



EN104

ELECTROTECHNICS AND ELECTRONICS

Approved:

Protocol: № 23/28.06.2022 г.

Lecturers:

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ANNOTATION

The discipline "Electrotechnics and Electronics" is a basic course for the Software Engineering major. The "EE" course aims to acquaint students from non-engineering majors with basic concepts, laws, and rules in electrical engineering and electronic circuit engineering. The discipline is a basic and initial course in the field of electronic circuit engineering and provides knowledge about the other hardware disciplines in the specialty. In laboratory exercises, students gain knowledge and experience in the study of electronic amplifiers, digital circuitry, rectifiers, etc. Students perform computer simulations of developed PSPICE simulation models of electronic circuits.

MAIN OBJECTIVES

The main goal of the course is to form knowledge and skills for selection, computer research and analysis of electronic devices. At the end of his studies in the discipline "Electrotechnics and Electronics", the student will:

- knows the basic laws of electrical engineering;
- can use modern software products for simulation and analysis of electronic circuits and devices;
- knows analog circuits, such as: amplifiers, linear and non-linear circuits with operational amplifiers, generators, basic digital circuits, power supply devices, pulse power supplies, UPS, etc., which are used in computer and communication technology;
- can apply the learned knowledge in operation and research of electronic devices.

PREREQUISITES

The discipline is initial and fundamental for the rest of the circuit engineering disciplines of the specialty and there is no requirement of prior listening to other technical disciplines. The discipline provides initial knowledge of the disciplines: Microprocessor technology, Computer architecture, Peripheral devices, Mobile communication systems and software.

STATUTE AND STRUCTURE

BACHELOR PROGRAMMES	Status	Credits	Full time				Part time			
			L	S	P	Total	L	S	P	Total
SOFTWARE ENGINEERING	Mandatory	6	30	0	30	60	15	0	15	30

COURSE CONTENT

Topic 1. Electric circuits for direct current Electric current, voltage, resistance. Ohm's and Kirchhoff's laws. Electric power, electric energy. Elements of the electric circuit. Sources. Resistors, capacitors, coils.

Topic 2. Electrical circuits for alternating current Parameters of sinusoidal voltage and current. Analysis for active and reactive load. Three-phase electrical circuits.

Topic 3. Electronic elements Semiconductor diodes. Thyristors. Bipolar transistors. Field effect transistors. New types of transistors. Modules of semiconductor elements.

Topic 4. Analog circuits Basic information and classification of analog circuits. Qualitative indicators of analog circuits. Constant current modes of analog circuits.

Topic 5. Transistor stage with aperiodic load Amplifier RC stage with aperiodic load. Multistage amplifiers. DC amplifiers. Differential amplifiers.

Topic 6. Operational amplifiers General information. Features. Power supplies

Topic 7. Linear circuits with operational amplifiers. Inverting and non-inverting amplifiers. Summing amplifiers. Measuring amplifiers. Controllable amplifiers. Sound signal amplifiers.

Topic 8. Non-linear circuits with operational amplifiers Logarithmic and anti-logarithmic amplifiers. Analog switches. Analog memories. Analog multiplexers and demultiplexers. Analog voltage comparators.

Topic 9. Selective amplifiers Resonant amplifiers. Active filters.

Topic 10. Generators. LC, RC generators of harmonic oscillations. Generators of rectangular pulses. Linear alternating voltage generators.

Topic 11. Digital circuitry. Logical elements. Electric impulses. Logic levels. Logic elements and logic functions. Basic logic elements. Bipolar, MOS and CMOS logic elements.

Topic 12. Triggers General information. Types of triggers.

Topic 13. Counters Classification. Asynchronous and synchronous counters.

Topic 14. Registers Parallel registers. Shift registers.

Topic 15. Combinational logic circuits Decoders and encoders. Multiplexers and demultiplexers.

Topic 16. Light indication Types of indicators. Management of indicators.

Topic 17. Rectifiers Operation with active load. General information. Classification. Specific parameters. Single-phase rectifiers. Three-phase current detectors.

Topic 18. Operation of rectifiers against E.D. Operation of rectifiers with active-capacitive load (RS). Voltage multipliers. Operation of rectifiers against electromotive voltage.

Topic 19. Smoothing filters General information. Parameters. Kinds. RLC smoothing filters.

