MSc Study program: **INFORMATION AND COMMUNICATION TECHNOLOGIES**

Overview of Courses in Study Program

1st year: Information and Communication Technologies						
1st semester			**Hours/week**			
No	**M/E**	**Course**	**L**	**NE**	**LE**	**ECTS**
1	M	Network Planning and Optimization	3	0	1	6
2	M	Advanced Communication Networks	3	0	1	6
3	M	Information Theory and Coding	3	0	1	6
4	M	Applied Digital Signal Processing	3	0	1	6
5	M	Wireless Communications 1	3	0	1	6
2nd semester			**Hors/week**			
No	**M/E**	**Course**	**L**	**NE**	**LE**	**ECTS**
1	M	Software Defined Radio	3	0	1	6
2	M	Wireless Communications 2	3	0	1	6
3. *& 4. Select two of the following electives.*						
1	E	Wireless Communications – LAB	2	0	2	5
2	E	Advanced Communication Networks lab	2	0	2	5
3	E	Advanced Programming for ICT	2	0	2	5
4	E	Image Processing and Computer Vision	2	0	2	5
5	E	3D Animation	2	0	2	5
5. *& 6. Select two of the following electives.*						
	E	Advanced Project Management in ICT	2	0	1	4
	E	Methodology of Scientific Research in ICT	2	0	1	4
	E	Regulation and Standardization in ICT	2	0	1	4
	E	Internet of Things	2	0	1	4

2nd year: Information and Communication Technologies						
3rd semester			**Hours/week**			
No	**M/E**	**Course**	**L**	**NE**	**LE**	**ECTS**
1	M	Networks and Communications Security	3	0	1	6
2. & 3. &4. &5 *Select fowr of the following electives.*						
1	E	Cognitive Radio	3	0	1	6
2	E	Vehicular Communications	3	0	1	6
3	E	Selected Topics in Multimedia Communications	3	0	1	6
4	E	Selec. Topics in Netw. and Communications	3	0	1	6
5	E	mmWave Communications	3	0	1	6
6	E	Satellite Communications	3	0	1	6
7	E	Microwave Systems	3	0	1	6
8	E	Advanced Optical Communications	3	0	1	6
9	E	Innovation and Technology Transfer	3	0	1	6
4rth semester						
No	**M/E**	**Course**	**L**	**NE**	**LE**	**ECTS**
1	M	Master Thesis				30

Explanation:

- Total number of credits (ECTS) accumulated for one year is 60 ECTS - credits.
- In every semester the student should accumulate 30 ECTS – credits from mandatory and elective courses.
- After choosing the elective course it becomes a Mandatory course, the student or the professor will not be able to change the course.

Comparability program with the study programs in other universities:

The ICT study program has been developed based on the recommendations of international projects for harmonization of curricula in Electrical and ICT Engineering, some of them are:

- Boosting the Telecommunication engineer profile to meet modern society and industry needs https://www.project-benefit.eu

- THEIERE Toward harmonization of study programs in electrical and information engineering http://www.eaeeie.org/sites/all/themes/eaeeie/tnprojects/theiere/THEIERE_monograph_CD_fichiers/CD/THEIERE.pdf

Comparison of study programs with similar programs in the region:

- University of Zagreb, Electrical Engineering and Information Technology, 75-80 % https://www.fer.unizg.hr/en/study_programs

- University of Ljubljana, Faculty of electrical engineering, Information and Communication Technologies program, 70-75% http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/electrical_engineering/curriculum/
- University of Pittsburgh, School of Computing and Information, >65%, http://sci.pitt.edu/academics/masters/mst/

Course contents

Course: Network Planning and Optimization

Lecturer: Prof. Asoc. Dr. Bujar Krasniqi
Course status: Mandatory, Semester I, 6 ECTS

Course content: This course describes planning and optimization of wireless networks. The course begins with the business plan of a wireless network, continuing with 3rd generation network planning aspects including resource allocation, performance evaluation and optimization. In the second part student recognize 4th generation network planning including dimensioning of LTE and LTE-Advanced, network performance evaluation using key performance indicators and optimization. In the last part student solve co-planning of wireless networks (2G, 3G and 4G) as well as 5G planning in coordination with existing networks.
Course objectives: The purpose of this course is that the student during lectures and laboratory exercises realized with one of the software tools for planning and optimization of network, to expand and deepen their knowledge for planning and optimization of 2G, 3G, 4G and 5G networks. Moreover, student distinguish challenges related to co-planning, differentiate practical solutions and examine key performance indicators for network performance evaluation
Learning outcomes: Upon completion of this course the student will be able to:

- report business plan (Capex and Opex)
- demonstrate detailed planning and optimization of wireless networks (2G, 3G, 4G and 5G)
- implement resource optimization algorithms and use methods to enhance coverage and capacity
- distinguish malfunctioning of a planned network through key performance indicators evaluation
- argue methodology used for planning and optimization of a wireless network
- Identify new methodologies for planning, evaluation, optimization and resource allocation of a wireless network

Teaching methodology: Lectures, Discussion, Laboratory work.
Evaluation methods: The successful practical work: 40%, First intermediate evaluation; 25%, Second intermediate evaluation:25%, Regular attendance and involvement in discussions 10%, Total: 100 %.
Concretization tools/IT: Computer, projector, laboratory equipped for ICT
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 60:40
Literature:

- H. Holma, A. Toskala, P. Tapia (2014): HSPA+ Evolution to Release 12 Performance and Optimization, Publishing House "Wiley", USA.
- L. Korowajczuk (2019): LTE-A, WiMAX 2.2 and WLAN (4G/5G): Network Design, Optimization and Performance Analysis, Publishing House Willey, USA
- X. Zhang (2018): LTE Optimization Engineering Handbook Publishing House Willey, USA

- J. Pentinnen (2016): The LTE-Advanced Deployment Handbook, Publishing House Willey, USA
- E. Dahlman, S. Parkvall, J. Skold (2018): 5G NR: The Next Generation Wireless Access Technology 1st Edition, Publishing House Academic Press Elsevier
- S. Boyd, L. Viedenberghe (2004): Convex Optimization, Publishing House Cambridge, USA

Course: Advanced Communication Networks

Lecturer: Prof. Dr. Mimoza Ibrani

Course status: Mandatory, Semester I, 6 ECTS

Course content: Basic techniques for modeling and analyzing communication networks. Fairness and utility functions, routing, congestion control, pricing, queuing models, loss networks, multi-class queues and scheduling. IP traffic generation, TCP connection control. Packet filtering; Network monitoring and management; TCP connection management scheme and congestion control mechanisms. Multimedia Networking and Protocols for Real-Time Interactive Applications. Design issues for high speed networks including network characterization, application performance guarantees, traffic policing and congestion control. Introduction to techniques for performance modeling and analysis of computer systems and communication networks. Analysis of measurements. Performance Study: estimating one or more metrics via measurement, simulation and analysis. Fairness and network utility maximization. . Optimization based routing and congestion control. Basic queueing models and their application to switching and scheduling in networks. Quality of Service, reliability and availability.

