University of Banja Luka

Faculty of Electrical Engineering

STUDY ON THE JUSTIFIABILITY OF ESTABLISHMENT AND ADMINISTRATION OF DIGITAL BROADCASTING AND BROADBAND TECHNOLOGIES SECOND-CYCLE STUDY PROGRAMME

Banja Luka, December 2016.

CONTENT

1. INTRODUCTION

The University of Banja Luka will organize second-cycle studies (master studies) in the field of digital broadcasting and broadband technologies under the title of:

- Digital Broadcasting and Broadband Technologies second-cycle studies (Master studies).

The study programme will be implemented at the Faculty of Electrical Engineering of the University of Banja Luka. The study programme has been developed within the scope of implementation of the DBBT (Digital Broadcasting and Broadband Technologies) master study project, which is financially supported by the Erasmus+ programme of the European Union.

The goal of the project is to develop curricula for academic and vocational studies in the field of digital broadcasting and broadband technologies. The new curriculum will be in line with what is implemented at lead world institutions of higher education in the field concerned, and harmonized with the Europe 2020 strategy, a strategic framework for European cooperation in the field of education and training and with the Bologna process. The curriculum is introduced to ensure knowledge in the field of digital broadcasting and broadband technologies, just like to educate students to use, design and develop solutions in the said filed. All courses within the scope of the proposed curriculum will be implemented using modern educational methods.

The project is implemented by a consortium comprised of:

- University of Pristina temporarily seated in Kosovska Mitrovica,
- Higher Technical Professional School in Zvečan,
- University of Banja Luka,
- University of Bihać,
- School of Electrical Engineering and Computer Science Applied Studies, Belgrade
- Singidunum University.
- Technical University of Ostrava,
- Polytechnic University of Madrid,
- University of Tartu,
- TV Mreža,
- Public Enterprise Broadcasting Equipment and Links and
- Alternativna Televizija Banja Luka.

The leader of project implementation activities at the University of Banja Luka is the Faculty of Electrical Engineering. More information on the DBBT project is available on web page https://dbbt.pr.ac.rs.

The new study program will be implemented during one academic year and will correspond to 60 ECTS credits. The study programme may be attended by candidates who have obtained at least 240 ECTS points at first-cycle basic academic studies at the Faculty of Electrical Engineering or another related faculty with appropriate study programme.

2. BASIC INFORMATION ABOUT THE UNIVERSITY

The University of Banja Luka is the oldest and the biggest institution of higher education in the Republic of Srpska. In its 41-year long history, it has given over 30000 graduate engineers, doctors, economists, lawyers, professors and other profiles of experts, 700 specialists, over 3000 students who have completed their second-cycle studies, around 1100 masters of science and over 580 doctors of science. Many of them hold responsible social functions today and represent influential players in the overall social milieu. This fact facilitates the fulfilment of the University's interests and of its role in the society.

During the long pedagogical tradition, which started a long time before the establishment of the University, or more precisely in 1950, when the Teachers College was established in Banja Luka, valuable experience has piled up with regard to the teaching-scientific process and other forms of work with students. The University of Banja Luka, thus, has the reputation of an institution that keeps high academic standards, which attracts a large number of students. 20000 of them, together with 1 400 employees, represent the most important resource of the society, a centre of knowledge and competence, culture and ethics, technique, technology, medicine, economy and other human and democratic values.

The teaching process at the University of Banja is implemented by 811 teachers and associates on full-time basis. In addition to them, 170 teachers are engaged on an additional employment basis, 168 visiting professors from abroad and 121 expert associates needed for the implementation of clinical practice are engaged at the University. 559 officers provide administrative-technical support. The majority of university teachers are known to the public, in particular the experts in respective fields. Individuals are recruited from amongst university staff to hold important social functions. Distinguished professors give their contribution to the establishment of institutions and bodies, laboratories and centres, in adoption of strategies and policies, laws and rulebooks, they participate in the work of committees, boards and other bodies. Opinion of university professors with regard to important issues is sought at various debates and forums organised by public and commercial media, economic and social institutions and institutions of culture.

University teachers are authors of a large number of printed papers, of which over 450 monographs and textbooks. Those are publications by way of which knowledge has for a while been spread in companies and institutions. Students of other universities learn from them. Experts use them in practice: engineers, banking people, lawyers, doctors, professors and many others. University teachers sometimes write textbooks for lower levels of education, they often write critical reviews or define contents of those textbooks thus participating in the modelling of the overall education system in the Republic of Srpska.

Organization of scientific - expert conferences, exhibitions and other events has already become a tradition at the University, during which scientific and cultural achievements are presented and exchanged. Each faculty has a specific scientific gathering, conference or a similar annual or biannual event on topics related to the fields it nourishes. Scientific results presented at those gatherings are printed in proceedings. A certain number of faculties have their own journals that have already become known, spreading new knowledge across the world.

Students' Parliament of the University of Banja Luka organizes its own scientific-expert conference "Students Towards Science" with international participation (http:/www.stes.rs.ba/).

Apart from scientific and expert conferences and symposiums, the University also organizes counsellings on other educational issues and reforms, such as the Bologna Process, on the basis of which the system of higher education is modelled in the Republic of Srpska.

A wide range of educational disciplines enables the development of versatile persons, persons who in addition to their professional also possess general (soft, transferable) skills. With 16 faculties and

57 study programmes (only at the first cycle level), the University offers an opportunity for complex knowledge adoption, not only in the main disciplines, but, also, in borderline and related disciplines. Research work nowadays requires multidisciplinary knowledge, for the most important researches take place along the borders of various disciplines.

Openness is one of the main principles of work of the University. Everything that takes place at the University, both good examples just like bad occurrences, is discussed openly with media representatives and other interested parties, which should be recognised in the surroundings as a virtue and strength that should lead to a more just and fairer society and enhance the reputation and the appeal of the University.

The University of Banja Luka is committed to international cooperation with the main objective of such cooperation leading to most advanced knowledge and technologies. Over 100 cooperation agreements, membership in a number of international associations and networks and participation in international educational, scientific and research projects represent prerequisites for establishment of rich international cooperation. The number of our students continuing master and doctoral studies in the world, and in particular in Europe, increases year by year. The number of teachers who are doing their doctoral theses or have already done them abroad is increasing. There is an aspiration of organising doctoral studies in cooperation with other domestic and European universities, as joint studies.

The University of Banja Luka possesses exceptional spatial resources. It consists of two campuses – the old one, Campus 1, closer to the centre of the town, of the area of 2 ha (20703 m^2) and the new one, Campus - University City, of the area of around 27 ha (273817 m^2). The University City provides all conditions for the University's needs for space. The total area of classrooms is around 16000 m^2, and of laboratories around 10.000 m^2. Most of the classrooms are equipped with video projectors and computers for showing digital teaching contents. The University has 20 computer rooms with a round-o-clock access to Internet. Libraries have 190,000 books, with subscription for a large number of scientific journals.

The fact that the University of Banja Luka is a public university financed to the largest extent, from the Republic of Srpska Budget represents yet another value. Around 50% of students are exempt from scholarship, with the scholarship fee being rather low for the remaining ones. Such a policy of Government makes the University available for all students regardless of their financial situation. For the University this is yet another opportunity to attract most talented students and achieve the most valuable output results.

The evolution the University has been going through over the past years takes place in the scenario of gradual getting closer to the European Higher Education Area. A large number of Tempus projects has steered the development of the University in directions of strategic approach to planning and management, introduction of European quality standards and harmonisation of output profiles with the framework of qualifications. More attention is given to the development of human resources, stronger investments in laboratory equipment and information infrastructure are visible, the existing facilities are rehabilitated and new ones are built. More diverse forms of support to curricular and extra-curricular activities of students are being sought for.

Further development and progress of the University may only be achieved through a better use of capacities of an integrated university. By integrating faculties into one legal entity conditions have been created for a synergetic approach to the development of certain disciplines and a multi-disciplinary approach to the teaching and science. Those advantages have still not been used to a considerable extent.

The University is expected to contribute even more to the economic and social development. In conditions of faster and faster development of new knowledge and technologies, the role of university grows in importance. New technologies, organisational structures and social models shut down a

number low-skilled jobs and open new ones that require different and more advanced knowledge and skills. The task of the University is to spread current knowledge and technologies thus maintain the vitality of its community. In initiating a research, it is necessary to connect more closely with the industry, with a view to improving the industrial production through products and processes innovation.

In so doing, the University must refrain from sinking into the trap of mere commercialization of research results and thus jeopardizing its wider role – attracting of most capable students and their training for tasks of different nature and complexity. Highly skilled people will be able to improve the existing companies and even to found new companies.

On a wider social plan, the University has the strategic task of achieving an important position wherefrom its voice will be heard better, wherefrom it will point at new developments in the surrounding and in the world, propose changes, criticize bad occurrences and actions, provide support to work out better solutions in an easier way, all of which for a better living of citizens of Republic of Srpska.

3. BASIC INFORMATION ABOUT THE FACULTY

To complete the picture about the work of the Faculty of Electrical Engineering, it is necessary to bear in mind that on 24 November 1961 a decision of the Peoples' Board of the Banja Luka County was published in the Official Gazette of the Banja Luka County to establish a Technical Faculty in Banja Luka with an Electrical Engineering Department – low voltage. Based on this decision, the first generation of students started studying electronics and telecommunications at the ***Electrical Engineering Department – Department of Electronics and Telecommunications*** in the autumn of 1962.

The first visible step of institutional involvement in scientific-research work was the initiation of its own postgraduate studies starting from the academic year of 1971/1972. Educational activities at the Department of Electrical Engineering were additionally strengthened in academic year 1972/1973 through the initiation of the ***Department of Computer Science and Automatics.***

Bearing in mind the achieved human resources potential and the growing needs of the region for experts in electrical engineering, the Assembly of the Socialist Republic of Bosnia and Herzegovina, at the proposal of the Meeting of Working People of the Technical Faculty, issued, on 28 March 1975, a decision the transformation the Department of Electrical Engineering into the Faculty of Electrical Engineering. The Faculty continued to work with two ***Departments: Electronics and Telecommunications and Computer Science and Automatics.*** Development needs of the Republic of Srpska required the establishment of the ***Department of Power Engineering*** in 1994. The establishment of the Department was supported to the greatest extent by the Power Utility of Republic of Srpska and its then daughter companies Elektroprenos, Elektrokrajina i Hidroelektrane na Vrbasu. On the other hand, teachers from the Faculty of Electrical Engineering from Belgrade took over the main burden in the development and implementation of the curriculum. Immediately after the establishment of the Department, the Power Utility of Republic of Srpska donated a laboratory for power systems – Micronetwork, which is still unique in the territory of the former Yugoslavia.

The year of 1977 is especially important for the development of the Faculty, when first master theses were defended. The theses were prepared b students who had completed their graduate and postgraduate studies at the Faculty. Also, in 1977, the Faculty participated in the organisation of a scientific conference for the first time. That year, the Faculty was a co-organiser, together with the Association for Electronics, Telecommunications, Automatics and Nuclear Technique (ETAN), of the 21st Conference for ETAN in Banja Luka. During the period from 1975 until 1990, the Faculty , together with Čajavec, was the organizer of Yugoslav Symposiums in microelectronics – MIEL. In addition to the Faculties of Electrical Engineering from Banja Luke, Belgrade, Niš, Zagreb and Ljubljana, the symposium was organized by the then developed electronic industry of the SFRY (Čajavec, EI NIš, Iskra, RIZ, Mikroelektronika-Belgrade). At the beginning of the eighties of the past century, the Faculty organized three symposiums Autoelectronics that represented a direct scientific support for the development of Čajavec electronics installed in cars.

The past ten years of the work of the Faculty may primarily be characterised by an expanding involvement in the European Higher Education Area. Its almost uninterrupted and intense involvement in recognised international projects *TEMPUS, DAAD, FP, HERD, WUS* and others, helps improve the Faculty's equipment and enhances its expert and scientific capacities. Thanks to participation in the said projects, teachers and students stayed at more Universities in Europe. Especially important were study stays at the National Technical University in Athens, University in Paderborn and University in Ilmenau. This way the Faculty and its teaching staff established permanent connection with the partners from abroad.

