Partner in the Project
Quality Improvement of Master Programs
in Sustainable Energy and Environment

QIMSEE

HERD ENERGY PROJECT
QUALITY IMPROVEMENT OF MASTER PROGRAMS IN
SUSTAINABLE ENERGY AND ENVIRONMENT

# Plan for achieving quality of the study program Sustainable energy and environment

**-MASTER PROGRAM-**

Ss. Cyril and Methodius University in Skopje

Faculty of Mechanical Engineering - Skopje

# 1 INTRODUCTION

The Ss. Cyril and Methodius University in Skopje (UKIM) is the first state University in the Republic of Macedonia, founded in 1949, initially with three faculties: the Faculty of Philosophy, the Faculty of Medicine and the Faculty of Agriculture and Forestry. At the moment, the University represents a functional community of 23 faculties, 5 research institutes and 11 accompanying members. The Ss. Cyril and Methodius University develops study programmes in all scientific fields – natural sciences and mathematics, tecnical and technological sciences, medical sciences and health, biotechnical sciences, social sciences, humanities and arts. Nowadays, the illustration of UKIM through figures is as follows: around 50.000 enrolled students from Republic of Macedonia in all cycles of studies, as well as over 700 foreign students; over 2.700 teaching, research and associate academic staff at the faculties and at the institutes; over 126.000 graduated high-professional staff (with obtained Bachelor degree); over 5,300 candidates obtained Master's degree; and around 3,200 doctors of science in all teaching and scientific fields.

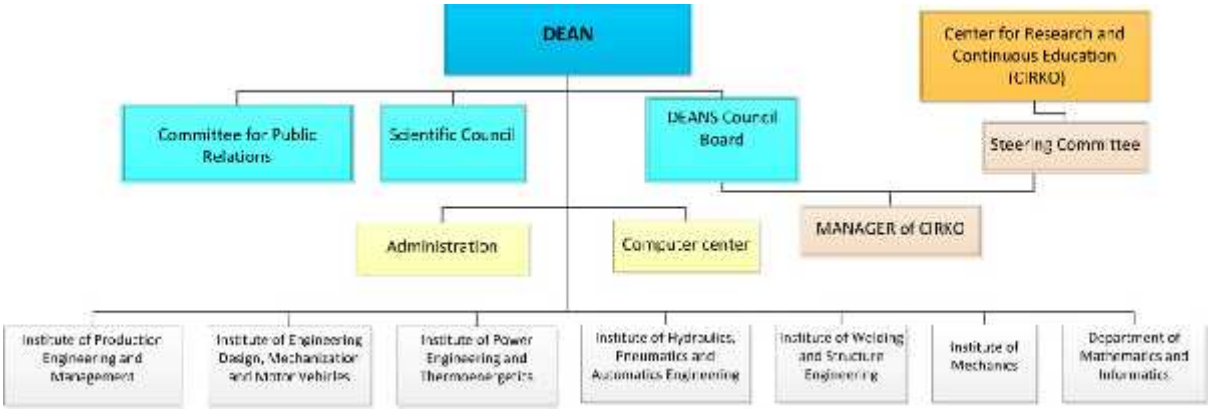
Mechanical Engineering studies started in the autumn of 1959 at the Technical Faculty in Skopje, within which the Department of the Electrical and Mechanical Engineering was created. Due to the increased social demand for mechanical engineers in Republic of Macedonia, in 1965 within the Ss. Cyril and Methodius University, a separate Faculty of Mechanical Engineering was established with two divisions: Electrical Engineering and Mechanical Engineering.The development of studies in Mechanical Engineering brought about the necessity of establishing a separate Faculty of Mechanical Engineering and it dates from 1977 existing up to date. Within over five decades, the Faculty develops its own characteristics, which to a large extent correspond with the visions of its founders, yet also reflecting the experience gained throughout its early stage of development. The last reform of the Faculty's curriculum that was done in 2012 permitted the incorporation of new trends in the science of Mechanical Engineering. Today, the Faculty of Mechanical Engineering offers educational process with incorporated new trends in European Higher Education Area, as an ECTS and postulates of Bologna Declaration and currently hosts in excess of 1,500 students at all levels of education. The offered study programs are according the demand of the industry sector for advanced engineering technologies and competitive economic growth of the Macedonian industry sector. The Faculty of Mechanical Engineering offers one and two year postgraduate studies - Master of Science in Mechanical Engineering. Apart from its educational activity, the Faculty of Mechanical Engineering undertakes research activities in the field of Mechanical Engineering. With its staff potentials, it represents a centre for the development of science, scientific thought and the application of science in the economy.

# 2 FACULTY CAPACITY

## 2.1 Organization and staff

In education process at Faculty of Mechanical engineering Skopje is realized by 38 full time professors, 8 associate professors and 13 assistant professors. In addition to this, there are 13 assistants and 19 employees as administration staff and 2 as IT staff.

The following chart shows the organization of Faculty of Mechanical Engineering and its institutes, department and other bodies.




## 2.2 Strategies and procedures for quality assurance

The internal mechanism for ensuring quality control of the studies consists in development of curricula, implementation of the teaching process, assessing of students, development of project works, evaluation of the quality of teaching using the surveys of the students at the end of each semester for each subject, evaluation of the quality of the curriculum by the students once they are awarded with diploma, other procedures related to resources and logistics of the teaching process. The last report about the external evaluation of University Ss Cyril and Methodius in Skopje was issued by the European University Association in 2011 and regarded the period from 2006/07 to 2009/10. The last Self-evaluation report was conducted late 2014.

## 2.3 Analyzing the shortage of capacities

The Faculty of Mechanical Engineering is facing with the need for additional researchers and teaching assistants to be involved in the educational, research and application work of the Faculty of Mechanical Engineering.

The Faculty is dealing with a shortage of assistants and assistant professors. There are 59 professors, associate professors and assistant professors, but only 13 assistants, which means that the number of assistants is only 25% of the number of professors. It is necessary to ensure new employments of young assistants.

- Some administrative staff positions which exist in the sistematization of the working positions at the Faculty are not filled in with employees, so it is necessary to get permission from the Ministry of Education and Science to cover such positions. The lack of administrative staff makes difficulties in the realization of the administartive activities of the Faculty. The problem of insufficient number of technicians in the laboratories of the Faculty is especially significant problem, which decreases the quality of realization of the student laboratory exercises in the teaching process.
- The age structure of the Faculty staff is unfavorable, i.e. 40% of the employees are older than 50 years, and 60% are older than 45 years. This fact also testifies the high demand for employment of new young staff at the Faculty.
- Gender structure of employees who have teaching title at the Faculty of Mechanical Engineering in Skopje is extremely uneven: the number of females

is only about 12% of the total number of teachers. The gender structure of the employees as assistants is even: the number of females is 50% of the total number of assistants.

# 3 DEPARTMENTS' (INSTITUTE'S) CAPACITY

## 3.1 Organizational structure of the Department/Institutes

Two institutes (Institute of Thermal engineering and the Institute of Hydraulics and Automation) are principle organizers of the Sustainable energy and environment study program, but also professors from the Department of Methematics and Informatics and Institute of Production Engineering and Management are involved. They are the following:

1.Professor Armenski Slave
2.Professor Dimitrovski Mile
3.Professor Chakmakov Dusan
4.Professor Tuneski Atanasko
5.Professor Malcheski Aleksa
6.Professor Stojkovski Valentino
7.Professor Tuneski Nikola
8.Professor Kochov Atanas
9.Associate professor Tashevski Done
10.Associate professor Filkoski Risto
11.Associate professor Markov Zoran
12.Assistant professor Lazarevska Ana
13.Assistant professor Dimitrovski Dame
14.Assistant professor Babunski Darko
15.Assistant professor Zaev Emil
16.Assistant professor Celakoska Emilija
17.Assistant professor Prangoski Bojan

## 3.2 Professors knowledge catalogue

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|---|---|
| Prof. Armenski Slave | Non-Conventional thermal power plant, Thermal energy |
| Prof. Dimitrovski Mile | ICE Engines, IC engines and environment |
| Prof. Chakmakov Dusan | Information systems, Searching in multimedia information |
| Prof. Tuneski Atanasko | Mechanical engineering, Control systems |
| Prof. Malcheski Aleksa | Functional analysis, Banal spaces, n-normed spaces |
| Prof. Stojkovski Valentino | Fluid mechanic and fluid flow systems |
| Prof. Tuneski Nikola | Complex analysis, Geometric function theory |
| Prof. Kochov Atanas | Mechanical engineering, Composite materials |
| Assoc.prof. Tashevski Done | Energy, Energy and ecology, Fuel cells |
| Assoc.prof. Filkoski Risto | Power engineering, Mathematical modeling and simulation of energy procceses |
| Assoc.prof.dr Zoran Markov | Fluid mechanics, Turbomachinery flow, Water and waste water treatment |

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| Ass. prof. Lazarevska Ana | Mechanical engineering, Fluid mechanics, Environmental protection |
| Ass. prof. Dimitrovski Dame | Thermoenergy, IC engines and environment |
| Ass. prof. Babunski Darko | Programmable logic controllers, environmental monitoring systems and instrumentation, optimal systems |
| Ass. prof. Zaev Emil | Hardware-in-the-loop simulations, SCADA systems, fluid power systems - simulations and control |
| Ass. prof. Celakoska Emilija | Mathematics, Diferential geometry |
| Ass. prof. Prangoski Bojan | Functional analyses, Ultra distributions, Pseudo differential operators |

## 3.3 Competencies of technical staff

The technical (IT) staff consists of two IT engineers: Boris Roshkov, head of Computer center (CC) and Zarko Vasilevik, IT engineer in the CC

Some of their credentials involve:

- Cisco Certified Network Professional (CCNP) 642-813
- Cisco Networking, Advanced Switching, VLAN and WAN Technologies
- Basic and Intermediate Linux Course
- Linux introduction, basic administration, backup practices, shells, networking, openssh, scripting
- SAP Introduction training
- SAP overview (SAP01), SAP Business Suite - Fundamentals (SAP20), SAP Business Suite - Fundamental navigation (WDESAP)
- Cisco Certified Network Associate (CCNA) 640-802
- Cisco Networking, Routers and routing, Switching and WAN Technologies

## 3.4 Facilities (laboratories, library, computer equipment, software, experimental line, a place to learn, availability and profiting from Internet)

Postgraduate studies are organized as full-time study with teaching.
The Faculty of Mechanical Engineering has more than sufficient space for the implementation of teaching the first, second and third cycle. The practical part of teaching is mostly performed in the laboratories of the Faculty of Mechanical Engineering (shown in the table below).

The course programs usually incorporate guest lecturers from industry by hiring prominent experts in their respective fields.