Course objectives: Develop understanding of some fundamental techniques used to model and analyze communication networks. Learn about network management and monitoring. Develop analytical tools to analyze the performance of various networks. More importantly, understanding this material can help one to develop intuition about some of the important issues in networking and provide the background needed to carry our research in this field.

Learning outcomes: After successful completion of the course, students should be able to:

- Understand the analytical tools and conceptual models used in network performance analysis.
- Select appropriate network performance evaluation techniques.
- Organize experiments for measurement or simulation-based network performance study.
- Utilize statistical techniques to compare performance results from several alternatives.
- Use a simulation tool to conduct a network performance study.
- Compare different solutions for given information networks.

Teaching methodology: Lectures for theoretical aspects, laboratory exercises and team-work for real-case scenarios and problem solving through project work.

Evaluation methods and criteria: Project based work 30%, Homework and attendance 10 %, Mid-term evaluation 30%, Final evaluation 30%, Total: 100 %

Concretization tools/ IT: Computer, projector and different apps for lectures. State of the art computer communication and multimedia lab to support course activities.

Literature:

- Thomas Bonald, Mathieu Feuillet "Network Performance Analysis ", Willey, 2011
- Kurose, J. F., & Ross, K. W. (7th Edition) (2016). *Computer networking: a top-down approach*.
- Selected survey and original papers published in ISI indexed journals

Course title:Theory and Coding techniques

Lecturer: Prof. Ass. Dr. Zana Limani

Course status: Mandatory, Semester I, 6 ECTS

Course description: Introduction: Review of probability theory; basic concepts of information theory: uncertainty, information, and entropy, mutual information, channel capacity, information rate, Shannon's noiseless coding theorem and Shannon's fundamental coding theorem; modelling of information sources: zero-memory and Markov models; modelling of information channels: binary symmetric channel (BSC) and binary erasure channel (BEC) channels, additivity of information and cascaded channels; construction of compact source codes: Kraft inequality, compact codes, Data compression, Huffman and Lempel-Ziv-Welch (LZW) compression codes; analysis and design of error-control channel codes: Hamming distance, binary linear codes and the parity-check matrix, Hamming codes, cyclic codes and cyclic redundancy codes (CRC).

Course objectives: The main purpose of this course is to introduce students with the basic concepts of information theory, to provide them with an overview of the different coding techniques and their fitness for a specific application.

Learning outcomes: On successful completion of this course the student will be able:
-to analyze the fundamental parameters relevant to information theory,
-Compare and Contrast codes capable of correcting a specified number of errors,
-Explain the operating principles of block codes, cyclic codes and convolutional codes,
-Implement an error correcting code for a given application,
-Recognize the fundamental limits of error correction.
Teaching methodology: lecture, discussion, seminar paper.
Evaluation Methods: Seminar paper: 40%. Attendance 5%, Final Exam: 55%
Concretization tools/ IT: Computer, projector and white board.
Ratio between theoretical and practical part: Ratio between practical and theoretical part 50%/50%

Literature:

- Essentials of error-control coding, Jorge Castiñeira Moreira, Patrick Guy Farrell, 2006 John Wiley & Sons Ltd.
- Fundamentals of Information Theory and Coding Design, Roberto Togneri, Christopher J.S. deSilva, 2005 Chapman &Hall/CRC.
- Telecommunications Demystified, Carl Nassar, by LLH Technology Publishing, 2001.

Course: Applied digital processing

Lecturer: Prof. Ass. Dr. Hena Maloku

Course status: Mandatory, Semester I, 6 ECTS

Short description: The rapid development in the field of integrated circuits has had a significant impact on digital signal processing methods. Knowledge digital processing fundamentals has become essential in all disciplines where there is a need for signal processing, such as wireless communications, biomedical engineering, audio/video signal processing. This course introduces students to the concept and basic principles of discrete-time processing. Concepts are illustrated through examples of algorithms and standardized technologies.

Course objectives: The objective of this course is to provide the students with knowledge about signal processing techniques, and their application in various fields of engineering.

Expected Learning Outcomes: After successful completion of this course, the student will be able to:

- understand the concepts of sampling and over sampling, A / D quantization and conversion, digital filtering, Discrete Fourier Transform and FFT
- Implement digital filters according to the application
- assess the application of digital processing techniques for various purposes, such as audio / video signal processing, biomedical signal processing, application of digital filters to wireless networks and autonomous vehicles, etc.

Teaching Methods: Lectures, discussions, laboratory, seminar.

Assessment Methods and Criteria: Lab work: 15%, First intermediary assessment 15%, Second intermediary assessment 20%, Attendance and active participation in class and seminars 10%, Final exam: 40%, Total: 100 %.

Teaching tools/IT: Computer, projector, whiteboard, and computer lab equipped with adequate software.

Ratio between theoretical and practical parts of the course: 3:1

Primary literature:

- Hayes M.; "Statistical Digital Signal Processing and Modeling", John Wiley & Sons, Inc., 1996.
- Manolakis D. G., Ingle V. K.," Applied Digital Signal Processing: Theory and Practice", Cambridge University Press, New York, 2011.

Course: Wireless Communications I (Radio wave propagation)

Lecturer: Prof. Dr. Luan Ahma

Course status: Mandatory, Semester I, 6 ECTS

Course content: Introduction. Modes of propagation – Line of sight propagation, NON LOS propagation. Atmospheric effects – atmospheric refraction, the radio horizon, ducting, atmospheric attenuation. Wave propagation in ionosphere. Communication Systems and the Link Budget-path loss, Near earth propagation models-Weissberger's model, ITU model, Egli model, Longley-Rice model. Propagation in built-up areas – Young model, Okumura model, Hatta model, COST 231 model, Lee model. Outdoor propagation models – empirical path loss models, the Okumura-Hata model, the COST 231 –Hata model, the Ikegami model. Fading and multipath characterization – large scale or normal fading, Surface Roughness, Fresnel Zones, diffraction, Quantifying Diffraction Loss. Small scale fading – delay spread, Doppler spread, channel modeling. Indoor Propagation Models – Interference, indoor propagation effects, indoor propagation modeling.

Course objectives: The goal of the course is to introduce the basic principles of radio wave propagation, especially in analysis of events in radio channel during propagation in ideal and real conditions.

Learning outcomes: After successful completion of the course, students should be able to:

- Describe basic principles of radio wave propagation
- Elaborate all phenomenon's that are affecting on the quality of the transmission of information on the radio channel.
- Explain influence of the atmospheric conditions in radio wave propagation,
- Apply gained knowledge of wave radio propagation in other professional courses
- Write a research seminar paper on RF propagation based on case-study

Teaching methodology: Lectures for theoretical aspects, numerical exercises and team-work for real-case scenarios and problem solving through project work. Study visits and industry invited lecturers.

