Core Courses**

| No    | Title of the Course                           | Credits |           |       | Teaching Hours |           |       |
|-------|---|---------|-----------|-------|----------------|-----------|-------|
|       |   | Theory  | Practical | Total | Theory         | Practical | Total |
| 1     | Medical Robotics                              | 3       | 0         | 3     | 51             |           | 51    |
| 2     | Robotic Sensors and Actuators                 | 2       | 1         | 3     | 34             | 34        | 68    |
| 3     | Advanced Topics in Analysis of Medical Images | 3       | 0         | 3     | 51             |           | 51    |
| 4     | Advanced Research Methods                     | 2       | 0         | 2     | 34             |           | 34    |
| Total |   | 11      |           |       |                |           |       |

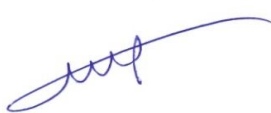
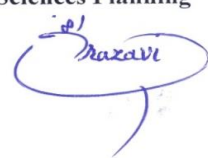
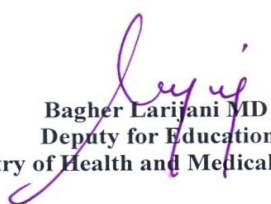
**Table 3. Non-Core Courses\***

| No | Title of the Course   | Credits |           |       | Teaching Hours |           |       |
|----|---|---------|-----------|-------|----------------|-----------|-------|
|    |   | Theory  | Practical | Total | Theory         | Practical | Total |
| 1  | Principles of Surgery   | 2       | 1         | 3     | 34             | 34        | 68    |
| 2  | Robotic and Computer Assisted Surgery                                   | 2       | 1         | 3     | 34             | 34        | 68    |
| 3  | Surgery Navigation  | 2       | 1         | 3     | 34             | 34        | 68    |
| 4  | Haptics in Medicine   | 2       | 1         | 3     | 34             | 34        | 68    |
| 5  | Principles of Rehabilitation  | 2       | 1         | 3     | 34             | 34        | 68    |
| 6  | Principles of Exercise Therapy  | 2       | 1         | 3     | 34             | 34        | 68    |
| 7  | Robotic and Computer Assisted Rehabilitation                            | 2       | 1         | 3     | 34             | 34        | 68    |
| 8  | Prostheses and Assistive Devices  | 2       | 1         | 3     | 34             | 34        | 68    |
| 9  | Kinesiology and Biomechanics  | 3       | 0         | 3     | 51             |           | 51    |
| 10 | Human and Robot Recognition Topics                                      | 3       | 0         | 3     | 51             |           | 51    |
| 11 | Intelligence Systems in Medical Robotics                                | 3       | 0         | 3     | 51             |           | 51    |
| 12 | Stochastic Process in Medical Robotics                                  | 3       | 0         | 3     | 51             |           | 51    |
| 13 | Cybernetics and Human – Robot Interaction                               | 3       | 0         | 3     | 51             |           | 51    |
| 14 | Advanced Topics in Human Movements Controlling and Learning             | 3       | 0         | 3     | 51             |           | 51    |
| 15 | Advanced Topics in Ultrasound and their Application in Medical Robotics | 3       | 0         | 3     | 51             |           | 51    |
| 16 | Advanced Control in Medical   | 3       | 0         | 3     | 51             |           | 51    |



|              | Robotics   |    |   |   |    |    |    |
|--------------|--|----|---|---|----|----|----|
| 17           | Advanced Control in Neuromuscular System                 | 3  | 0 | 3 | 51 |    | 51 |
| 18           | Advanced Topics in Electrophysiology                     | 3  | 0 | 3 | 51 |    | 51 |
| 19           | Specialized Topics in Medical Robotics 1                 | 3  | 0 | 3 | 51 |    | 51 |
| 20           | Specialized Topics in Medical Robotics 2                 | 3  | 0 | 3 | 51 |    | 51 |
| 21           | Biosignals Modeling and Analysis                         | 3  | 0 | 3 | 51 |    | 51 |
| 22           | Speech Processing and Recognition                        | 3  | 0 | 3 | 51 |    | 51 |
| 23           | Fuzzy Systems in Medical Robotics                        | 3  | 0 | 3 | 51 |    | 51 |
| 24           | Laser and its Application in Medical Robotics            | 3  | 0 | 3 | 51 |    | 51 |
| 25           | Expert and Navigator Systems in Medical Robotics         | 3  | 0 | 3 | 51 |    | 51 |
| 26           | Advanced Topics in Systems Identification                | 3  | 0 | 3 | 51 |    | 51 |
| 27           | Advanced Topics in Identification of Stochastic Patterns | 3  | 0 | 3 | 51 |    | 51 |
| 28           | Advanced Topics in Machine Vision                        | 3  | 0 | 3 | 51 |    | 51 |
| 29           | Advanced Computer Graphics                               | 3  | 0 | 3 | 51 |    | 51 |
| 30           | Functional Imaging Analysis in Medical Robotics          | 2  | 1 | 3 | 34 | 34 | 68 |
| <b>Total</b> |  | 90 |   |   |    |    |    |

\* Students have to pass 9 credits based on their dissertation topics, and approval of their thesis adviser and postgraduate education council.

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|---|---|
| <p><b>Jamshid Hajati PhD</b><br/>Secretariat of the Council for<br/>Education of Health and Basic<br/>Medical Sciences (Undergraduate<br/>and Postgraduate)</p>  | <p><b>Seyed Mansour Razavi MD</b><br/>Secretary of the Supreme<br/>Council for Medical<br/>Sciences Planning</p>  |
| <p><b>Bagher Larijani MD</b><br/>Deputy for Education<br/>Ministry of Health and Medical Education</p>   |   |