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|---|---|
| Basic office Lab and educational space at the FME | 1. Total area (gross area)<br>(space for teaching and yard)<br>**9918 m$^2$** |

2. Total teaching area (net space)

**4840 $m^2$**

3. Number of lecture theaters with total number of chairs

lecture theaters with total number of chairs 480

4. Number of classrooms with total number of chairs

24 classrooms with total number of chairs 1111

| no. | Types of didactic space numeration | Number of premises | Area in square metres | Total seating capacity |
|---|---|---|---|---|
| **1.** | **Lecture theaters** | **2** | **426** | **480** |
| | AMF | 1 | 228 | 300 |
| | 225 | 1 | 198 | 180 |
| **2.** | **Classrooms** | **25** | **1628,8** | **1113** |
| | 123 | 1 | 87 | 56 |
| | 124 | 1 | 87 | 64 |
| | 125 | 1 | 75 | 40 |
| | 224 | 1 | 111 | 80 |
| | 310 | 1 | 127 | 88 |
| | 311 | 1 | 76 | 48 |
| | A1-1 | 1 | 88 | 88 |
| | A1-2 left | 1 | 38 | 38 |
| | A1-2 right | 1 | 43 | 28 |
| | A1-3 | 1 | 43 | 28 |
| | A1-5 | 1 | 43 | 28 |
| | F1-2 | 1 | 54,5 | 22 |
| | F2-4 | 1 | 60,4 | 32 |
| | F2-5 | 1 | 42,3 | 18 |
| | F2-6 | 1 | 53,3 | 22 |
| | K2-6 | 1 | 44,7 | 28 |

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|---|---|---|---|---|
| | K2-7 | 1 | 44,7 | 25 |
| | K2-15 | 1 | 44,7 | 20 |
| | K3-9 | 1 | 80 | 40 |
| | K3-1 | 1 | 55,1 | 36 |
| | K3-18 | 1 | 55,1 | 36 |

Information about the equipment for teaching and research

1. Number of classrooms with computer and capacity of computer workplaces

10 classrooms with total 274 workplaces

| no. | Types of didactic space numeration | Number of premises | Area in square metres | Total seating capacity |
|---|---|---|---|---|
| **1** | **Computer rooms** | **10** | **391** | **274** |
| | Room 309 | 1 | 75 | 25 |
| | Room 312<br>Web Lab | 1 | 75 | 25 |
| | Computer center 1 | 1 | 79 | 30 |
| | Computer center 2 | 1 | 84 | 44 |
| | Room K1-2 | 1 | 47,4 | 24 |
| | Room K1-3 | 1 | 47,4 | 24 |
| | Room K2-8 | 1 | 48,3 | 40 |
| | Room K3-18<br>Idea.lab | 1 | 44,7 | 12 |
| | Room F1-1 | 1 | 35 | 22 |
| | Room A1-4 | 1 | 43 | 28 |

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| | 2. Number of laboratories for practical teaching …… **21** |

The Faculty of Mechanical Engineering - Skopje has the following laboratory equipment which is used for teaching:

- Spectrometer System for Field Measurements S::CAN Austria, http://www.s-can.at/
- WTW - Wissenschaftlich-Technische Werkstätten GmbH Germany, http://www.wtw.de
- Portable Data Acquisition System (PDAS) for Ambient vibration measurements
- Spectrophotometers for Laboratory Measurements, Hach-Lange Gmbh Germany, http://shop.hachlange.com
- Portable Radar Flow Meter with Automatic Water Sampler; Hach-Lange Gmbh Germany, http://shop.hach-lange.com
- Ammonia, Nitrate, Chlorine, Potassium, Temperature and pH Ion-Selective Measurement System;
- Nadler Chemische Analysentechnik AG Switzerland, http://www.nadler.ch/
- Dissolved Oxygen and Conductivity Measurement Equipment; S::CAN Austria, http://www.s-can.at/
- Devices for chemical preparation of water,
- Handheld devices for measuring water quality Eureka Manta Multiprobe Logger 3.0, Cond Graphite,
- 4 electrode, Amphibian Display Package ;
- Ultrasonic flowmeter EESIFLO PORTALOK 7S;
- Hiperspectral process photometer spectro::lyser:
- Data acquisition system con::stat - industrial process control terminal (900/1800 MHz GSM);
- Laboratory testing equipment, Laboratory Conductivity Meter, Laboratory Oxygen Meter;
- GPS - Global Positioning Unit, One Frequence R3 GPS system (Base+rover) with post-processing software Trimble Recon;
- Zeta - Meter 3.0 + System with Microscope Unitron FSB 4c;
- Hydraulic system for measurements of small turbine;
- System for laboratory tests of fluidized bed combustion (defining the flow and the temperature in the
- combustion of solid fuels in fluidized bed);
- Portable pressure sensor;
- sensors for fluid pressure
- force sensor
- sensors (of different types) to measure temperature;
- A device for measuring relative humidity and speed;
- Chamber for air conditioning on a certain temperature and relative humidity;
- Chamber of examination and testing of thermal devices;
- Instruments for measuring heat.

## 3.5 Teachers publications in the period 2009-2014

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| 2009 | 1. Popovski P., **Markov Z**., Talevski G., "Procedure for Development and Manufacturing of a Centrifugal Pump using CAD/CAM/CAE System", Proceedings of the 9th International Conference on Advanced Manufacturing Operations, vol. 2, pp. 379-383, Kranevo, Bulgaria, 2009, http://amo.dmt-product.com/amo-09/en/index.html<br>2. Popovski P., **Markov Z**., "Development of Basic Criteria for Establishing of Feed-In Tariffs in R. Macedonia", Proceedings of the 5th Conference on Sustainable Development of Energy, Water and Environment Systems, Dubrovnik, Croatia, 2009, pp. 407 (Book of abstracts), http://www.sdewes.fsb.hr/schedule.php<br>3. Andreski F., **Markov Z**., Diebold L., Gazzola T., "Numerical Simulation of Sloshing in Rectangular Tanks with OpenFOAM CFD package", Mechanical Engineering-Scientific Journal, Faculty of Mechanical Engineering-Skopje, vol. 28, no. 2, pp. 95-99, 2009<br>4. **Atanasko Tuneski**, "TEMPUS DEREC Project: Expected Outcomes, Achieved Objectives and Future Perspective", paper included in the book: Towards a New Curriculum: the DEREC (Development of Environmental and Resources Engineering Curriculum) Experience, edited by Enrica Caporali, Atanasko Tuneski, Firenze: Firenze University Press, 2009, ISBN 978-88-8453-876-5 (print), ISBN 978-88-8453-877-2 (online), pp. 1-8.<br>5. Enrica Caporali, **Atanasko Tuneski**, Towards a New Curriculum: the DEREC (Development of Environmental and Resources Engineering Curriculum) Experience, book edited by Enrica Caporali, Atanasko Tuneski, Firenze: Firenze University Press, 2009, ISBN 978-88-8453-876-5 (print), ISBN 978-88-8453-877-2 (online)<br>6. **Darko Babunski, Atanasko Tuneski, Emil Zaev**, "Design and Analysis of Hydroturbine-Governor Control System", 9th International Conference on Advanced Materials and Operations, Kranevo, Bulgaria, 2009, ISSN1313-4264, pp.233-239.<br>7. **Emil Zaev, Atanasko Tuneski, Darko Babunski**, "Design of Optimal SCADA Program for Automation of HPP", 9th International Conference on Advanced Materials and Operations, Kranevo, Bulgaria, 2009, ISSN1313-4264, pp.227-231.<br>8. **D. Babunski, E. Zaev, A. Tuneski**, "SCADA simulation for Monitoring and Control of HPP using Robust Law" Proceedings of the IX National Conference With International Participation ETAI 2009, Section A, pages 90-96, Ohrid, R. Macedonia, 2009.<br>9. **R. V. Filkoski**, I. J. Petrovski, A. T. Nospal, **V. M. Stojkovski**: Energy Efficiency and Energy Saving in Industry and Services, 14 Simposium of Thermal Engineers, Sokobanja, Serbia, 2009<br>10. **R.V. Filkoski**: Renewable Energy Sources: Greenhouse Gases Emission Mitigation Potential in the SE European Countries, WFEO Int. Eng. Congress "Alternative Energy Applications, Option or Necessity?", Kuwait, 2009<br>11. **R.V. Filkoski**: The Power of Energy Efficiency, Purdue Session "Global Engineering Challenges", WFEO Int. Eng. Congress "Alternative Energy Applications, Option or Necessity?", Kuwait, 2009<br>12. Saibah, Darus M., **Tuneski N**., Quasi–convolution Properties of Certain Subclasses of Meromorphic p–valent Functions, Journal of Analysis and Applications, Vol.7 No.2 (2009), 109–117.<br>13. **Tuneski N**., Some simple sufficient conditions for starlikeness and convexity, Applied Mathematics Letters, Vol.22 (2009) 693–697. |

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| | 14. Hendrikx I., **Tuneski N.**, Emerging Issues in Regulations and Standards – Sampling Considerations Within Market Surveillance Actions, Conformity Vol. 22 (2009), 23–27.<br>15. Irmak H., Tinaztepe G., **Tuneski N**., Cetin O.F., An ordinary differential operator and its applications to certain classes of multivalently meromorphic functions, Bulletin of Mathematical Analysis and Applications, Vol. 1 No. 2 (2009), 17–22.<br>16. I. Hendrikx, **N. Tuneski**: Sampling considerations within Market Surveillance actions, Proceedings of IEEE Symposium on Product Compliance Engineering, 26–28 October, 2009, Toronto, Canada , 1–4. DOI 10.1109/PSES.2009.5356011<br>17. **A.Kochov,** J.Chaloska: **"**Macedonian case for sustaianble production, cleaner production technologies", session: Sustainable production issues through PLM concept, ICT Innovations Conference, September, 2009, Ohrid, Macedonia, CD-ISBN 978-4568 |
| 2010 | 1. D.Babunski, E.Zaev, **A.Tuneski,** "Simulation of HPP Monitoring and Control", Proceedings of the International Conference on Energetics, organized by ZEMAK (Macedonian Society of Energetics), Book 1, pages 393- 403, Ohrid, Macedonia, 2010.<br>2. E. Zaev, D. Babunski, **A.Tuneski,** "Non-Linear Modeling and HIL Simulation of Hydraulic Cylinder for Hydro Turbine Governing System" Proceedings of the International Conference on Energetics, organized by ZEMAK (Macedonian Society of Energetics), Book 1, pages 379-393, Ohrid, R. Macedonia, 2010.<br>3. **R.V. Filkoski**, I.J. Petrovski, M. Ginovska, H. Borchsenius: A Case Study of Energy recovery in Ferro-Alloys Industry, II Regional Conference IEEP '10, Zlatibor, Serbia, 2010<br>4. **R.V. Filkoski**, I.J. Petrovski, I. Janev: A Case Study of Energy Management Improvement in Concrete Products Industry, II Conference "Sustainable Development and Climate Changes SUSTAINNIS 2010", Nis, Serbia, 2010<br>5. L.J. Bureska, **R.V. Filkoski**, I.J. Petrovski: Possible actions on boilers in TPP Bitola for reduction of NOx emission, International Symposium ZEMAK 2010, Ohrid, 2010<br>6. **R. V. Filkoski**, I. J. Petrovski, L. J. Bureska, **D.J. Tashevski**: Advanced Computational Methods for Complex Simulation of Pulverised-Coal Combustion with Staged Air Introduction, International Symposium ZEMAK 2010, Ohrid, 2010<br>7. **D. J. Tashevski**, **R. V. Filkoski**: Trigeneration power plants for complex buildings, International Symposium ZEMAK 2010, Ohrid, 2010<br>8. **R. V. Filkoski**, L. J. Bureska, I. J. Petrovski: Advanced Numerical Methods for Investigation of Energy Conversion Processes, International Symposium "Power Plants 2010", Vrnjacka Banja, Serbia, 2010<br>9. **R. V. Filkoski**: Energy efficiency and cleaner production – some experiences in Macedonia, Seminar "Promotion of the CP concept", JICA Project, Skopje, 2010<br>10. E. Popovic, V. V. Strezov, **R. V. Filkoski**, P. Shah: Bio-gas, bio-oil and biochar production from pyrolysis of tobacco waste, Bioenergy Australia 2010 Conference, Sidney, 2010<br>11. **Tuneski N**., Convex Functions and Functions with Bounded Turning, Tamsui Oxford Journal of Mathematical Sciences, Vol. 26 No. 2 (2010), 161–172.<br>12. **Tuneski N.,** On starlikeness of an analytic function, Southeast Asian Bulletin of Mathematics, Vol. 34 No. 2 (2010), 365–370.<br>13. **Tuneski N**., Irmak H., On some sufficient conditions for starlikeness, Scientia Magna Vol. 6 No. 1 (2010), 105–109. |

