The aim of this course is to train students in methods of design, and evaluation of biomedical systems covering all the design phases from conception to regulations compliance.

Learning results of the subject:

- Ability to understand the physical functions of sensors used to build biomedical equipment.
- Ability to design biomedical equipment ad-hoc to the field of utilization: low-noise systems, energy efficient systems, isolated systems, etc.
- Ability to understand the technical specifications of measurement equipment and electronic components used to design biomedical instrumentation.
- Ability to design biomedical devices based on mobile devices.
- Ability to understand the regulations concerning biomedical systems.
- Ability to understand the test required to verify EMC and safety issues concerning biomedical systems.
- Ability to design biomedical instrumentation from simple circuits to complex systems for any field of use (monitoring patients at home, hospital machines, biomedical devices for non-medical applications etc.)
- Ability to interpret and analyze the systems design restrictions imposed by the field of use (explosive areas, sterile atmospheres etc.)
- Ability to create biomedical systems using specific sensors and mobile devices
- Ability to interpret the requirements from the medical standards, in the fields of safety, electromagnetic compatibility and usability.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>13h</th>
<th>10.40%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>26h</td>
<td>20.80%</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>86h</td>
<td>68.80%</td>
</tr>
</tbody>
</table>
# Content

## 1. Introduction to biomedical systems

**Learning time:** 5h  
- Theory classes: 1h  
- Self study: 4h  

**Description:**  
- Aims of the subject  
- Basic definitions  
- Historic review

## 2. Bioelectric signals

**Learning time:** 70h  
- Theory classes: 8h  
- Laboratory classes: 16h  
- Self study: 46h  

**Description:**  
- Electrobiological phenomena  
- Biomedical electrodes  
- Biopotential measurement systems  
- Medical equipment for biopotential measurement  
- Electrical bioimpedance measurement systems

## 3. Safety of electrical equipment

**Learning time:** 18h  
- Theory classes: 2h  
- Laboratory classes: 4h  
- Self study: 12h  

**Description:**  
- Safety of Electrical equipment  
- Regulations and Standards
4. Measurements in the cardiovascular and respiratory systems

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 32h</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Blood pressure measurements</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>- Flux, flow and cardiac output measurements</td>
<td>Laboratory classes: 6h</td>
</tr>
<tr>
<td>- Impedance plethysmography and impedance cardiography</td>
<td>Self study: 24h</td>
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<tr>
<td>- Respiratory flux and respiratory volume</td>
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<tr>
<td>- Pulmonary ventilation monitors</td>
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</tbody>
</table>
## Planning of activities

| Theoretical Classes | Hours: 13h  
Theory classes: 13h |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>Theoretical Classes</td>
<td></td>
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</tbody>
</table>

| LABORATORY          | Hours: 26h  
Laboratory classes: 26h |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
</tbody>
</table>
| - Bioelectrical signals amplifier.  
- Safety evaluation.  
- Respiration measurement. |                  |

| EXERCISES           | Hours: 26h  
Self study: 26h |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>Exercises to strengthen the theoretical knowledge.</td>
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</tr>
</tbody>
</table>

| SHORT ANSWER TEST  | Hours: 1h  
Theory classes: 1h |
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<tbody>
<tr>
<td><strong>Description:</strong></td>
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<tr>
<td>Mid term control.</td>
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| FINAL EXAMINATION:  | Hours: 2h 30m  
Theory classes: 2h 30m |
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>Final examination.</td>
<td></td>
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</tbody>
</table>

| Self Study         | Hours: 56h 30m  
Theory classes: 56h 30m |
|---------------------|------------------|
Qualification system

Final examination: 30%
Partial examinations and controls: 5%
Exercises: 5%
Laboratory assessments: 60%

Bibliography

Basic:


Complementary:
