COURSE DESCRIPTION CARD - SYLLABUS

Course name
Prosthesis of limbs and spine [S2IBio1-UMiR>PKiK]

Course

Field of study
Biomedical Engineering

Year/Semester
1/2

Area of study (specialization)
Medical and Rehabilitation Devices

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
30

Number of credit points

4,00

Coordinators

dr inż. Adam Patalas
adam.patalas@put.poznan.pl

Lecturers

Prerequisites

- basic knowledge in the field of orthopedic biomechanics and anatomy and physiology with kinesiology, basic knowledge in the field of structural mechanics, construction materials, manufacturing technology- Logical thinking, sourcing information from the library and the internet. - basic skills in the field of engineering tools for computer design (CAD) and numerical analysis (FEM), use of news from magazines and the Internet, logical thinking and planning. - understanding the need to learn and acquire new knowledge.

Course objective

Poznanie wiedzy z zakresu protezowania zewnętrznego i endoprotezowania stosowanego w leczeniu wybranych schorzeń narządu ruchu oraz podstawowej wiedzy o tych schorzeniach. Zdobycie umiejętności bioinżynierskiego projektowania zewnętrznych protez kończyn i kręgosłupa oraz implantów ortopedycznych i endoprotez stawowych z wykorzystaniem współczesnych narzędzi inżynierskich (CAD, FEM).

Course-related learning outcomes

Knowledge:
1 Student should characterize the types of upper and lower limb prostheses used in the treatment of

orthopedic prostheses, has a basic knowledge of the construction materials used in the design of limb prostheses and joint implants (endoprostheses).
2. Student has a basic knowledge of applied prostheses of the musculoskeletal system and joint endoprostheses. The student should master the indications for the use of rehabilitation and orthopedic equipment (corsets, shoelaces) and external prostheses and joint endoprostheses.

Skills:
1. Student is able to obtain information from literature, databases and other properly selected sources (also in English) regarding the design of external prosthetic motor organs, rehabilitation and orthopedic equipment and joint endoprostheses. He/she can suggest a type of rehabilitation and orthopedic equipment depending on the type of dysfunction.
2. Student is able to choose and evaluate the usefulness of various technical constructions of rehabilitation and orthopedic equipment, prostheses and endoprostheses for the proper treatment of selected diseases and dysfunctions of motor organs.
3. Student can use the tools for engineering analysis and design (FEM, CAD) to design a structural solution for joint endoprosthesis or external prosthesis, choose the right structural material and propose manufacturing technology.

Social competences:
1.Student is able to cooperate in a group.
2. Student is aware of the need to use a properly designed prosthesis, spine endoprosthesis and corset in various diseases.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Forming rating:
a) for the lectures:
- Based on answers to questions concerning the material discussed in previous lectures
b) for the design classes:
- On the basis of an assessment of the current progress of tasks,
Summary rating:
Lecture and design classes:
Exam consisting of 5-10 questions in the field of material discussed during lectures. The condition for receiving a positive evaluation is to obtain at least 50% of the points available.
Completion of project classes takes place on the basis of ongoing control and assessment of progress in the project implementation and on the basis of the assessment of the submitted project development in the form of a brochure.

Programme content

Lecture:
Part I - External prosthesis of limbs and spine:
1. Types of amputation of limbs and indications for prosthesis, general division of prostheses
2. Lower limb prostheses - division due to the level, type of disease and general condition of the patient
• with enucleation in the hip joint,
• femoral: full-contact, vacuum,
• atypical shin prostheses: PTB, PTS, KBM
3. Upper limb prostheses - division due to the level and therapeutic indications
• Cosmetics,
• functional: mechanical, hybrid bioelectric,
• manipulators and grippers
4. Principles of using dentures (biofeedback)
5. Corsets and laces of the spine. Spinal diseases:
• degenerative changes,
• osteoporosis,
• lateral curvature of the spine
Corsets used in lateral idiopathic curvatures of the spine: Cheneau and Boston corsets
Part II - Endoprostheses of the joints:

6. Introduction to arthroplasty of limb and spine joints
7. Characteristics of technologies and materials used in the production of endoprostheses
8. Arthroplasty of the joints (hip, knee, ankle, shoulder and elbow)
9. Endoprosthesis fixing, biomechanics
10. Complications of arthroplasty - biological, biomechanical, technical reasons ...
11. Implants in spinal surgery (instrumentation, rods, screws, intervertebral cages, endoprostheses, stent of the vertebral body)
Projects:
1. Presentation at the first classes of project topics concerning bioengineering of implants used in spine surgery and upper and lower limb arthroplasty as well as external dentures of upper and lower limbs and spine.
2. Introduction to endoprostheses of the spine and demonstration of orthopedic prostheses and corsets (classes in, among others, orthopedic workshops, 3 meetings, Dr. med. M. Dąbrowski).
3. Ongoing control and assessment of progress in the implementation of the project.
In the implementation (team) of each of the design topics, account is taken of:
• construction design using CAD engineering tools,
• basic engineering analysis of the structure using FEM methods,
• selection of construction material / biomaterial,
• selection of manufacturing technology,
• application of bioengineering methods affecting the surface of the implant"s tissue contact surface.