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| | 14. Darus M., Ibrahim R.W., **Tuneski N**., Mugur A., Classes of meromorphic functions with respect to N–symmetric points, Acta Universitatis Apulensis, Vol. 22 (2010), 7–15.<br>15. Irmak H., **Tuneski N**., Fractional calculus operator and its certain applications in the geometric function theory, Sarajevo Journal of Mathematics, Vol.6 (1) (2010), 51–57.<br>16. Rabha W. Ibrahim, Maslina Darus and **Nikola Tuneski**: On subordination for classes of non–Bazilevič type, Annales Universitatis Mariae Curie–Skłodowska (Section A), Vol.46 (2) (2010), 49–60.<br>17. Irmak H., Bulboaca T., **Tuneski N**., Certain relations between α–convex type functions and Bazilevič type functions, Applied Mathematics Letters, Vol. 24 (12) (2011), 2010–2014. |
| 2011 | 1. Ristova E., **Markov Z**., "The Importance of Development and Implementation of National Environmental Strategy for Manufacturing Companies", International Virtual Journal Machines, Technologies, Materials, pp. 47-50, Issue 3, 2011<br>2. Enrica Caporali, **Atanasko Tuneski,** et.al., "Enhancing Environmental Engineering Education in Europe", World Engineering Education Week, Lisbon, September, 2011, pages 659-665.<br>3. **Darko Babunski, Emil Zaev**, **Atanasko Tuneski,** "Design of Robust Control Law for Hydroturbine and SCADA Simulation", Journal of Energetics 2011, Journal of Association of Energy Sector, No.2, year XIII, March 2011, UDC 620.9, ISSN 0354-8651, UDC: 621.224.011:62-5, pages 85-89.<br>4. **Emil Zaev**, Gerhard Rath, **Darko Babunski**, **Atanasko Tuneski** et al., "HPP Simulator for Real-Time Simulation and SCADA Software Testing", 6th Annual South East European Conference: Infusing Research and Knowledge in South-East Europe, in organization of SEERC (South-East European Research Centre, September 19th and 20th, 2011, Thessaloniki, Greece, pages 358-366.<br>5. V. Iliev, I. Mirceski, **D. Babunski**, "Simulation model for automatic regulation of HVAC systems", proceedings of X International conference ETAI, September 2011, Ohrid, Macedonia, pp 105-111.<br>6. I. Mirceski, V. Iliev, **D. Babunski**, "Design of cascade compensator for control of hydraulic system", proceedings of X International conference ETAI, September 2011, Ohrid, Macedonia, pp 63-69.<br>7. **V.Stojkovski**, Z.Kostic, A.Nospal: Inplementation CFD analyzes refer to cavitation regime at the Howell Bunger valve with installed deflector, Medjunarodno Savetovanje: Energetika 2011<br>8. **V.Stojkovski**, Z.Kostic, A.Nospal: Transient analisys into the water supply system of hydropower plants with short penstock, (presented at symposium) Medjunarodno Savetovanje: Energetika 2011<br>9. A.Levkovski, **V.Stojkovski**, Z.Kostic: Odregjivanje pojave kavitacije u setu prigusnica sa merenjem nivo buke, (presented at symposium) Medjunarodno Savetovanje: Energetika 2011<br>10. **R. V. Filkoski**: Energy efficiency in industry and services - Its real potential, Workshop "Opportunities for financing energy efficiency projects in Macedonia", Norsk Energi and Centre for Climate Changes – MK, Skopje, 1 February 2011<br>11. **Armenski S., Filkoski R.V**., Modern technologies for utilization of geothermal energy and its influence to the environment, In "Geothermal energy in Macedonia – Kochani depression", Published by the Municipality of Kochani, Patron: President of RM, Kochani, 2011. Published also in Presing, Journal of the Chamber of authorised architects and engineers of Macedonia, ISSN1857-744X, No. 3, 2011, pp.5-15 |

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| | 12. **Filkoski R.V**., Popovic E., Strezov V., Experimental study of product composition during slow pyrolysis processing of tobacco residues, 7th International Conference on Biomass for Energy, Kyiv, Ukraine, 2011<br>13. Lazarov D., Stanojevska B., **Filkoski R.V**., Petrovski I.J., A case study of fuel switch from light oil to biomass for public building heating, 7th International Conference on Biomass for Energy, Kyiv, Ukraine, 2011<br>14. **Tuneski, N**., On a Class of Functions Defined by Takahashi and Nunokawa, Mathematica Balkanica, Vol. 25 (1–2) (2011), 203–209.<br>15. Irmak H., Bulboaca T., **Tuneski N**., Certain relations between α–convex type functions and Bazilevič type functions, Applied Mathematics Letters, Vol. 24 (12) (2011), 2010–2014.<br>16. **Tuneski N**., Obradovic M., Some properties of certain expression of analytic functions**,** Computers and Mathematics with Applications, 62 (9) (2011), 3438–3445.<br>17. **A.Kochov,** B.Dunjic**:** Low-Carbon production concept in managing SME in WBC, Regional Resource Efficient & Cleaner Production Net meeting of NVPCs and NCPPs from the European and Central Asian countries, 4th Nevsky International Ecological Congress, May 2011; St. Petersburg, Russia.<br>18. **A.Kochov:** "Green manufacturing driving low carbon, resource efficient and claen industrialization in developing and transition economies", 2nd Global Network Conference on Resource Efficient and Cleaner Production (RECP – 2011), UN – Gigiri, Nairobi, Kenya, 17-19 October 2011.<br>19. **A.Kochov:** "Influence of the size of and hole derived in the initial material on drawing workability of the cold roled metal sheets", invited paper, 8th ICIT & MTP, Ljubljana, Slovenia, October 2011. |
| 2012 | 1. **D. Babunski, A. Tuneski, E. Zaev**, "Simulation of Load Rejection on a Nonlinear Hydro Power Plant Model with Mixed Mode Nonlinear Controller", Proceedings of MECO 2012 Conference on Advances and Challenges in Embedded Computing, Bar, Montenegro, pages 274-277, ISBN 978-9940-9436-0-8.<br>2. **E. Zaev, D. Babunski, A.Tuneski** , "Hydro Power Plant Governor Testing Using Hardware-in-the-Loop Simulation", Proceedings of MECO 2012 Conference on Advances and Challenges in Embedded Computing, Bar, Montenegro, pages 270-273, ISBN 978-9940-9436-0-8.<br>3. Enrica Caporali, **Atanasko Tuneski,** et.al., "Development of an Environmental and Resources Engineering Education Framework", 40th SEFI Annual Conference, September 2012, Thessaloniki, Greece.<br>4. Enrica Caporali, **Atanasko Tuneski,** et.al., "Video Conferencing as an Educational System: A Case Study", Firenze University Press, 2012, ISBN 978-88-6655-102-7, paper printed in the book "Video Conferencing as a Tool for Higher Education: the TEMPUS VICES Experience", edited by Enrica Caporali and Vladimir Trajkovic.<br>5. **Filkoski R. V**., Past and present research activities on combustion at the Faculty of Mechanical Engineering in Skopje, ACH Combustion Meeting, Zagreb, 2012<br>6. **Filkoski R.V**., Bureska L.J., Petrovski I.J., Improvement of combustion efficiency of pulverised coal with under-fire air introduction, 7th International Conference On Sustainable Development of Energy, Water and Environment Systems SDEWES 2012, Ohrid, 2012, ISSN 1847-7186<br>7. **Filkoski R.V**., Petrovski I. J., Stanojevska B., Utilisation of vineyard pruning residues for centralised heating of public buildings, 5th International Mechanical Engineering Forum IMEF 2012, Prague, 2012<br>8. **Filkoski R. V**., Bureska L.J., Petrovski I. J., CFD as research, educational and |

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| | design tool in energy and environmental engineering, 5th International Mechanical Engineering Forum IMEF 2012, Prague, 2012<br>9. Mikulčić H., Markovska N., Vujanović M., **Filkoski R. V**., Ban M., Duić N., Potential for $CO_2$ emission reduction in the cement industry, 7th Int. Conf. On Sustainable Development of Energy, Water and Environment Systems SDEWES 2012, Ohrid, 2012, ISSN 1847-7186<br>10. **Filkoski R. V**., Petrovski I. J., Radivchev J., Mladenovska D., Energy efficiency and environmental aspects of power plants cooling towers modernisation, Int. Symposium "Energetics 2012" Ohrid, 2012<br>11. **D. Dimitrovski**, M. Dimevska, **D. Tashevski**: Strategic connection of Republic of Macedonia to the European natural gas streams. International gas conference of South Eastern Europe, Sarajevo, Bosnia and Herzegovina, 2012. (IOC)<br>12. **D. Tashevski, D. Dimitrovski**: Optimization of binary co-generative thermal power plants with SOFC on solid fuel. 7th Conference on Sustainable Development of Energy, Water and Environment Systems - SDEWES 2012, Ohrid, CET-OH12-011, 1-7 July 2012 (IOC)<br>13. **D. Tashevski**, I. Shesho: Biogas integrated plant – digester/gas turbine combined power plant. International symposium – Energetic 2012 ZEMAK, proceedings book No.1, p. 57-66, Ohrid, 4-5 October 2012.<br>14. I. Shesho, **D. Tashevski**: Analysis of thermal comfort and energy efficiency on systems with inductive fanconverters. International symposium – Energetic 2012 ZEMAK, proceedings book No.2, p. 777-789, Ohrid, 4-5 October 2012.<br>15. H. M. Srivastava, **N. Tuneski**, **Emilija Georgieva–Celakoska**: Some Distortion and Other Properties Associated with a Family of the n–Fold Symmetric Koebe Type Functions, Australian Journal of Mathematical Analysis and Applications, Vol. 9, Issue 2, Article 1, (2012) 1-17.<br>16. Obradovic M., Ponnusamy S., **Tuneski N**., Radius of univalence of certain combination of univalent and analytic functions, Bulletin of the Malaysian Mathematical Sciences Society (2) 35(2) (2012), 325–334.<br>17. **N. Tuneski**, M. Darus, On functions that are Janowski starlike with respect to N–symmetric points, Hacettepe Journal of Mathematics and Statistics, Vol. 41 (2) (2012), 271 – 275.<br>18. **N. Tuneski**, T. Bulboaca, E. Aliaga, Some Results Over the First Derivative of Analytic Functions, Advances in Mathematics: Scientific Journal, Vol. 1 No. 1 (2012), 7 - 13.<br>19. **N. Tuneski**, M. Darus, E. Gelova, Simple Criteria for Bounded Turning of an Analytic Function, Advances in Mathematics: Scientific Journal, Vol. 1 No. 2 (2012), 87 - 93.<br>20. Jovanoski I., Popovski P. **Markov Z., Tuneski A**., Nencev A., "Possibilities for energy efficiency improvement at municipal wastewater treatment plants", Proceedings of the 7th Conference on Sustainable Development of Energy, Water and Environment Systems, Ohrid |
| 2013 | 1. **Markov Z., Dimitrovski D**., Aleksic V., "Development of Gas Distribution Network for the City of Kumanovo – Challenges and Solutions", 5th International Gas Conference of Southeast Europe, Sarajevo, Bosnia-Herzegovina,<br>2. **D. Babunski**, **A.Tuneski,** et al. "Comparison of Simulated and Measured Response of Nonlinear Plant Model With Mixed Mode Nonlinear Controller", Scientific Works, Volume LX, "Food, Science, Engineering and Technology 2013", Plovdiv, Bulgaria, pages 91-94. |