Evaluation methods and criteria: Homework and attendance 10 %, Mid-term evaluation 30%, Final evaluation 30%, Seminar 30 %, Total: 100 %.

Concretization tools/ IT: Computer, projector and different apps for lectures. State of the art computer communication lab for laboratory exercises.

Ratio between theoretical and practical part: Ratio between practical and theoretical part 50%/50%

Literature:

- Th. Rappaport, *Wireless communications*, *Principles and Practice*, 2nd edition Prentice Hall, New Jersey, 2019.
- J. Seybold, *Introduction to RF propagation*, John Wiley & Sons, Inc. New Jersey, 2005.
- Ch. Haslett, *Essentials of radio wave propagation,* Cambridge University Press, New York, 2008.

Course: Software defined radio

Lecturer: Prof. Ass. Dr. Hena Maloku

Course status: Mandatory, Semester II, 6 ECTS

Course description: this course is designed for students that have a background in signal & systems and computer engineering area, and also for students that have knowledge in communication systems.
The course contains theoretical explanations about different devices that comprise a communication system, and also practical examples that helps in understanding of theoretical concepts.

Course goal: The purpose of this course is to provide a hands-on learning experience using SDR for engineering students. This course offers an advanced perspective on understanding and creating communication systems from the initial steps of building such a system.

Learning outcomes After successful completion of the course, students should be able to:

- Understand the basic concepts of communication systems and SDR technology,
- Explain concepts that are related with digital signal processing, filters design and their application in communication systems and digital communication principles: modulation, digital transmissions and receiver structure,
- Understand SDR hardware,
- Implement and analyze a communication system,
- Implement and investigate some equalization methodology

Teaching methodology: Lecturer, research-based learning and presentations
Evaluation methods and criteria: Seminar and presentation: 40%, mid-term exam; 20%, attendance 10%, final exam: 30%.
Concretization tools/ IT: Computer, projector and different software tools for lectures.
Ratio between theoretical and practical part: Ratio between practical and theoretical part 50/50%.

Literature:

- Travis F. Collins, Robin Getz, Di Pu, and Alexander M. Wyglinski; "Software-Defined Radio for Engineers" Artech House, ISBN-13: 978-1-63081-457-1, 2018
- T. Reymund "Software Defined Radio with User Interface" Vienna 2008
- T Rouphael. "Rf and Digital Signal processing for Software Defined Radio'' Elsevier 2009

Course title: Wireless Communications 2

Teacher: Prof. Dr. Enver Hamiti
Course status: Mandatory, Sem. II, 6 ECTS

Course content: Introduction to wireless communication systems. Modern wireless communication systems, 1G, 2G, 3G and 4G. The cellular concept –System design fundamentals. Modulation techniques for mobile radio. Equalization, diversity and channel coding. Multiple access techniques for wireless communications.

The goal: The purpose of the course is to provide students with fundamental treatment about practical and theoretical concepts of wireless communications.

Learning outcomes: On completion of this course, students will be able to:
-Describe fundamental knowledge about wireless communications.
-Solve theoretical and practical problems
-Analyze different aspects of implementation in wireless communications and propose solutions.
Methods of teaching: 30 hours of lectures + 30 hours of auditorial exercises. Approximately 90 hours of personal study and exercise, including seminars.
Grading System
Seminar 10%, Intermediate assessment, 30 %, Final Exam 60 %
Concretization tools: Computer, video projector, and internship in industry (PTK, 3CIS, Interadria), **to** illustrate all teaching material.

Literature:

- Theodore S. Rappaport, "**Wireless Communications" ,** Principles and Practice, Prentice Hall,Inc., 2002
- Andreas F Molisch, **"Wireless Communications"** - Wiley – IEEE, 2nd Edition, © 2011 John Wiley & Sons Ltd.
- David Tse, Pramod Wiswanath " **Fundamentals of Wireless Communications"** Cambridge university press, 2005
- S. Haykin and M. Moher "**Modern Wireless Communications**", Prentice Hall,Inc., 2005 .

Course: Wireless communications lab

Lecturer: Prof. Ass. Dr. Zana Limani
Course status: Elective, Sem. II, 5 ECTS

Short description: Introduction to software defined radio communications. Analysis of communication channels when using modulation schemes such as PSK and QAM. Advanced modulation techniques such as OFDM and DSSC. Signal representation in time and frequency domain. Analysis and design parameters for communication systems. Signal processing with different sampling speed. Modeling of communication systems in MATLAB. Practical implementation of simple communication systems.

Course objectives: The objectives of this course are to provide students with theoretical and practical knowledge regarding radio communications and performance evaluation of wireless communication systems.

Expected Learning Outcomes: After successful completion of this course, the student will be able to:

- Recognize advanced modulation techniques
- Classify signal processing techniques with varying sampling speed
- Apply signal processing techniques in wireless communications
- Conduct simulations of simple wireless communication systems

Teaching Methods: Lectures, discussions, laboratory, seminar.
Assessment Methods and Criteria: Lab work: 35%, First intermediary assessment 15%, Second intermediary assessment 15%, Attendance and active participation in class and seminars 10%, Final exam: 25%, Total: 100 %.
Teaching tools/IT: Computer, projector, whiteboard, and computer lab equipped with adequate software.
Ratio between theoretical and practical parts of the course: 1:1

Primary literature:

- T. Reymund "Software Defined Radio with User Interface" Vienna 2008
- T Rouphael. "Rf and Digital Signal processing for Software Defined Radio'' Elsevier 2009

Course Name: Advanced Communication Networks Lab

Lecturer: Prof. Ass. Dr. Zana Limani, Mr. Sc. Fatos Peci
Course status: Elective, Sem. II, 5 ECTS

Short description: This course describes wireless sensor and actuator networks and protocols applied in these networks. Special attention is paid to the principles, architecture and protocols of industrial communications.
Purpose of the course: The purpose of this course is to gain theoretical and practical knowledge about fundamental wireless sensor and actuator networks. One of the basic technologies in industrial communications, IEEE 802.15.4 standard that describes, physical (PHY), medium access control (MAC) and various upper layer protocols will be elaborated, focusing on differences between various technologies such as Wireless Hart, Zigbee, ISA100, Bluetooth etc. Furthermore, through the lab exercises, such concepts will be implemented and demonstrated.
Expected outcomes from studying this course: After finishing this course student will be able to:

- Upon completion of this course, the student will be able to:
- Identify and explain various technologies and protocols that are elaborated during the course.
- Illustrate and examine communication topologies and cluster based network protocols.
- Investigate performance of the communication link for various use-cases and scenarios.
- Investigate and compare network lifetime of sensor nodes for various protocols such as low energy adaptive clustering hierarchy (LEACH), flooding algorithms and hierarchical routing.
- Implement technologies, protocols, standards in IoT networks.