One of the effects of Faculty's international activities have been the modifications of curricula at all levels of study. The Faculty was thus the first in Bosnia and Herzegovina to start administering classes at the

first cycle of studies in accordance with the principles of the Bologna process in 2003. By accepting the new concept of European university education (the Bologna process) in 2003, the Faculty

shifted from five-year to four-year studies with three study programmes: Electronics and Telecommunications, Computer Engineering and informatics and Power Engineering and Industrial Systems. **Second-cycle courses** started already in academic year 2998/2009, with the **third cycle courses** starting from the academic year 2009/2010.

Second-cycle studies are organised at three study programmes: Co***mputer Engineering and Informatics (programmes- Information Technologies and Computer Engineering), Electronics and Telecommunications (programmes – Electronics, Telecommunications and Signals and Systems) and Power Engineering and Industrial Systems (programmes – Automatics and Power Engineering).***

Third-cycle studies are organised at the study programme of ***Information - Communication Technologies*** with the following modules: ***Programme Technologies, Programme Engineering, Multimedia and Communications.***

Good-quality life-long learning in the field of informatics and specialist courses for information-communication technologies (*ICT*) is organised by the Faculty within the scope of the School of Informatics and the ICT Academy. The School of Informatics is based on many years of experience in the field of informatics and transfer of knowledge at the level of contemporary computer technologies. The essence of training consists of interactive work of learners with the teaching staff through learning and permanent exercises. One computer per each candidate at each work post is provided for efficient method of work.

More thousand candidates and staff from many work organisations in Banja Luka such as Elektrokrajina, Banjalučka banka, Agroprom Banka, Institute of Urbanism, Water Supply Company, Institute of Geodesy, RTRS, have been trained within the **School of Informatics** since 1994. Special projects were conducted to train journalists, young doctors at the Medical Centre, just like many other professions including retired persons. Additional training of teaching staff in computer science and information was organised. Free-of-charge training for a large number of elementary school kids was also organised. A large number of high school graduates across the Republic of Srpska were provided with additional training within the scope of special programmes. Candidates were trained for use of Internet Windows operating system, MS Office package (Word, Excel, Power point, Access), just like for work with graphic oriented programmes.

Special contribution was given to the field of programming (Pascal, C++). Special training was provided for use of mathematical software packages (Matlab, MathCAD), as well as programmes for the needs of architecture, TV presentations , WEB design.

The mission of the ***ICT Academy*** of the Faculty of Electrical Engineering is to transfer current high technology knowledge in the field of information-communication technologies to users, with a view to enhancing the capability of individuals, companies, institutions and other systems from our environment for efficient use of these technologies.

Through specialist courses learners, with the formal knowledge that they possess, also gain specific specialist knowledge that they need in their work and that enable them to acquire industrial, internationally recognized certificates. Learners thus acquire the opportunity to find jobs more easily, to do their job more efficiently and to make faster career advancement. Employers get more productive personnel that enable them to return as fast as possible on often considerable investments in network infrastructure. The Academy for Specialist Courses for Information – Communication Technologies was founded and started to work as a local CISCO academy in July 2004.

The Academy of the Faculty of Electrical Engineering made necessary preparations and submitted an application in 2008 for organisation of demanding CISCO CCNP courses for

professionals in the field of network technologies The Faculty of Electrical Engineering -local CISCO Academy received a great support for the provision of equipment for the CCNP course from the Ministry of Science and Technology of Republic of Srpska.

After fulfilling the conditions and registration, the CISCO Academy has been continuously providing training under this, most complex CISCO CCNP programme since 2009, while since 2011 training has been provided under the CISCO CCNA Security Programme.

Since September 2010, the Academy, in addition to CISCO courses started providing specialised Linux courses, and the Academy was named ICT Academy.

Specialist training in programming through two courses of the Java programming language started for the first time at the Academy in September 2011. The courses currently organised at the Academy are: CISCO CCNA Exploration, CISCO CCNP, CISCO CCNA Security, Linux++ Basic course, Linux++ Advanced course, Basics of Java Programming Language and OO analyses and design, Advanced Java Course.

Through many years of its work, the ICT Academy of the Faculty of Electrical Engineering gained the reputation of a professional academy of extremely good quality. The Academy implements courses on the basis of international (CISCO and C ompTIA Linux+) programme and its own training programmes (Java).The courses enable learners to acquire appropriate knowledge and be fully prepared for passing and obtaining of appropriate industrial certificates (CISCO CCNA, CCNP and CCNA Security, CompTIA Linux+, LPIC, CLA and Oracle Java certificates). Over 500 learners have attended the Academy so far with the percentage of successfulness of 90%.

At the NetAcad Excellence 2012 regional conference of CISCO instructors, which was organised from 18 until 19 May 2012 in Split, the ***CISCO Academy of the Faculty of Electrical Engineering was proclaimed as the best CISCO Academy in the Central and Eastern Europe Region, Russia and the Commonwealth of Independent States, in the category of the highest and most demanding CISCO CCNP courses.*** This recognition is even more significant because it was obtained in a competition of 1818 CISCO academies from 30 countries of the said region. The work of the CISCO Academy of the Faculty of Electrical Engineering was presented as a "success story" by the CISCO Company at the CISCO web site: (https://www.netacad.com/web/about-us/cisco-networking-academy-recognition-for-ccnp excellence).

The Faculty is the first institution in the Republic of Srpska and Bosnia and Herzegovina that implemented in 2006 interconnection with the European academic scientific-research network GEANT. A first important step in connecting the scientific-research area of the Republic of Srpska with the European one was thus made.

In addition to a large number of other activities (implementation of a large number of projects, publication of scientific papers in journals and proceedings from conferences), the Faculty, thanks to its long cooperation with the ETRAN society, was also the co-organiser of prestigious 46th and 55th ETRAN conferences held in 2002 and 2011 in Teslić. The Faculty has been organising the prestigious **Industrial electronics Symposium (INDEL)** with international participation since 1997. The symposium is held every two years at the beginning of November. The 11th symposium was held during the period from 3 until 05 November 2016, recording a number of positive breakthroughs in programming and organisational sense. One of the most important results of this year's INDEL was achieved through the co-sponsorship of the world organisation of IEE and the participation of authors from the countries that are not former republics of the former Yugoslavia (for example Russia, Turkey, Great Britain, Poland, Germany, Spain and Malaysia). We have been organising an **international competition of students "Hardware and Software"** as a related event of the Symposium since 2006. The topic of this year's competition, which usually includes the fields of computer science, automatics and electronics, was the development of an autonomous system for product sorting in an arbitrary form. The resources for the competition included a combination of

the existing laboratory equipment of the Faculty and the development systems donated by the Mikroelektronika Company from Belgrade.

The Faculty has over the past few years been almost regularly winning the 3rd or 4th place at the knowledge **competitions of students of electrical engineering (ELEKTRIJADA),** on a global level, in the competition of around 20 faculties from the region, and students of the Faculty often win first prizes in individual or team competition in individual disciplines.

Over the past 50 years and more, the Faculty has given over 2000 graduate engineers, 32 masters, 70 masters of Science and 23 doctors of science as a direct contribution to the development of electrical engineering. Many of them later continued with scientific-research work at reputable universities in the world, and some are renowned teachers at world universities.

The following two data speak about the extent to which the results achieved by the Faculty in educational-scientific-research work are recognizable in the surroundings. At the Webometrics list of world universities the Faculty is the best ranked faculty from the Republic Srpska this year, too. At the Festival of Science held in Banja Luka in 2012, under the auspices of the Ministry of Science and Technology of the Republic Srpska Government, **the Faculty was declared as the best scientific-research organization.**

In addition to significant human resources, the Faculty continuously improves the infrastructural resources. The works on building an additional floor on the Faculty buildings were completed thanks to the funds from the Republic of Srpska Development Programme. The Faculty thus obtained an additional 750 m^2 of usable area, where cabinets for teaching staff and conference rooms are situated. The second floor has been completely rehabilitated, and the ground floor and the first floor of the old building have been partly rehabilitated. Space has been created for seven laboratories, two classrooms and a number of cabinets for associates.

During the year of 2013, laboratory equipment worth EUR 1,400,000 that will be used to raise the quality of scientific and teaching work was installed at the Faculty. Provision of the equipment was ensued by the Republic of Srpska Government with credit resources of the Austrian Government. Besides, we stress that the Faculty has been recognized by private companies as an institution that is worth investing in. Three private companies have financed equipment for six new computer laboratories which is the best **example of interest-driven public-private partnership.** If one adds the support of the University of Banja Luka for the provision of computer equipment, it can be concluded with certainty that laboratory computer techniques conditions have been provided in line with world standards. If equipment from the Austrian loan is added here, the laboratories for automatics, telecommunications and general electrical engineering are equipped in line with the same standards.

The Faculty has expanded public-private partnership beyond the borders of the Republic of Srpska. In November 2013, a memorandum on business and technical cooperation with the “RT-RK Institute” from Novi Sad was signed. In September 2014, a joint entity of the Institute started operating at the Faculty, hiring, so far, 80 engineers. Furthermore, the “RT-RK Institute” provided modern equipment for the laboratory for the development of computer embedded systems at the Faculty.

Over the past year, 3 international projects: NORBOTECH (HERD), WBCInno (TEMPUS) and BioEmis (TEMPUS) have been completed at the Faculty. VI SEEM (Horizon 2020), DBBT (Erasmus+) and Euroweb+(Erasmus Mundus) are currently active. In addition to international projects, the Faculty participates in 15 projects with national sources of financing.

Up to this year, professors and associates of the Faculty were coordinators of over thirty international projects, around fifty projects supported by the Ministry of Science and Technology of the RS Government/SNZ for science of BiH, seventeen projects for state institutions and around seventy projects for economy.

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Since 1997 the Faculty has been **publishing the Electronics magazine** that is referenced in the following scientific bases: Scopus, Compendex, EI Compendex, Index Copernicus –IC Value 2012: 6.40, DOAJ, CrossRef, DoiSrpska, KOBSON, Open J-Gate, SHERPA/RoMEO, Socol@r, WorldCat, NewJour and GetCited. The magazine is published twice a year (June and December). Only original and easily referenced scientific papers of authors from across the world are published. The magazine is published in English. The Editorial board is international and it is made up of respectable university professors from Europe and the USA. The magazine is delivered free of charge to all Faculties of Electrical Engineering and Colleges of Electrical Engineering from the territory of the former SFRY (18 institutions), just like, through the library exchange, to several technical universities in Europe. Moreover, the electronic version of the magazine is available to broad public (thus supporting the Open Access publication model) at the official web page (www.electronics.etfbl.et) that registers 200 unique visits per month (based on Google Analytics report) from over 40 countries across the world (India, Serbia, Bosnia and Herzegovina, USA, Philippines China, Italy, Bangladesh, Pakistan, Germany etc.). The magazine has its number registered at the Republic of Srpska National and University Library (www.doisrpska.nub.rs) since 2012.

The Faculty has realised publishing activity through the publication of textbooks, monographs, scientific books, proceedings and brochures for the needs of professional publications (information bulletins and brochures for the needs of students). Teachers and associates of the Faculty are authors/co-authors of over forty books, fourteen proceedings, twenty drafts, ten brochures. It should also be added that Faculty's students published two magazines of students of electrical engineering: **Pozitron** (1974-1979) and **Impuls** (1997).

The Faculty is the organiser of the **Energetic Efficiency Symposium (ENEF)** that was held in 2013 and 2015. The plan is to dedicate a scientific conference to this up-to-date topic of world importance every two years and thus integrate the researches of technical faculties and institutes of the University of Banja Luka in this field.

Immediately after the establishment of electrical engineering studies, the **Students Alliance** started working as an organisational form through which activities related to the living and work of students were performed. Within the Association of Students, a **Club of Students of Electrical Engineering (KSET)** was formed at the beginning of seventies. Since the start of its work KSET has been very successful in popularisation and realisation of cultural and entertainment events for students of electrical engineering. It overgrew the boundaries of electrical engineering very soon and became the initiator and the implementer of important cultural activities of students of other faculties and the youth of the City of Banja Luka. Our students have, through the work of the KSET, been recognisable as key initiators of important cultural events in Banja Luka for almost entire two decades.

The Activities of the Students Alliance and KEST, during the period from 1975 until 1990, overgrew the boundaries of Banja Luka and became recognisable in the territory of the former Yugoslavia.

From that period it is worth mentioning that on 19 February 1977, under the auspices of the KSET a first audition for members of the Student Theatre in Banja Luka was held in the "fourteen"" (popular name for classroom number 14).

The Faculty has **well-supplied library** with over 18000 printed books and around 250 serial publications (around 40 in Serbian and 210 in foreign languages). In addition to the library, there are two reading rooms available for the students.