3. **E. Zaev**, **A.Tuneski,** et al. "Hardware-in-the-Loop Testing of SCADA Program for Mini Brewery", Scientific Works, Volume LX, "Food, Science, Engineering and Technology 2013", Plovdiv, Bulgaria, pages 138-141.
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5. Enrica Caporali, **Atanasko Tuneski**, "Enhancing Environmental Engineering Education in Eastern Europe", European Geosciences Union Conference, Vienna, April, 2013, EGU2013-12837.
6. V.Fustic, **V.Stojkovski** et.al.: EXPERTS' ANALYSIS OF THE EQUIPMENT IN THE SMALL HYDRO POWER PLANTS IN THE "TRANSFER" PHASE OF THE ROT PROJECT, International council on large electric systems Macedonian national committee-Conference 2013
7. **R.Filkovski**, F.Stojkovski, **V.Stojkovski**: A CFD study of a solar chimney power plant operation, 6th International conference on sustainable energy & environmental protection SEEP 2013, Maribor, Slovenia
8. **Filkoski R.V**., Petrovski I.J., Stanojevska B., Some observations on the possibility of using wine twigs for energy needs, Proceedings of the 6th International Conference on Sustainable Energy and Environmental Protection SEEP 2013, pp. 418-426, Maribor, Slovenia, 20-23 August 2013, (ISBN 978-961-248-379-1)
9. **Filkoski R. V**., The smart energy concept: the demand side potential, Workshop on Smart Grids and Power Highways for the Enlarged Europe: Assessing the Challenges, Organized by European Commission, Joint Research Centre, Institute for Energy and Transport, Petten, 18-20 September 2013, Antalya
10. Mikulcic H., Vujanovic M., Markovska N., **Filkoski R**., Ban M., Duic N., CO2 Emission Reduction in the Cement Industry, 16th Conference Process Integration, Modelling and Optimisation for Energy Saving and Pollution Reduction PRES'13, 29 September – 2 October, Rhodes, Greece, 2013
11. **D. Tashevski**, I. Shesho: Three-generation Power Plant with High-temperature Fuel Cells for Complex Building. International Journal of Engineering Research and Development, Volume 6, Issue 5, pp. 46-52, India, March 2013
12. **D. Tashevski, D. Dimitrovski**: Optimization of Binary Co-generative Thermal Power Plants with SOFC on Solid Fuel. Chemical engineering transaction, vol. 34, pp. 31-36, Italy, 2013.
13. **D. Tashevski, D. Dimitrovski, Z. Markov**, I. Shesho: Energy and Ecology Benefits of Independent SOFC/Gas Turbine Co-generation Power Plant on Natural Gas. 1st Internatinal U.O.C. – B.E.N.A. – Conference "The Sustainability of Pharmaceutical, Medical and Ecological Education and Research – SPHAMEER – 2013", p. 6, Constanca, Romania 20-23 June, 2013. (IOC)
14. **D. Dimitrovski**, K. Belcheska, **D. Tashevski,** M. Kocubovski: Possible Scenarios for Achiving the Goal 20/20/20 in FYR-Macedonia. 1st Internatinal U.O.C. – B.E.N.A. – Conference "The Sustainability of Pharmaceutical, Medical and Ecological Education and Research – SPHAMEER – 2013", p. 6, Constanca, Romania, 20-23 June, 2013. (IOC)
15. **D. Dimitrovski, M. Dimitrovski**, G. Popsimonova, **D. Tashevski**: Biogas – Overview of the Possibilities for Implementation in the Macedonian Agricultural Sector. 16th Symposium on Thermal Science and Engineering of Serbia – SIMTERM 2013, p. 11, Sokobanja, Serbia, 22-25 October, 2013. (IOC)
16. I. Shesho, **D. Tashevski**: Developing simulation application using graphical programming language for optimization of solar collector position. Mechanical engineering scientific journal, Vol. 31, No. 1-2, pp. 63-75, Skopje, 2013
17. **N.Tuneski**, Embedding α-convex functions in the class $U$, Proceedings of a symposium held at the Research Institute for Mathematical Sciences, Kyoto

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| | University, Kyoto, Japan, May 22–24, 2013, 94-99. (English; Japanese) |
| 2014 | 1. **Darko Babunski**, **Atanasko Tuneski, Emil Zaev**, "Comparison of Simulated and Measured Response of Load Rejection on a Hydro Power Plant Model with Mixed Mode Nonlinear Controller", Scientific Journal of Mechanical Engineering, Skopje, Vol.32, No.1, 2014, ISSN 1857-5293, pages 65-69.<br>2. Enrica Caporali, **Atanasko Tuneski,** et.al., "Development of an Environmental and Resources Engineering Learning", SEFI 42nd Annual Conference, September 2014, Birmingham, United Kingdom<br>3. P.Popovski, **V.Stojkovski**, K.Najdenkovski: Method for measuring the guaranteed energy performance of small hydro power plant, Macedonian energy association International symposium Energetics 2014<br>4. **Filkoski R. V**., Experiences on the feasibility of the utilisation of vineyard and vine-culture residues for energy purposes, Symposium: Biomass solutions for LCP and traffic in Adria region - R&D and application, Adria Section of International Combustion Institute, Sarajevo, 2014<br>5. **Filkoski R.V**., Chekerovska M., Experimental and numerical study of a flat-plate solar energy collector performance, Proceedings of SEEP 2014, Dubai, 23-25 November, 2014<br>6. **Filkoski R.V**., Petrovski I. J., Research on the possibility of using agriculture biomass residues for energy purposes, Proceedings of SEEP 2014, Dubai, 23-25 November 2014<br>7. **N. Tuneski**, T. Bulboaca, On bounded turning of analytic functions, Bulletin of Calcutta Mathematical Society 106 (3) (2014), 189-200.<br>8. **Tuneski N**., Darus M., Gelova E., Simple sufficient conditions for bounded turning, Rendiconti del Seminario Matematico della Università di Padova, Vol. 132 (2014), 231 – 238.<br>9. E. Aliaga, **N. Tuneski**, Some connections between class $U$ and α-convex functions, Abstract and Applied Analysis, Volume 2014, Article ID 692327<br>10. **N. Tuneski**, M. Petrusevski, B. Jolevska-Tuneska, On starlikeness of analytic functions with bounded derivative, PanAmerican Mathematical Journal, Vol.24 No.1 (2014), 93-101. |

## 3.6 Scientific projects of the departments in the period 2009-2014

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| 2009 | 1. Monitoring and Improving the Rivers in the Vardar/Axios Watershed (MIRVAX), NATO Partnership for Peace co-financed project, SfP981877, 2006-2009.<br>2. Application of CFD and CAX technology in the fluid flow processes in the power production and environmental engineering, Research project funded by the Ministry of Education and Science of R. Macedonia.<br>3. Numerical Simulation Program in Mechanical Engineering, Tempus CARDS JEP-19017<br>4. Research and optimization of thermal processes in thermo energetic equipment with numerical analyses, Ministry of education and science of Republic Macedonia<br>5. Investigation and Optimisation of Thermal Processes in Energy Devices and Plants with the Numerical Thermal Analysis Technique, Scientific-research project fin. by the Min. Educ. And Science of R. Macedonia |
| 2010 | 1. Monitoring and Improving Rivers in the Vardar/Axios Watershed (MIRVAX), NATO Science for Peace Project, SfP 981877, 2006-2010<br>2. Development of Environmental and Resources Engineering Learning (DEREL), TEMPUS IV project, EU Directorate for Education and Science, Project |

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| | No.:511001-TEMPUS-1-2010-1-IT-TEMPUS-JPCR |
| 2011 | 1. Europe and Eurasia energy security and market development program - Implementation plan for EE improvement MACEF-USAID; 2010-2011.<br>2. Increase in energy and ecological efficiency of processes in pulverized coal-fired furnace and optimization of utility steam boiler air pre-heater by using in-house developed software tools, Scientific research project (No. TR-33018), Vincha Institute, Belgrade<br>3. Products of distributions in Colombeau algebras and their applications", financed by the Faculty of Electrical Engineering and Information Technologies. |
| 2012 | 1. Strengthening of the Serbian system of market surveillance for non-food and food products, financed by the European Union (EU Contract Number: 2012/292-614).<br>2. Production of briquettes and pellets from agricultural waste – Agro energy; SIDA, CeProSard<br>3. Capacity Building of the Secondary Education Teachers in the Field of Environmental and Social Impact of Renewable Energy, UNESCO Project, 2012. |
| 2014 | 1. The Programme in Higher Education, Research and Development in the Western Balkans, Project: Quality Improvement of Master programs in Sustainable Energy and Environment - HERD-QIMSEE, 2014-2016<br>2. Efficient Harvesting of the Wind Energy, AEOLUS4FUTURE project, coordinated by Lulea University of Technology (Sweden), Marie Curie Innovative Training Networks (ITN), Call H2020-MSCA-ITN-2014. |

## 3.7 Training of teachers in the period 2009-2014

Prof. Atanasko Tuneski, assoc.prof. Zoran Markov, ass.prof. Darko Babunski, assoc.prof. Nikola Tuneski: Vienna University of Technology, Austria, 2012

N.Tuneski: International Short Joint Research Workshop "Some inequalities concerned with the geometric function theory", The Research Institute for Mathematical Sciences, Kyoto University, Kyoto, Japan, May 22 – 24, 2013.

