The Study Program in the Education of Mining Engineering – Electrical Engineering

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Abstract: The idea of an individual study program for mining engineering studies originated from a discussion at the ICEE 99 international conference. In the majority of countries in the world a proportionally small number of mining engineers are educated at universities and therefore their significance for the life of people in the world is great. Their work and their knowledge is connected with people's approaches to nature, towards the use of raw materials and energetic sources, towards building transport systems in the countryside, and with other areas.
The authors see the significance of an individual program for the education of mining engineers. They have enabled the issuing of a top quality textbook for most of the countries of the world. They have also allowed the short-term exchange of teaching personnel between universities, the exchange of knowledge, the exchange of students, co-operation in working out diploma work, and in other areas. It is almost obvious that this is the stimulation for the establishment of an international, university, mining society founded on the co-operation between universities and mining branches.
The themes of the teaching plan from engineering and electro-engineering is worked out in this contribution, which was recommended to have an extent of lessons of 225 hours from a total number from a five-year study program in its original proposal from ICEE 99. In the area of engineering, emphasis is placed on the systematics of mining machines and knowledge of basic machine components and their stress is necessary for it. In the area of electro-engineering, the main emphasis is placed on the properties of electric motors, switching instruments and the principles of distributing electrical energy, including the safe operation of electrical equipment.

Keywords: education, subjects, fundamentals, mining engineering

1. Fundamentals of teaching electro technical subjects

According to the design which was submitted at the conference ICEE' 99, the block of subjects for 4^{th},5^{th} and 6^{th} semester for teaching electro technical subjects was designed, as shown at Table 1. The extent of subjects in each semester is not possible to define and it is not even necessary the special area would have the entire extent of 225 hours. The number of 210 hours will be sufficient. They can be divided in the following way:

4^{th} semester	The fundamentals of electro techniques	extent 2-2	total of 60 hours
	The fundamentals of electronics	extent 2-1	total of 45 hours
5^{th} semester	Electrical drives	extent 2-2	total of 60 hours
6^{th} semester	Electrical equipment	extent 2-1	total of 45 hours

Teaching all el. subjects for future mining engineers is motivated by a present situation in mines, where most of the equipment is run on el. drives. In such case the mining engineer works with the el. equipment daily, and not only one instrument, or blackout of mining is caused by failure or unqualified operation by attendance of machines run on electrical drives.

The result of teaching of these four subjects should be to educate mining engineers with such knowledge will lead them towards quite responsible and privy discussions with electricians about problems with distribution and use of electrical energy.

From this point of view it is necessary that mining engineers will have sufficient knowledge about following areas:

- construction of common el. equipment used in mines
- properties of el. drives, running, warming up during its loading, and others

- distribution of el. energy, measuring of consumption and dangerous states
- and provisions connected to using el. energy in equipment and operation.

All of the chapters shown for each subject should have almost the unified structure.

1. Introduction describing the significance and use of described elements or the whole
2. Principle activity – functions of these elements always with static characteristics of functions of voltage depending on current. Voltage and current and current on another characteristic variable (for example for the el. drives it is the revolution), output parameters, energy losses during the operation, serial and parallel co-operation, (if used)
3. Dependence on temperature of loaded elements and limiting operation conditions
4. Construction and industrial make used in operation of mining companies.

These four basic points should be consistently kept in each chapter of suggested subjects. The content of each subject should be as follows:

Basic of Electrical Engineering *2+2® 60 hrs*

Introduction - Electrical Field - Electrical Potential - El. Conductor - Insolent - Stridence Solidity of Insolent.

Magnetic Field - Intensity of mg. Field - mg. Induction - Diamagnetic Material - Paramagnetic Material - Magnetism's Diagrams - Magnetic Hysteresis.

Electric Circuit of Direct Current - Ohm Rule - Kirchhof's rules - Serial and Parallel connection - Potentiometer - Temperature Relation of Resistor.

Capacitor - Dielectric Circuit - Dielectric Flow - Difference between Flow in Conductor and Dielectric flow - Capacity - Serial and Parallel Connection of Capacitors - Energy in the Capacitor.

Reels - Magnetic Circuit - Magnetic Current - Mg. Strain - Mg. Permanence - Mg. Induction - Inductance - Energy of Mg. Field - Loss of the Iron - Electrodynamics Effect.

Alternating Current - Sinus Function - Average value - Effective value - Resistance of Alternating current - Ohm's - Induction's - Capacitor's - Serial and Parallel connection of resistance - Power of Alternating Current.