Course topics

none

Teaching methods

1. Lecture: multimedia presentation.
2. Project: project development, discussion, team work.

Bibliography

Basic
1. „Ortopedia i Rehabilitacja”, tom I i II, pod redakcją W. Marciniaka, A. Szulca, PZWL, Warszawa, 2003.
2. „Rehabilitacja medyczna”, II wydanie, pod redakcją W. Degi i K. Milanowskiej, Wydawnictwo PZWL, Warszawa, 1993.
3. „Rehabilitacja medyczna” t. I i II pod redakcją Andrzeja Kwolka, 2003
4. „Rehabilitacja medyczna”, I wydanie, pod redakcją Jerzego Kiwerskiego, Wydawnictwo Lekarskie PZWL, Warszawa, 2006.
5. Alloplastyka stawu biodrowego - Lawrence D. Dorr, red. wyd. pol. Wojciech Marczyński, Elsevier Urban & Partner
6. Alloplastyka stawu biodrowego, Andrzej Pozowski, Wydawnictwo Medyczne Wrocław 2011,
7. Pierwotna endoprotezoplastyka stawu kolanowego Jacek Kowalczewski Warszawa 2013
8. Kieszonkowy atlas chirurgii kręgosłupa Kern Singh, Alexander R. Vaccaro, red. wyd. pol. Krzysztof Kwiatkowski, Wyd.1, Medisfera, Warszawa 2013.
9. Basic Orthopaedic Biomechanics & Mechano-biology, pod redakcją Mow VC., Huiskes R., Lippincott Williams & Wilkins, 2005.
10. Biomechanika i inżynieria rehabilitacyjna, Tom 5 serii „Biocybernetyka i Inżynieria Biomedyczna 2000”, red.: R. Będziński, K. Kędzior, J. Kiwerski, A. Morecki, K. Skalski, A. Wall, A. Wit, Wydawsnictwo Exit, Warszawa 2005
11. The Biomedical engineering handbook, J. D. Bronzino, CRC Press, 2000,
12. Problemy wytrzymałości i trwałości zmęczeniowej materiałów i konstrukcji w inżynierii biomedycznej, - T. Topoliński T, Wydawnictwo Naukowe Instytutu Technologii Eksploatacji - PIB, 2009.
13. Introduction to Biomedical engineering, J. D. Bronzino, Elsevier Academic Press, 2012
14. Biomateriały, tom 4 serii „Biocybernetyka i Inżynieria Biomedyczna 2000”, red.: Błażewicz S., Stoch L. (red.): Wydawnictwo Exit, Warszawa 2004.
15. Zagadnienia teoretyczne i aplikacyjne w implantach. Łaskawiec J., Michalik R., Wyd. Politechniki Śląskiej. Gliwice 2002.
Additional

1. C. Liebenson: Rehabilitation of the spine a practitioner' s Manual, W:Lippincott Williams& Wilkins, 2006
2. Lisa Maxey: Rehabilitation for the postsurgical orthopedic Patient 2e, W: Mosby, 2007
3. R. C. Manske: Postsurgical orthopedic sports rehabilitation, W.Mosby 2006
4. T. S. Ellenbecker: Shoulder rehabilitation,W: Georg Thieme Verlag 2006
5. Michael A. Pagliarulo: Introduction to physical therapy, W: Elsevier Science Publishers 2006
6. Rehabilitacja medyczna – kwartalnik
7. Shoulder Arthroplasty Gilles Walch, Pascal Boileau Springer Science & Business Media 2012
8. Shoulder and Elbow Arthroplasty Gerald R. Williams Lippincott Williams & Wilkins, 2005
9. An Introduction to Mechanical Engineering Part1, 2, pod redakcją M. Clifford, CRC Press, 2009
10. Materiały inżynierskie w zastosowaniach biomedycznych, H. Leda, Wydawnictwo Politechniki Poznańskiej, 2011
11. Advanced Manufacturing Technology for Medical Applications, pod redakcją: Gibson I., Jon Wiley & Sons. Honk Kong 2005.
12. Bio-Implant Interface. Improving Biomaterials and Tissue Reactions, pod redakcją Ellingsen J.E, Lyngstadaas S.P., CRC Press LLC, Boca Raton 2003.
13. Wybrane zagraniczne czasopisma obejmujące problematykę z zakresu bioinżynierii medycznej:
• Acta Orthopaedica Scandinaviaca (Scandinavian University Press)
• Journal of Arthroplasty (Churchill Livingstone)
• Journal of Biomechanics (Elsevier Science)
• Journal of Biomechanical Engineering (American Society of Mechanical Engineers)
• Journal of Bone and Joint Surgery (Am) (Journal of Bone and Joint Surgery, Inc.)
• Journal of Bone and Joint Surgery (Br) (British Editorial Society of Bone and Joint Surgery)
• Journal of Orthopaedic Research (Journal of Bone and Joint Surgery, Inc.)

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	53	2,00