A.Kochov: Sustainable industrial development in the context of Low Carbon Society concept, UNIDO-PREPARE conference: *"SCP: How to make it possible"* Kaunas, Lithuania, September 2011.
"Creating R&D Capacities and Instruments for boosting Higher Education-Economy Co-operations"; 25-31.03, 2009, Gratz, Austria
Joint Research Center : Support to Sustainable Agiruculture and Rural Development in the Western Balkans, October 19, 2010; Skopje, Macedonia
Prof. Atanasko Tuneski, assoc.prof. Zoran Markov, assoc.prof. Nikola Tuneski: Ruhr University of Bochum, Germany, 2012

Dame Dimitrovski: GTZ Energy efficiency for certified engineers, Chamber of certified engineers of Serbia, University of Nish, 2014; EC Energy agency, Sustainable transport technologies, Copenhagen, September 2011; Carbon capture and storage, DAAD, Munich, June 2011

## 3.8 Teachers visiting other universities

- Assoc. prof. Zoran Markov, Fulbright scholar, The Pennsylvania State University, Aerospace Department, 2010-2011
- Prof. Valentino Stojkovski and assoc. prof. dr. Zoran Markov: VRIJE University Bruxeles, Department for fluid mechanic, 2009
- Assoc. prof. Risto Filkoski: University in Zagreb, Faculty of Mechanical Engineering and naval Architecture, 2013
- Ass.prof. Dame Dimitrovski, Technische Fachhoch Schule Wildau, Berlin, 2004
- Ass.Prof. Dame Dimitrovski, Vanderbilt University, Nashville, Tennessee, USA, 2007-2008
- Prof. Atanasko Tuneski: University of Florence, Italy, numerous short visits in period 2010-2014 in the framework of the TEMPUS DEREL project 511001-TEMPUS-1-2010-3375/001-001.
- Prof. Atanasko Tuneski, assoc.prof. Zoran Markov, ass.prof. Darko Babunski, assoc.prof. Nikola Tuneski: Vienna University of Technology, Austria, 2012 (training seminar in the framework of the TEMPUS DEREL project 511001-TEMPUS-1-2010-3375/001-001).
- Prof. Atanasko Tuneski, assoc.prof. Zoran Markov, assoc.prof. Nikola Tuneski: Ruhr University of Bochum, Germany, 2012, (quality control meeting and training seminar in the framework of the TEMPUS DEREL project 511001-TEMPUS-1-2010-3375/001-001).
- Prof. Atanasko Tuneski, ass.prof. Darko Babunski: Aristotle University of Thessaloniki, Greece, 2012, 2013, 2014 (short visits in the framework of the TEMPUS DEREL project 511001-TEMPUS-1-2010-3375/001-001).
- Prof. Atanasko Tuneski, assoc.prof. Zoran Markov, assis.prof. Dame Dimitrovski: Polytechnic University of Tirana, Albania, 2012, (scientific visit in the framework of the TEMPUS DEREL project 511001-TEMPUS-1-2010-3375/001-001).
- Prof. Atanasko Tuneski: Polytechnic University of Tirana, Albania, 2012, 2013, 2014, (several visits in the framework of the TEMPUS DEREL project 511001-TEMPUS-1-2010-3375/001-001).
- Prof. Atanasko Tuneski, ass.prof. Darko Babunski: University of Novi Sad, Serbia, 2011, 2012, 2013, 2014 (coordination activities in the framework of the TEMPUS DEREL project 511001-TEMPUS-1-2010-3375/001-001).
- Prof. Atanasko Tuneski, assoc.prof. Zoran Markov, ass.prof. Darko Babunski, assist.prof. Emil Zaev: University of Novi Sad, Serbia, 2013, (dissemination activities in the framework of the TEMPUS DEREL project 511001-TEMPUS-1-2010-3375/001-001).

## 3.9 Cooperation with industry

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| 2009 | 1. Control measurement on the technical characteristics of the turbine aggregates in the HPP Popova Sapka-4 - EVN-Skopje<br>2. Repairing and reconstruction of the siphon Makarija – left cannel of the WSS Tikves - WSS Tikves- Kavadarci<br>3. Measurement of the aggregate efficiency at the SHPP Zafat - Hidro-EKO-Inzenering-Skopje<br>4. Redesign, repairing on the flow domain and implementation technical solution at the Howell bunger valves installed at the dam Lisice refer to overcoming a cavitations - WSS Lisice – Veles |

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| | 5. Technical report from fire resistant calculations of single rotation fire resistant door ”SEF 120-1” of 120 min. fire resistant for SEF DOOEL Skopje, No. 07-1705/5, Skopje, June 2009.<br>6. Technical documentation for implementation of the project “Replacement of fossil fuel with grape residues in Kavadarci municipality”, “Norsk Energi” NGO “Center for climate changes” Skopje, August, 2009.<br>7. Cleaner and More Effective Industry in Macedonia, 2009-2012, Norsk Energi, Project funded by the Government of Kingdom of Norway<br>8. UNIDO project - CP – Cleaner production technologies in metal industry in Macedonia ( 2007-2009)<br>9. UNIDO project RECP – Resource efficient and cleaner production technologies in metal and food processing industry ( 2009-2011) |
| 2010 | 1. Homology and acceptance the runner for aggregate 1 od HPP Sv Petka - AD ELEM-Skopje<br>2. Revision of preliminary and basic design for SHPP Selecka reka- mechanical part - Mali hidroelektrani-Skopje<br>3. Revision of preliminary and basic design for SHPP Kamenicka reka- mechanical part - Mali hidroelektrani-Skopje<br>4. Test pressure of spiral case of aggregate 1 and 2 for HPP Sv Petka - AD ELEM-Skopje<br>5. Revision of preliminary and basic design for SHPP Krkljanska reka- mechanical part - Mali hidroelektrani-Skopje<br>6. Revision of preliminary and basic design for SHPP Kranska reka- mechanical part - Mali hidroelektrani-Skopje<br>7. Revision of preliminary and basic design for SHPP Kriva reka- mechanical part - Mali hidroelektrani-Skopje<br>8. Revision of preliminary and basic design for SHPP Drugovo- mechanical part - Mali hidroelektrani-Skopje<br>9. Revision of preliminary and basic design for SHPP Brbusnica- mechanical part - Mali hidroelektrani-Skopje<br>10. Study for improvement stability of penstock for SHPP Pesocani - Makhidro proekt-Skopje<br>11. Inplementation system for reliability and maintenance of the pumps from PS Gavato and PS Bogdanci - JPV WS Dojransko ezero- st.Dojran<br>12. Homology and acceptance of turbine shaft for aggregate 2 of HPP Sv Petka - AD ELEM-Skopje<br>13. Redesign, repairing on the flow domain and implementation technical solution at the Hawell Bunger valves installed at the dam Lisice for overcoming cavitation - CMO-Tulusa, Spain<br>14. Homology of equipment: draft tube for aggregate 1 and 2 of HPP Sv Petka - AD ELEM-Skopje<br>15. Technical report from fire resistant calculations of archive fire resistant pane ”T-2008” of 60 min. fire resistant for SHPENDI DOO Dzepciste, No. 07-490/5, Tetovo, April 2010.<br>16. Technical report from fire resistant calculations of single rotation fire resistant door ”1PPV-30” of 30 min, ”1PPV-60” of 60 min, ”1PPV-90” of 90 min, ”1PPV-120” of 120 min fire resistant for METALTEHNA DOO Skopje, No. 07-3331/5, No. 07-34191/5, No. 07-3331/6, No. 07-367/5,Skopje, December 2010.<br>17. Implementation plan for the energy efficiency strategy of the Republic of Macedonia, E&E regional energy security and market development project, Prepared with USAID funding by MACEF, TimelProekt, Alliance to Save Energy and IRG, Skopje, 2010<br>18.Modernisation of cooling towers in TPP Bitola, Programme “Cleaner and more effective industry in Macedonia”, Norsk Energi and CCC, 2010-11 |

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| | 19.TPP Bitola –Bitola district heating with thermal energy from TPP Bitola, Programme "Cleaner and more effective industry in Macedonia", Norsk Energi and CCC, 2010-11<br>20. Energy efficiency in OHIS AD - Skopje, Programme "Cleaner and more effective industry in Macedonia", Norsk Energi and CCC, 2010-11<br>21. Kavadarci municipality – Biomass: Grape pruning residues for energy, Programme "Cleaner and more effective industry in Macedonia", Norsk Energi and CCC, 2010-11<br>22. Europe and Eurasia energy security and market development program: Implementation plan for energy efficiency improvement, MACEF, USAID, Skopje, 2010-2011 |
| 2011 | 1.Technical report from fire resistant calculations of single and double sliding fire resistant door "1PPL-90" and "2PPL-90"of 90 min. fire resistant for METALTEHNA DOO Skopje, No. 07-615/5, Skopje, march 2011.<br>2. Head mechanical project – Air heating for ES Shutovo, Oslomej, November 2011.<br>3. Technical report from fire resistant calculations of single and double rotation fire resistant door whit class surface "2PPVS-90" and "2PPL-90"of 90 min. fire resistant for METALTEHNA DOO Skopje, No. 07-3165/5, Skopje, November 2011.<br>4. Technical report from analysis and calculation on the functionality and energy efficiency of the electricity appliance for air heating, Faculty of Mechanical Engineering, Skopje, 2011)<br>5.Project for air heating system of PS "Milto Gura", Oslomej, Faculty of Mechanical Engineering, Skopje, 2011)<br>6.Energy efficiency assessment in Socotab - Bitola, Programme "Cleaner and more effective industry in Macedonia", Norsk Energi and CCC, 2011-12<br>7.Energy efficiency improvement opportunities in Vardar Dolomite - Gostivar, Programme "Cleaner and more effective industry in Macedonia", Norsk Energi and CCC, 2011-12<br>8. Improvement of energy efficiency and environmental parameters of the operation of a boiler plant on thermal oil (BIM - Sv. Nikole), Technology development project, co-fin. by the Min. of Science of RM, Skopje 2011-2012<br>9. Improvement of the energy efficiency in processes of thermal treatment of concrete products (Factory Karpos AD), Technology development project, co-fin. by the Min. of Science of RM, Skopje 2011-2012<br>10. UNIDO project LC – Low carbon technologies in metal industry, agro bussines , food processing and wine industry in Macedonia ( 2011-2014) |
| 2012 | 1. Review of the Basic Design documentation for Waste water treatment plant for the Aluminum and zinc pressure casting factory for automotive parts (Industrial Area 1-Skopje), 2012.<br>2. Index test for aggregate 1 and 2 of HPP Sv Petka - AD ELEM-Skopje<br>3. Preliminary and basic design for SHPP Kadina 158- mechanical part - IMPG-Skopje<br>4. Preliminary and basic design for SHPP Zrnovska 353- mechanical part - IMPG-Skopje<br>5. Revision of tender documents- general and special technical requirements for mechanical equipment of HPP Boskov most-LOT-3 - AD ELEM-Skopje<br>6. Preliminary project for secondary water supply system from the lake Tikves - FENI INDUSTRIES- Kavadarci<br>7. Internal supervision on realization project for SHPP Pesocani 392, SHPP Pesocani 393 and SHPP Tresonce - NLB Tutunska banka –Skopje<br>8. Feasibility study and design documentation for SHPP Bosava - IMPG-Skopje |