Three-Phase Flow - Phase Voltage - Associate Voltage - Connection to Star and to Triangle

Battery and - Power of Three-Phase Current, Galvanic cell, leaden accumulators, alkali accumulators

Accumulators - Galvanic cell - Leaden Accumulator -Alkaline Accumulator.

Measuring of Electrical Value - Measuring of Current,

Voltage, Power, Energy, Resistance, Capacities, Induction.

Electrical

Safety Considerations - Personal and Equipment - General Rules and Procedures - Eye, Ear and Skin Protection - Electrical and Electronic Device Safety - Power Feeder Handling Safety - Post accident Procedure.

Basic of Electronics *2+1® 45 hrs*

Introduction – repeats the Solid State Element of Fysics from point of view the Basic Principle

General Control System Diagram and the connotation for using of Electronic Elements

Electrical Control Devices – Basic Principles of Electrical Switching, Toggle, Push-button, Selector Switches, Solenoids – Relays – Electromechanical Timers and Counters – Transformers – Potentiometers

Solid states Devices – Diodes – Power diodes - Zener Diodes – Transistors – Bipolar and FET Transistors – Integrated Circuits – Linear and Digital Thyristors – Diac and Triac – Light Activated Semiconductors and Optoisolators

Operational Amplifiers – Basic Operational Amplifiers Configurations – O.A. Applications

Industrial Power Supplies – Electrical Power Distribution – Rectifiers and Filters – Linear Voltage Regulators – Switching Voltage Regulators – Special Power Suppliers

Electrical Machines *2+2® 60 hrs*

Transformer - Some Topology - Principal of Operation - Three-Phase Transformer -Parallel working of Transformer - Autotransformer

Synchronous Motor - the generation of rotating magnetic fields - Industrial Motor Construction - Torque Characteristic - Current Characteristic - "V' Curve-synchronous Motor as Compensator.

Asynchronous Motor (Induction Motor) - Principle of Operation - Industrial Motor Construction - Speed-torque curves - Speed control by Adjustment of Rotor Resistance - Rotor Slot Designed - Round Diagram - Speed Control - Single-phase Induction Motors.

Direct current Motors - Industrial Motor Construction - Series Motor - Shunt Motor - Compound Motor - Speed Control - Speed-torque curves - Current Curves.

Fervency Transformer - The Main Principle of Operation - Industry Design - Control of Frequency.

Electrical Devices *2+1® 45 hrs*

Common Low-voltage Switches

Electrical Magnetic Contractor - Current Protection - Short-circuit protection - Control with Push-button Switch -Tandem Contractor.

Circuit Breaker – Overload Protection – Overvoltage Protection

Switch Fuse – Overcurent Fuse - Low Voltage Fuse - High Voltage Fuse

Switch Breaker – Power Switch – Protective Relay

Electromagnets – Single-phase Electromagnet – D.C Electromagnet – Electrohydraulic Brake Release

Electric-distribution System The Main Schema of Electric Distribution System

Transformers – Transformers in the Mining Industry – Parallel Work of Transformers

Switching Station – Main Switching Station on the Mine – Underground Switching Station - Switching Board Conductors – Cable Conductors – Power Cable Conductor

Lighting - Electric Lighting – Face Lighting – Industrial Lighting – Discharge Lamp – Mercury-vapor-Lamp – Sodium-vapor Lamp – Xenon Discharge Lamp

6. Conclusion

Considering the extent of this contribution it was not possible to describe in detail individual parts of the subjects. Further, it is not possible to explain details, which belong to the competence of electroengineers, to the mining engineers. Still, it is necessary to think about this area as an approach which gives the mining engineer the overview in order that he/she would be able to, with the full responsibility, manage the enterprise and use el. energy in a proper way and save el. equipment so that it will not be the source of frequent failures.

I was teaching the subjects of electro-techniques for mining engineers for 11 years, and that is why I know from my experience the problems, which the non-electrotechnical students have with the study of el. subjects. I am, however, persuaded that it is because some fundamental issues are explained less popularly and more educationally, with insufficient direction towards practical use. Exactly this I would like to replace with by in detail description of individual each discipline so that this curriculum could be a good guide for teaching and so that mining engineers could leave the school with the experience of good knowledge of electrical equipment and of their proper use.

4. References

[1] J. Webb, K. Greshock Industrial Control Electronics. Merrill Publishing Company. Columbus, Ohio 43216, 1999, 617 pp.

[2] E.R. Laithwaite, L.L. Freris. Electric Energy: its generation, transmission and use. Mc Graw Hill Book Company (UK). London, 1980. 357pp.

[3] V. Chura Electrotechniques for Mining and Metallurgy Engineers (in Czech). SNTL-ALFA. Prague 1972, pp 383.