COURSE DESCRIPTION CARD - SYLLABUS

Course name

Electrical engineering and electronics

Course

Field of study

Aerospace Engineering

Year/Semester

1/1

Area of study (specialization)

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
30	30	
Tutorials	Projects/seminars	

Number of credit points

5

Lecturers

Responsible for the course/lecturer:

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Prerequisites

Basic information form mathematics and physics at level of High School. Skills in understanding and interpretation of information and effective self-education in field of science related with chosen academic discipline. Student should have consciousness of necessity of improving his competences, readiness to work individual and cooperate within groups.

Course objective

Introduction of physical quantities and basic laws and theorems in the field of electric engineering in direct current circuits, one-phase alternating current circuits. Introduction of analytical methods of calculations for electric circuits and rules of connection and carrying on measurements. Introduction of

the properties, characteristics, and principles of application of electronic components - an active and passive. Understanding the basic methods of analysis of the analog and digital electronics circuits.

Course-related learning outcomes

Knowledge

1. Has knowledge in physics, covering the basics of electricity, necessary to understand issues in the theory of electrical and electronic circuits

2. Has a basic knowledge of the methods of measuring electrical quantities, characteristics of measuring instruments and their classification by purpose, principles of operation and characteristics

3. Has basic knowledge of DC and AC motors

Skills

1. Has the ability to self-study with the use of modern teaching tools, such as websites and databases, electronic books on electrical engineering and electronics

2. Can obtain information in the field of electrical engineering and electronics from literature, the Internet, databases and other sources. Is able to integrate obtained information, interpret and draw conclusions from it.

3. Can create a scheme of the electrical system, select elements and perform basic calculations of the electrical and electronic system

Social competences

1. Is aware of the importance of maintaining the principles of professional ethics

2. Understands the need for a critical assessment of knowledge and continuous learning

3. Is aware of the importance and understands the non-technical aspects and effects of engineering activities, including its impact on the environment, and the associated responsibility for the decisions taken

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:

– assess the knowledge and skills listed on the written exam of theory of circuits.

Laboratories:

– the test and awarding a bonus to the essential knowledge of problems for the accomplishment stated in the given area of laboratory tasks,

– evaluation of the knowledge and the abilities associated with the performance of a task exercise,

– assessment of the report of the exercise performed.

Obtaining additional points for activity during exercises, in particular way for:

– proposing to discuss additional aspects of the subject,

– effective use of knowledge obtained during solving of given problem,

– comments related to improve teaching material,

– aesthetic care of the developed tasks within self-study.

Programme content

Electric signals and classification, basic definitions in field of circuits with lumped parameters and circuits with distributed parameters, elements of electric circuits, arrow convention for voltage and current, electric circuits laws, methods of analysis of direct current circuits and one-phases alternating current circuits, circuits theorems, real power, reactive power an complex power, energy in electric circuits, resonance effect, measurements of power and energy in electric circuits. Solving accounting tasks in field of analysis of direct current circuits, one-phase alternating current circuits.

Properties of basic semiconductor devices and electronics components: diodes, bipolar and field effect transistors, passive elements. Their operating circuits. Semiconductor optoelectronics devices – properties, applications. Feedback in analog circuits. Operational amplifiers – parameters, applications. Power amplifiers – parameters, applications. Electronics generators – conditions of self-exciting, types and applications of generators. Analog filters – properties, design principles. Fundamentals of digital technology: binary numbers coding system, basic mathematical operations, logical functors, digital combination and sequential systems. Digital circuits of the TTL family. Semiconductor memories – general classification, properties.

PART-66

MODULE 3. BASIC NEWS FROM THE FIELD OF ELECTRICITY

3.1 Theory of electron

Structure and displacement of electric charges within: atoms, molecules, ions and compounds; Molecular structure of conductors, semiconductors and insulators.[1]

3.2 Static electricity and conductivity

Static electricity and distribution of electrostatic charges; Electrostatic laws of attraction and repulsion; Cargo units, Culomb's law;Conduction of electricity in solids, liquids, gases and in a vacuum.[2]

3.3 Electrical terminology

The following terms, their units and factors affecting them: potential difference, strength electromotive, voltage, current, resistance, conductivity, charge, electron flow.[2]

3.4 Production of electricity

Production of electricity by the following methods: source of light, heat, friction, pressure, chemical action, magnetism and movement.[1]

3.5 DC sources

Construction and basic chemical activity: galvanic cells, cells battery, lead-acid cells, nickel-cadmium cells, other cells alkali; Cells connected in series and in parallel; Internal resistance and its effects on the battery; Construction, materials and operation of thermocouples; Photovoltaic Operation[2]