The Faculty is rightfully expected to be the leader of development of most recent technologies. In the teaching sense, it means that its graduate engineers are able to develop and apply contemporary technologies and thus create prerequisites for establishment of new companies in Banja Luka, Republic of Srpska and in the surroundings.

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Those are precisely the reasons for which we add new study programmes actualizing their contents in accordance with the needs of the very demanding market in this field. Nowadays, the Faculty has good-quality personnel that is able to implement ambitious study programmes and educate students according to the world standards. Permanently employed staff members include 8 full-time professors, 6 associate professors, 7 assistant professors, 16 senior assistants and 14 assistants. In 2016, two assistants defended their doctoral thesis and fulfilled the conditions for their election into the title of assistant professor. Administrative tasks are performed by 29 staff members.

4. REASONS FOR ESTABLISHMENT AND ADMINISTRATION OF THE STUDY PROGRAMME

In adopting the European standards and the process of getting closer to the European Union, Bosnia and Herzegovina, and thus also the Republic of Srpska, had to harmonise it policies and legal regulations with recommendations and directives of the European Union in the field of radio and television broadcasting, just like the management of the spectrum as a resource.

Document entitled Policy in the Broadcasting Sector in Bosnia and Herzegovina was thus adopted in 2006. The commitment of Bosnia and Herzegovina to shift to digital broadcasting of programme contents was expressed in the said document. Unfortunately, it was only this year that the first steps towards the implementation of the proclaimed commitments were made.

The implementation of the DBBT master study project is an indicator that the institutions of higher education in the Republic of Srpska, Bosnia and Hercegovina, and in the region are aware of the need for good-quality personnel purposefully trained for the field for digital broadcasting and broadband technologies. Furthermore, the fact that the project is financially supported by the European Union through the Erasmus+ programme means that it has been assessed that the problem of establishment of digital broadcasting in Bosnia and Herzegovina and in the region is approached in a systematic way. This implies introduction of new study programmes at the second cycle of studies, in accordance with the European standards and good European and regional practice. Through this project, assistance and professional expertise of colleagues from the below-listed institutions of higher education from the European Union is made available for higher education institutions in Bosnia and Herzegovina:

- Technical University of Ostrava,
- University of Ljubljana,
- Polytechnic University of Madrid and
- University of Tartu.

Furthermore, support has been provided by non-academic institutions/partners such as:

- TV Mreža,
- Public Enterprise Broadcasting Equipment and Links and
- Alternativna Televizija Banja Luka.

Through their participation in the project, information is provided with regard to practical aspects of the implementation of digital broadcasting and introduction of broadband technologies, just like an insight with regard to the real needs of broadcasters in the Republic of Srpska and in the region.

It is important to stress that according to information available on the web page of the Bosnia and Herzegovina Communications Regulatory Agency, 43 TV stations and 3 public broadcasting services in Bosnia and Herzegovina have TV broadcasting licenses, while over 130 radio stations and 3 public broadcasting services have radio broadcasting license. This shows clearly that there is a need at the labour market for good quality human resources trained in the field of digital broadcasting and broadband technologies. This fact gains in importance if one takes account of all related activities, such as designing, testing, purchase, sale and similar, concerning the system of digital broadcasting and broadband technologies.

Here it is necessary to note that all prerequisites for the establishment and introduction of a good-quality study programme in the field of digital broadcasting and broadband technologies are provided through the said project. This is ensured through the following:

- familiarization with the best European practice in the field of training of human resources for the needs of digital broadcasting and introduction of broadband technologies,
- training of human resources,
- financial support for equipping modern laboratories,
- introduction of new study programmes with the respect for European standards,
- introduction of quality system from the very start of project implementation,
- secured support of non-academic institutions/partners,
- introduction of the principle of self-sustainability of new study programmes and
- establishment of contacts and cooperation with experts and professionals in the region and in the European Union.

5. OPENNESS OF STUDIES TO MOBILITY OF STUDENTS

All levels of studies at the University for Banja Luka are harmonised with the principles of the Bologna Declaration. This implies, also, the mobility for students and teachers. Valuation of activities of students learners is base d on the system of ECTS points, which is a prerequisite for mobility of students.

The curriculum of the proposed second-cycle studies in Digital Broadcasting and Broadband Technologies foresees a group of required and a considerably bigger group of elective courses. The proper choice of courses enables students to acquire adequate level of knowledge needed for the preparation of the second-cycle final thesis, for each of the anticipated profiles.

Mobility towards other second-cycle studies and vice versa is possible in principle. It depends on each specific case and will, in most of the situations, be related to a potential need of completing of supplemental courses and contents.

6. CURRICULA

6.1 GENERAL INFORMATION ABOUT THE STUDY PROGRAMME

Programme Title	Digital Broadcasting and Broadband Technologies
Model	1-year second cycle of studies
Number of ECTS points	60 (total 300)
Type of study	Academic studies
Title	Master
Field of education	Technical Sciences – engineering – electrical engineering
Mode of administration	Full-time studies, at the seta, of the duration of 1 year
First offered on	
Last revision date	
Programme accredited by	
Responsible organisational unit	Faculty of electrical Engineering Banja Luka

6.2. OBJECTIVES OF THE STUDY PROGRAMME

The main objective of this second-cycle study programme is to educate and create human resources that will be able to work in different fields related to digital broadcasting and broadband technologies. The experts of this profile would have an especially important role in the implementation of the digital broadcasting systems and application of broadband technologies in telecommunication systems. Furthermore, they would lead or would be involved in the activities of state agencies, in the design, implementation and testing of performances of new systems and products, provision of services with regard to the selection and use of new equipment and a number of other activities where support needs to be provided for radio and/or TV broadcasters.

The strategy of development of education in the Republic of Srpska defines the mission of the University for Banja Luka, just like that of the Faculty of Electrical Engineering that is in charge of the implementation of this study programme. All activities relating to the implementation of the study programme are taking place in accordance with the Decree on the conditions for establishment and start of work of institutions of higher education and procedure of determining of fulfilment of conditions as defined by the Republic of Srpska Ministry of Education and Culture (Official Gazette 35/11). Many years of experience in educating graduate engineers, masters and doctors of science, just like the need for harmonization with contemporary trends in the fields of digital broadcasting and broadband technologies, including contemporary trends in higher education, constitute a base for that. The objectives of this programme of studies of second cycle are this way.

We at the Faculty for Electrical Engineering of the University of Banja Luka start from the fact that a contemporary university is the main initiator of economic development, and that it is precisely the knowledge and the skills that are needed at the labour market that represent the main objectives in the development of study programmes. The below listed strategies and opinions have been taken into account to allow for a good definition of the objectives of the D*igital Broadcasting and Broadband Technologies* study programme:

- development forecasts in the given area – country's development strategy,
- opinions of business entities that employ experts from this field,
- opinions of teachers and former and current students of the study programme and
- views of experts from various fields of work.

Based on the foregoing, it can be said that the objectives of the *Digital Broadcasting and Broadband Technologies* study programme at the second cycle of studies are as follows:

- to ensure that learning outcomes at this study programme correspond to the needs of the market,
- to improve learning outcomes with the introduction of contemporary teaching methods, in narrow disciplinary courses, with the use of appropriate laboratory equipment and modern software tools;
- to take account of strategic commitments of the society in the domains relaying on the application of these scientific fields;
- to anticipate the directions of development of these fields in the content of the study programme curricula;
- to realize specialist development of students of second-cycle studies in an appropriate field;
- to ensure more independent and research work of students;
- to create conditions for mobility of students;

- to establish national and international cooperation in the implementation of the teaching process within the scope of the Study programme and
- to improve the skills of second-cycle students relating to the preparation and management of complex projects.

6.3. QUALIFICATION PROFILE

Master of Digital Broadcasting and Broadband Technologies – 300 ECTS, 1-year academic studies, 60 ECTS points

Second-cycle students need to acquire specialist theoretical knowledge and skills in the field of digital broadcasting, broadband technologies and audio and video production with an emphasis on mastering and applying of contemporary knowledge, methods, procedures and skills relating to the functioning, development, design, implementation, application, use and maintenance of an integral system of digital broadcasting, just like of some of its systems, including practical application of broadband technologies. Furthermore, the students will be trained to use and apply appropriate methods and procedures of analysis and design of digital broadcasting systems and appropriate software tools for development, design, implementation and maintenance of the said systems, its parts, devices and systems for various purposes, preparation and implementation of complex projects, use of professional literature and research work in the narrow field.

6.4. LEARNING OUTCOMES OF THE STUDY PROGRAMME

The outcome of the learning process includes appropriate educational achievements of students in acquiring expected knowledge and understanding of the studied fields, skills and competences relating to theoretical knowledge, practical and operational application, just like the capability to express and use the said knowledge after completion of the selected study programme, as well as students' views and responsibilities.

A. Knowledge and understanding

1. Specialist knowledge and skills possessed by a Master of Digital Broadcasting and Broadband Technologies shall include:

- To have deep and systematic understanding of the knowledge concerned,
- To have knowledge of one narrow filed from the study programme that the final thesis belongs to,
- To be capable of coming up with original ideas,
- To be trained to implement research work,
- To be aware of future developments in the field of digital broadcasting and broadband technologies.

B. As a learning outcome in the field of analysis, design and implementation, a student who has completed the second cycle of the *Digital Broadcasting and Broadband Technologies* study programme shall be expected to:

- Be able to provide a critical analysis of on-going researches,
- Be capable of defining and solving of complex problems, just like those he/she is dealing with for the first time,
- To be able to formulate and solve problems relating to new scientific fields of the study programme,
- To be capable of applying most recent and innovative methods in problem solving, including other disciplines,
- To form opinions in conditions of incomplete information,
- To be creative and capable of developing new and original ideas and methods,
- To know methodological concepts and their mutual relations,
- To know current research works and literature,
- To be trained for independent work in the industry.

C Technological and methodological competences a student who has completed the second cycle of studies should have are as follows:

- Integration of knowledge from various fields,
- Good overview and understanding of applicable methods and techniques, just like their limitations,
- Capability to apply most recent technological achievements in practice,
- Knowledge of modelling of complex systems and processes,
- A level of knowledge that may contribute to further development of digital broadcasting and broadband technologies.

D Other professional skills a student should acquire during his/her second cycle studies shall include:

- Ability to work independently and deepen the knowledge in the field of digital broadcasting and broadband technologies
- Ability to give direction to one's own further education,
- Ability to transfer knowledge,
- Ability to work in a team and good managerial skills,
- Work and communication in national and international contexts,
- Use of systematic approach to risk management.

6.5. ADMISSION REQUIREMENTS FOR THE STUDY PROGRAMME

Pursuant to Article 8, paragraph 3 of the Law on Higher Education of the Republic of Srpska (Official Gazette of the Republic of Srpska, number 73/10, 104/11, 84/12, 108/13), Article 8 of the Rules of Study at the first and second-cycle studies of the University of Banja Luka and Article 5 of the Rules of Study at the second-cycle studies of the Faculty of Electrical Engineering, only candidates who have earned at least 240 ECTS points at the basic academic studies of first cycle at the Faculty of Electrical Engineering or at another related Faculty of appropriate study programme may enrol in second-cycle study programmes.

Candidates who studied at the Faculty of Electrical Engineering in Banja Luka or at another related faculty under the curriculum before the introduction of the system of ECTS points, or who have completed their basic academic studies under the ECTS system at other faculties in related fields, may request the Faculty of Electrical Engineering to valuate the said studies and the obtained study results into an equivalent number of ECTS points under the curriculum of the Faculty of Electrical Engineering.

In addition to admission requirements prescribed under the Law on Higher Education, the Statute and other acts of the University and the Faculty, a candidate wishing to enrol in the second-cycle of the *Digital Broadcasting and Broadband Technologies* study programme needs to have:

- completed 2 courses or 12 ECTS points in mathematics the content of which corresponds to the required mathematic courses at the Faculty of Electrical Engineering of the University of Banja Luka and
- 150 ECTS points in the scientific filed of Electrical engineering, electronics and information engineering.

A committee will be set up that will examine whether a candidate possesses a sufficient level of prior knowledge to attend the study programme. Specific admission requirements will be defined by means of a competition.

A candidate who has completed a first-cycle study programme that is not entirely compatible in the above sense, may enrol conditionally with the obligation to pass supplemental exams the maximum number of which shall be three exams or 18 ECTS points, in order to fulfil the said compatibility criteria.