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| | 9. Feasibility study and design documentation for WSS Studenicani - IMPG-Skopje<br>10. Preliminary and basic design for SHPP Estericka- mechanical part - IMPG-Skopje<br>11. Study for reliability of hydro mechanical equipment at dam Ratevo-Berovo - WS Berovo-Berovo<br>12. Technical report from fire resistant calculations of single rotation fire resistant door ”MPPSV-30” of 30 min. fire resistant for TDP MILSON DOOEL, No. 07-893/5, Skopje, march 2012.<br>13. Head project – mechanical installation, termotechnical installation an facilities for resindetial-bussines object st. M. Apsotolski, tech. No 226/2012, Shtip, may 2012.<br>14. Technical reports from fire resistant calculations of single rotation fire resistant doors ”OG-1PPV-30””, ”OG-1PPV-60”, ”OG-1PPV-90”, ”OG-1PPVS-90”of 30, 60, 90 min. fire resistant for OPREMA GRADING, No. 07-1958/5, 1958/7, 1958/9, 2264/3, Skopje, jul - august 2012.<br>15. Technical reports from fire resistant calculations of single rotation fire resistant doors ”ZR-M-1””, ”ZR-M-2”, ”ZR-M-3”, ”ZR-M-S-1”of 30 and 90 min. fire resistant for ZLATNA RAKA-M, No. 07-2967/5, 2967/7, 2967/9, 2967/11, Skopje, November 2012.<br>16. Review of the Basic Design documentation for Waste water treatment plant for the Aluminum and zinc pressure casting factory for automotive parts (Industrial Area 1-Skopje), 2012. |
| 2013 | 1. Review of the Basic Design Documentation for Small Hydro Power Plants Kalin Kamen 1 and 2, and Stanci 1 and 2, (for the company DPT Hidro-Osogovo, DOO Skopje), 2013.<br>2. Review of the Basic Design documentation for SHPP Kriva reka, no. 179-1, (for EMK Mali Hidroelektrani-Skopje), 2013.<br>3. Review of the Basic Design documentation for SHPP Kriva reka, no. 179-2, (for EMK Mali Hidroelektrani-Skopje), 2013.<br>4. Review of the Basic Design documentation for SHPP Toranica, no. 179-3, (for EMK Mali Hidroelektrani-Skopje), 2013.<br>5. Review of the Basic Design documentation for Irrigation Programme “Southern Vardar Valley”, Phase II: Irrigation Scheme Gevgelija (mechanical part), (for the Ministry of Agriculture , Forestry and Water Economy-Skopje), 2013<br>6. Review of the Basic Design documentation for Irrigation Programme “Southern Vardar Valley”, Phase II: Irrigation Scheme Negorci-Prdejci (mechanical part), (for the Ministry of Agriculture , Forestry and Water Economy-Skopje), 2013.<br>7. Consultant services for Macedonian Power Plants (ELEM), 2013-2015<br>8. Supervising the activity for transfer of seven SHPP after revitalization-mechanical part - EVN-Skopje<br>9. Calculation and inspection of built for corrugated pipe system for water supply through Recki kanal (part of the project for revitalization of six HPP) - AD ELEM-Skopje<br>10. Determination turbine efficiency of SHPP Pesocani 393- index test - GPS-Skopje<br>11. Revision of preliminary and basic design for SHPP Jablanica- mechanical part-MHE Jablanica DOO-Skopje<br>12. Revision of the basic project for pump station – atmospheric water - FENI INDUSTRIES- Kavadarci<br>13. Performance test of SHPP Eksploatacionen minimum from WSS Strezevo - WSS Strezevo-Bitola<br>14. Feasibility study for SHPP Estericka 373 on the base of regression analysis - IMPG-Skopje |

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| | 15. Feasibility study for SHPP Zrnovska 351 on the base of regression analysis - IMPG-Skopje<br>16. Feasibility study for SHPP Zrnovska 353 on the base of regression analysis - IMPG-Skopje<br>17. Feasibility study for SHPP Kadina 158 on the base of regression analysis - IMPG-Skopje<br>18. Internal evaluation and feasibility to invest into project SHPP Kazani - NLB Tutunska banka-Skopje<br>19. Energy audit report of JOUDG „Angel Shajce“ object „Buba Mara“, No. 07-235/5, Skopje, january 2013.<br>20. Technical report from fire resistant calculation of fireproof wols in cable factory “Drekslmaer” Kavadarci with fire resistant of 90 min for, IGM Trade Ilija i dr., Kavadarci, No. 07-651/4, Skopje, march, 2013.<br>21. Technical reports from fire resistant calculations of double rotation fire resistant doors ”ZR-DV-1” and ”ZR-DVS-1”, 90 min fire resistant for ZLATNA RAKA-M, No. 07-1387/5 и 1387/7, Skopje, june 2013.<br>22. Technical reports from fire resistant calculations of single rotation save fire resistant and fire resistand doors „E-34“and „E-90“, 30 and 90 min fire resistant for ERKA ENGINEERING LTD No. 07-1209/5, 1209/7, Skopje, june 2013.<br>23. Technical reports from fire resistant calculations of single and double rotation fire resistant door ”SEF 90-1” and ”SEF 90-2” of 90 min. fire resistant for SEF DOOEL Skopje, No. 07-3443/5 and 07-3443/7 Skopje, November 2013.<br>24. Technical report of explosion od hot water boiler on LPG located in „Cevahir residence and mall project“ – Skopje for Cevahir Gurup Istanbul R. Turkie, subsidiary in R. Macedonia, No. 07-1983/4, Skopje, December 2013.<br>25. Professional expertise for the inability of hot start, constructive problem of gas turbine, and other uncorrected defects in installation and commissioning of TE-TO AD Skopje, No. 07-3270/5, December 2013<br>26. Review of the Basic Design documentation for SHPP Kriva reka, no. 179-1, (for EMK Mali Hidroelektrani-Skopje), 2013.<br>27. Review of the Basic Design documentation for SHPP Kriva reka, no. 179-2, (for EMK Mali Hidroelektrani-Skopje), 2013.<br>28. Review of the Basic Design documentation for SHPP Toranica, no. 179-3, (for EMK Mali Hidroelektrani-Skopje), 2013.<br>29. Review of the Basic Design documentation for Irrigation Programme “Southern Vardar Valley”, Phase II: Irrigation Scheme Gevgelija (mechanical part), (for the Ministry of Agriculture , Forestry and Water Economy-Skopje), 2013.<br>30. Review of the Basic Design documentation for Irrigation Programme “Southern Vardar Valley”, Phase II: Irrigation Scheme Negorci-Prdejci (mechanical part), (for the Ministry of Agriculture , Forestry and Water Economy-Skopje), 2013.<br>31. Consultant services for Macedonian Power Plants (ELEM), 2013-2015<br>32. Technical report on hot-water boiler explosion in “Cevahir Residence and Mall Project – Skopje”, Faculty of Mechanical Engineering, 2013<br>33. Technical report on power plant hot start issue, gas turbine technical problem, latent and other deffects in TE-TO AD Skopje, Faculty of Mechanical Engineering, 2013 |
| 2014 | 1. Preliminary design for construction of SHPP Kovachka 1, 2 and 3 (for Kleinwasserkraftwerke Gmbh & Co KG), 2014<br>2. Study for improvement the hydraulic stability of water supply system Patiska reka and opportunity for energy use - PEMA INZENERING-Skopje<br>3. Performance test for aggregate 1 and 2 of HPP Sv Petka - AD ELEM-Skopje<br>4. Feasibility study for nine location of SHPP with technical solution (tendering documents for new concessions) IMPG-Skopje<br>5. General and particular technical specifications for built of SHPP – tender |

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| | documentation-mechanical part - IMPG-Skopje<br>6. Internal evaluation and feasibility to invest into SHPP Jadovska project - NLB Tutunska banka-Skopje<br>7. Internal evaluation and feasibility to invest into SHPP Ribnicka project - NLB Tutunska banka-Skopje<br>8. Internal evaluation and feasibility to invest into SHPP Zrnovska 352 project - NLB Tutunska banka-Skopje<br>9. Revision of detail project documentation of HPP Boskov most - mechanical equipment - AD ELEM-Skopje<br>10. Revision of basic design-changes for SHPP Jablanica- mechanical part - MHE Jablanica DOO-Skopje<br>11. Improving Energy Management at Macedonian Industry – IEM@MI, Implemented by CSO "Center for Climate Change" – Skopje, Project financially supported by The Royal Norwegian Embassy in Belgrade, 2014 |

## 3.10 International cooperation

| | |
|---|---|
| 2006-2010 | Monitoring and Improving Rivers in the Vardar/Axios Watershed (MIRVAX), NATO Science for Peace Project, SfP 981877, 2006-2010 |
| 2010-2014 | Development of Environmental and Resources Engineering Learning (DEREL), TEMPUS IV project, EU Directorate for Education and Science, 2010-2014, Project Agreement Number 2010-3375/001-001, Project No.:511001-TEMPUS-1-2010-1-IT-TEMPUS-JPCR. |
| 2010-2013 | Development of Environmental and Resources Engineering Learning (DEREL), EU TEMPUS co-financed Project |
| 2012 | Capacity Building of the Secondary Education Teachers in the Field of Environmental and Social Impact of Renewable Energy, UNESCO Project Sustainable Management for New Products Development, финансиран од TEMPUS MAS-PLM , Torino, Italy, 2012 |
| 2011 | UNIDO - UNEP Resource Efficiency and Cleaner Production , Low Carbon society, Nairobi, Kenya, 15- 21 October 2011 |
| 2014-2017 | "Efficient Harvesting of the Wind Energy", AEOLUS4FUTURE project, coordinated by Lulea University of Technology (Sweden), Marie Curie Innovative Training Networks (ITN), Call H2020-MSCA-ITN-2014. |

## 3.11 Load of teachers

The maximum number of courses, in the second cycle of the study program in Sustainable energy and environment, that each teacher can give is 2 at a time and each teacher should give no more than 12 hour classes per week (usually twice weekly).

The average load of teachers based on the complete stucture of all study programs at the Faculty of Mechanical Engineering in Skopje is 3,35 courses per semester, 9,35 lecture hours per week and 26 sudents per semester.

The average load of assistants based on the complete stucture of all study programs at the Faculty of Mechanical Engineering in Skopje is 9,32 (exercises) hours per week and about 60 sudents per semester.

## 3.12 Financing

Covering the costs of the postgraduate study program in Sustainable energy and environment will be done by self-financing by the candidates. The amount, method of payment, and all other conditions are regulated by the conditions, rules and criteria for enrollment and study in the first and second cycle of studies at the University of ,,Ss. Cyril and Methodius" in Skopje (currently 2,000 EUR for the entire studies). If the State participates in future, the amount of participation will be taken into account when defining the amount of funds for co-financing.

## 3.13 Analyzing the shortage of capacities

- Not enough mobility of professors and students. Lack of visiting professors from region/EU
- Access to up-to-date scientific data bases
- Completing necessary equipment for inovated Sustainable energy and environmental curricullum.
- Lack of messuring and laboratiry equpment for research
- Lack of laboratory equpment for teaching puprose, Energy efficiency basic measurements, Thermal camera, measuring equipment for: temperature, humidity, air velocity, etc.
- Measuring equpment for emission analysis: The equpment in the laboratories for measuring emission parameters in not in function, and should be recalibrated.
- Software for labaratory meassurements, data transfer to computer, basic components.

# 4 STUDY PROGRAM ANALYSIS

## 4.1 Analysis of the study program, a description of outcomes in relation to Bloom’s taxonomy, connections between learning outcomes, teaching and assessment

Specific qualification descriptors that determine learning outcomes for second cycle one year university studies 60 ECTS at study program Sustainable energy and environment in accordance with the Regulation on the National Framework for higher education qualifications

| | |
|---|---|
| Knowledge and understanding | Shows the thorough knowledge and understanding in scientific research fields and areas acquired in the second cycle and relate to:<br>• Knowledge of energy sources, ways of transformation and its efficient use<br>• exploitation and maintenance of power plants<br>• regulations and testing of machines and power plants<br>• technical control, supervision and inspection during the construction of power plants and systems<br>• Development of expertise and expert on energy machinery and equipment<br>• Knowledge of techniques, rules and measures to protect the environment |
| Applying knowledge and understanding | Qualified for the study of complex tasks under consideration, showing elements of insight, and can apply knowledge and understanding in a way that indicates a professional approach to the job or profession.<br><br>Shows the competence in identifying, analyzing and solving problems in related scientific fields studied in the second cycle.<br><br>Is Capable of finding and reliance arguments within the field and areas of study. |
| Ability assessment | Possesses the ability to collect, analyze, evaluate and present information, ideas, concepts of relevant data. Makes appropriate estimates taking into account the personal, social, scientific and ethical aspects.<br><br>Able to evaluate the theoretical and practical issues in the field of Sustainable energy and environment, to give arguments explaining the causes that give rise to certain phenomena, explaining the rules and choose an appropriate solution. |
| Communication skills | Develops ability to establish communication and to discuss with the experts, and the lay public, for information, ideas, problems and solutions when deciding criteria and scope of the task is clearly defined.<br><br>Taking split, separate collective responsibility for results. Is capable of independent participation, professional approach, specific, scientific and interdisciplinary discussions. |
| Learning skills | Take the initiative to identify the needs for further knowledge acquisition and learning with a high degree of independence, ie estimates of the need for continuous upgrading his knowledge and skills. |

## 4.2 Procedures for adjustments of allocated credits with realistic assessment of student load

Evaluation of student load distribution of lectures, excersises, lab work, individual and team work of the students is conducted for each particular course. The study program board will serve as a body where all adjustments shall be made and final course delivery approved.