Topic 20. Voltage stabilizers General information. Parameters, characteristics. Parametric stabilizers. Compensating stabilizers with continuous action. Single-cycle pulse stabilizers. Two-stroke pulse stabilizers.

Topic 21. Practical schemes of power supply units Serially produced power supply units. Power supply units of communication equipment (posts, faxes, etc.). Computer power supply units. Uninterruptible power supply systems (UPS)

LABORATORY EXERCISES::

Topic 1. Measurement of the parameters of passive electronic elements: resistances, capacitors, inductances.

Topic 2. Study of the volt-ampere characteristic of a semiconductor diode connected in the forward direction.

Topic 3. Study of the volt-ampere characteristic of a semiconductor diode connected in the opposite direction.

Topic 4. Study of special semiconductor diodes: zener diodes, Schottky and tunnel diodes

Topic 5. Study of the static characteristics of a bipolar transistor.

Topic 6. Research the temperature dependence of electronic elements.

Topic 7. Research volt - ampere characteristics of thyristors.

Topic 8. Study of the volt-ampere characteristic of a field-effect transistor with a controlling P-N junction.

Topic 9. Research volt-ampere characteristic of MOSFET - field effect transistor.

Topic 10. Research volt - ampere characteristic of IGBT.

Topic 11. Study of semiconductor photodetectors.

Topic 12. Study of semiconductor photoemitters.

Topic 13. Measuring the parameters of semiconductor solar panels.

Topic 14. Study of the frequency and impulse properties of semiconductor diodes.

PLANNED LEARNING ACTIVITIES AND TEACHING METHODS

1. At the first lecture, students receive complete information about the content of the course program, the requirements for the preparation of the course and the synopsis.
2. The lectures are on questions from the synopsis, grouped by topics, which end with summary questions for self-preparation.
3. During the training are made visits to real operating companies.
4. During the laboratory exercises, some of the practical problems are discussed together with specialists from the practice.
5. Electronic materials support the learning process of students and expand the possibilities of the teacher in the implementation of ongoing control.

ABSTRACT

The preparation of the essay begins with each student receiving an individually assigned topic. The student makes an overview of the given topic and in agreement with the supervisor, chooses a system that he describes and on which he makes a detailed analysis of action, functional characteristics and parameters.

EVALUATION METHODS BY POINT SYSTEM

A. Students who have not completed 60% of the hours attended for seminars or laboratory exercises do not receive a certificate from the teacher.

C. The semester exam is written and includes three questions. The final assessment is formed by the obtained grade from the exam and the grade for each student's work during the semester.

To form the assessment, the student collects points, the maximum value of which is 100. The distribution of points by evaluated activities is as follows:

1. Auditor employment..... 34 points

1.1. Current control of lectures, control tests - 14 points

1.2. Current control of seminar, laboratory exercises - 20 points

(visits, control works, participation in exercises, independent works, etc.)

2. Outside classroom employment 12 points

2.1. Course assignments, term papers, projects, protocols, etc. - 12 points

3. Examination procedure..... 54 points

The overall grade is determined by the sum of the points during the semester and by the examination procedure:

36-50p. - Average (3); 51-65p. – Good (4); 66-80 p.– Very Good(5); Over 81 points – Excellent (6).

The student must have a minimum of 14 points from the control during the semester and a minimum of 22 points from the examination procedure in order to form a comprehensive assessment.

RECOMMENDED LITERATURE

1. D. Yudov, Electrical engineering and electronics, BSU, 2007
2. D. Mareva, Electrical engineering and electronics (manual for laboratory exercises), BSU, 2010.
3. Valkov St., Yamakov Iv., Doichinova R., Hristov M., Vasileva T. "Electronic and semiconductor elements and integrated circuits", Technics, 2002.
4. Dinkova M. "Semiconductor elements", UHT ed., Plovdiv, 2001.
5. Stoyanov, I "Building elements in electronics", Technology 2006;
6. Stoyanov, I., Nikolov, G. "Laboratory practice on building elements", Technique 2008;
7. SEMICONDUCTOR DEVICES AND TECHNOLOGY David W. Greve Department of Electrical and Computer Engineering Carnegie Mellon University With the exception of clearly identified illustrations, all material copyright D.W. Greve, 2019.
8. Electrical and electronic components of devices and systems (2021) V.V. Baranov et al., Minsk: BGUIR.