3.6 DC circuits

Ohm's law, Kirchhoff's first and second laws; Calculation using the above laws for determining resistance, voltage and current; The importance of internal power supply resistance.[2]

3.7 Resistance / resistor

a) Resistance and influencing factors; Specific resistance; Resistor color code, values and tolerances, preferred values, rated power in watts;Resistors connected in series and in parallel;Calculation of total resistance using series, parallel and their connections;Operation and use of potentiometers and rheostats;Wheatstone bridge operation.[2]

b) Conductivity at negative and positive temperature coefficient; Fixed resistor, stability, tolerance and limitations, construction methods; Adjustable resistor, thermistor, varistor; Construction of potentiometers and rheostats; Construction of the Wheatstone bridge.[2]

3.8 Power

Power, work and energy (kinetic and potential); Power dissipation through a resistor; Power formula; Calculations taking into account power, work and energy.[2]

3.9 Electrical capacity / capacitor

Capacitor operation and functions; Factors affecting the area of electrode capacity, distance between electrodes, number of electrodes, dielectric and dielectric constant, operating voltage, rated voltage; Capacitor types, construction and functions; Capacitor color codes; Calculation of capacitance and voltage in series and parallel circuits; Exponential charge and discharge of a capacitor, time constants; Capacitor testing.[2]

3.10 Magnetism

a) Theory of magnetism; Magnet properties; Operation of a magnet suspended in the Earth's magnetic field; Magnetization and demagnetization; Magnetic screen; Different types of magnetic materials Electromagnet design and operating principle; Determining the magnetic field around a conductive conductor according to the rule three fingers.[2]

b) Magnetomotor force, field strength, magnetic induction, permeability, loop hysteresis, magnetic residue, coercive field strength, magnetic saturation, eddy currents; Precautions when monitoring and storing magnets.[2]

3.11 Inductance / Induction Coil

Faraday's law; Excitation of voltage in a conductor moving in a magnetic field; Principles of induction; Impact of the following factors on the amount of induced voltage: field strength magnetic, flux change rate, number of conductor turns; Mutual induction; The effect of the rate of change of the primary current and mutual inductance at excited voltage; Factors affecting mutual induction: number of turns in the coil, coil size, coil permeability, mutual coil positions; Lenz's law and polarity determinants; emf, self induction; Magnetic saturation; Basic applications of the induction coil.[2]

3.12 Theory of DC generator / motor

Basic engine and generator theory; Construction and meaning, components of a DC generator; Operation and factors affecting output power and current direction in current generators solid; Operation and factors affecting output power, torque, speed and direction rotation of DC motors; Series motor, shunt motor and series shunt motors; Construction of starting generator.[2]

3.13 Theory of alternating current

Sinusoidal wave shape: phase, period, frequency, cycle; Instantaneous, average, square mean, peak, current peak-to-peak and calculating these values in relation to voltage, current and power; Triangular and square waves; One phase / three phase rules.[2]

3.14 Resistance, Capacitive © and Inductive (L) Circuits

Phase relationships between voltage and current in parallel, L, C and R circuits, serial and serial-parallel; Power dissipation in L, C and R circuits; Apparent resistance, phase angle, power factors and current calculation; Calculation of active power, apparent power and reactive power.[2]

3.15 Transformers

Operation and principles of transformer construction; Transformer losses and methods to overcome them; Transformer operation under load and no load; Power transfer, efficiency, polarity marking; Calculation of line and phase voltage and flows; Calculation of power in a three-phase system; Primary and secondary current, voltage, coil gear, power, efficiency; Autotransformer.[2]

3.16 Filters

Operation and applied of the following filters: low pass, high pass, bandpass, bandpass.[1]

3.17 AC Generators

Loop rotation in a magnetic field and the shape of the generated wave; Construction and operation of the rotating armature and AC generator; Single-phase, two-phase and three-phase alternators; Advantages and applications of three-phase star and delta connection; Permanent magnet generator.[2]

3.18 AC motor

Construction, principles of operation and properties of a synchronous and induction current motor variable, single and multiphase; Methods of controlling speed and direction of rotation; Methods for producing the rotating field capacitor, induction coil, pole shaded and split.[2]

MODULE 4. BASIC NEWS FROM THE FIELD OF ELECTRONICS

4.1 Semiconductors

4.1.1 LEDs

a) LED symbols;LED properties;Diodes connected in series and in parallel;Main properties and application of silicon controlled rectifiers (thyristors), light emitting diodes, photoconductive diodes, varistor, rectifying diodes;Functional testing of diodes.[2]

b) Materials, electron configuration, electrical properties;Type P and N materials: effects of impuritieson conduction; PN junction in a semiconductor, potential development in the PN junction under conditions non polarization, positive polarization and reverse polarization;Diode parameters: peak reverse voltage, maximum forward current, temperature, frequency, leakage current, power dissipation;Operation and functions of diodes in the following circuits: clipping systems, systemsleveling, full wave and half wave rectifier, rectifier bridge, doubler and voltage tripper;Detailed operation and properties of the following devices: controlled rectifiers silicon (thyristors), light emitting diode, Shottky diode, photoconductive diode, diode capacitive, varistor, rectifying diode, Zener diode. [-]