6.6. CONDITIONS FOR TRANSFER FROM OTHER STUDY PROGRAMMES

Pursuant to Article 42 of the Law on Higher Education of the Republic of Srpska (Official Gazette of the Republic of Srpska, number 73/10) and Article 24 of the Rules of study at the first and second cycles studies of the University of Banja Luka, a student may be allowed to transfer from their study programmes within the same or related fields of study.

During the first semester, the student has to earn a minimum of 18 ECTS points on the basis of courses of this study programme. The student may earn a maximum of 12 ECTS points on the basis of courses of other study programmes of second cycle of the Faculty of Electrical Engineering of the University of Banja Luka.

During the transfer from other study programmes administered at the Faculty of Electrical Engineering, the Dean, at the request of the student, makes a decision on the transfer to the study programme, which contains a list of recognized completed courses from the study programme that the student is being transferred to.

Transfer from other study programmes that are not administered at the Faculty of Electrical Engineering will be conducted in accordance with the rules adopted by the Senate, on the basis of a proposal of the Teaching-Scientific Council of the Faculty of Electrical Engineering.

The right to change the study programme may be exercised in accordance with the Rules of study at the first and second cycles of study of the University of Banja Luka.

6.7. CURRICULUM

1ST YEAR					
No.	**COURSE NAME**	**Sem.**	**Points**	**Hours**	**Type**
1	Digital Broadcasting Systems and Technologies	1	6	2+3	A
2	DTV Receivers and Software Support in DVB Framework	1	6	2+3	A
3	Studio Audio and Video Production	1	6	2+3	B1
4	Digital Broadband Access Technologies	1	6	2+3	B1
5	Advanced DTV – Middleware, Interactive TV	1	6	2+3	B1
6	Regulation, Standards and Radio Monitoring	1	6	2+3	B1
7	Multimedia Content on the Web	1	6	2+3	B2
8	Multimedia Content Search	1	6	2+3	B2
9	Graphics and Animation	1	6	2+3	B2
10	Multimedia Content Security	1	6	2+3	B2
11	Modern Application Environments of DTV Receivers	1	6	2+3	B2
12	Human-Computer Interaction	1	6	2+3	B2
Total 1st semester			**30**	**25**	
1	Research work	2	10		C
2	Student practice	2	10		C
3	Final thesis of second-cycle studies	2	20		A
Total 2nd semester			**30**		

Legend:

A Required course for study programme students

B1,B2 Elective course for study programme students. Students choose at least one course from B1 group

C Elective course in second semester. Students choose at least one of the two offered options.

UNIVERSITY OF BANJA LUKA
FACULTY OF ELECTRICAL ENGINEERING

Study program: Digital broadcasting and broadband technologies

Course title	Digital broadcasting systems and technologies			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Required	1	2+3	6
Teacher(s)	Jugoslav Joković, assistant professor			

Course prerequisite(s)	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

Familiarization of students with the basic principles of creating, transmitting and receiving of TV signal in digital broadcasting systems.

Learning outcomes:

Upon completing the course, students will be able to recognize and describe architectures of digital broadcasting systems. They will also be able to explain, describe and classify standards for satellite, cable and terrestrial digital transmission, as well as for network planning for TV signals distribution, and will be able to name, describe and classify standard technical details and functionality of equipment for the production, transmission and measurement of TV signals.

Course content:

Broadcasting systems - types, frequency bands, DTV system architecture. Studio TV Production - formation of TV signals, digitalization and compression of audio and video signal, additional services, TS, interfaces, TV program multiplexing. Digital TV broadcasting (DVB-x) - Satellite / Cable / Terrestrial - primary and secondary distribution, microwave links, transmitter architecture, parameters of TV transmission. Network planning for terrestrial broadcasting - MFN and SFN, gap fillers, calculation of EM field level and service area of digital TV transmitters. Receiving a digital TV signal - receiver architecture, quality of service and measurement of TV signal parameters.

Methodology:

Literature:

1. W. Ficher, Digital Video and Audio Broadcasting Technology, Springer, 2010.
2. E. P. J. Tozer, Broadcast Engineer's Reference Book, Focal Press, Oxford, 2004.
3. J.C. Whitaker, Standard Handbook of Broadcast Engineering, McGraw-Hill, NY 2005.
4. H. Benoit, Digital Television - Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework, Focal Press 2008.
5. U. Reimers, DVB - The Family of International Standards for Digital Video Broadcasting, Springer, 2005.
6. R. Beutler, The Digital Dividend of Terrestrial Broadcasting, Springer, 2011.

Evaluation:

Project task	40	Computer exercises	20	Final exam	40

Note(s):

Teacher who prepared the file: Jugoslav Joković, assistant professor

	UNIVERSITY OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study program: Digital broadcasting and broadband technologies	

Course title	DTV receivers and software support in the DVB framework			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Required	1	2+3	6
Teacher(s)	Nikola Teslić, professor			

Course prerequisite(s)	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

The course aims to provide fundamental knowledge about TV, broadcasting, transmission and multimedia content reproduction to users. It deals with broadcasting TV technologies in DVB framework, with special regard to architecture and DTV receivers' software design.

Learning outcomes:

During the course, the students will be trained to design a software for multimedia content reception and reproduction devices with an emphasis on video content. They will learn the methods and techniques of video coding, just like the systems and techniques for video content protection. Practical work will include software development for actual DVB-T2 set-top box devices. The students will fully understand all the phases of broadcasting, as well as solutions for content reproduction and control of processing of all components of multimedia content, including screen video and graphics.

Course content:

Basics of television; Signal transmission techniques; TV signal, standards and formats. Digital television development; Digital TV pro et contra; Digital transmission and reception technologies; Digital modulation overview; Transport stream; Digital TV standards; DVB core standards; Basic notions of DVB-T2; Synchronization and metadata; Signaling tables, Digital TV receiver architecture; Transport stream processor,; Decoder, Graphical sub-system, Output interfaces; Communication between integrated circuits, Signal routing, reproduction scenarios. DTV receiver software. TV receiver software model. Architecture of T application and design patterns. Cases of used in DTV applications. Video coding and actual standards. Temporal and spatial model. Overview of video coding standards. Profiles and levels. Most recent standards. Content access control systems. System architecture. Conditional access in DVB. Scrambling; Signalization. Security elements in hardware and software. System integration and practical aspects. DTV system components and manufacturers. Technical documentation. Levels of integration and practice of software integration. Real DTV application development through practical work.

Methodology:

Lectures. Tutorials. Computer exercises and independent work. Consultations.

Literature:

1. M. Bjelica, N. Teslic, V. Mihic, „TV software and image processing 1“, 2016.
1. Fischer, W. "Digital Video and Audio Broadcasting Technology - A Practical Engineering Guide," Springer-Verlag, 2010.
2. Benoit, H. "Digital Television - Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework", Focal Press, 2008
4. Richardson, I. E. G. "H.264 and MPEG-4 Video Compression", Wiley, 2004

Evaluation:

Lectures. Tutorials. Papers and computer exercises (60%). Consultations. Final exam is a theory test (40%)

Papers	50	Computer exercises	10	Theory exam	40

Note(s):

Teacher who prepared the file: Nikola Teslić, professor

	UNIVERSITY OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study program: Digital broadcasting and broadband technologies	

Course title	Studio Audio and Video production			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Elective	1	2+3	6
Teacher(s)	Slavko Šajić, assistant professor			

Course prerequisite(s)	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

Familiarization of students with the basic concept of TV studio production and A/V signal processing in production and postproduction.

Learning outcomes

Upon completing the course, students will understand the principles of TV studios and production of audio and video content within it. Also, students shall acquire knowledge to use video and audio equipment and perform basic measurements.

Course content

TV studio -basic concepts. Audio - Sound field properties. Analog and digital audio signals. Concepts of audio systems. Effects of input (recording) and output (listening) environment. Auditory system as an audio system output. Perceptive effects of sound. Sound recording and reproduction (techniques and devices). Audio components and equipment. Audio signal processing. Audio monitoring and production. Audio compression, standards, audio signal quality measures. Video - Video formats and conversions, scalability, video compression, control errors in video. Video effects and transitions. Linear and non-linear editing. Video postproduction. Video components and equipment. Video servers. TV center - concept of synchronization. Mixers of video and audio signals. Digital interfaces. SDI SDTI - ASI, routing video and audio. Video services. Automation of the production center. AAF , MXF. The virtual studio. Measurements in television.

Methodology:

Literature:

1. D. Self, R. Brice, B. Duncan, J. Linsley Hood, I. Sinclair, A. Singmin, D. Davis, E. Patronis, J. Watkinson, Audio Engineering, Newnes (Elsevier), 2009
2. M. Talbot-Smith: Audio engineer's reference book, 2nd edition, Focal Press, Oxford, 1999.
3. Karl Paulsen, Moving Media Storage Technologies Applications & Workflows for Video and Media, 2011.,
4. Al Kovalick, Video Systems in an IT Environment, Focal Press, 2005.
5. E. P. J. Tozer, Broadcast Engineer's Reference Book, Focal Press, Oxford, 2004.
6. C. Wootton, A practical guide to video and audio compression, Focal Press, Oxford, 2005.

Evaluation:

Project task	40	Computer exercises	20	Final exam	40

Note(s):

Teacher who prepared the file: Jugoslav Joković, assistant professor

	UNIVERSITY OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study program: Digital broadcasting and broadband technologies	

Course title	Digital broadband access technologies			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Elective	1	2+3	6
Teacher(s)	Gordana Gardašević, professor			

Course prerequisite(s)	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

Acquiring basic knowledge about access technologies for broadband interactive services distribution. Introducing types and architectures of broadband access networks and related standards and recommendations.

Learning outcomes:

Upon completing the course, students will be able to name, describe and identify basic characteristics of broadband access technologies. They will also learn how to choose the optimal access network architectures from the point of view of efficient distribution of broadband interactive services.

Course content:

General model of access network. Review of transmission media characteristics. Standards and recommendations. Broadband access technology over telecommunication cables with symmetric pairs. Symmetric and asymmetric xDSL access technologies (HDSL, SHDSL, ADSL2+, VDSL). Devices for broadband access (splitters, IP-DSLAM, xDSL modems). Fiber in the loop (FITL). Topologies of optical access networks. Passive and active optical networks in the local loop (BPON, GPON, EPON, AON). DWDM systems. Combined technologies in access networks. Modernization of cable distribution system by using hybrid networks with optical and coaxial cables (HFC network). Bidirectional signal transmission and services (cable TV, internet, video on demand, voice transmission). Cable modem terminal system (CMTS). Cable modems. Broadband access over power lines. PLC access network via low-voltage power lines (basic elements: PLC base station modem, repeater, gateway). In-home PLC networks. Wireless local loop (RITL). Fixed and mobile wireless access. Broadband wireless access technologies (WLAN, UWB, Wi-Max). Multiservice access node (MSAN).

Methodology:

Presentations. Lectures. Projects.

Literature:

1. Milan Janković, Zoran Petrović, Broadband digital networks of integrated digital services - Network access, 2nd Edition, Akademska misao, 2003.
2. Philip Golden, Herve Dedieu, Krista Jacobsen, Fundamentals of DSL technology, Auerbach Publications, Taylor & Francis Group, 2006.
3. Chinlon Lin, Broadband Optical Access Networks and Fiber-to-the-Home, John Wiley and Sons Ltd, 2006.
4. Halid Hrasnica, Abdelfatteh Haidine, Ralf Lehnert, Broadband Powerline Communications - Network Design, John Wiley and Sons Ltd, 2004.
5. Martin Clark, Wireless Access Networks: Fixed Wireless Access and WLL Networks – Design and Operations, John Wiley and Sons Ltd, 2000.

Evaluation:

Project task	40	Preliminary exam	20	Final exam	40

Note(s):

Teacher who prepared the file: Gordana Gardašević, professor

	UNIVERSITY OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study program: Digital broadcasting and broadband technologies	

Course title	Advanced DTV - Middleware, Interactive TV, IPTV			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Elective	1	2+3	6
Teacher(s)	Milan Bjelica, assistant professor			

Course prerequisite(s)	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

The course provides in-depth knowledge about the realization of systems for TV signal reception and practice in system integration and application for operators and end users. Basic focus is on understanding the implementation of DTV middleware, as well as technologies and framework for development and application of complex DTV applications. Particular chapters deal with various aspects of non-linear TV, such as IP TV, Internet TV, Social TV and second screens paradigms.

