

Study plan

Name of study plan: Aerospace Engineering

Faculty/Institute/Others: Faculty of Electrical Engineering

Department: Department of Measurement

Branch of study guaranteed by the department: Avionics

Garantor of the study branch:

Program of study: Aerospace Engineering

Type of study: Follow-up master full-time

Required credits: 100

Elective courses credits: 20

Sum of credits in the plan: 120

Note on the plan:

Name of the block: Compulsory courses in the program

Minimal number of credits of the block: 60

The role of the block: P

Code of the group: 2016_MLAKBME

Name of the group: Safety of the master's studies

Requirement credits in the group:

Requirement courses in the group: In this group you have to complete 1 course

Credits in the group: 0

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
BEZM	Safety in Electrical Engineering for a master's degree Vladimír K la, Radek Havlí ek, Ivana Nová, Josef ernohous, Petr Novák, Zden k Burian, Adam Bou a, Pavel Mlejnek Radek Havlí ek Vladimír K la (Gar.)	Z	0	2BP+2BC	Z	P

Characteristics of the courses of this group of Study Plan: Code=2016_MLAKBME Name=Safety of the master's studies

BEZM	Safety in Electrical Engineering for a master's degree	Z	0			
The course provides for students of all programs periodic training guidelines for health and occupational safety and gives knowledge of electrical hazard of given branch of study. Students receive indispensable qualification according to the current Directive of the Dean.						

Code of the group: 2016_MLAKDIP

Name of the group: Diploma Thesis

Requirement credits in the group: In this group you have to gain 30 credits

Requirement courses in the group: In this group you have to complete 1 course

Credits in the group: 30

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
BDIP30	Diploma Thesis	Z	30	22s	L	P

Characteristics of the courses of this group of Study Plan: Code=2016_MLAKDIP Name=Diploma Thesis

BDIP30	Diploma Thesis	Z	30			
Independent final comprehensive work for the Master's degree study programme. A student will choose a topic from a range of topics related to his or her branch of study, which will be specified by branch department or branch departments. The diploma thesis will be defended in front of the board of examiners for the comprehensive final examination.						

Code of the group: 2016_MLAKP

Name of the group: Compulsory subjects of the programme

Requirement credits in the group: In this group you have to gain 30 credits

Requirement courses in the group: In this group you have to complete 6 courses

Credits in the group: 30

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
B9M38LKS	Aircraft Structures and Materials Robert Theiner Jan Rohá Robert Theiner (Gar.)	Z,ZK	5	3P+1C	Z	P
B3M37LRS	Aeronautical radio systems Pavel Ková Pavel Ková (Gar.)	Z,ZK	6	2P+2L	Z	P
B9M38POL	Aircraft Propulsion Jan Klesa Jan Klesa	Z,ZK	5	3P+1C	Z	P
B9M38PRM	Project Management and Marketing Vladimír Žá ek, Petr Žemli ka Vladimír Žá ek Vladimír Žá ek (Gar.)	Z,ZK	2	2P+1C	Z	P
B9M38PSL	Aircraft Avionics Jan Rohá Jan Rohá (Gar.)	Z,ZK	6	2P+2L	Z	P
B9M38TYP	Team Project Jan Rohá , Martin Šipoš Jan Rohá Jan Rohá (Gar.)	KZ	6	0P+6C	L	P

Characteristics of the courses of this group of Study Plan: Code=2016_MLAKP Name=Compulsory subjects of the programme

B9M38LKS	Aircraft Structures and Materials	Z,ZK	5	The course is an introduction lecture for structure branch aerospace technology/avionics and air traffic. The course acquaints with fundamental types of aircraft structures, forces acting on the aircraft structures and aircraft materials. It further acquaints with functions of aircraft control surfaces. Philosophy of the safety, reliability, strength certification, and airworthiness as well as the aviation regulations is given.		
B3M37LRS	Aeronautical radio systems	Z,ZK	6	The course introduces students to the aeronautical radio engineering, aeronautical analogue, digital and satellite communication systems, aeronautical radio navigation including satellites navigation, primary secondary and passive radiolocation. The course gets students theoretical and practical knowledge of the operation of the aeronautical radio systems and their integration to the aircraft systems.		
B9M38POL	Aircraft Propulsion	Z,ZK	5	This course gives basic knowledge of the aircraft propulsion theory, thermal cycles of aircraft powerplants and basics of aero- and thermodynamics of aircraft powerplants components. The influence of design parameters on propulsion system efficiency, specific fuel consumption and thrust is analyzed for the given flight velocity. Design layouts of the aerospace propulsion units are introduced and function of their components is described. The focus is given on the comparison of various systems and the choose of the appropriate one. Enviromental aspects are mentioned together with the common and alternative fuels and energy sources.		
B9M38PRM	Project Management and Marketing	Z,ZK	2	Currently it is in enterprises carried out much of the work in the form of one-off projects. These projects are often a crucial part of the strategic management of the business. The aim of the project might be, for example, the rapid introduction of new products into production and its subsequent application in the market and helps to project management, and marketing.		
B9M38PSL	Aircraft Avionics	Z,ZK	6	The subject is focused into a field of aircraft avionics including principles, sensors, measurement and evaluation systems and signal/data processing methods. The subject goes into details of studied systems, i.e. engine and aircraft monitoring systems, power systems, pressure-based systems, low-frequency navigation means, and flight recorders. The subject introduces currently used technology and methodology on aircraft and thus serves to understand fundamentals of avionics. Inertial navigation systems are discussed in more details as well as their aiding systems and sensors. The course focuses on both small and large aircraft as well as on UAV suited avionics.		
B9M38TYP	Team Project	KZ	6			

