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

30

Laboratory classes

30

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

5

Lecturers

Responsible for the course/lecturer:

dr hab. inż. Michał Gwóźdź

email: Michal.Gwozdz@put.poznan.pl

tel. 616652646

Wydział Automatyki, Robotyki i Elektrotechniki

ul. Piotrowo 3A, 60-965 Poznań

Responsible for the course/lecturer:

dr inż. Jarosław Jajczyk

email: Jaroslaw.Jajczyk@put.poznan.pl

tel. 616652659

Wydział Automatyki, Robotyki i Elektrotechniki

ul. Piotrowo 3A, 60-965 Poznań

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.

Zmienia się sposób działania historii

Wkrótce historia tłumaczeń będzie dostępna tylko po zalogowaniu się. Zarządzanie nią będzie możliwe w obszarze Moja aktywność. W ramach tego uaktualnienia historia jest czyszczona. Dlatego zapisz tłumaczenia, do których chcesz mieć dostęp później.

OK

4824/5000

Limit znaków: 5000

PART - 66 (THEORY - 22.5 hours, PRACTICE - 22.5 hours)

MODULE 3. BASIC INFORMATION ON ELECTRICITY

3.1 The theory of the electron

The structure and movement of electric charges within: atoms, molecules, ions and

unions;

Molecular structure of conductors, semiconductors and insulators. [1]

3.2 Static electricity and conductivity

Static electricity and distribution of electrostatic charges;

The electrostatic laws of attraction and repulsion;

Charge units, Coulomb'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 Generation of electricity

Electricity production by the following methods: light, heat, friction,

pressure, chemical action, magnetism and motion. [1]

3.5 DC sources

Construction and basic chemical operation of: primary cells, battery cells, lead-acid cells, nickel-cadmium cells, other alkaline cells;

Cells connected in series and in parallel;

Internal resistance and its effects on batteries;

Construction, materials and operation of thermocouples;

Operation of solar cells. [2]

3.6 DC circuits

Ohm's Law, Kirchhoff's First and Second Law;

Calculation using the above laws to find resistance, voltage and current;

The importance of the internal resistance of the power supply. [2]

3.7 Resistance / resistor

a) Resistance and influencing factors;

Specific resistance;

Resistor color code, values and tolerances, preferred values, power rating in watts;

Resistors connected in series and in parallel;

Calculating total resistance using series, parallel and combination of both;

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 the resistor;

Power Formula;

Calculations taking into account power, work and energy. [2]

3.9 Electric capacity / capacitor

Operation and functions of the capacitor;

Factors affecting the area of electrode capacity, the distance between the electrodes,

number of electrodes, dielectric and dielectric constant, operating voltage, rated voltage;

Types of capacitor, structure 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;

Properties of the magnet;

Operation of a magnet suspended in the Earth's magnetic field;

Magnetization and demagnetization;

Magnetic screen;

Various types of magnetic materials

Construction of the electromagnet and principles of operation;

Establishing a magnetic field around a conductive conductor according to the three-finger rule. [2]

b) Magnetomotor force, field strength, magnetic induction, permeability, loop

hysteresis, magnetic residual, coercive field strength, magnetic saturation,

eddy currents;

Precautions for the supervision and storage of magnets. [2]

3.11 Inductance / inductor

Faraday's Law;

Excitation of voltage in a conductor moving in a magnetic field;

Principles of induction;

Influence of the following factors on the amount of induced voltage: magnetic field strength, rate of flux changes, number of conductor turns;

Mutual induction;

The effect of the rate of change of the primary current and the mutual inductance on the induced voltage;

Factors influencing mutual induction: number of turns in the coil, coil size, coil permeability, mutual positions of the coils;

Lenz's law and polarity determinants;

Self-induction;

Magnetic saturation;

Basic applications of an inductor. [2]

3.12 DC generator / motor theory

Basic theory of the engine and generator;

Construction and meaning, components of a DC generator;

Operation of and factors influencing output power and direction of current in DC generators;

Operation and factors affecting the output power, torque, speed and direction of rotation of DC motors;

Series motor, shunt motor and series shunt motors;

Construction of a starting generator. [2]