Teaching methodology: Lecture and Lab exercises.
Evaluation methods and pass criteria: The successful exercise work: 20%,
First intermediate evaluation; 35%,
Second intermediate evaluation:35%,
Regular attendance and involvement in discussions 10%,
Total 100%.
Tools for lectures and lab/ IT: Computer/Laptop, Projector, Lab equipment and Python
Theoretical vs Practical rapport of course study: 1:2
Primary Literature:

- Roberto Verdone, Davide Dardari, Gianluca Mazzini, Andrea Conti, Wireless Sensor and Actuator Networks: Technologies, Analysis and Design, Academic Press, 27 Jul 2010.
- Richard Zurawski, Industrial Communication Technology Handbook, ISA Group, 2015, San Francisco California, USA.Doyle, J. , Caroll, J(2016): Routing TCP/IP, Volume II, USA

Course: Advanced programming for ICT

Lecturer: Prof. Ass. Dr. Zana. Limani
Course status: Elective, Semester II, 5 ECTS

Short description: This course will introduce students to the application of software in the field of ICT, with particular emphasis on the application of software packages for simulation, design and performance evaluation of communication systems. Topics to be covered include: modeling of digital communication systems, basic concepts from estimation theory and its application to communication systems simulation, semi-analytical techniques for error probability estimation, and simulation and modeling of advanced modulation techniques and transmission.
Course objectives: The purpose of this course is to enable students to use software tools for modeling, analysis and design of communication systems in the physical layer, both theoretically and practically.
Expected Learning Outcomes: After successful completion of this course, the student will:

- explain the basic modeling techniques and the basic blocks of communication systems
- compare and contrast the different techniques for evaluating the performance of a communication system
- be able to utilize various software tools for simulating and modeling communication systems.
- implement and optimize a communication system through these software tools.

Teaching Methods: Lectures, discussions, laboratory, seminar.
Assessment Methods and Criteria: Lab work: 35%, First intermediary assessment 15%, Second intermediary assessment 15%, Attendance and active participation in class and seminars 10%, Final exam: 25%, Total: 100 % .
Teaching tools/IT: Computer, projector, whiteboard, and computer lab equipped with adequate software.
Ratio between theoretical and practical parts of the course: 1:1

Primary literature:

- Michel C. Jeruchim, Philip Balaban, K. Sam Shanmugan, "Simulation and Software Radio for Mobile Communications", ISBN: 1580530443, Artech House (Fitchburg, MA, USA), 2002.

Course: Image processing and computer vision

Lecturer: Prof. Ass. Dr. Hena Maloku
Course status: Elective, Semester II, 5 ECTS

Course description: The course is designed to give the graduate students all the fundamental concepts in digital image processing with emphasis in filtering, enhancement, restoration, compression, segmentation and recognition of images.
In this course, lots of technology will be explored and will learn to understand and rebuild the complex visual world. Computer vision is designed for students who are interested in learning about basic principles and important computer vision applications.

Course goal: This course aims to teach students basic concepts in digital image processing and computer vision, algorithms that can diagnose medical images; modern AI applications that can perceive, understand and rebuild the complex visual world.
Learning outcomes After successful completion of the course, students should be able to:

- Describe image formation and the role human visual system plays in perception of grey and color image data;
- Distinguish various applications of image processing in industry, medicine, and defense;
- Classify the signal processing algorithms and techniques in image enhancement and image restoration;
- Acquire an appreciation for the image processing issues and techniques and apply these techniques to real world problems; and
- Demonstrate independent study and analysis of image processing problems and techniques.

Teaching methodology: Lectures, discussions, seminars.
Evaluation methods and criteria: seminar: 40%, mid-term exam; 20%, attendance 10%, final exam: 30%.
Concretization tools/ IT: Computer, projector and laboratory.
Ratio between theoretical and practical part: Ratio between practical and theoretical part 50/50%.
Literature:

- Digital Image Processing: Practical Approach. B. Furht, E. Akar, A. Andrews, Springer 2018, ISBN: 3319966332, 9783319966335
- Digital Image Processing. R. C. Gonzalez, R. E. Woods, 4th Edn, Pearson 2017. ISBN-10: 1292223049, ISBN-13: 978-1292223049.
- Introduction to Visual Computing: Core Concepts in Computer Vision, Graphics, and Image Processing. A. Majumder, M. Gopi, CRC Press 2018. ISBN: 978-1-4822-4491-5, 1482244918.
- Computer Vision, Pattern Recognition, Image Processing, and Graphics. R. Rameshan, C. Arora, SD. Roy, Springer Singapore 2018, ISBN: 978-981-13-0019-6,978-981-13-0020-2
- Computer Vision and Graphics", LJ. Chmielewski, R. Kozera, A. Orłowski, K. Wojciechowski, AM. Bruckstein, N. Petkov, Springer Publishing 2018. ISBN: 978-3-030-00691-4;978-3-030-00692-1

Course: 3D Animation

Lecturer: Prof. Ass. Dr. Hena Maloku
Course status: Elective, Semester II, 5 ECTS

Course description: This course focuses on advanced work in the practical principles and techniques of 3D software animation environments. Includes quad mesh design and editing for complex motions, shading techniques and lighting, different camera projection models, rendering techniques, and efficient use of GPU resources for photo realistic real-time 3D animation.

Course goal: the purpose of this course is to enhance student's skills in creation of 3D animation through different software.

Learning outcomes: By the end of this course, students will be able to:

- Demonstrate a complete workflow for 3D character animation in film and game industry.
- Articulate the differences between animation pipelines for films and for video games.
- Complete a simple dynamic simulation in Maya.
- Create a key framed animation with a complex body motion.
- Export game-biped animation for video games.

Teaching methodology: Lectures, discussions, seminars.
Evaluation methods and criteria: seminar: 40%, mid-term exam; 20%, attendance 10%, final exam: 30%.
Concretization tools/ IT: Computer, projector and laboratory.
Ratio between theoretical and practical part: Ratio between practical and theoretical part 50/50%.

Literature:

- Mastering Autodesk Maya 2016: Autodesk Official Press. T. Palamar, Sybex 2015. ISBN-10: 1119059828, ISBN-13: 978-1119059820.
- Essential skills for 3D modeling, rendering, and animation. NB. Zeman, Taylor & Francis 2015. ISBN: 9781482224122, 1482224127, 1482224143, 9781482224146.
- 3D animation for the raw beginner using Maya. R. King, Taylor & Francis 2015. ISBN: 9781482249255, 1482249251.

Course: Advanced Project management in ICT

Lecturer: Prof. Ass. Dr. Driton Statovci
Course status: Elective, Semester II, 4 ECTS

Course content: This course will outline advanced project management methods and strategies, including tools and techniques used for project management in the area of information and communication technology (ICT).

