Course Specifications
Valid in the academic year 2016-2017

Human and Environment, Safety and Regulations (E092720)

Course size

<table>
<thead>
<tr>
<th>Credits</th>
<th>Study time</th>
<th>Contact hrs</th>
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<tbody>
<tr>
<td>6.0</td>
<td>180 h</td>
<td>82.5 h</td>
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Course offerings and teaching methods in academic year 2016-2017

A (semester 2)
- seminar 15.0 h
- practicum 10.0 h
- project 12.5 h
- lecture 45.0 h

B (semester 2)
- practicum 10.0 h
- seminar 15.0 h
- lecture 45.0 h
- project 12.5 h

Lecturers in academic year 2016-2017

- De Wagter, Carlos: GE17 lecturer-in-charge
- Joseph, Wout: TW05 co-lecturer
- Lambert, Hendrik: GE17 co-lecturer

Offered in the following programmes in 2016-2017

- Bridging Programme Master of Science in Biomedical Engineering 6 B
- Master of Science in Biomedical Engineering 6 B
- International Master of Science in Biomedical Engineering 6 B
- Master of Science in Biomedical Engineering 6 A

Teaching languages

- Dutch, English

Keywords

- Biological effects, electric currents and fields, radiation, medical applications, safety standards, guidelines, IEC standards, patient safety

Position of the course

To understand that humans - in biological sense - are a "product" of their environment, with which they interact as never before. To gain insights into the interaction mechanisms when exposed to environmental factors, resulting effects and health hazards. Derivation of protective measures and safety standards. The emphasis is on electricity and the radiation fields that have been emerging over the past few decades due to the technological developments. A special focus is on medical appliances and the hospital environment.

Contents

- Introduction: life, carbon cycle, energy flows, thermodynamic aspects, ecosystems, biodiversity, evolution
- Impact of human activities on the environment: exploitation, environmental impact, irreversible habitat loss
- Influence of the "natural" and "artificial" environment on humans: chemical, biological and physical agents, electricity, electromagnetic fields and ionising radiation, time-
dose relationships, reversible and non-reversible biological effects, emission standards versus exposure standards; standards for members of public, employees and patients

- Interactions at the cellular level: the biological cell as a basic building block of life, DNA as carrier of genetic information, cell division and reproduction, damage from free radicals, mutagenic and carcinogenous agents, ageing, cancer
- Interactions at level of human organs and systems: control systems in the human body, heat transfer in the human body, bioheat model, organs and systems that are vulnerable to the different agents
- Electricity, safety and regulations: direct and indirect health risks to humans, important physical quantities, derivation of protection measures and safety standards, laws, recommendations, standards and regulations in the Belgian and European context, standards for medical electrical devices, CE conformity marking, specific legislation for hospitals and safety of medical appliances, services for prevention and protection at the workplace, quality management systems in the medical practice, risk management in the engineering practice (seminars)
- Electromagnetism and the interactions with the human body: assignment of electromagnetic spectrum to industrial, scientific and medical applications, thermal and non-thermal biological effects on humans, thermo-acoustic effects, important physical quantities, sources of electromagnetic fields, GSM/cellular telephony, microwave heating, near and far field, numerical dosimetry, computational methods, experimental dosimetry, phantoms, measuring equipment, base restrictions, reference levels, Belgian and international directives and standards
- Medical applications of electromagnetism: electromagnetic stimulation and detection, nuclear magnetic resonance, hyperthermia, diathermy, laser treatment, safety issues
- Ionising radiation in medicine: radioactivity and radiation for diagnosis, radioprotection, radiotherapy, external and internal sources, important physical quantities, concepts of numerical dosimetry and computational methods, basic technology and equipment, rationale of experimental dosimetry
- Critical assessment of speculative scientific literature: introduction to statistics and hypothesis testing, interpreting of clinical trials and epidemiological studies, some statistical pitfalls, statistical significance versus practical significance

Initial competences
No specific prior knowledge required

Final competences
1. Coping and reasoning with the following concepts: biology and entropy, homeostatic regulation, photosynthesis, acid rain, greenhouse effect, global warming, ozone problem, electromagnetic spectrum, ISM frequencies, ionisation, immission and emission, SAR (Specific Absorption Rate), GSM, UMTS, EMC (ElectroMagnetic Compatibility), ICNIRP directives, null hypothesis and alternative hypothesis
2. Realize that biological life is not contradictory to the 2nd law of thermodynamics and interpret the exposure to environmental factors at a fundamental level
3. Define and compare dose quantities for reversible and irreversible bioeffects. Understand the relation with thermal and non-thermal effects
4. Conduct a critical scientific literature review
5. Interpret results of scientific research critically and evaluate their applicability
6. Act ethically, professionally and socially responsibly
7. Take into account medical ethics, legislation and regulations when conducting medical-technical procedures and scientific research in a clinical environment
8. Determine dose quantities (e.g. SAR) experimentally
9. Correctly estimate the importance of maintenance, quality control, safety and risk management and regulations

Conditions for credit contract
Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract
This course unit cannot be taken via an exam contract

Teaching methods
Lecture, practicum, project, seminar

Learning materials and price
Syllabus, hands out of power point presentations and scientific articles (on paper and Minerva).

References
- "The Fragile environment", Laurie Friday, Ronald Laskey (Eds). Cambridge

(Approved)
Evaluation methods
end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period
Open book examination

Examination methods in case of periodic evaluation during the second examination period
Open book examination

Examination methods in case of permanent evaluation
Skills test, report

Possibilities of retake in case of permanent evaluation
examination during the second examination period is possible

Extra information on the examination methods
During semester: 2 graded lab sessions, 10 task reports, 2 project reports.

Calculation of the examination mark
During examination period / Throughout semester = 75%/25%