

**In the Name of God**

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

**Biomedical Engineering (Bioelectric)  
Doctor of Philosophy (PhD)**

**Total Course Credits**

- Core: 9
- Non-core (Elective): 15
- Dissertation: 20

**Program Description**

The field of Biomedical Engineering (Bioelectric) is a branch of Medical engineering in which graduates learn and practice specific topics in Bioelectrical Engineering and Medical Sciences to be able to administer and perform advanced research in medical and engineering fields. The graduates are enabled to develop new methods and techniques for the design and production of diagnostic and therapeutic devices to promote health systems according to scientific principles.

The discipline of Biomedical Engineering (Bioelectric) is an integration of Engineering, Basic Sciences, Medicine and Biology, which bridges toward modern technology through the study of the principles and performance of living systems, and the application of Biological and Physiological data to the human body.

This discipline plays a significant role in different areas such as Biomedical Instrumentation, Modeling and Control of Biologic Systems, Processing of Biologic Signals and Medical Images, Robotics in Medical Design, Neural Networks, Modeling of the Human Brain Structure and Functions, Rehabilitation Engineering and Artificial Organs.

The main objective is to educate and train Bioelectrical Engineering specialists as members of clinical research and education centers or hospitals to be able to evaluate, select and observe the implementation of clinical research and premium application of medical devices in clinical diagnosis and therapy such as:

- Performing basic and applied research to get advantage of basic and engineering sciences to improve the quality of community health
- Training the experienced specialists in bioelectrical engineering fields
- Training the specialized lecturers and researchers to teach, perform research and progress the research levels in bioelectrical engineering field in universities and allied research centers
- Training the required specialized personnel for the application of new advanced techniques in biomedical engineering to improve the quality of community health
- Advancing the qualitative and quantitative aspects of diagnostic and therapeutic systems by the invention or standardization of medical devices
- Advising and helping the administrators of the hospital and health centers in the acquisition of new medical devices, and education of medical staff

## Admission Requirements

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

| M.Sc. Degree                          | M.Sc. Degree                  |
|---------------------------------------|-------------------------------|
| Electrical engineering (all branches) | Computer (all branches)       |
| Physics (all branches)                | Information technology        |
| Prostheses and assistive devices      | Audiology                     |
| Speech therapy                        | Optometry                     |
| Occupational therapy                  | Sports physiotherapy          |
| Ergonomics                            | Physiotherapy                 |
| Medical physics                       | Medical radiation engineering |
| Medical informatics                   |                               |

- Meeting admission criteria based on regulations of universities
- Being eligible for entering the program
- Acceptance in specialized entrance exam including the subjects in the following table:

| No. | Subjects in Entrance Exam                                    | weight |
|-----|--------------------------------------------------------------|--------|
| 1   | Digital Signal Processing                                    | 2      |
| 2   | Medical Image Processing                                     | 2      |
| 3   | Medical Bioinstrumentations                                  | 2      |
| 4   | Advanced Engineering Mathematic , Probability and Statistics | 2      |
|     | Total Coefficient                                            | 8      |

\*Important note: 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:

- Managing and conducting biomedical engineering offices in hospitals and health centers -
- Managing and performing theoretical and applied research in general biomedical and, specifically, in bioelectrical engineering fields
- Designing and developing new techniques, methods and devices in special areas of biomedical engineering technology

-Teaching basic and new biomedical engineering technologies to medical, and biomedical engineering and students of basic sciences in engineering and medical schools and also the medical staff in hospitals

### Educational Strategies, Methods and Techniques\* Student Assessment (Types and Methods)

- Formative (quizzes and midterm Exam)
- Summative (Final Exam)
- Comprehensive exam
- Oral and written exams, observation, clinical competence assessments
- (OSCE, OSLE, OSFE, DOPS, 360 degree evaluation competency)
- Portfolio assessment: Logbook, test results, reports, articles, certificates, promotions, etc.

### Ethical Considerations

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

### Tables of the Courses

**Table 1. Core Courses**

| Code of the course | Title of the Course                        | Total Credits | Credits     |           | Teaching Hours |           |       |
|--------------------|--------------------------------------------|---------------|-------------|-----------|----------------|-----------|-------|
|                    |                                            |               | Theoretical | Practical | Theoretical    | Practical | Total |
| 1                  | Advanced Topics in Bio signal Processing   | 3             | 3           |           | 51             |           | 51    |
| 2                  | Advanced Topics in Bio system Modeling     | 3             | 3           |           | 51             |           | 51    |
| 3                  | Advanced Topics in Medical Imaging Systems | 3             | 2.5         | 0.5       | 43             | 17        | 60    |
|                    | Total                                      |               | 9           |           |                |           |       |

