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NECESSITY FOR MASTER'S DEGREE IN SAFETY ENGINEERING

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ABSTRACT

The paper substantiates the necessity for full-time and correspondent Master's Degree studies in Safety Engineering in Bulgaria. Training objectives are formulated. Brief analysis is presented of the syllabus, which is consistent with formulated objectives and with government requirements for a Master's degree. The main carrier opportunities are listed for graduate MSc engineers in Safety Engineering.

INTRODUCTION

In 1997 the Law on Safe & healthy Working Conditions was enforced. The Law regulates activities and responsibilities in respect of ensuring safe work environment. It caused adoption of by-laws such as the Regulation on the rules, ways and periods of risk assessment, which is regarded as continuous process of hazard analysis and neutralization by means of technological and organizational measures. The experts to be assigned to those activities should possess sufficient knowledge and skills from studying fundamental, general engineering, humanitarian and special subjects.

Safety engineering represents a set of such knowledge directed to ensuring safe and hygienic working environment. Safety does mean only to make safe anything that is hazardous. It also related to better design of items, machines and facilities, to human behavior in the complex system man-machine- working environment, and to better management and control of hazards via efficient safety and health risk management.

Integral improvement of working conditions, together in investment of significant material resources, requires adequately trained engineers on Master's level in "**Safety Engineering**".

TRAINING OBJECTIVES

The main objective of training in Safety Engineering is to respond to the public need for engineers with special higher qualification in the field of safety and health risk assessment and management.

Educational objectives of training to higher than bachelor's degree are, as follows

- Study of Bulgarian and European legislation relevant to working conditions;
- Acquisition of theoretical and practical knowledge about risk analysis and assessment, about efficient control on compliance with laws, decrees and regulations pertaining to ensuring harmless and safe working conditions and accident prevention;
- Acquisition of qualifications for design and implementation of a set of measures and means for ensuring harmless and safe working conditions and accident prevention;
- Acquisition of manager's qualification in "working conditions".

So far, no training has been conducted in our country in Safety Engineering and there are no graduate experts. This type of specialized training is carried out by universities in USA [1] and Australia [2]. Following enforcement of the Framework directive 89/391/EEC, 12th of June 1989 (introduction of measures to encourage improvements in the safety and health of workers at work) and its analogues outside Europe, more technical and medical universities are trying to provide qualified experts to for its application. To this end, the Medical Academy in Sofia is endeavoring to provide specialized training in labor medicine for its medical students.

Specialized training in certain fields of labor safety and health has only been included in post-graduate studies.

MASTER'S DEGREE SYLLABUS

The first stage of training organization in Safety Engineering is the development of a syllabus. Such syllabus for Master's degree training was developed at Mine Ventilation & Safety Department. Table 1 shows the full-time training syllabus. For

correspondence training, the courses are the same, but hours of reading are reduced by half

The main considerations in developing the syllabus for the education-qualification degree "Master", are government requirements [3] for higher education in "Mineral Resource Mining", professional direction "Mining Engineering".

Major parameters of state requirements are:

- Training duration - 1,5 academic years;
- Horaria - 960 hours;
- Number of study courses - 14.

The guiding principle for selection of course and horaria, was the utmost realization of educational objectives.

Mandatory courses numbered 1, 2, 3, 4, 7, 8, 9 and 10 provide special knowledge to students, and elective courses numbered 4 and 5 supplement the special knowledge.

Mandatory courses "Computer methods in safety" and "Language and information training" augment the remaining courses of the syllabus and provide knowledge and skills that are mandatory for the trainees. These were developed on a module basis with scheduled interaction both between individual modules and other courses.

Table 1. SYLLABUS for Master's Degree studies in Safety Engineering – full-time training

Courses – compulsory	Hours
First semester	**300**
1. Industrial safety (I part)	60
2. Industrial Ventilation	75
3. Industrial hygiene and professional diseases	75
4. Computer methods in safety – Module A (Database management)	30
5. Language and information studies – Module A (Translation)	30
6. Elective course (1-st , 2-nd or 3-rd elective)	30
Second semester	**345**
7. Safety psychology and ergonomics	45
8. **Industrial safety (II part)**	75
9. Fire safety and rescue	60
10. Management of safety and industrial risks	60
4 Computer methods in safety – Module B (Applied statistics)	30
5. Language and information studies – Module B	30
11. Elective course (among 4-th or 5-th elective)	45
Third semester – work on Master's degree thesis	**315**
5. Language and information studies – Module C	30
13. Elective course (among 3-rd, 4-th or 5-th elective)	45
Pre-thesis practice	90
Lectures and seminars on Masters' thesis	90
Consultations on Masters' thesis	60
Defence of Masters' thesis	-
Total for study	**960**
Elective courses	**Hours**
И-1. Microcosiology	30
И-2. Mine safety	
И-3. Applied illumination	30
И-4. Drilling, exploration, transportation, storage, and usage of oil and gas	45
И-5. Geotechnical safety	45
И-6. Ventilation and air conditioning systems' control	45

Module A of "Computer methods…." gives additional (as compared to bachelor's degree level) knowledge for working with electronic tables and databases. Practical courses comprise mostly individual work and assignments on other subjects – for instance, assignment on "Industrial ventilation" or analysis and processing of measurements in "Industrial hygiene…". Module B of "Computer methods…." further improves students' knowledge in Safety statistics focusing on processing of statistical and other data, criteria evaluations and verification of hypotheses.