4.1.2 Transistors

a) Transistor symbols;Description of components and their directionality;Transistor properties.[1]

b) Construction and operation of PNP and NPN transistors;Base, collector and emitter configurations;Transistor testing;Basic assessment of other transistor types and their applications;Transistors application: amplifier classes (A, B, C);Basic circuits including: polarization, decoupling, feedback and stabilization;The principles of a multi-stage circuit: cascades, in push-pull system, oscillator, multivibrator, flip-flop.[-]

4.1.3 Integrated circuits

a) Description and operation of logic circuits and linear circuits / operational amplifiers.[1]

b) Description and operation of logic and linear circuits;Introduction to the operation and function of the operational amplifier used as: integrator,differential circuit, voltage follower, comparator;Operation and methods of connecting amplifier stages: resistive capacitive,induction (transformer), inductive resistance (IR), direct;Advantages and disadvantages of positive and negative feedback. [-]

4.2 Printed circuit boards

Description and use of printed circuit boards [2]

MODULE 5. SYSTEMS OF ELECTRONIC INSTRUMENTS OF DIGITAL TECHNIQUES

5.10 Fiber optics

Advantages and disadvantages of fiber optic data transmission over transmission electric wire; Fiber optic data bus; Terms related to fiber optics; Terminal equipment; Connectors, control terminals, remote terminals; The use of fiber optics in aircraft systems. [1]

5.11 Electronic screen monitors

Operating principles of commonly used types of screen monitors used in modern aircraft, together with a cathode ray tube, diode glowing and liquid crystal monitor. [1]

5.12 Electrostatically sensitive devices

Special handling of discharge sensitive components electrostatic; Risk and possible damage awareness, antistatic protection instruments components and staff. [2]

5.13 Software management control

Awareness of restrictions, airworthiness requirements and possible catastrophic the effects of unapproved changes to the software. [1]

MODULE 6. MATERIALS AND EQUIPMENT

6.11 Electrical cables and connectors

Cable types, construction and properties; High voltage and coaxial cables; notching; Types of connectors, plugs, plugs, sockets, insulators, rated current and voltages, coupling, identification codes. [2]

Teaching methods

Lectures: – lecture with multimedia presentation (including: drawings, photos, animations) supplemented with examples given on the board, – initiate discussion during the lecture, – theory presented in connection with current knowledge of students, – presenting a new topic preceded by a reminder of related content known to students from other subjects.

Laboratories: – demonstrations, – work in teams, – instructors detailed review of the reports and discussions about comments

Bibliography

Basic

1. Bolkowski S., Teoria obwodów elektrycznych, WNT, Warszawa 2008.

2. Frąckowiak J., Nawrowski R., Zielińska M., Podstawy elektrotechniki. Laboratorium, Wydawnictwo Politechniki Poznańskiej, Poznań 2011.

3. Szabatin J., Śliwa E., Zbiór zadań z teorii obwodów. Część 1, Wydawnictwo Politechniki Warszawskiej, Warszawa 2015.

4. Horowitz P., W. Hill, Sztuka elektroniki. Część 1 i 2, WKŁ, 2014.

5. Górecki P., Wzmacniacze operacyjne, Wydawnictwo BTC, Warszawa, 2004.

6. Kalisz J., Podstawy elektroniki cyfrowej, WKiŁ, Warszawa, 2002.

Additional

1. Krakowski M., Elektrotechnika teoretyczna, PWN, Warszawa 1995.

2. Chua L. O., Desoer C. A., Kuh E. S., Linear and nonlinear circuits, McGraw-Hill Inc., New York 1987.

3. Kaźmierkowski M.P., Matysik J.T., Wprowadzenie do elektroniki i energoelektroniki, Oficyna Wyd. PW, Warszawa, 2005.

4. Scherz P., Monk S., Practical Electronics for Inventors, Fourth Edition, Mc Graw Hill, 2016, ISBN-13: 978-1259587542.

Breakdown of average student's workload

	Hours	ECTS
Total workload	118	5,0
Classes requiring direct contact with the teacher	64	2,5
Student's own work (literature studies, preparation for laboratory classes, preparation for exam, preparation of laboratory reports) [1]	52	2,5

[1] delete or add other activities as appropriate