Course objectives: The purpose of this course is to provide the student with the necessary knowledge, skills and competencies to initiate, evaluate, plan, control and successfully complete ICT projects under predefined processes. Additionally, the student will expand and deepen his/her knowledge about modern methods and techniques used in project management as well as specifics of managing research projects.

Learning outcomes:
Upon completion of this course the student will be able to:

- Describe how to start, evaluate, plan, execute, control and successfully complete projects;
- List the tools and techniques used to manage ICT projects;
- Outline the importance of project management in a structured manner;
- Implement project plans for project scenarios that includes key tasks, critical paths, dependencies, timeframes, and budget analyses;
- Discuss the project management strategies and concretize them through a case study during planning of an actual project;
- Understand the specifics of managing research projects.

Teaching methodology: Lectures, discussions, case studies, seminar work and practical project management examples.
Evaluation methods: Seminar work: 40%; Regular attendance and involvement in discussions: 10%; Final oral exam: 50%, Total: 100%.
Concretization tools/IT: Computer, projector, project management case studies from the field of ICT.
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 1:1.

Literature:

- Samuel J. Mantel Jr., Jack R. Meredith, Scott M. Shafer "Project Management: A Strategic Managerial Approach," Wiley; 10-th edition, Dec. 2017, ISBN-13: 978-1119369097.
- Celia Desmond, "The ComSoc Guide to Managing Telecommunications Projects," Wiley-IEEE Press, May 4, 2011, ISBN-13: 978-0470284759.
- Harold Kerzner, "Project Management: Case Studies," Wiley; 4-th edition, Feb. 2013, ISBN-13: 978-1118022283.
- Different literature (scientific papers, case studies) about the management of research projects.

Course: Methodology of scientific research in ICT

Lecturer: Prof. Dr. Mimoza Ibrani
Course status: Elective, Semester II, 4 ECTS

Course content:
Research methodology: An Introduction Meaning of research, Objectives of research, Motivation in research, Types of research, Research methods vs. methodology, Research process, Science vs. pseudoscience?! Defining the research problem & research design. Techniques involved in defining a problem, Meaning and need of research design, Different research design, Basic principles of experimental design, developing a research plan. Types of publications, Measures of research impact, Bibliographic databases, Literature review, Reference managers, Patents. Scientific writing, Manuscripts: research papers and review articles. Research ethics, Intellectual properties, Authorship. Conference Communication: Poster and Conference Abstracts, Oral presentations. Scientific assignments: Draft a manuscript, review colleague's manuscript, present a paper on course mini-conference.

Course objectives: To inform students with basics principles of research and scientific methods in engineering and ICT. To give the students the theoretical and practical skills to plan, conduct, analyze and present a scientific assignment in the area of their expertise.
Learning outcomes: After successful completion of the course, students should be able to:

- Identify basic principles of scientific thinking and research
- Explain and apply scientific methodologies in engineering
- Practice searching bibliographic databases, gather and interpret data, summarize others work
- Prepare and present the scientific paper
- Perform opposition and review others scientific work

Teaching methodology: Lectures for theoretical aspects, practical assignment on manuscript writing, manuscript review and paper presentation.
Evaluation methods and criteria:
Intermediary exam -25 % of grade; Final exam -35% of grade; scientific assignments –40 % of grade: Manuscript drafting 20 %; Manuscript reviewing 10 %; Conference presentation 10 %
Concretization tools/ IT: Computer, projector and different software applications for lecture and exercises
Ratio between theoretical and practical part: Ratio between practical and theoretical part 50%/50%

Literature:

- Kothari B.L., (2009). "*Research Methodology: Tools and Techniques*", New Age International
- Publishers,
- Booth, W. C., Colomb, G. G., & Williams, J. M. (2008). *The Craft of Research*. University of Chicago Press.
- Journal and conference papers

Course: Regulation and standardization in ICT

Lecturer: Prof. Asoc. Dr. Bujar Krasniqi
Course status: Elective, Semester II, 4 ECTS

Course content: This course describes standardization in ICT field, including standardization bodies. Also, important part of the course are ICT regulation issues such as> spectrum management, interconnection and competition. The last part of the course is focused on exploring directives for regulation

Course objectives: The purpose of this course is that the student during lectures and practical application expand and deepen their knowledge for standardization bodies and the ways how they coordinate. Also, spectrum management regulation, interconnection and competition as well as content liability distributed over ICT infrastructure.

Learning outcomes: Upon completion of this course the student will be able to:

- distinguish the necessity for standardization and standardization bodies
- describe issues of spectrum regulation, interconnection and competition
- apply in practice methodologies for analyzing and monitoring of spectrum usage
- describe issues related to content liability transmitted over ICT infrastructure
- interpret law of electronic communication

Teaching methodology: Lectures, Discussion, practice work.
Evaluation methods: The successful practical work: 20%, First intermediate evaluation; 35%, Second intermediate evaluation:35%, Regular attendance and involvement in discussions 10%, Total: 100 %.
Concretization tools/IT: Computer, projector
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 80:20

Literature:

- Walden (2018): Telecommunication Law and Regulation, 5th Edition, Publishing House "Oxford", UK
- Gentzoglanis, A. Henten (2010): Regulation and the Evolution of the Global Telecommunications Industry, Publishing House Edward Elgar, UK

Course: Internet of Things

Teacher: Prof. Asoc. Dr. Bujar Krasniqi
Course status: Elective, Semester II, 4 ECTS
Course description: Internet of Things (IoT) provides advanced data collection, connectivity, and analysis of data information, which thing has lead Machine-to-Machine communication concepts further than ever before. This course includes explanations of the architecture and design of software and hardware solutions for Internet of Things, and the application of these solutions in many areas. This course integrates the fields of Electronics, Information Technology and Communication and Management of potential IoT products.
Course goals: This course describes the basic concepts, including the components, tools and analysis behind IoT. Student will understand the software and hardware solutions needed to create Internet of Things products. They also will understand the features of wireless components, communications networks, protocols, costs and performance of Internet of Things platforms.
Expected Learning Outcomes:

- Explain the architecture and characteristics of IoT.
- Describe the limitations, opportunities, and differences between technologies that support IoT.
- Explain IoT communication protocols.
- Discuss the architecture, operations and business benefits of IoT solutions.
- Explore the relationships between IoT, cloud computing, and big data.
- Apply acquired knowledge to connect IoT devices.
- Apply acquired knowledge to implement IoT solutions for different application areas.

Teaching Methods: Lectures, exercises during class using different materials, one final project work in group of 3 students (independent work), individual homework.
Evaluation methods:

- Course pass limit is 60%
- Student Attendance 10%
- Individual assignments completed at home 20%
- Two tests 20% + 20%
- Final exam 60%
- Final project 30%.
- Total: 100 %.