Learning outcomes:

Upon successful course completion, students will be able to understand, design and transfer complex software of DTV receivers and multimedia applications. Through practical work, developing parts of complex software for a set-top box receiver, using modern middleware implementation solutions and implementation on modern operating systems (Android), students will be able to design and implement DTV software, as well as complex software architectures for consumer electronic devices in general.

Course content:

DTV Middleware overview; Abstracting middleware from hardware platform; Software model of DTV receiver in middleware implementation. Abstract signal routes; Software validation; Middleware functions: Channels, Multiplexes, Tables, EPG; Application APIs. Overview of technologies for the development of graphical TV applications. Native GUI programming; Declarative GUI implementation; HTML-based GUI; Android-based GUI; GUI integration layers – Browser plugin, JNI; TV convergence and two ways; Social TV and second screen; Hybrid TV; IP TV overview; Internet TV and Over-the Top services; Protocols in IP-based TV; Content sharing concept and protocols. Home protocol convertor. Fast channel change technologies; Standards in IP TV. Over-the-Top TV software; OTT middleware introduction; OTT client agent; OTT protocols, REST, JSON, XML; Secure communication; DRM and first reproduction; OTT interfaces and software integration. Basics of applicative hybrid DTV standards. Interactive TV. Application life cycle. Architecture of environment for application execution. Signalization. Integration. Programming languages for application standards. Actual application standards HbbTV, MHEG. Example of real DTV application. Taxonomy; DTV application development phases; Usability design; User interface design phases, Prototyping; Design patterns; Application elements overview. Development of real hybrid DTV application software through practical work.

Methodology:

Lectures. Tutorials. Computer exercises and independent work. Consultations.

Literature:

1. M. Bjelica, N. Teslic, V. Mihic, „TV software and image processing 1“, 2016
2. Fischer, W. "Digital Video and Audio Broadcasting Technology - A Practical Engineering Guide," Springer-Verlag, 2010.
3. Benoit, H. "Digital Television - Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework", Focal Press, 2008
4. Richardson, I. E. G. "H.264 and MPEG-4 Video Compression", Wiley, 2004

Evaluation:

Lectures. Tutorials. Papers and computer exercises (60%). Consultations. Final exam is the test in theory (40%).

Papers	50	Computer exercises	10	Test in theory	40

Note(s):

Teacher who prepared the file: Nikola Teslić, professor

	UNIVERSITY OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study program: Digital broadcasting and broadband technologies	

Course title	Regulation, standards and radio monitoring			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Elective	1	2+3	6
Teacher(s)	Branko Dokić, professor			

Course prerequisite(s)	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

The course's main goal is to gain theoretical knowledge and practical skills in:
- technical standards in radio broadcasting,
- the latest information about standards in radio-signal measurements and electromagnetic compatibility,
- measurement of intensity and relevant parameters of radio-signals,
- recognizing and evaluating radio-signals' compatibility with accepted technical standards,
- recognizing and evaluating the equipment's compatibility with recommendations and accepted standards,

Learning outcomes:

Upon completing this course students will:
- understand the standardization process and compatibility of regulation rules and procedures,
- be able to prepare, accept and implement technical standards in radio communications,
- be able to handle the measurement equipment,
- be able to analyze the measured results, present measuring results and manage unwanted obstructions,
- possess knowledge and skills in the field of surveillance of radio broadcasting systems of public broadcast.

Course content:

Method for following the up to date technical standards in radio broadcasting. Methods for measurement and surveillance of radio signals usage. Testing and measurement of signals in all points of audio and video content broadcast in the public broadcasting chain. Equipment and methods for measurement and surveillance of radio spectrum usage. Design and testing the public broadcasting network (cable, satellite and terrestrial MFN and SFN radio networks)

Methodology:

Interactive lectures and laboratory exercises based on hardware and software for the preparation of signals for multiplexing, transport stream analysis, broadcasting, radio-signal reception and transport stream analysis.

Literature:

Technical standards published on pages ITU-R, ITU-T, CEPT/ERC/ECC, RSK BiH, BAS (www.bas.gov.ba), published rules of the Communications Regulatory Agency of Bosnia and Herzegovina.

Evaluation:

Taking of exam requires 50% of each listed activity

Lectures		Homework	40	Final exam	40
Class activity		Preliminary exam	20		

Note(s):

Teacher who prepared the file: Branko Dokić, professor

	UNIVERSITY OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study program: Digital broadcasting and broadband technologies	

Course title	Multimedia Content on the Web			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Elective	1	2+3	6
Teacher(s)	Zoran Đurić, professor			

Course prerequisite(s)	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

Familiarize students with key concepts of importance for the development of Web-based multimedia applications. Mastering the latest HTML language specifications and related specifications and API's for Web-based multimedia applications development.

Learning outcomes:

Students will be able to develop multimedia Web-based applications using the corresponding complexity of the most effective methods and technologies. Through the course content they will be familiarized with and will be able to name, describe and identify current standards, technologies, languages, tools, and programming framework necessary for the development of multimedia Web-based applications, HTML 5 games, as well as the system for distributing audio and video content on the Web.

Course content:

HTML development. HTML, CSS, JavaScript. HTML 5 and 5.1, new HTML elements, specifications, APIs. Web Audio API. WebRTC API. Web Workers API. Images. img element. Formats, resolutions. Effects. Graphics. canvas and svg elements. Maps. JavaScript animations. Audio and video. Multimedia audio and video formats on Web. Audio, video, source and track elements. Embed and object elements. Webcasting/Live Video Stream. Protocols and formats. DRM. Development of multimedia web applications. Development of HTML 5 games.

Methodology:

Lectures, presentations, e-Learning, project tasks

Literature:

1. Denise M. Woods: HTML5 and CSS: Complete, Course Technology, 2012
2. Ken Bluttman and Lee Cottrell: HTML5 Multimedia Developer's Guide, McGraw-Hill Education, 2012
3. Jacob Seidelin, HTML5 Games: Creating Fun with HTML5, CSS3 and WebGL, Wiley, 2014
4. David Geary, Core HTML5 Canvas: Graphics, Animation, and Game Development, Prentice Hall, 2012
5. Hans W. Barz and Gregory A. Bassett, Multimedia Networks: Protocols, Design and Applications, Wiley, 2016
6. Materials from lectures and exercises

Evaluation:

Project task	30	Preliminary exam	30	Final exam	40

Note(s):

Teacher who prepared the file: Zoran Đurić, professor

	UNIVERSITY OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study program: Digital broadcasting and broadband technologies	

Course title	Multimedia Content Search			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Elective	1	2+3	6
Teacher(s)	Vladimir Risojević, assistant professor			

Course prerequisite(s)	**Prerequisite(s) form**
Basic knowledge of digital image processing and MATLAB required.	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

The course's main goal is to gain theoretical knowledge and practical skills in labeling and search of multimedia databases.

Learning outcomes:

Upon completing the course, students will have a theoretical and practical knowledge of managing the multimedia files and will be able to name and describe modern solutions and implementations, both in home files and professional systems including the field of medicine. Through project tasks, the students will gain experience in team work.

Course content:

Multimedia data structure. Basic objective descriptors of image content: color, texture, line orientation, shape. Objective image similarity measures. Search engines based on image content. Semantic gap. Implementation of user reaction in search engine. High-level image descriptors – semantic image description. MPEG-7: image content description standard. Labeling and search of audio content. Methods for protection of authenticity of multimedia content (watermarking). Basic application of a search engine: private, professional and medical files.

Methodology:

Interactive lectures with the use of projector and laboratory exercises using hardware and software for digital image processing based on Matlab.
Student workload: 45 hours of lectures, 30 hours of exercises and project work and 105 classes of individual work.

Literature:

Basic:
D. Feng, W.C. Siu, H.J. Zhang (Eds.), Multimedia Information Retrieval and Management, Springer, Berlin, 2003
Recommended:
M.S. Nixon, A.S. Aguado, Feature Extraction and Image Processing, Second Ed., Elsevier, 2008
Miodrag V. Popović: Digital Image Processing, Akademska Misao, Belgrade, 2006
Rafael C. Gonzalez, Richard E. Woods: Digital Image Processing, Third Ed., Pearson Prentice Hall, NJ, 2008
Rafael C. Gonzalez, Richard Eugene Woods, Steven L. Eddins: Digital Image Processing Using MATLAB, Pearson Prentice Hall, NJ, 2004

Evaluation:

Taking of final exam requires 50% of each listed activity

Homework	40	Preliminary exam	20	Final exam	40

Note(s):

Teacher who prepared the file: Vladimir Risojević, assistant professor

	UNIVERSITY OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study program: Digital broadcasting and broadband technologies	

Course title	Graphics and Animation			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Elective	1	2+3	6
Teacher(s)	Vladimir Risojević, assistant professor			

Course prerequisite(s)	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

The goal of this course is systematic study of modern concepts applied in graphics and animation.

Learning outcomes:

Upon completing the course, student will be able to use a modern graphic pipeline and to develop and write shaders. Student will also be able to learn independently the advanced techniques of computer graphics and animation.

Course content:

Basic notions of computer graphics, raster and vector graphics and corresponding tools, graphic API. Mathematic and program models during the rasterisation of 3D scene, matrix transformation, camera modeling, light and lightning, objects in a 3D scene, scene updating. Shaders, different shader languages. Rasterisation. Tessellation. Ray tracing and stochastic rendering methods. Advanced concepts of computer graphics and post-processing techniques.

Methodology:

Lectures. Laboratory exercises. Consultations. Term paper.

Literature:

1. Computer Graphics Using OpenGL (3rd Edition), Francis Hill Jr. Stephen Kelley
2. Vector Math for 3D Computer Graphics, 3rd Edition, CCSU Computer Science Department
3. Real-Time Collision Detection, Christer Ericson
4. Mathematics for 3D Game Programming and Computer Graphics, 3rd Edition, Eric Lengyel
5. Real-Time Rendering, Tomas Akenine-Moller, Eric Haines, Naty Hoffman

Evaluation:

Lab exercises	30%	Term paper	40%	Theory exam	30%

Note(s):

Teacher who prepared the file: Vladimir Risojević, assistant professor

	UNIVERSITY OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study program: Digital broadcasting and broadband technologies	

Course title	Multimedia Content Security			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Elective	1	2+3	6
Teacher(s)	Zoran Đurić, professor			

Course prerequisite(s)	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

Mastering different aspects of protection of data and applications, protection of computer systems and networks, operating systems and databases.

Learning outcomes:

Upon completing the course, students will acquire knowledge that will enable them to define security requirements for different types of systems, particularly DTV systems, as well as to implement various cryptographic algorithms and techniques and security protocols, to detect and/or remove various security shortcomings in DTV systems, Web applications, Web services, mobile applications, network services and wireless networks.

Course content:

Fundamental security requirements: confidentiality, integrity, non-repudiation, authentication. Cryptography and cryptanalysis. Historic cryptography algorithms. Modern cryptography. Symmetrical cryptography algorithms. DES, 3-DES, AES. IDEA. Asymmetrical cryptography algorithms. RSA. Message Authentication Code. Cryptography hash functions. MD2, MD4, MD5, RIPE-MD, SHA. Cryptography techniques. Digital envelope. Digital signature. PKI infrastructure. CA. RA. CRL. OCSP. Digital certificates. X.509 v3. Security protocols. Authentication (Needham-Schroeder, RADIUS, TACACS). Key management (Diffie-Hellman, Internet Key Exchange). Secure Web connections (HTTPS). Security of Web applications. Attacks on Web applications. Security of Web services. Attacks on Web services. Security of mobile applications. Analysis of security aspects of mobile applications. Defensive programming. Least-privilege and privilege-separation principles. Use of cryptography in software development. Network security. Security problems of network protocols (TCP, DNS, SMTP, POP3). Security of WLAN networks. Attacks and protection. Network and OS hardening. SSL/TLS. SSH. IPSec. VPN.
Threats to information security in digital television. Content protection. DRM. Digital signature and program verification. Protection of servers and equipment for audio/video signals broadcasting. User privacy. Connection to payment systems.

Methodology:

Lectures, laboratory exercises, presentations, e-Learning, project tasks.