Practical courses include solving of problems for analytical or graphic processing of information obtained during studying of other subjects of the current semester.

Language and information training comprises three modules, as follows:

- Technical translation from foreign language – Module A
- Information retrieval systems – Module B
- Document and report writing and presentation – Module C

Information search, translation, documents prepared and presented, all are generated from other courses of the semester of the master's degree study as a whole.

The elective course "Drilling, exploration, transportation, storage, and usage of oil and gas" enhances students' knowledge about widely applied technology in the country and with high degree of risk.

The elective course "Microsociology" provides essential knowledge to be used as basis for personnel management training – a problem which every engineer faces regardless of their chosen field of carrier.

The elective course "Applied Lighting Equipment" supplements the knowledge on labor hygiene and ergonomics and provides essential knowledge on accident reporting.

Diploma thesis and pre-diploma internship are related to specific sites whereof risk assessment, safety plans and other documents and analyses of use for the company are developed.

APPLICATION TERMS AND CONDITIONS

Eligible for training in the **Master's** program in **Safety Engineering** are students with bachelor's degree (or "engineer" according to the old educational classification) in all specialties of UMG, as well as engineers – bachelors from other higher technical schools (HTC) with general grade award from the education course and from state examination (diploma thesis) at least Very Good 4.50.

Table 2. Pre-qualification exams

Bachelor's degree majors	Pre-qualification exams		
	Mining Technology	Mineral Technologies	Geology & Mineral Resources
ME, S &G, MET, EE, IM, MT	No	No	No
DEOG, GMR, HEG, IG	No	**Yes**	No
Mechanical Engineer	**Yes**	**Yes**	**Yes**
Chemical engineer	**Yes**	**Yes**	**Yes**
Electrical engineer	**Yes**	**Yes**	**Yes**
Civil engineer	**Yes**	**Yes**	**Yes**

Depending on bachelor's major, **pre-qualification** courses are taught (Table 2) for the purpose of leveling the knowledge of engineers from other HTC and other specialties of UMG. Pre-qualification exams must be passed during the first academic year.

These pre-qualification exams are part of syllabuses for "Mining Equipment & Technology"(MET) and "Mining Engineering" (ME) (Table 3). Master's degree trainees in Safety Engineering may enroll in the regular study process and sit these exams at a time of their convenience.

Table 3.

Pre-qualification course	Major	Horaria
1.Mining technology	MET	90
2.Mineral technologies	ME	45
3.Geology & mineral resources	MET	45

QUALIFICATION AND CARRIER OPPORTUNITIES

Safety Engineering graduates are bestowed the education-qualification degree of "**Master**" at this stage of program development, with professional qualification "**mining engineer**". They acquire the skills defined in the qualification characteristic of the specialty:

- Analyze and assess industrial risk and working conditions;
- Design and implement technical, technological and organizational decisions for prevention and minimization of industrial risks and improvement of working conditions;
- Undertake applied and scientific research in the field of safety engineering, labor hygiene inclusive;
- Train technical personnel and workers to detect hazards, assess risks and apply measures for their prevention or minimization as specified in the general and company labor safety regulations.

With such training, the Master in safety engineering will have very good carrier opportunities, such as :

- SAFETY EXPERTS IN PLANNING AND CONSULTING COMPANIES;
- SAFETY INSPECTORS IN PUBLIC ORGANIZATIONS;
- SAFETY EXPERTS IN MINERAL RESOURCE SURVEY AND MINING ;
- SAFETY EXPERTS IN INSTITUTIONS, INDUSTRY, CONSTRUCTION, SERVICES AND COMMERCE.

MSC graduates in Safety Engineering may continue their education in the same scientific direction for acquiring the education-qualification degree of "**doctor**".

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Abreviations:
ME – Mining Engineering;
S&G –Surveying & Geodesy;
MET – Mine Equipment and Technology;
EE - Electric power and Electric Installations;
IM – Industrial Management;
MT – Mineral Technologies;
DEOG – Drilling and Exploration of Oil and Gas;
GMR – Geology of Mineral Resources;
HEG – Hydrogeology and Engineering Geology;
IG – Industrial Geophysics