Name of the block: Compulsory courses of the specialization

Minimal number of credits of the block: 32

The role of the block: PO

Code of the group: 2016_MLAKPO

Name of the group: Compulsory subjects of the branch

Requirement credits in the group: In this group you have to gain 32 credits

Requirement courses in the group: In this group you have to complete 7 courses

Credits in the group: 32

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) Tutors, authors and guarantors (gar.)	Completion	Credits	Scope	Semester	Role
BE9M04AKP	Academic Writing Markéta Havlíková, Michael Ynsua, Dana Saláková Dana Saláková Dana Saláková (Gar.)	KZ	2	2C	L	PO
B9M38AML	Aerodynamics and Mechanics of Flight Jiří Noží ka, Jakub Suchý Jan Rohá Jiří Noží ka (Gar.)	Z,ZK	6	2P+4L	Z	PO
B9M36BEP	Unmanned Vehicles Milan Rollo Jan Rohá Milan Rollo (Gar.)	Z,ZK	4	2P+2L	L	PO
B9M38INA	Integrated Avionics Martin Šipoš Martin Šipoš	Z,ZK	6	2P+2L	L	PO
B3M37KIN	Space Engineering Pavel Ková , Kristian Hengster-Movric, René Hudec, Stanislav Vítek, Martin Hromík, Martin Urban Stanislav Vítek René Hudec (Gar.)	Z,ZK	6	2P+2L	Z	PO

BE9M04PRE	Presentation Skills <i>Michael Ynsua, Dana Saláková, Erik Peter Stadnik Dana Saláková Dana Saláková (Gar.)</i>	KZ	2	2C	Z	PO
B9M35SRL	Flight Control Systems <i>Martin Hrom ik Martin Hrom ik Martin Hrom ik (Gar.)</i>	Z,ZK	6	2P+2L	Z	PO

Characteristics of the courses of this group of Study Plan: Code=2016_MLAKPO Name=Compulsory subjects of the branch

BE9M04AKP	Academic Writing	KZ	2			
ACADEMIC WRITING COURSE (BE9M04AKP) Objective(s): The overall aim of this course is not to increase the student's level of English, but to improve the student's skills and abilities of writing academically (in English). This course is not simply an opportunity for students who have registered to have someone (the instructor) simply proofread and correct their texts - the ultimate goal of the course will be that the student is able to write (better) in English at an academic level. If a student's level of English is not up to the expected level of this course (B2 Upper-Intermediate), it is the student's responsibility to take action to improve it (outside of this course). It is hoped that by working and writing in English on a regular basis throughout this course that participants will, naturally, improve their level of English in one way or another.						
B9M38AML	Aerodynamics and Mechanics of Flight	Z,ZK	6			
The course provides overview of key findings from aircraft aerodynamics and flight mechanics. In the first part, students are familiar with models and equations for the flow of an incompressible fluid. In the second part there are derived equations describing force and rotating effects of flow on the surface of the airfoils and wings. The important relations for effects of compressibility are derived in the next part. These findings are applied on flow around the airfoils and wings at high subsonic and supersonic speeds in last part. In the subject there are discussed basic modes of flight mechanics and basic design methods of air propellers.						
B9M36BEP	Unmanned Vehicles	Z,ZK	4			
Course is focused on area of unmanned systems. The focus will be primarily on unmanned aerial systems, but topics will cover unmanned surface and ground vehicles as well. Course will in details cover structural design, propulsion, sensors for navigation, stabilization and control and telemetric systems. Topics will cover modern methods for navigation, flight control, including trajectory following and target tracking. Besides this students will gain knowledge about trajectory planning and areas of application from the perspective of user payload. Legal issues related to unmanned systems operation will be discussed as well.						
B9M38INA	Integrated Avionics	Z,ZK	6			
Integrated Modular Avionics (IMA) course focuses on the latest concept used to the development and design of aircraft electronics (avionics), which is building on software units instead of a distributed hardware systems. The IMA concept uses high-speed data links to exchange data in scheduled air transport services. The current regulatory basis and shared airspace define the requirements for accuracy, reliability and functionality of electronic systems and their behavior in case of a failure. Students will learn the details regarding the requirements of the safety-critical multi-sensor systems, methods of data processing of overdetermined systems, fault detection algorithms, the method of primary/secondary system switching of a control system in parallel architectures, data bus technologies and methods of avionics testing/certification.						
B3M37KIN	Space Engineering	Z,ZK	6			
The subject acquaints students with the basics of physics of the space environment and the technologies used in space systems, satellites, spacecrafts and launchers and methods used for the design and preparation of space missions. Subject matter includes a detailed description of the instrumentation of satellites and spacecrafts and its resistance to external influences of the space environment, and analysis of instruments and systems for spacecrafts and methods of their testing. It provides a basic overview of the trajectories of spacecrafts and their applications. The course also covers optoelectronics in space systems, sensors used, their modeling and description. It discusses the principles of underlying calculations, simulations and their processing.						
BE9M04PRE	Presentation Skills	KZ	2			
The overall aim of this course is to develop communication and language skills in order to plan and deliver an effective presentation. Students will be taken systematically through the key stages of giving presentations, from planning and introducing to concluding. Students are guided, using interactive methods, to communicate their thoughts and ideas in a logical and structured order - and in as brief or succinct a way as possible. Emphasis is placed on independent, critical thinking and the correct formulation of presenting ideas; throughout this course students will practice skills that will enable them to become better speakers and presenters.						
B9M35SRL	Flight Control Systems	Z,ZK	6			
The course is devoted to classical and modern control design techniques for autopilots and flight control systems. Particular levels are discussed, starting with the dampers attitude angle stabilizers, to guidance and navigation systems. Next to the design itself, important aspects of aircraft modelling, both as a rigid body and considering flexibility of the structure, are discussed.						