Tools / IT: Computer, projector, table, lab equipped with other equipment according to projects and tasks.
The ratio between the theoretical and practical part of the study: The ratio between the theoretical and practical part is 3:1.
Literature:

- David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry (2017.), IoT Fundamentals, Cisco Press
- Arshdeep Bahga, Vijay Madisetti (2014.), Internet of Things: A Hands-On Approach, VPT
- Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms 1st Edition, 2016

Course: Networks and Communications Security

Lecturer: Prof. Asoc. Dr. Bujar Krasniqi
Course status: Mandatory, Semester III, 6 ECTS

Course content: This course describes the basics of Networks and Communications security beginning with network security fundamentals, continuing with security of mobile communication, ending with security systems for various wireless technologies and applications

Course objectives: The purpose of this course is that the student during lectures and discussion during presentation expand and deepen their knowledge for Networks and Communications Security and issues related to that. Also, student will examine network security basics, security of mobile networks (2G, 3G, 4G, 5G), IoT security, ITS security, Wireless payment security and other platforms functionality.
Learning outcomes: Upon completion of this course the student will be able to:

- describe networks and communications security fundamentals
- distinguish mobile communications security from 2G to 5G
- Compare and contrast wireless security platforms and their functionality
- Differentiate security mechanisms for IoT, ITS systems

Teaching methodology: Lectures, Discussion, Presentation work.
Evaluation methods: The successful practical work: 30%, First intermediate evaluation; 30%, Second intermediate evaluation:30%, Regular attendance and involvement in discussions 10%, Total: 100 %.
Concretization tools/IT: Computer, projector.
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 75:25

Literature:

- M. Ciampa "Security+ Guide to Network Security Fundamentals" Sixth Edition Cengage 2018
- N. Boudriga "Security of Mobile Communications" CRC Press 2010
- M. Liyanage "A Comprehensive Guide to 5G Security" 1st Edition Wiley 2018
- J. Penttinen "Wireless Communications Security" Solutions for the Internet of Things Wiley 2017
- M. Whitman, H. Mattord (2018): Principles of Information Security, 6th Edition, Publishing House "Cengage", USA.
- M. Whitman, H. Mattord (2018): Principles of Information Security, 6th Edition, Publishing House "Cengage", USA.
- J. Vacca (2017): Computer and Information Security, 3rd Edition, Publishing House Elsevier, USA

Course: Cognitive Radio

Lecturer: Prof. Ass. Dr. Zana Limani
Course status: Elective, Semester III, 6 ECTS

Short description: The rapid development of information technology and the increasing number of portable devices in use, has caused a significant increase in the demand for internet access at any time and from any location. As a consequence, wireless networks are increasingly facing lack of frequency spectrum. Next generation networks must accommodate these demands through efficient management of resources and application of new technologies such as cognitive radio and software defined radio (SDR). The combination of intelligent methods for spectrum access and cognitive radios has opened up several research paths and opportunities for further development.

Course objectives: The purpose of this course is to provide the student with knowledge about the work of cognitive radios and SDRs and the operation of heterogeneous wireless cognitive networks.
Expected Learning Outcomes: After successful completion of this course, the student will be able:

- distinguish between long-term static spectrum access and dynamic and opportunistic access
- Describe the working concepts of cognitive radios and SDRs
- know the architecture of wireless cognitive networks
- to perform a simple analysis for detecting primary users
- demonstrate knowledge of MAC protocols developed for cognitive networks
- be familiar with standards on cognitive radios, SDRs and cognitive networks.

Teaching Methods: Lectures, discussions, laboratory, seminar.
Assessment Methods and Criteria: Lab work: 15%, First intermediary assessment 15%, Second intermediary assessment 20%, Attendance and active participation in class and seminars 10%, Final exam: 40%, Total: 100 %.
Teaching tools/IT: Computer, projector, whiteboard, and computer lab equipped with adequate software.
Ratio between theoretical and practical parts of the course: 3:1

Primary literature:

- L. E. Doyle, "Essentials of Cognitive Radio". Cambridge: Cambridge University Press, 2009.
- Di Benedetto M-G, Catton A. F., Fiorina J., Bader F., De Nardis L., "Cognitive Radio and Networking for Heterogeneous Wireless Networks:. Springer, 2015.
- Setoodeh P., Haykin S., "Fundamentals of Cognitive Radio". John Wiley & Sons, Inc., 2017.

Course: Vehicular Communications

Lecturer: Prof. Ass. Dr. Hena Maloku
Course status: Elective, Semester III, 6 ECTS

Short description: This course will introduce students to emerging communication technologies, in particular their application in vehicular communication networks, also known as VANETs. Topics such vehicle mobility modeling, vehicular technologies and communications standards in the physical and network layers, will be addressed. Examples of emerging applications of vehicular communications in Intelligent Transportation Systems will also be studied and discussed.
Course objectives: The objectives of this course are to familiarize the student with wireless communications between vehicles (V2V) as well as between vehicles and infrastructure (V2X). The student will be acquainted with emerging standards for these types of communications and discuss open challenges.
Expected Learning Outcomes: After successful completion of this course, the student will be able to:

- Describe the basic principle, architecture and standards related to VANETs.
- Analyze, implement, and assess vehicular communication platforms and their application in various fields such as security and general communication.

Teaching Methods: Lectures, discussions, laboratory, seminar.
Assessment Methods and Criteria: Lab work: 15%, First intermediary assessment 15%, Second intermediary assessment 20%, Attendance and active participation in class and seminars 10%, Final exam: 40%, Total: 100 % .
Teaching tools/IT: Computer, projector, whiteboard, and computer lab equipped with adequate software.
Ratio between theoretical and practical parts of the course: 3:1

Primary literature:

- C. Sommer, F. Dressler, Vehicular Networking, Cambridge University Press, 2015.
- M. Emmelmann, B. Bochow and C. C. Kellum, Vehicular Networking: Automotive Applications and Beyond, Wiley, 2010.
- H. Moustafa, Y. Zhang, Vehicular Networks: Techniques, Standards, and Applications, CRC Press, 2009

Course title: Selected topics in multimedia communications

Lecturer: Prof. Ass. Dr. Hena Maloku
Course status: Elective, Semester III, 6 ECTS

Course description: Introduction of international standards. Image coding: DCT/subband/VQ. Image coding: JPEG. Video coding: ITU-T H.261, H.263, H.263 Version 2. Video coding: ISO MPEG-1, MPEG-2. MPEG audio coding. ITU-T speech coding: G.72x. MPEG-4 Video. Systems: ITU-T H.320, H.323, H.324, etc. MPEG-4 Systems. Networking issues: error resilience, network characteristics, Quality of Service (QoS). Error resilience in video codecs: H.26x and MPEG. Multimedia over IP: Multimedia over ATM. Multimedia over wireless/mobile networks

Course goals: This course introduces technologies for multimedia communications. We will address how to efficiently represent multimedia data, including video, image, and audio, and how to deliver them over a variety of networks. In the coding aspect, state-of-the art compression technologies will be presented. Emphasis will be given to a number of standards, including H.26x, MPEG and JPEG. In the networking aspect, special considerations will be given for sending multimedia over ATM, wireless, and IP networks, such as error resilience and quality of services. The H.32x series, standards for audiovisual communication systems in various network environments, will be described. Current research results in multimedia communications will be reviewed through student seminars in the last weeks of course.
Learning outcomes: At the end of the course the student will be able to:

- memorize an excellent understanding of multimedia enabling technologies, services and applications,
- describe basic Internet concepts and protocols; analyze analog and digital video signals and systems,
- Interpret the fundamental video processing techniques; acquire the basic skill of designing video compression,
- familiarize himself/herself with video compression standards,
- sketch the basic techniques in designing video transmission systems: error control and rate control.