Literature:

1. Stallings W., Network Security: Applications and Standards, 3rd ed., Addison-Wesley, 2003.
2. Stallings, W.: Cryptography and Network Security, Prentice Hall, 1999
3. B. Schneier, Applied Cryptography, 2nd edition, J. Wiley & Sons, 1996.
4. R. Anderson, Security Engineering, J. Wiley & Sons, 2001.
5. Dieter Gollmann. Computer Security. Wiley, 1999.
6. Simson Garfinkel, Gene Spafford: Practical Unix and Internet Security, O'Reilly, 1996
7. Douglas R. Stinson: Cryptography - Theory and Practice, CRC Press, 1995
8. Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone: Handbook of Applied Cryptography, CRC Press, October 1996
9. Bruce Schneier: Applied Cryptography - Protocols, Algorithms, and Source Code in C. Second edition, John Wiley & Sons Inc., 1996

Evaluation:

Homework	20	Project task	25	Final exam	55

Note(s):

Teacher who prepared the file: Zoran Đurić, professor

	UNIVERSIT OF BANJA LUKA **FACULTY OF ELECTRICAL ENGINEERING**	
	Study programme: Digital broadcasting and broadband technologies	

Course title	Modern Application Environments of DTV Receivers			
Course number	**Status**	**Semester**	**No.of classes**	**ECTS**
	Elective	1	2+3	6
Teacher(s)	Nikola Teslić, professor			

Course prerequisites	**Prerequisite(s) form**
	According to Rules of study at first and second -cycle studies of the University of Banja Luka

Course study goals:

Practical understanding and knowledge of operating systems and environments for the implementation of applications for today's modern multimedia devices ad TV receivers, including abstract, multiware software environments and modern design patters. Systemic and application aspects of the Android operating system. Aspects of integration with the client and over-the-top middleware, systemic services and graphical sub-systems, just like in the aspect of optimization for target systems.

Learning outcomes:

The students will acquire knowledge of design of complex systemic and application software for Android TV operating system, with special knowledge relating to the integration of DTV functionality into a complex software stack, following the Android example.

Course content:

Application environments and operating systems for DTV receivers. Access and interfaces based on HTML5, just like on the Android operating system. Aspects of integration. Aspects of graphical interfaces and interaction with users. Optimization. Introduction to Android TV. Interfaces in Android. Environment for development of Android applications. DTV Interfaces in Android. Systemic layer of the Android operating system. Linux in Android. Systemic services in Android. Native libraries. Native design patterns. Android expansions in the native layer. APT. Application environment of the Android operating system. Design patterns in the Android application environment. Android managers. Content Providers. Intents and notifications, Activities, windows and graphical aspects. Application interfaces. TV environment in the Android operating system (TIF). The concept of integration of DTV functionality in Android. TV Provider. TV Input Manager. TV Input. TV Input HAL. Certification requirements. Aspects of design of user interaction and graphic design. GUI SDK Android. Environments for the development of 3D graphical interfaces. Frame-level processing. Applications of virtual reality and 3D television. GUI design for DTV application for Android.

Methodology:

Lectures. Tutorials. Computer exercises and independent work. Consultations

Literature:

1. Ištvan Pap, Nemanja Lukić, „Software System Design and Architecture –Android-based Systems “, 2015.
2. M.Bjelica, N.Teslić, V.Mihić, „Software in Television and image Processing 1“, 2016.
3. Fischer, W. "Digital Video and Audio Broadcasting Technology - A Practical Engineering Guide," Springer-Verlag, 2010.
4. Benoit, H. "Digital Television - Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework", Focal Press, 2008.
5. Richardson, I. E. G. "H.264 and MPEG-4 Video Compression", Wiley, 2004.

Evaluation:

Lectures. Tutorials. Papers and computer exercises (60%). Consultations. Final exam is a theory test (40%).

Papers	50%	Computer exercises	10%	Theory test	40%

Note(s):

Teacher who prepared the file: Nikola Teslić, professor

UNIVERSITY OF BANJA LUKA
FACULTY OF ELECTRICAL ENGINEERING

Study program: Digital broadcasting and broadband technologies

Course title	Human-Computer Interaction			
Course number	**Status**	**Semester**	**No. of classes**	**ECTS**
	Elective	I	2+3	6
Teacher(s)	Dejan Rančić, professor			

Course prerequisites	**Prerequisite(s) form**
	According to Rules of study at first and second-cycle studies of the University of Banja Luka

Course study goals:

Training of students to design, implement and evaluate software-hardware solutions in a way to adjust them to the maximum extent possible to the user, tasks and environment.

Learning outcomes:

Upon successful completing of the course, the student will be able to create solutions of maximum usability, focused (but not limited to) on: perceptive and cognitive human processes, characteristics of interactive devices and technologies, and to use heuristics and recommendations in software design and implementation.

Course content:

HCI development and problems. Heuristics and guidelines for interaction development and evaluation. Human-senses, memory, knowledge/skills acquisition, mental models. Software - architectures, techniques for request collection and task description, interaction styles, interaction design space (GUI, Web, HandHeld, embedded, ubiquitous). Devices – keyboards, pointer devices of direct and indirect control, display devices, other Ecopy and Hcopy devices, user monitoring devices and devices for users with special needs.

Methodology:

Interactive (active) lectures supported by slide projection and video material. Laboratory exercise based on .Net and WPF technologies.

Literature:

1. Dragan Ivetić, *Human –Computer Interaction, draft, Faculty of Technical Sciences, Novi Sad*, 2014.
2. Alan Dix, Janet Finlay, Gregory Abowd, Russel Beale, *Human-Computer Interaction*, 3rd Ed., 2004.
3. Debbie Stone, Mark Woodroffe, Caroline Jarrett, Shailey Minocha, *User Interface Design And Evaluation*, 2005.
4. Marry B. Rosson, John M. Carroll, *Usability Engineering – Scenario-Based Development of HCI*, 2002.
5. Ben Shneiderman, *Designing the User Interface – Strategies for Effective Human-Computer Interaction*, 3rd Ed., 1998.

Evaluation:

Exam is taken through laboratory exercises, homework in interaction evaluation and verbal part of the exam.

Class activity	5	Practical part	50	Final exam	45

Note(s):

Teacher who prepared the file: Dragan Ivetić, professor

6.8. RESEARCH WORK, STUDENT PRACTICE AND FINAL THESIS AT SECOND-CYCLE STUDIES

Research work at second-cycle studies is implemented throughout the studies and in particular during the preparation of the final thesis, through the studying of reference literature, preparation of homework and term papers, practical laboratory work, participation in University/Faculty projects, participation in the programme of mobility between the Universities, publication of papers at professional and scientific-expert symposiums and conferences, as well as other activities that the candidate's mentor has assessed as expert work. The report on the conducted research work will be signed by the candidate's mentor and submitted to the Final Thesis Committee for second-cycle studies.

Professional practice is also foreseen at the ***Digital Broadcasting and Broadband Technologies*** study programme as an elective course in the second semester corresponding to 10 ECTS points. Such practice would be realized by students in business entities that the Faculty/University would conclude agreement on conduct of professional practice with containing the learning objectives that should be achieved through it. The purpose of professional practice is as follows:

- Learning about special technologies, models, techniques and organization of work,
- Enhancing of skills required at the work post,
- Developing of the spirit of team work in problem solving and
- Learning of the methodology of project documentation preparation.

A three-member committee of teachers from the study programme is formed by a decision of the Faculty's Teaching-Scientific Council for the conduct of professional practice. Upon completion of professional practice, students submit a report on conducted practice and an employer's certificate that the practice has been implemented in accordance with the agreement signed between the Faculty /University and the business entity.

Professional practice may also be implemented within the framework of approved scientific-research projects in which the Faculty/University participates, just like through activities of the International Association for the Exchange of Students for Technical Experience (IAESTE). Such practice is verified, under the same rules, by the study programme's committee for the implementation of professional practice.

A student may register his/her second-cycle final thesis after having obtained 30 ECTS points at the second-cycle studies. The final thesis' topic may only be from the narrow scientific fields representing the core of the study programme. Registration procedures, grades and defence of the final thesis are defined under the Statute of the University of Banja Luka, as well as the Rules of Study at the first and second cycles, of the University of Banja Luka and the Faculty of electrical Engineering.

6.9. MOBILITY OF STUDENTS

The curriculum of the ***Digital Broadcasting and Broadband Technologies*** study programme at the second-cycle studies provides for the possibility of mobility of students.

Within the programme of mobility between universities, a student may earn no more than 30 ECTS points at a second-cycle programme at another higher education institution (HEI) that the University of Banja Luka has an appropriate agreement signed with. A student attending his/her study year/semester at another HEI within the programme of mobility between universities signs an Agreement on Studying in accordance with Article 120 of the Statute of the University.

A student registering a year/semester at another HEI, within the programme of mobility between universities, is obliged to notify the academic coordinator with the curriculum of that study programme for the appropriate study year/semester as well as the list of courses that he/she intends to register for. With a view to recognising the results achieved within the framework of the mobility programme, it is necessary, before the agreement is signed, to obtain, for required courses from the mother HEI, an opinion of responsible teachers about their recognition. An opinion of the Head of the Study Programme, based on previously obtained decision of mother departments, needs to be obtained for other courses.

A student who has completed mobility programme between universities will provide original documents for conducting a procedure of recognition of points at another University, in accordance with Article 21 of the Statute of the University of Banja Luka. A decision will be issued at the mother HEI on passed exams that are recognised, which will be included in the Diploma Supplement.

6.10. COMPATIBILITY OF THE STUDY PROGRAMME WITH STUDY PROGRAMMES IN COUNTRIES SIGNATORIES OF THE BOLOGNA DECLARATION

The Faculty of electrical Engineering of the University of Banja Luka has obtained an opinion on the compatibility of this curriculum at the ***Digital Broadcasting and Broadband Technologies*** second-cycle study programme with the current university curricula in countries signatories of the Bologna Declaration.

Multimedia Study at the Faculty of Electrical Engineering and the Faculty of Computer Science and Informatics of the University of Ljubljana. The content of the study programme is available on the web page

http://www.fe.uni-lj.si/en/education/1st_cycle_academic_study_programme/multimedia/subjects/

Study Programmeof the Faculty of Electronics of the University of Niš. The content of the study programme is available on the web page

http://www.elfak.ni.ac.rs/downloads/akreditacija-2013/mas/tel/msc-book-of-subjects-tel.pdf

"Multimedia and digital television" study programme of the University of Durres, Albania. The content of the study programme is available on the web page

http://www.ricum.edu.rs/files/7_3/broshuraFINAL_Durres.pdf

Study programme of the University of Bradford. The content of the study programme is available on the web page

http://www.bradford.ac.uk/study/media/courses/ug/booklets/2015-10/Media-Design-and-Technology.pdf

Study Programme of the Griffith University. The content of the study programme is available on the web page

https://degrees.griffith.edu.au/Program/1046/Overview

6.11. NUMBER OF STUDENTS TO BE ENROLLED IN THE STUDY PROGRAMME

Based on an analysis of needs and possibilities for educating students at second-cycle Digital Broadcasting and Broadband Technologies study programme, it is proposed that a total of 10 students be enrolled in the first year of studies at this study programme.

6.12. MODE OF FINANCING OF THE STUDY PROGRAMME

This Study Programme should mainly be financed from the Republic of Srpska Budget or by candidates themselves. The studies are foreseen as full-time studies of the second cycle (master studies) to be implemented and financed in the same way as the full-time studies of the first and second cycles at the existing study programmes. A certain number of students would be entirely financed from the Republic of Srpska Budget. The rest of students would be co-financing students paying one part of the costs of studies or self-financing students paying the costs of studies in full. The Republic of Srpska Ministry of Culture and Education would, by its decision, determine the number of students and the costs of this second-cycle study (master study), on the basis of a proposal of the University of Banja Luka.

7. QUALITY ASSURANCE ELEMENTS

The Senate of the University of Banja Luka has issued a Rulebook on Quality Assurance at the University. This Rulebook defines the role and the responsibilities of University's bodies and faculties they are comprised of in the field of quality assurance, the bodies in charge of monitoring, improvement and development of quality. It also regulates in detail their competences and the way of work, fields of quality assurance, self-assessment and quality assessment procedures, just like other issues of importance for improving and developing quality of education. Assurance of quality of work and studies administered by the University of Banja Luka, and the Faculties it is comprised of, is part of the national quality assurance system and a prerequisite for diploma and qualification comparability within the European Higher Education Area.