**Table 2. Non-Core (Elective) Courses**

| Code of the Course | Title of the Course              | Total Credits | Credits     |           | Teaching Hours |           |       |
|--------------------|----------------------------------|---------------|-------------|-----------|----------------|-----------|-------|
|                    |                                  |               | Theoretical | Practical | Theoretical    | Practical | Total |
| 1                  | Brain and Recognition Physiology | 3             | 3           |           | 51             |           | 51    |
| 2                  | Bio electromagnetics             | 3             | 3           |           | 51             |           | 51    |

|    |                                                           |   |   |   |    |    |    |
|----|-----------------------------------------------------------|---|---|---|----|----|----|
| 3  | Artificial Intelligence and Expert Systems                | 3 | 3 |   | 51 |    | 51 |
| 4  | Advanced Topics in Neural Networks and Expert Systems     | 3 | 3 |   | 51 |    | 51 |
| 5  | 2nd order Cybernetics and Human-Machine Interaction       | 3 | 3 |   | 51 |    | 51 |
| 6  | Non-linear Methods in Bio signalProcessing                | 3 | 3 |   | 51 |    | 51 |
| 7  | Advance Topics in Control and learning of Human Movements | 3 | 3 |   | 51 |    | 51 |
| 8  | New Technologies in Medical Instrumentation               | 3 | 2 | 1 | 34 | 34 | 68 |
| 9  | Ultrasound and its Applications in Biomedical Engineering | 3 | 3 |   | 51 |    | 51 |
| 10 | Medical Robotics                                          | 3 | 3 |   | 51 |    | 51 |
| 11 | Neuromuscular System Control                              | 3 | 3 |   | 51 |    | 51 |
| 12 | Medical Imaging Systems                                   | 3 | 2 | 1 | 34 | 34 | 68 |
| 13 | Electrophysiology                                         | 3 | 2 | 1 | 34 | 34 | 68 |
| 14 | Special Topics in Biomedical Engineering – Bioelectric 1  | 3 | 3 |   | 51 |    | 51 |
| 15 | Special Topics in Biomedical Engineering – Bioelectric 2  | 3 | 3 |   | 51 |    | 51 |
| 16 | Advanced Digital Signal Processing                        | 3 | 3 |   | 51 |    | 51 |
|    | Digital Image Processing                                  | 3 | 3 |   | 51 |    | 51 |
| 17 | Speech Processing and Recognition                         | 3 | 3 |   | 51 |    | 51 |
| 18 | Stochastic                                                | 3 | 3 |   | 51 |    | 51 |

|              |                                                                                           |           |     |     |    |    |    |
|--------------|-------------------------------------------------------------------------------------------|-----------|-----|-----|----|----|----|
| 19           | Fuzzy Systems<br>(application in<br>Biomedical<br>Engineering )                           | 3         | 3   |     | 51 |    | 51 |
| 20           | Optic and its<br>Application in<br>Biomedical<br>Engineering                              | 3         | 3   |     | 51 |    | 51 |
| 21           | Optimized Control                                                                         | 3         | 3   |     | 51 |    | 51 |
| 22           | Systems Estimation<br>and Identification                                                  | 3         | 3   |     | 51 |    | 51 |
| 23           | Pattern Recognition                                                                       | 3         | 3   |     | 51 |    | 51 |
| 24           | Advanced Topics in<br>Digital image<br>Processing                                         | 3         | 3   |     | 51 |    | 51 |
| 25           | Wavelet and its<br>Application in<br>Digital Signal and<br>Image Processing               | 3         | 3   |     | 51 |    | 51 |
| 26           | Mathematical<br>Issues in<br>Analyzing and<br>Processing of<br>Functional Brain<br>Images | 3         | 2.5 | 0.5 | 43 | 17 | 60 |
| <b>Total</b> |                                                                                           | <b>81</b> |     |     |    |    |    |

#### **Duration:**

The total duration of Biomedical Engineering (Bioelectric) Ph.D. Program is in accordance with the regulations for Ph.D. degrees adopted by the Supreme Council of Educational Planning.

#### **Graduation Requirements:**

According to the graduation regulations adopted by the Supreme Council of Educational Planning, successful completion of the total of 46 credits of theoretical and applied courses according to the following table is required:

| Course Title              | Credit |
|---------------------------|--------|
| Compulsory core courses   | 9      |
| Elective non-core courses | 15     |
| Seminar                   | 2      |
| Dissertation              | 20     |
| Total number of credits   | 46     |

There are two successive periods in Biomedical Engineering Ph.D. program: 1-

#### **Educational period:**

Students are required to register and successfully pass 24 specialized credits including 9 core compulsory credits in table 1 and also 15 non-core elective credits in table 2 offered by the biomedical engineering department, and approved by the Council of Graduate Studies of the university.

#### **2- Research and Dissertation Period:**

Students who have successfully passed the comprehensive exam would register for the dissertation and begin their research work. The students would be graduated after successful defense of their dissertation.

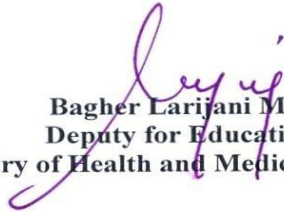
**Note:** Besides the above courses, students should register and pass at most 12 credits of the following complementary or compensatory courses as specified by the Biomedical Engineering Department and approved by the Postgraduate Education Council.

- Biomedical Instrumentations
- Physiological Modeling
- Biosignal Processing
- Anatomy and Physiology
- Medical Informatics
- Advanced Engineering Mathematics

**Jamshid Hajati PhD**  
Secretariat of the Council for  
Education of Health and Basic  
Medical Sciences (Undergraduate  
and Postgraduate)



**Bagher Larijani MD**  
Deputy for Education  
Ministry of Health and Medical Education



**Seyed Mansour Razavi MD**  
Secretary of the Supreme  
Council for Medical  
Sciences Planning