Teaching methodology: Problem-based learning and Project-oriented approach.
Evaluation methods and criteria: 70% project/seminar work, 30 % presentation.
Concretization tools/ IT: Computer, projector and different apps for lectures.

Literature:

- R. Steinmetz and K. Nahrstedt, Media Coding and Content Processing, Prentice Hall, 2002,
- G. Lu, "Communication and Computing for Distributed Multimedia Systems", Artech House, 1996,
- R. Steinmetz and K. Nahrstedt, Multimedia: Computing, Communications and Applications, Prentice Hall, 1995,
- P. K. Andleigh and K. Thakrar, Multimedia Systems Design, Prentice Hall, 1996.

Course: Special topics in Communications and Networking

Lecturer: Prof. Dr. Mimoza Ibrani
Course status: Elective, Semester III, 6 ECTS

Course content: The course adopts a broad approach, where a student is encouraged to adopt the area as per the interest. Problem-based learning and Project-oriented approach will be adopted. We will be studying from many research papers. The core theme of the course is wireless communication and networking. The course is run in a seminar style with a project component. Groups of 2-3 students will work on a project related to the course topics. Students are expected to pick a topic, read papers, implement and evaluate a system or propose and analyze a novel mechanism. Few of topics include: Ultra wide band communications, Personal Area Networks, IoT, Experimental assessment of Radio Frequency Electromagnetic Field Expose to emerging wireless systems and technologies, Multiparametric network planning and optimization etc. The topics will be either the ones emerged as hot topics in the industrial communications community in the last few years or which could be worthwhile research topics in the next few years.

Course objectives: The goal of the course is to introduce concepts, tools and methodologies in communications and networking research, and how to apply them to solve practical and emerging problems.
Learning outcomes: After successful completion of the course, students should be able to:

- Refine their skills of quickly familiarizing themselves with new material.
- Extracting relevant details, and presenting their results orally as well as in writing.
- Modeling a communication network/system with software tool.
- Experimental setup building and demonstration relevant to the topic.
- Survey the state of the art in relevant research field and identify potential knowledge gaps.

Teaching methodology: Problem-based learning and Project-oriented approach.
Evaluation methods and criteria: 70% project/seminar work, 30 % presentation.
Concretization tools/ IT: Computer, projector and different apps for lectures. Computer communication and multimedia labs to support course activities.
Ratio between theoretical and practical part: Ratio between practical and theoretical part 0/100%.

Literature:
There is no text book for the course. The material would be covered from research papers from leading conferences and journals.
Some of the publication venues we plan to explore are from:

- ISI Web of Science
- IEEE Communications Society
- Elsevier and Springer

Course: MmWave Communications

Lecturer: Prof. Dr. Luan Ahma
Course status: Elective, Semester II, 6 ECTS

Course content: Millimeter Wave Wireless Communications and Implementation challenges. Emerging Applications of MmWave Communications. Wireless Communication Background. Radio Wave propagation for MmWave: Large-Scale Propagation Chanel Effects, Small -Scale Chanel Effects, Spatial Characterization of Multipath and Beam Combining. Outdoor Chanel Models, including Vehicle to Vehicle models. Indoor Chanel Models: Ray-Tracing, Rayleigh, Rician and Multiwave Fading Models. IEEE 802.15.3c and IEEE 802.11ad Chanel Models. Antennas and Arrays for MmWave Applications. MmWave devices and circuits. MmWave Applications. 60 GHz Spectrum regulations, Wireless HD.

Course objectives: Gain knowledge of mmWave communications, implementation challenges propagation effects and emerging applications.
Learning outcomes: After successful completion of the course, students should be able to:

- List potential MmWave emerging applications.
- Identify MmWave implementation challenges.
- Elaborate Radio Wave propagation effects for MmWave.
- Conduct comparative analysis of MmWave channel models for outdoor and indoor environments.
- Explain MmWave devices, circuits and standards.

Teaching methodology: Lectures for theoretical aspects, case studies/research papers for practical part of course.
Evaluation methods and criteria: Mid-term evaluation 30%, Final evaluation 30%, Seminar 30%, Attendance and homework 10 %, Total: 100 %.
Concretization tools/ IT: Computer, projector for lectures.
Ratio between theoretical and practical part: Ratio between practical and theoretical part 50%/50%

Literature:

- T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. Murdock, *Millimeter Wave Wireless Communications*. Prentice Hall, September 2014.
- Research papers.

Course: Satellite Communications

Lecturer: Prof. Asoc. Dr. Bujar Krasniqi
Course status: Elective, Semester III, 6 ECTS

Course content: This course describes satellite communication beginning with orbits, satellite subsystems, the impact of atmospheric factors in signal propagation and multiple access schemes. Moreover, important part of the course are interference mitigation and innovation in the field of satellite communication.
Course objectives: The purpose of this course is that the student during lectures and laboratory exercises expand and deepen their knowledge for satellite communication including challenges of communication to the satellite in space and to the earth. The last part of the course is focused on innovation in the field of satellite communication especially for high throughput satellites.
Learning outcomes: Upon completion of this course the student will be able to:

- distinguish satellite communication, satellite orbits and satellite subsystems
- classify challenges of link composing
- interpret access schemes and interference mitigation
- classify latest innovation in satellite communication

Teaching methodology: Lectures, Discussion, Laboratory work.
Evaluation methods: The successful practical work: 30%, First intermediate evaluation; 30%, Second intermediate evaluation:30%, Regular attendance and involvement in discussions 10%, Total: 100 %.
Concretization tools/IT: Computer, projector, laboratory equipped for ICT
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 75:25

Literature:

- L. Whitman, H. Ippolitto (2017): Satellite Communications Systems Engineering 2nd Edition, Publishing House Wiley USA.
- D. Minoli (2015): Innovation in Satellite Communication and Satellite Technology, Publishing House Wiley, USA

Course title: Microwave Systems
Teacher: Prof. Dr. Enver Hamiti
Course status: Elective, Semester III, 6 ECTS

Course content: Transmission Lines. Waveguides. Smith Charts and Scattering Parameters applications. CAD tools- Microwave office, Matlab, Python, etc. Microwave Filters. Impedance-Matching Networks and Coupling Structures. Microwave Amplifiers. Oscillators and Frequency Synthesizers. Microwave planning systems. Noise and distortion in Microwave systems.