The University of Banja Luka, including the Faculties it is comprised of, assure quality of their higher education in accordance with:

- Internationally accepted documents in the field of higher education,
- Framework Law on Higher Education in Bosnia and Herzegovina,
- Law on Higher Education of the Republic of Srpska,
- Standards and guidelines for quality assurance in higher education in Bosnia and Herzegovina,
- Rulebooks on quality assurance at the university and at faculties, - other general acts of the University and the faculties.

The University of Banja Luka implements continuously the procedure of self-assessment (self-evaluation) and assessment of quality of its study programmes, teaching process and work conditions. This is done, as a rule, at the end of each academic year, and in intervals of no more than several academic years in accordance with the Rulebook on Quality Assurance and other general acts of the University. Students take part in the self-assessment procedure and students' assessment is taken into consideration, too. The report on self-assessment and quality assessment is published in a way to be available for both the academic staff and students of the University, The University submits to the Republic of Srpska Ministry of Education and Culture information on the procedure and results of self-assessment and quality assessment, just like other data of importance for the assessment and assurance of quality of education.

One of the main criteria in the preparation of the curriculum for the second-cycle *Digital Broadcasting and Broadband Technologies* study programme was to achieve academic and scientific standards of a study programme. Certain quality indicators were set for this purpose that will be monitored for the said study programme:

- Quality and structure of applying and enrolling students of the study programme,
- Average duration of studies.
- Percentage of students that complete the study in time,
- Number of passing students by year,
- Relevance of the Study programme for the Labour Market,
- Programme assessment by a representatives of institutions and the labour market,
- Study programme assessment by students,
- Number of incoming and outgoing "mobile" students.

Representatives of universities and business entities participating in the implementation of the DBBT Master Studies project took part in the preparation of the Study on the Justifiability of Establishment and Administration of *Digital Broadcasting and Broadband Technologies Second-Cycle Study Programme*, supported by the Erasmus+ programme, Radio and Television of Republic of Srpska Public Broadcasting Service, BiH Communications Regulatory Agency, and the RT-RK Institute.

A thematic session of the Teaching-Scientific Council of the Faculty is foreseen to take place once a year to analyse the results achieved at this study programme, according to the mentioned quality indicators.

Continuing enhancement of the quality of teaching and research work at the University of Banja Luka and the Faculty of Electrical Engineering that is involved in the implementation of this study programme is their strategic commitment. This is best achieved through continuing investment in human and technical resources, which is a continuing activity at the those institutions. The number of papers published in scientific journals and proceedings from international conference the authors/co-authors of which are teachers and associates of the said institutions increases year by year. Investments in technical resources are considerable, too. New laboratories are built and equipped. Libraries, reading rooms and computer rooms are improved and expanded for students' independent work.

8. PROOFS OF AVAILABILITY OF NECESSARY HUMAN AND TECHNICAL RESOURCES

TEACHERS AND ASSOCIATES	Number	Comment
Permanently employed teachers	21	
Permanently employed associates	30	
Teachers that are not permanently employed - contracted	15	
Associates that are not permanently employed - contracted	0	
Staff hired to support the teaching process	2	
Other staff	28	

MATERIAL OF THE FACULTY OF ELECTRICAL ENGINEERING'S LIBRARY			
Monograph Publications		Serial Publications	
Number of printed books	17863	Total number	251
Doctoral theses	38		
Post-graduation theses	82	Number of journals in Serbian language	41
Graduation theses	1941	Number of journals in foreign languages	210
Final theses of second cycle	38		

8.1 List of publications of the Faculty of Electrical Engineering of the University of Banja Luka since 2007, the authors/co-authors/editors of which are teachers/associates of the Faculty

Textbooks, collections, books and monographs:

1. Ratko Dejanović, LJubiša Preradović: *Software Engineering*, Faculty of Electrical Engineering of the University of Banja Luka, 2007. ISBN: 978-99938-793-8-1
2. Branko L. Dokić, *Power Electronics, Convertors and Regulators, 2nd edition*, Faculty of Electrical Engineering of the University of Banja Luka and Akademska misao, Belgrade, 2007. ISBN: 86-7122-021-4
3. Milorad M. Božić, Petar S.Marić, *Basics of Automatic Management Systems*, Faculty of Electrical Engineering of the University of Banja Luka, 2008. ISBN: 978-99938-793-9-8
4. Slaviša Krunić, Nikola Đoković, *Thermal and Electro-mechanical Calculations of Switchyard Elements:* exercise book, Faculty of Electrical Engineering of the University of Banja Luka, 2008. ISBN: 978-99955-46-00-7
5. Zoran Đurić, *Step into the JAVA World*, Faculty of Electrical Engineering of the University of Banja Luka, 2010. ISBN: 978-99955-46-02-1
6. Zdenka Babić, *Analysis and Processing of CT Signals,* Faculty of Electrical Engineering of the University of Banja Luka and PPGD „Komesgrafika“ d.o.o. Banja Luka, 2012. ISBN: 978-99955-46-05-2
7. Zdenka Babić, *Analog Filters,* Faculty of Electrical Engineering of the University of Banja Luka and PPGD „Komesgrafika“ d.o.o. Banja Luka 2012. ISBN: 978-99955-46-06-9
8. Slavko Marić, Dražen Brđanin, *Relational Databases*, Faculty of Electrical Engineering of the University of Banja Luka 2012. ISBN: 978-99955-46-07-6
9. Slavko Marić, Dražen Brđanin, Goran Banjac, *Relational Databases: book of solved problems*, Faculty of Electrical Engineering of the University of Banja Luka 2012. ISBN: 978-99955-46-08-3
10. Branko L. Dokić, Tatjana Pešić-Brđanin, *Linear Integrated Circuits;* Faculty of Electrical Engineering of the University of Banja Luka and Akademska misao, Belgrade 2012. ISBN: 978-99955-46-09-0
11. Branko L. Dokić, *Digital Electronics;* Faculty of Electrical Engineering of the University of Banja Luka and Akademska misao, Belgrade 2012. ISBN: 978-99955-46-10-6
12. Milorad M. Božić, Petar S.Marić, *Digital Management Systems*, Faculty of Electrical Engineering of the University of Banja Luka, 2012. ISBN: 978-99955-46-11-3
13. Zoran Mitrović, *Mathematical Analysis I*, Faculty of Electrical Engineering of the University of Banja Luka, 2011. ISBN: 978-99955-46-13-7
14. Ferid Softić, *Electronic Components,* Faculty of Electrical Engineering of the University of Banja Luka, 2013. ISBN: 978-99955-46-15-1
15. Zoran Mitrović, Momir Ćelić, Ivan-Vanja Boroja, Snježana Maksimović, *Exercise Book with Answers from ETF Entrance Exams in Banja Luka: 2010.-2012.*, Faculty of Electrical Engineering of the University of Banja Luka, 2013. ISBN: 978-99955-46-16-8
16. Branko Dokić, Branko Blanuša, Željko Ivanović, , *Power Converters in Renewable Energy Sources,* Faculty of Electrical Engineering of the University of Banja Luka and Akademska misao, Belgrade 2013. ISBN: 978-99955-46-17-5
17. *50 years of the Faculty of Electrical Engineering*, Faculty of Electrical Engineering of the University of Banja Luka, 2012. ISBN: 978-99955-46-12-0
18. Milorad M.Božić, Petar S.Marić, *Basics of Automatic Management Systems*, 2nd updated edition, Faculty of Electrical Engineering of the University of Banja Luka, 2014. ISBN: 978-99938-793-9-8

19. Gordana Gardašević, Nebojša Maletić, *Introduction to Telecommunication Systems and Networks*, Faculty of Electrical Engineering of the University of Banja Luka, 2014. ISBN: 978-99955-46-21-2
20. Aleksej Avramović, Tatjana Pešić-Brđanin, *Basics of Electrical Engineering 1: work book for laboratory exercises*, Faculty of Electrical Engineering of the University of Banja Luka, 2015. ISBN: 978-99955-792-8-9
21. Petar Matić, *Electrical Machines 1*, Akademska misao and Faculty of Electrical Engineering of the University of Banja Luka, 2016. ISBN: 978-99955-46-25-0

Manuals:

22. *Manual for Specifying Sources in Scientific and Professional Papers*, (editor: Zdenka Babić) Faculty of Electrical Engineering of the University of Banja Luka, 2011. ISBN: 978-99955-46-04-5

Proceedings:

23. *Proceedings / VII Symposium Industrial Electronics INDEL - 2008, Banja Luka, 7-8 November 2008.* (organized by the Faculty of Electrical Engineering Banja Luka, Symposium Chairman Branko Dokić) ISBN: 978-99955-46-01-4
24. *Proceedings / VIII Symposium Industrial Electronics INDEL - 2010, Banja Luka, Republic of Srpska, 4 -6 November 2010*. (organized by the Faculty of Electrical Engineering Banja Luka, Symposium Chairman Branko Dokić) ISBN: 978-99955-46-03-8
25. *Symposium proceedings / IX Symposium industrial electronics INDEL - 2012, Banja Luka, 1-3 November 2012.* (symposium chairman Branko Dokić) ISBN: 978-99955-46-14-4
26. *Proceedings / Scientific-Expert Symposium Energetic Efficiency ENEF 2013*, Banja Luka*, Republic of Srpska, BiH, 22.-23 November 2013.*, (organized by the Faculty of Electrical Engineering of the University of Banja Luka, Association of Energy Sector Specialists of Republic of Srpska, Banja Luka, editorial board Branko Dokić, Tatjana Pešić-Brđanin, Željko Ivanović, chief editor Branko Dokić, responsible editor Tatjana Pešić-Brđanin) ISBN: 978-99955-46-18-2
27. *Proceedings / Scientific-Expert Symposium Energetic Efficiency ENEF 2015*, Banja Luka*, Republic of Srpska, BiH, 25-26 September 2015.*, (organized by the Faculty of Electrical Engineering of the University of Banja Luka, Association of Energy Sector Specialists of Republic of Srpska, Banja Luka, editorial board Branko Dokić,, Čedomir Zeljković, Bojan Erceg, chief editor Branko Dokić, responsible editor Čedomir Zeljković) ISBN: 978-99955-46-23-6

Journals:

23. *Електроника-Electronics,* Faculty of Electrical Engineering of the University of Banja Luka (two editions per year, editor: Branko Dokić). ISSN: 1450-5843

8.2.OVERVIEW OF CLASSROOMS, LABORATORIES, CABINETS AND CONFERENCE ROOMS

The total number of students attending first-cycle and second cycles studies at the Faculty of Electrical Engineering is 975. 106 students are studying at second-cycle studies. The Faculty has around 5000 m^2 of available space, with 10 classrooms of the area of 604 m^2, 24 laboratories of the total area of 1117 m^2, 36 cabinets for teachers and associates of the total area of 963 m^2, Dean's Office, Registrar's Office, space for Administration, library, 2 reading rooms, Computer Centre and 3 conference rooms.

In addition to laboratories that will be equipped using the project's financial resources, there are, for the ***Digital Broadcasting and Broadband Technologies*** study programme, also 6 dedicated laboratories for disciplinary and narrow disciplinary courses, 2 laboratories for electronics, 2 laboratories for telecommunications and 2 laboratories for general electrical engineering. Furthermore, 8 computer laboratories are available for laboratory exercises requiring use of computers.