## 4.3 Comparison of the structure of the study program with the accreditation requirements

The study program in Sustainable Energy and Environment (as shown in the table below) fulfills all National accreditation requirements regarding the compulsory/elective courses ratio, Entrepreneurship/innovations and internship courses, as well as aditional accreditational requirements stipulated in the Law for Higher education (January 2015). Some of this indicators are shown in the table below.

| Study Program | Duration of the studies (years)/ECTS | Total number/ percentage of the study program | Number / percentage of the compulsory courses by module (max 60%) | Number / percentage of the elective courses, from study program (min 30%) | Number / percentage of the elective courses, from University list (min 10%) |
|---|---|---|---|---|---|
| Sustainable Energy and Environment | 1 year<br>60 ECTS | 7<br>100% | 0<br>0 % | 6<br>86 % | 1<br>14 % |

## 4.4 Description and evaluation of teaching methods

## 4.5 The structure in the manner of taking written exams

The following tables give an overview of the items 4.4 and 4.5 (case example):

| Study methods: lectures, lab, project assignments, individual assignments, self-study. | | |
|---|---|---|
| Lectures/Lab | Lectures (15 weeks x 3) | 30 hours |
| | Lab (student work) | 45 hours |
| Project Work/Assignments | Project assignments | 40 hours |

| | | |
|---|---|---|
| | Individual assignments | 30 hours |
| | Team work/Self-study | 35 hours |

| Points/Marks: | | |
|---|---|---|
| Exams | | 40 |
| Projects | | 50 |
| Attendance | | 10 |
| Grading scale | Under 50 | 5 (five) (F) |
| | 51 - 60 points | 6 (six) (E) |
| | 61 - 70 points | 7 (seven) (D) |
| | 71 - 80 points | 8 (eight) (C) |
| | 81 - 90 points | 9 (nine) (B) |
| | 91 - 100 points | 10 (ten) (A) |

## 4.6 The implementation of practical and field work

Internship is mandatory by Law during each summer vacation lasting one month, but is also a compulsory course during first cycle studies.

The practical and field work during second cycle studies is done during the Master thesis research, usually in the industry.

## 4.7 Students satisfaction with study program, teaching methods, teaching styles

Every year the FME there is a graduation ceremony in June and all students are obligated to complete a poll. The questions and the results of the latest poll/survey (June 2014) are given below. Next survey in will be conducted in February 2015 with the questions defined on University level.

| Survey<br>for graduated students from 01.02.2013 till 31.01.2014 (24.06.2014) | | | | | |
|---|---|---|---|---|---|
| **Question** | **a)** | **b)** | **c)** | **Total** | **%, a)** |
| **1.Was your choice to study at the Faculty of Mechanical Engineering the right one?** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| a) yes, b) partialy, c) no | **104** | **11** | **0** | **115** | **90,4** |
| **2.Did the studing at this Faculty fulfill your expetations?** | | | | | |
| a) yes, b) partialy, c) no | **82** | **31** | **2** | **115** | **71,3** |
| **3. How do you evaluate the range of activities (teaching methods, practical work, exams, programs, projects)?** | | | | | |
| a) too large, b) appropriate, c) dissatisfied | **9** | **83** | **23** | **115** | |
| **4. Orientation, the number of study programs and modules:** | | | | | |
| a) too large, b) appropriate, c) dissatisfied | **7** | **103** | **5** | **115** | |
| **5.Orientation in the the studies begins** | | | | | |
| a) too soon, b) appropriate, c) too late | **8** | **86** | **21** | **115** | |
| **6.The ratio of theoretical and practical method of teaching is:** | | | | | |
| a) appropriate, b) not enough theory, c) not enough practical work | **46** | **4** | **65** | **115** | **40,0** |
| **7. Was it usefull to visit courses (lectures and lab.work)?** | | | | | |
| a) yes, b) partialy, c) no | **76** | **36** | **3** | **115** | **66,1** |
| **8. How were the criteria of assessing?** | | | | | |
| a) objective, b) variable, c) not-objective enough | **73** | **38** | **4** | **115** | **63,5** |
| **9. Are you satisfied with the colaboration with professors?** | | | | | |
| a) yes, b) partialy, c) no | **85** | **30** | **0** | **115** | **73,9** |
| **10. Are you satisfied with the colaboration with assistants?** | | | | | |
| a) yes, b) partialy, c) no | **92** | **22** | **1** | **115** | **80,0** |
| **11. Are you satisfied with the administrative support?** | | | | | |
| **11.1. Office of student afairs** | | | | | |
| a) yes, b) partialy, c) no | **108** | **6** | **1** | **115** | **93,9** |
| **11.2. Library** | | | | | |
| a) yes, b) partialy, c) no | **99** | **16** | **0** | **115** | **86,1** |
| **11.3. Other services (archive, accounting office...)** | | | | | |
| a) yes, b) partialy, c) no | **83** | **27** | **5** | **115** | **72,2** |
| **12. Are you employed?** | | | | | |
| a) yes, in my Major, b) yes, not in my Major, c) not at all | **59** | **17** | **39** | **115** | **(66)** |
| **13. Do you expect changes after fulfilling this poll?** | | | | | |
| a) yes, b) partialy, c) no | **55** | **39** | **21** | **115** | **47,8** |
| **14. Are you interested in further forms of education (courses, seminars, master or doctorial studies)?** | | | | | |
| a) yes, b) partialy, c) no | **83** | **23** | **9** | **115** | **72,2** |

## 4.8 Analyzes of diploma supplement

The Diploma Supplement follows the model developed by the European Commission, Council of Europe and UNESCO/CEPES. The purpose of the supplement is to providesufficient independent data to improve the international 'transparency' and fair academic and professional recognition of qualifications. It is designed to prove a description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free from any value judgment, equivalence statements

or suggestions about recognition. Information in all eight sections should be provided. Where information is not provided, an explanation should give the reason why.

The diploma supplement issued by the Faculty of Mechanical Engineering for this study program is given as an annex to this QEP.

## 4.9 Market requirements for qualifications offered by the study program

In Macedonia there is a clear justification for the existence of a innovated second cycle curriculum in the Sustainable Energy and Environment with respect to the market needs. There are numerous regulations and bylaws in the environmental area that need to be respected and applied, which further emphasizes the need for well educated professionals in the field of environmental protection and resources.
For example, Article 47 of the Environment Law states:
"The advancement of environmental protection is based on scientific and technological development; encouraging, assisting and organizing scientific and technological research; training and improvement of personnel in the field of environmental protection ....."
Article 48 states:
(1) The Minister of Education should approve curricula for primary and secondary schools, in which the environmental protection will be an elective or compulsory course;
(2) The state administration responsible for the environment issues shall provide the necessary support to educational and scientific institutions, professional organizations and associations of citizens established to promote environmental protection and sustainable development and implementation of educational activities.
Article 23, paragraph 3, states:
"In order to gain the accreditation for assessment of the technology, technological line, product, intermediate or raw material, legal and physical persons must have at least one employee with higher education in the technological and metallurgical, chemical or environmental scientific area, with three years of work experience in the field."
The following text which proves the feasibility of existence of a new second cycle curriculum in environmental and resources engineering with respect to the market needs. It is published on the web-address of the Macedonian Government (http://vlada.mk/node/106):
"Sustainable use of natural resources is necessary for environmental protection. Environmental management will be conducted in a manner that will increase the responsibility of the central and local government, while increasing the accountability of the industry by providing measures to apply the latest technologies and practices in industrial processes. According to the National Strategy for Environmental Investments, public access to environmental information by conducting educational campaigns to raise public awareness must be provided.

**On-going activities to meet the market needs**
In the period 2011-2015 the protection, promotion and utilization of water resources should be performed through the following activities:

- Adoption of the Master Plan of Macedonia and adoption of a National Strategy for Water Management in the Republic of Macedonia (2013);
- Identification of agglomerations for wastewater treatment and identification of vulnerable areas in the country in terms of discharge of urban waste water and in terms of other parameters in accordance with EU Directives (September 2012);
- Start the process of integrated water management in accordance with the principle of integrated river basin management (2014);

- Strengthen the administrative capacity of the river basin management and develop plans for river basin management (2014);
- Adopt a plan for managing the river basins of the river Vardar, Strumica River, Bregalnitsa river (2014);
- Adopt a national study methodology for charging services in the water sector in accordance with the polluter pays principle, in order to improve the system of collection (2013);
- Construct small water reservoirs to provide the population with drinking water (2014-2015) ;
- Improve public water monitoring network to measure the quality and quantity of groundwater (2014-2015);
- Continue to maintain and upgrade the project for the supply of water from wells for the Lake Doiran (October 2013);
- Preparation of basic design of the sewerage network and preliminary design of wastewater treatment plant effluent in Skopje, IPA funding (2014);
- Renovation and expansion of the sewerage network in Prilep, preparation of basic design and construction of wastewater treatment plant effluent, the IPA funds and domestic share (2013-2016)
- Construction of a wastewater treatment plants in Strumica, Gevgelija, Volkovo and Saraj (2014-2015);
- Preparation of feasibility studies and detailed design for several agglomerations in the country with more than 10,000 population equivalent in: Bitola, Tetovo, Gostivar, Debar, Kavadarci, Tearce, from IPA funds ( 2012-2014 );
- Preparation of project for the reorganization of the public communal utilities, in order to separate from them the units for water utility (2012-2014) ;

In the period 2011-2015 the following activities should be provided in the solid waste management:

- Construction of landfills and establishing an integrated system of solid waste management in the North-West and South-East region of Macedonia through the concept of public-private partnership (2013);
- Project: "Stop using plastic bags";
- Program for clean-up and relocation of illegal landfills and solid waste landfills that are located adjacent to motorways and major regional roads;
- Strengthening the administrative and technical capacity of regional bodies for solid waste management;
- Preparation of regional plans for solid waste management in at least two regions for solid waste management (2013);
- Preparation of feasibility studies, basic projects, cost-benefit analysis for at least 2 regions for solid waste management (2014);
- Plan with feasibility study on electrical and electronic equipment waste
- Establishing systems for the collection, treatment and recycling of waste from packaging, batteries and accumulators and electrical and electronic equipment waste (2012);
- Issuing concession on the processing and utilization of mineral concentrates in the lead and zinc mines (2014);

In the period 2011-2015 the following activities should be provided in the sector “nature”:

- Adoption of a National Strategy for the Conservation of Nature (2011);
- Adoption of a Plan for management of natural and cultural heritage in the Ohrid region (2011);

- Adoption of the Red List species and wild Red Book of affected wild species (2013);
- Adopt Plans for management of all protected areas in the country;
- Establish a National Ecological Network of protected areas (2014);
- Identify areas that will be proposed to enter into environmental protection areas for the EU Natura 2000 network (2015);
- Establish a record of environmental protection through the introduction of the Land Registry and protected areas of natural heritage (2015);
- Establish a national information system on Biological Diversity (2015);
- Adopt a management plan of the protected area Alshar and its promotion among scientists outside the country (2013);
- Declare parts of Osogovo mountains as a protected area and make plans for their management (2014);
- Examine the possibility of declaring the Shara Mountains as a National Park
- Project Mariovo: revitalization of villages in terms of the ecological food production, development of ecological farming, eco-tourism, construction of accommodation facilities, solar plants etc. (2012-2015)
- Project Krivolak: ecological food manufacturing and solar energy (2013-2015)
- Cleaning solid waste disposals (continuing activity).