The goal: The purpose of the course is to provide students with advanced theoretical and practical survey of Microwaves, Microwave circuits and system design.

Learning outcomes: On completion of this course, students will be able to:

- Demonstrate advanced knowledge about Microwaves, Microwave circuits and systems.
- Use advanced software tools to analyze and design Microwave circuits and systems,
- Analyze and implement of practical Microwave systems.

Methods of teaching: 30 hours of lectures + 30 hours of auditorial exercises. Approximately 100 hours of personal study and exercise, including seminars.
Grading System: Seminar 10%, Project 50 %, Final Exam 40 %
Concretization tools: Computer, video projector, software lab and equipped lab with necessary devices to illustrate all teaching material.

Literature:

- David M. Pozar "**Microwave Engineering** ", Copyright, 2012, John Wiley & Sons Inc.
- 2. D. M. Pozar, **Microwave and RF Design of Wireless Systems,** John Wiley & Sons, 2001
- E. da Silva, "**High Frequency and Microwave Engineering** " Lineacre House, Jordan Hill, OXFORD OX2 8DP, First publish 2001.

Course: Advanced Optical Communications

Lecturer: From Industry

Course status: Elective, Semester III, 6 ECTS

Course content: This course describes the light propagation in optical fiber, reflection and refraction of light in the border of two materials with different refraction index. Important part of the course are the techniques used to build the optical fiber, the material used, fabrication techniques, chromatic polarization dispersion and non-linear effects in optical fibers. Moreover in this course, are presented the detailed characteristics of sources of light (longitudinal coherence and transversal, source modulation and type of source), optical receivers (thermal, photo-resistor, photo-diode), quantic efficiency, thermal noise etc. as well as modulators (phase electro-optic, amplitude electro-optic and absorption electro-optic). At the end of the course student distinguish advanced modulation, coding and detection schemes in optical communication.

Course objectives: The purpose of this course is that the student during lectures and laboratory exercises expand and deepen their advanced knowledge for optical signal transmission in optical network. Moreover, student will learn sources of light, receivers and other advanced elements (modulation, coding and detection) for a link in optical communication

Learning outcomes: Upon completion of this course the student will be able to:

- argue advanced knowledge for optical communication systems
- interpret in detail the physics of light propagation in optical fiber, optical sources and optical receivers
- demonstrate appropriate knowledge for modulation, coding and detection of optical signal
- organize measurements in existing optical networks and identify faults in that network.
- defend satisfactory knowledge for optical communication and show that is prepared for academics and industrial work in optical communication

Teaching methodology: Lectures, Discussion, Laboratory work.

Evaluation methods: The successful practical work: 30%, First intermediate evaluation; 30%, Second intermediate evaluation:30%, Regular attendance and involvement in discussions 10%, Total: 100 % .

Concretization tools/IT: Computer, projector, laboratory equipped for ICT

Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 60:40

Literature:

- M. Cvijetic, I. Djordjevic (2013): Advanced Optical Communication: Systems and Networks, Publishing House: Artech house, USA
- B.E.A. Salej, M.C. Teich (2007): Fundamental of Photonics, Second Edition, New Jersey.
- John M. Senior. (2009): Optical Fiber Communications: Principles and Practice. Third Edition, London.
- G.P. Agrawal. (2010): Fiber-Optic Communication Systems, Fourth Edition, New Jersey.
- Bostjan Batagelj. (2017): OPTIČNE KOMUNIKACIJE Laboratorijske vaje, Ljubljana.

Course: Innovation and Technology Transfer

Lecturer: Dr. sc. Driton Statovci
Course status: Elective, Semester III, 6 ECTS

Course content: This course describes the importance of innovation and technology transfer as an important competitive support in the global knowledge economy. In particular, will be analysed the motivation of students for innovation, successful management of innovation and the importance of understanding when technology has a commercial potential.
Course objectives: The purpose of this course is that student during lectures and case studies understand how commercial potential can be transferred to a new or existing business. In addition, the student will understand the importance of intellectual property and its protection as an important part of innovation process.
Learning outcomes:
Upon completion of this course the student will be able to:

- Describe concepts and theoretical models of innovation;
- Critically evaluate the variety of theories and concepts related to innovation;
- Communicate ideas and arguments of innovation fluently and effectively both in writing and in speaking;
- List the importance of innovation and competitive advantages in the market;
- Analyze the use of research knowledge in innovation;
- Interpret the role of incubators and science parks in supporting new businesses;
- Distinguish the significance of technology innovation to the sustainability of societies.

Teaching methodology: Lectures, discussions, case studies from practice and if possible guest lecturers from industry and innovation centers.
Evaluation methods: Seminar work and presentation: 40%; Regular attendance and involvement in discussions: 10%; Final oral exam: 50%; Total: 100%.
Concretization tools/IT: Computer, projector, case studies.
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 1:1.

Literature:

- Joe Tidd and John Bessant, "Managing Innovation: Integrating Technological, Market and Organizational Change." Wiley, 6-th edition, Sep. 2018, ISBN-13: 978-1119441090.
- Keith Goffin and Rick Mitchell, "Innovation Management: Effective strategy and implementation," Red Globe Press; 3rd edition. 2017, ISBN-13: 978-1137373434.
- Eric Ries, "The Lean Startup: How Constant Innovation Creates Radically Successful Businesses," Portfolio Penguin; Oct. 2011, ISBN-13: 978-0670921607.

Course: Diploma thesis

Course status: Mandatory, Semester III, 30 ECTS

Course description: The thesis could be proposed by the supervisor or can be chosen by the student, and should be in the accordance with the qualification profile. 1. Reading of the state of the art. 2. Understanding and specifying the problem. 3. Design and implement different solutions. 4. Analyze and discuss critically the results.

Course goals: Master thesis is the final scientific work that will prove the student capability to work on a scientific topic independently by using methodologically sound approaches.

Learning outcomes: At the end of this course, students will be capable to:

- Read and understand state-of-the-art literature.
- Independently specify, analyze and propose solutions.
- Explain and discuss critically results.
- Present and defend the thesis in a written and oral form.

Methods of teaching: Compliant with the actual regulation at the faculty level on how to conduct a master thesis.

Literature :

- Jean-Luc LeBrun. Scientific Writing. World Scientific, 2007.
- Depending on the topic covered in thesis, different bibliographic resources will be recommended by the teachers.