List of most important laboratory equipment			
Study Programme: ***Electronics and Telecommunications***			
	DEVICE	NOTE	NUMBER OF UNITS
1.	Altera DE1 Board	Development environment	1
2.	Altera DE2-115 Board	Development environment	5
3.	Altera DE1-SoC Board	Development environment	10
4.	HP OSCILLOSCOPE 54600B	Oscilloscope	2
5.	HP Multimeter 974A	Digital multimiter	2
6.	BEST 936E	Soldering iron	2
7.	Mikroelektronika BIGPI	Development environment	1
8.	Mikroelektronika dsPIC	Development environment	1
9.	Mikroelektronika Easy8051	Development environment	12
10.	Mikroelektronika EasyAVR	Development environment	12
11.	Mikroelektronika	Development environment	2

	EasyARM		
12.	Mikroelektronika Fusion V7	Development environment	10
13.	Mikroelektonika Easy PIC	Development environment	2
14.	Hilscher NANL-C500-RE	Industrial protocol analyser	1
15.	EtherCAT Network Setup	Experimental setup for EtherCAT Protocol	1
16.	ProtoBoard no. 203A-203B	Prototype development board	25
17.	RIGOL DS1052	Oscilloscope	12
18.	USB Instrumentation EasyScope	Oscilloscope	1
19.	FUNCTION GENERATOR	Function generator	15
20.	PandaBoard ES DR-PRO	Development environment	2
21.	PandaBoard Rev. A4 Kit	Development environment	2
22.	Humusoft MF624	Acquisition card	1
23.	Agilent Mixed Signal Oscilloscope MS07012A	Digital oscilloscope	1
24.	HP8645A Agile Signal Generator 0.26-1000 MHz	Agile signal generator	1
25.	Agilent CSA Spectrum Analyzer 100KHz-3GHz	Spectrum analyser	1
26.	HP4194A Impedance/Gain-Phase Analyzer	Impedance analyser	1
27.	HP8656B Signal Generator 0.1-990MHz	RF signal generator	1
28.	HP8568B Spectrum Analyzer 100KHz-1.5GHz	Spectrum analyser	1
29.	HP8903A Audio Analyzer 10Hz-100KHz	Audio signal analyser	1
30.	HP3712A Correlator + Spectrum	Correlator with spectrum analyser	1

31.	HP8902A Measuring Receiver 150KHz-1.3GHz	Measuring receiver	1
32.	Agilent E5061B Network Analyzer 100KHz - 1,5GHz	Network analyser	1
33.	Agilent 85033E Calibration Kit and adapters	Calibration kit of the network analyser	1
34.	Agilent N9000A CXA Signal Analyzer 9KHz-3GHz (EMI Meas. App)	Signal and spectrum analyser	1
35.	Sonomi 310 11909A Low Noise Amplifier (gain32 dB±1,5 dB 9KHz – 1GHz; NF 1,8 dB 5-500 MHz; NF 2,5 dB @ 1 GHz)	Low noise amplifier	1
36.	Langer RF1 Close-Field Probe Set	Close field probe set	1
37.	EM-7600 Transient Limiter	Limiter	1
38.	ETS-3810 Line Impedance Stab. Network	Stabilisation network	1
39.	Agilent InfiniiVision Oscilloscope MSOX3012A (100 MHz, 4 G Sa/s; 2 analog channels + 16 digital channels + function generator + 3 passive probes)	Digital oscilloscope	1
40.	Agilent N9310A RF Signal Generator 9KHz - 3 GHz	RF signal generator	1
41.	82357B USB/GPIB Interface	USB/GPIB interface	2
42.	Agilent N9340B Handheld RF Spectrum Analyzer 100KHz-3GHz	Handheld RF signal generator	1
43.	Agilent 53220A Universal Counter 350 MHz, 100ps	Function generator/counter	1
44.	8498A Coaxial fixed Attenuator	Attenuator	1
45.	Agilent N9010A EXA Signal Analyzer 10Hz - 3,6 GHz (Analog-Digital demod, Vector signal analysis, NF measurement, Noise source)	Signal and spectrum analyser	1
46.	PeakTech 1100 FM stereo/ FM-AM Signal	FM stereo/ FM-AM Signal Generator	1

	Generator		
47.	Agilent N9330B Handheld Cable And Antenna Tester 25MHz - 4GHz	Handheld cable and antenna tester	2
48.	Agilent Infinii Vision Oscilloscope DSOX3024A (200 MHz, 4 G Sa/s; 4 analog channels + function generator + 3 passive probes)	Digital oscilloscope	3
49.	Agilent InfiniiVision Mixed Signal Oscilloscope MSO7012B (100 MHz, 4 G Sa/s; 2 analog channels + 16 digital channels + 3 passive probes)	Digital oscilloscope	1
50.	Agilent N9310A RF Signal generator 9KHz - 3GHz	RF signal generator	1
51.	10074D Passive Probe	Passive probes	10
52.	Agilent InfiniiVision Mixed Signal Oscilloscope MSO7032B (350 MHz, 2 G Sa/s; 2 analog channels + 16 digital channels + 3 passive probes)	Digital oscilloscope	2
53.	SmartclassE1 E1 Service Testing Tool	E1 testing tool	2
54.	Agilent MXA N9020A Signal Analyzer 10Hz - 8,4GHz (Phase Noise measurement)	Signal and spectrum analyser	1
55.	Agilent MXG N5182B Vector signal generator 9KHz - 3GHz	Vector signal generator	1
56.	41800A Active probe	Active probes	1
57.	Agilent U1604B Handheld Oscilloscope 40 MHz, 200 M Sa/s + 2 passive probes + current clamps + temperature sensor	Digital oscilloscope	1
58.	Faraday cage		1
59.	Climatic chamber		1
58.	Oscilloscope DSO10502B		8

59.	Handheld spectrum analyser Spectran NF5030		1
60.	Broadband electric field meter NMB-520		1
61.	Oscilloscope2GSa/s DSOX2022A		4
62.	Signal generator 33521B		5
63.	Digital multimeter 34450A		5
64.	DC supply source E3631A		4
65.	DC supply source E3634A		2
66.	Programmable DC supply source E3632A		5
67.	Digital multimeter U3401A		5
68.	Milliameter GOM802		1
69.	Wattmeter PM1000+		1
70.	LCR meter 4263B		1
71.	Spectrum analyser GSP-830		1
72.	Multinorm – light and sound measuring MI 6201 ST		1
73.	Omega GT plus		1
74.	Thermovision camera		1
75.	Steinbichler Comet L3D	3D scanner with corresponding software	1
76.	Analogue Devices ADSP-21489 EZKIT Lite	Development system for DSP	8
77.	Texas Instruments TMS320VC5510	Development system for DSP	7
78.	Atlys Spartan 6	Development system for FPGA	8
79.	NIKON D5000	Camera	1
80.	Sony camcorder	Mini camcorder	1

81.	Iris recognition system	Camera accessory for iris imaging	1

ANNEX

UNIVERSITY OF BANJA LUKA

RECEIVED ON 03 May 2017	
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	1303/17

REPUBLIC OF SRPSKA

MINISTRY OF EDUCATION AND CULTURE

Banja Luka, Trg Republike Srpske 1, Telephone 051/338-831, *www.vladars.net*, e-mail: *mp@mp.vladars.net*

Number: 07.050/612-105-7-2/16
Banja Luka, 20 April 2017

Pursuant to Article 22 of the Law on Higher Education (Official Gazette of the Republic of Srpska, number 73/10, 104/11, 84/12, 108/13, 44/15 and 90/16), Article 16 and 18 of the Decree on requirements for the establishment and commencement of work of higher education institutions and on the procedure for determination of fulfilment of requirements (Official Gazette of the Republic of Srpska, number 35/11 and 51/11), acting upon request of the University of Banja Luka, the Minister of Education and Culture is issuing the following

DECISION

1. It is hereby established that the Organizational Unit of the Faculty of Electrical Engineering, University of Banja Luka, fulfils the requirements for administering the study programme of **Digital Broadcasting and Broadband Technologies** – 60 ECTS at the second cycle of studies in the academic year of 2017/2018.

2.The fulfilment of requirements for performing the activity of higher education shall be verified in accordance with provisions of the Law on Higher Education (Official Gazette of the Republic of Srpska, number 73/10, 104/11, 84/12, 108/13, 44/15 and 90/16), and the Decree on requirements for the establishment and commencement of work of higher education institutions and on the procedure for determination of fulfilment of requirements (Official Gazette of the Republic of Srpska, number 35/11 and 51/11)

R a t i o n a l e

The Organizational Unit of the Faculty of Electrical Engineering, University of Banja Luka, filed a request to the Ministry of Culture and Education of the Republic of Srpska for the licensing of the second cycle of the Digital Broadcasting and Broadband Technologies study programme.
Pursuant to Article 16 of the Decree on requirements for the establishment and commencement of work of higher education institutions and on the procedure for determination of fulfilment of requirements, the Minister of Education and Culture issued a decision number: 07.050/612-105-7-1/16 from 06 March 2017 appointing a licencing Committee for the said study programme comprised of:
1. prof.dr Milomir Šoja, Faculty of Electrical Engineering of the University of Istočno Sarajevo, Committee Chair
2.doc.dr Mirjana Maksimović, Faculty of Electrical Engineering of the University of Istočno Sarajevo, member and

STUDY ON THE JUSTIFIABILITY OF ESTABLISHMENT AND IMPLEMENTATION OF THE DIGITAL BROADCASTING AND BROADBAND TECHNOLOGIES SECOND-CYCLE STUDY PROGRAMME

3.doc.dr Božidar Popović, Faculty of Electrical Engineering of the University of Istočno Sarajevo, member.

Based on an analysis of the documentation submitted by the Organizational Unit of the Faculty of Electrical Engineering, University of Banja Luka, and a review of spatial, material-technical and other conditions at the address of Patre 5, the Committee, on 06 April 2017, made a Report on the fulfilment of requirements for administering the second cycle of the Digital Broadcasting and Broadband Technologies study programme.

The Committee's Report notes that the Organizational Unit of the Faculty of Electrical Engineering, University of Banja Luka:

- has necessary space and equipment for administering the second cycle of the Digital Broadcasting and Broadband Technologies study programme;
- has the necessary number of teachers and associates engaged under indefinite term employment contracts for administering the said study programme;
- that the structure of courses has been prepared in a satisfactory manner and that the curricula are complete and harmonised with similar study programmes administered at other licensed and accredited higher education institutions in countries signatories of the Bologna Declaration;
- that the title acquired upon completion of the said study programme is as follows: *Master of Digital Broadcasting and Broadband Technologies – 300 ECTS;*
- that the number of students the higher education institution plans to enrol in the said study programme is: 10.

Given the foregoing, the Committee's Report, made on 10 April 2017, noted that the Faculty of Electrical Engineering of the University of Banja Luka had fulfilled all necessary requirements and standards to start administering the second cycle of the Digital Broadcasting and Broadband Technologies study programme.

Legal remedy: This Decision is final in the administrative procedure and an administrative dispute may be initiated against it before the District Court in Banja Luka within 30 days of its delivery date.

/seal:
Republic of Srpska
Ministry of Education and Culture
Banja Luka/

MINISTER

/signature/

dr Dane Malešević

Copies to:
1.University of Banja Luka, Rector's Office
Bulevar Vojvode Petra Bojovića 1A
2.Higher Education Sector
3.a/a

I hereby certify that the above translation is a faithful and complete translation of the original document written in Serbian language
Registry No.: *127218*
Date, place: 18.06.2018 Banja Luka
Tamara Umićević
Permanent Court Interpreter for English and German Language

STUDY ON THE JUSTIFIABILITY OF ESTABLISHMENT AND IMPLEMENTATION OF THE DIGITAL BROADCASTING AND BROADBAND TECHNOLOGIES SECOND-CYCLE STUDY PROGRAMME

REPUBLIC OF SRPSKA

MINISTRY OF EDUCATION AND CULTURE

Banja Luka, Trg Republike Srpske 1, Telephone 051/338-831, www.vladars.net, e-mail: mp@mp.vladars.net

Pursuant to Article 22, paragraph 8, of the Law on Higher Education (Official Gazette of the Republic of Srpska, number 73/10, 104/11, 84/12, 108/13, 44/15 and 90/16), and Article 18, paragraph 2, of the Decree on requirements for the establishment and commencement of work of higher education institutions and on the procedure for determination of fulfilment of requirements (Official Gazette of the Republic of Srpska, number 35/11 and 51/11), and the Decision number 07.050/612-105-7-2/16 from 20 April 2017, the Minister of Education and Culture is issuing the following

LICENSE

FOR

ADMINISTRATION OF STUDY PROGRAMME

The University of Banja Luka with registered office in Banja Luka, Univerzitetski Grad –Bulevar Vojvode Petra Bojovića 1A, is hereby authorised to administer, starting from the academic **2017/2018** year, the study programme of

DIGITAL BROADCASTING AND BROADBAND TECHNOLOGIES - 60 ECTS

at the second cycle of studies, in the duration of one year, at the Organizational unit of the Faculty of Electrical Engineering, address Banja Luka, Patre br. 5

/seal:
Republic of Srpska
Ministry of Education and Culture
Banja Luka/

MINISTER

/signature/

dr Dane Malešević

Number: 07.050/612-105-7-2-1/16

Date: 22 May 2017

I hereby certify that the above translation is a faithful and complete translation of the original document written in Serbian language

Registry No.: *127218-2*

Date, place: 18.06.2018 Banja Luka

Tamara Umićević

Permanent Court Interpreter for English and German Language

STUDY ON THE JUSTIFIABILITY OF ESTABLISHMENT A
BROADCASTING AND BROADBAND TECHNOLOGIES S