3.13 The theory of alternating current

Sinusoidal waveform: phase, period, frequency, cycle;

Instantaneous, mean, rms, peak, current peak-to-peak, and

calculating these values for voltage, current and power;

Triangular and square waves;

One / three phase principles. [2]

3.14 Resistive ®, Capacitive © and Inductive (L) Circuits

Phase relationships between voltage and current in L, C and R circuits, parallel,

serial and series-parallel;

Power dissipation in the 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 construction of transformers;

Transformer losses and methods of overcoming them;

Operation of the transformer with load and no load;

Power transmission, efficiency, polarity marking;

Calculation of line and phase voltage and flows;

Power calculation in a three-phase system;

Primary and secondary current, voltage, turn ratio, power, efficiency;

Autotransformer. [2]

3.16 Filters

Operation and application of the following filters: low-pass, high-pass,

band-pass, band-stop. [1]

3.17 Alternating current generators

Rotation of the loop in a magnetic field and the shape of the generated wave;

Construction and operation of a rotating armature and alternating current generator;

Single-phase, two-phase and three-phase alternators;

Advantages and applications of three-phase star and triangle connection;

Permanent magnet generator. [2]

MODULE 4. BASIC INFORMATION ON ELECTRONICS

4.1 Semiconductors

4.1.1 Diodes

a) LED symbols;

Properties of diodes;

Diodes connected in series and in parallel;

Main properties and application of silicone-controlled rectifiers (thyristors),

light emitting diodes, photoconductive diodes, varistor, rectifier diodes;

Diode functional testing. [2]

b) Materials, electron configuration, electrical properties;

P and N type materials: effects of impurities on conduction;

PN junction in a semiconductor, development of a potential at a PN junction under non-polarization, positive bias and reverse bias conditions;

Diode parameters: peak reverse voltage, maximum forward current, temperature, frequency, leakage current, power dissipation;

Operation and functions of diodes in the following circuits: clipping circuits, clamping circuits, full and half wave rectifier, bridge rectifier, voltage doubler and triple;

Detailed operation and characteristics of the following devices: silicon controlled rectifiers (thyristors), light emitting diode, Shottky diode, photo conductive diode, capacitive diode, varistor, rectifier diode, Zener diode. [-]

4.1.2 Transistors

a) Transistor symbols;

Description of the components and their directionality;

Properties of the transistor. [1]

b) Construction and operation of PNP and NPN transistors;

Base, collector and emitter configurations;

Testing of transistors;

Basic evaluation of other transistor types and their uses;

Application of transistors: amplifier classes (A, B, C);

Basic circuits including: polarization, decoupling, feedback and stabilization;

Principles of a multi-stage circuit: cascade, push-pull, 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 functions of an operational amplifier used as: integrator, derivative circuit, voltage follower, comparator;

Operation and amplifier stages connection methods: resistive capacitive, inductive (transformer), inductive resistive (IR), direct;

Advantages and disadvantages of positive and negative feedback. [-]

MODULE 5. ELECTRONIC INSTRUMENT SYSTEMS, DIGITAL TECHNIQUES

5.10. Fiber optic technique

Advantages and disadvantages of fiber optic data transmission over electric wire transmission;

Fiber optic data bus;

Fiber optic related terms;

Terminal equipment;

Connectors, control terminals, remote terminals;

The use of fiber optics in aircraft systems. [1]

5.11 Electronic display monitors

Principles of operation of common types of display monitors used in modern aircraft, including a picture tube, light-emitting diode, and liquid crystal display. [1]

5.12 Electrostatically sensitive devices

Special handling of components sensitive to electrostatic discharge;

Awareness of risks and possible damage, devices for antistatic protection of components and personnel. [2]

MODULE 6. MATERIALS AND EQUIPMENT

6.11 Electrical cables and connectors

Cable types, structure and properties;

High voltage and coaxial cables;

Notching;

Types of fittings, plugs, plugs, sockets, insulators, current rating 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	127	4,0
Classes requiring direct contact with the teacher	75	3,0
Student's own work (literature studies, preparation for laboratory classes, preparation for exam, preparation of laboratory reports) [1]	52	2,0

[1] delete or add other activities as appropriate