Key project activities in the period 2011-2015 in the integrated prevention and control of air pollution are:

- Completing the system of issuing IPPC permits for compliance with the operating plan for all industrial sectors (2012);
- Support the introduction of at least 10 marked environmental products and services (2014) ;
- Support for an eco-label marking of at least 10 tourist accommodation facilities (2013);
- Improve and regular maintenance of the State monitoring network with 4 air monitoring stations (2014);
- Adoption of a National Plan for the Air Protection (2012);
- National Program for Adopting the gradual reduction of the quantity of emissions of certain pollutants in the Republic of Macedonia (2012);
- Establish an information system for air quality (2012).

Key project activities in the period 2011-2015 to reduce noise pollution are:

- Development of strategic noise maps for all agglomerations, major roads, railways and airports in the Republic of Macedonia (2014);
- Establishment of State Network for noise monitoring with at least 10 automatic monitoring stations (2015);
- Preparation of Action Plans for Environmental Noise (2015).

Key project activities in the period 2013 – 2017 for energy efficiency in buildings are:

- New Law of building 2014;
- New Law of energy 2015;
- New Rulebook of energy characteristics of buildings 2015;
- New methodology for calculation of energy efficiency in objects, industry and transport 2013;
- Training and licensing for Energy evaluators 2014

**Evaluation**
The SEE curriculum is developed in response to the needs of the industry, business and institutions, which have to face environmental problems and ask for engineers with interdisciplinary expertise in the field of environmental engineering. This requirement is fulfilled because the curriculum was specifically designed within the Tempus Project DEREL on the basis of an extensive needs analysis and surveys of labor market needs, as reported on http://www.derel.ukim.edu.mk/derel-documents - Surveys of Labor Market Needs. It ensures consistency and practical relevance of the academic program in the area of environmental protection at national and international level.

## 4.10 Qualifications awarded by the study program in relation to the Framework for Qualifications of the European Higher Education Area and mobility

| Level in the national frame of higher education qualifications | Higher education | Level in the European frame of higher education qualifications |
|---|---|---|
| VIIA | Second cycle, university, postgraduate academic studies, One year studies 60 ECTS | 7 |

## 4.11 Analyzing the shortage of capacities

The Faculty of Mechanical engineering has been implementing curriculum for several types of mechanical engineers. The energy engineering departments have numerous courses in the fields of thermal and hydro engineering. Previously, modeling of the curricula the energy sector in the country was based on large scale systems and global solutions to the problems. But, today new changeless emerge in the society. In the last 10 years, Macedonia has devoted to small scale solution (local solutions). Starting from small scale energy sources (Hydropower plants, solar PV, biogas etc.) and going to reducing the energy consumption with implementation of energy efficiency measures in housing and industry and implementing RES in the sectors. Employers in Macedonia are in need to have engineers with knowledge of the basic power engineering and have upgraded in the fields of energy efficiency, renewable energy sources and environmental factors. These areas have been intensively implemented in the Macedonia legal system and must be applied in all new buildings, industrial objects and other applications. Therefore, Macedonian energy engineers must be offered the possibility to develop additional knowledge and skills in these areas and be in step with the latest technical norms, standards and regulations and be a step in front of the Macedonian industry and be able to develop it. It is the best way to increasing the employability of the young engineers.

# 5 Summary of identified deficiencies

The Faculty of Mechanical Engineering is facing with the need for additional researchers and teaching assistants to be involved in the educational, research and application work of the Faculty of Mechanical Engineering.

- The Faculty is dealing with a shortage of assistants and assistant professors. There are 59 professors, associate professors and assistant professors, but only 13 assistants, which means that the number of assistants is only 25% of the number of professors. It is necessary to ensure new employments of young assistants.
- Some administrative staff positions which exist in the sistematization of the working positions at the Faculty are not filled in with employees, so it is necessary to get permission from the Ministry of Education and Science to cover such positions. The lack of administrative staff makes difficulties in the realization of the administartive activities of the Faculty. The problem of insufficient number of technicians in the laboratories of the Faculty is especially significant problem, which decreases the quality of realization of the student laboratory exercises in the teaching process.
- The age structure of the Faculty staff is unfavorable, i.e. 40% of the employees are older than 50 years, and 60% are older than 45 years. This fact also testifies the high demand for employment of new young staff at the Faculty.
- Gender structure of employees who have teaching title at the Faculty of Mechanical Engineering in Skopje is extremely uneven: the number of females is only about 12% of the total number of teachers. The gender structure of the employees as assistants is even: the number of females is 50% of the total number of assistants.
- Not enough mobility of professors and students. Lack of visiting professors from region/EU
- Access to up-to-date scientific data bases
- Completing necessary equipment for inovated Sustainable energy and environmental curricullum.
- Lack of messuring and laboratiry equpment for research
- Lack of laboratory equpment for teaching puprose, Energy efficiency basic measurements, Thermal camera, measuring equipment for: temperature, humidity, air velocity, etc.
- Measuring equpment for emission analysis: The equpment in the laboratories for measuring emission parameters in not in function, and should be recalibrated.
- Softver for labaratory meassurements, data transfer to computer, basic components.

# 6 Activity plan for achieving quality

According the planned SWOT analysis which should be done in the first quarter of 2015, the following activities are expected to be taken:

- the exchange of students will contribute toward the improvement of the mutual understanding, cultural exchange

- the professors are expected to improve the exchange information with WB colleagues, as well as publishing results of the research within the master thesis realization in the foreign journals
- establishing long term collaboration with WB universities, professors and researchers
- strengthening capacity for high quality in the MSc educational level by implementing experience of the Norwegian colleagues
- implementing modern techniques for Experts in Teamwork approach that gives students advantages at the labor market

As a results of the analysis showing lack of staff at all levels, the Dean's council has decided to open call for 20-30 positions for students to be engaged as additional staff for realizing practical work and labs of the students. This has contributed to the maintainance and improvement of the quality of the educational process.

This QEP identify gaps for good quality student coursework, design projects and MS thesis, covering laboratory requirements, professional literature, software, etc. Also, Self-evaluation report will be delivered by the Faculty Committee. The implementation of the new program and the new colaboration with the Universities from Western Balkan will give the Faculty the availability of distance learning. Proffesors from other universities in the country and abroad can give lectures to the students from this Faculty and vice-versa. All of this would be possible with the new multi-functional conference room, which should be finished in 2015.

The lack of necessary measuring equipment in the laboratories is a substantial quality gap for implementation of quality practical knowledge and visual and theoretical understanding of processes. It would be of great assistance to be equipped with thermal camera for building and industrial use for small boilers for HVAC systems. Also basic measuring equipment for preparing student projects is needed in the form of temperature and humidity measuring, flow of exhaust emissions, temperature and components of exhaust emissions, measurements for U-value in objects and connecting equipment and software for calculation of the parameters. The equipment will be used in the laboratory for Thermal energetic and Laboratory for Internal Combustion engines as a tool for practical experiments and student projects.

FACULTY OF MECHANICAL ENGINEERING – SKOPJE
Diploma Supplement

| | |
|---|---|
| **1. Data of the Diploma Holder** | |
| 1.1. Name | |
| 1.2. Surname | |
| 1.3. Birth date, place and state of birth | |
| 1.4. Personal identification number | |
| **2. Data of the Acquired Qualification** | |
| 2.1. Date of Issue | |
| 2.2. Title of Qualification | Bachelor of Science in<br>Sustainable Energy and Environment |
| 2.3. Name of the study program, i.e. main study area, scientific and research field and subject | Study program: Sustainable Energy and Environment<br><br>Study Area: Technical and technological sciences<br><br>Scientific and Research Field: 214 Mechanical engineering, 205 Energy, 225 Environment<br><br>Scientific and Research Subject: |
| 2.4. Name and status of the higher education/scientific institution which is issuing the diploma | "Ss Cyril and Methodius" University in Skopje (CMU),<br><br>holders of the study are three CMU faculties: Faculty of Mechanical Engineering – Skopje |
| 2.5. Name and status of the higher education/scientific institution (if different) which is administrating the diploma | |
| 2.6. Language of Teaching | English |
| **3. Data of the level (cycle) of qualification** | |
| 3.1. Type of qualification (academic/professional studies) | Academic university studies |
| 3.2. Level (cycle) of qualification | Second cycle studies (master studies) |
| 3.3. Duration of the study program: years and ECTS | 2 semesters, 1 year, minimum 60 ECTS |
| 3.4. Conditions for enrollment in the study program | Finished high education, first cycle of studies (240 ECTS) |

| 4. Data for the curriculum and achieved results | | |
|---|---|---|
| 4.1. Type of studying (full time, part-time) | Full-time | |
| 4.2. Requirements and results of the study program | Bachelor of Science in Sustainable Energy and Environment has knowledge and understanding in scientific research fields and areas acquired in the second cycle and relate to: Knowledge of energy sources, ways of transformation and its efficient use; Operation and maintenance of power plants; Regulations and testing of machines and power plants; Technical control, supervision and inspection during the construction of power plants and systems; Development of expert reports on energy machinery and equipment; Knowledge of techniques, | |
| 4.3. Data about the study program (paths, modules, grades, ECTS)[1] | The study program has 7 courses with a total of 60 ECTS, in two semesters, in one academic year, and the courses have 6 ECTS. There is one path, there are no predefined modules, and modulating of the study program is made through selection of 6 elective courses from a list of 19 courses. The lowest passing grade is 6, the highest grade is 10 | |
| 4.4. Grading system (scheme of grades and criteria for obtaining the grades) | up to 50 points | Five (5) – not-passed exam, ECTS grade A |
| | from 51 to 60 pts | Seven (6) – passed exam, ECTS grade B |
| | from 61 to 70 pts | Seven (7) – passed exam, ECTS grade C |
| | from 71 to 80 pts | Seven (8) – passed exam, ECTS grade D |
| | from 81 to 90 pts | Seven (9) – passed exam, ECTS grade E |
| | from 91 to 100 pt | Seven (10) – passed exam, ECTS grade F |
| 4.5. Average grade in the studying | | |
| 5. Data about the using of the qualification | | |
| 5.1. Access to further studies | Third cycle studies | |
| 5.2. Professional status (if applicable) | The diploma allows employment. | |
| 6. Additional information | | |
| 6.1. Additional information about the student | | |
| 6.2. Additional information about the higher education institution | "Ss. Cyril and Methodius" University in Skopje (CMU) is the first public university in the country, founded in 1949. Today CMU has 23 faculties, 5 research institutes, 4 public research institutions, and 8 associate members, with study programs in all scientific fields, with more than 60,000 students and 3,100 teaching and research associates, as well as administrative staff. | |
| 7. Attestation of the Diploma Supplement | | |
| 7.1. Date and place | | |
| 7.2. Name and signature | Prof.d-r Atanas Kochov | Prof.d-r Velimir Stojkovski |
| 7.3. Position of the signed person | dean | rector |
| 7.4. Seal | | |

[1] Annex to 4.3 is the Certification of the passed exams