Name of the block: Compulsory elective courses

Minimal number of credits of the block: 8

The role of the block: PV

Code of the group: 2016_MLAKPV

Name of the group: Compulsory subjects of the programme

Requirement credits in the group: In this group you have to gain at least 8 credits (at most 19)

Requirement courses in the group: In this group you have to complete 2 courses

Credits in the group: 8

Note on the group:

Code	Name of the course / Name of the group of courses (in case of groups of courses the list of codes of their members) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
B3M33ARO	Autonomous Robotics <i>Vojt ch Vonásek, Karel Zimmermann, Václav Hlavá Karel Zimmermann Karel Zimmermann (Gar.)</i>	Z,ZK	7	3P+2L	L	PV
B9M38EML	Experimental Methods in Aeronautics <i>Jan Rohá</i>	KZ	4	3P+1L	Z	PV
B9M35OFD	Estimation, Filtering and Detection <i>Vladimír Havlena Martin Hrom ik Vladimír Havlena (Gar.)</i>	Z,ZK	4	2P+2C	Z	PV
B9M38VBM	Videometry and Contactless Measurement <i>Jan Fischer Jan Fischer (Gar.)</i>	Z,ZK	4	2P+2L	L	PV

Characteristics of the courses of this group of Study Plan: Code=2016_MLAKPV Name=Compulsory subjects of the programme

B3M33ARO	Autonomous Robotics	Z,ZK	7
The subject teaches principles allowing to build/explore robots perceiving surrounding world and understanding activities in it including the abilities to modify it. Various architectures of robots with cognitive abilities and their realizations will be explained. Students will experiment with cognitive robots in practical assignments. Studied material is applicable more widely while building intelligent machines.			
B9M38EML	Experimental Methods in Aeronautics	KZ	4
Introduction to the basic methods of measuring non-electrical quantities, procedures for conducting engineering experiments, evaluation and processing of data. Introduction to basic methods of aircraft specifics testing. Processing of individual labs and practical demonstrations of experimental techniques and procedures.			
B9M35OFD	Estimation, Filtering and Detection	Z,ZK	4
This course will cover description of the uncertainty of hidden variables (parameters and state of a dynamic system) using the probability language and methods for their estimation. Based on bayesian problem formulation principles of rational behavior under uncertainty will be analyzed and used to develop algorithms for parameter estimations (ARX models, Gaussian process regression), filtering (Kalman filter) and detection (likelihood ratio theory) . We will demonstrate numerically robust implementation of the algorithms applicable in real life problems for the areas of industrial process control, robotics and avionics.			
B9M38VBM	Videometry and Contactless Measurement	Z,ZK	4
This course focuses on CCD and CMOS video sensors, and optoelectronic sensors in general and their use in contactless videometric measurement systems. Further optical radiation, its features, behavior and its use for acquiring object parameters, optical projection system, design of measurement cameras and processing of their signal will be presented. Students will design, realize and debug an independent project - 'Optoelectronic reflective sensor', during labs.			

Name of the block: Elective courses

Minimal number of credits of the block: 0

The role of the block: V

Code of the group: 2016_MLAKVOL

Name of the group: Elective subjects

Requirement credits in the group:

Requirement courses in the group:

Credits in the group: 0

Note on the group:

~Nabídku volitelných předmětů uspořádaných podle kateder najdete na webových stránkách
<http://www.fel.cvut.cz/cz/education/volitelne-predmety.html>

List of courses of this pass:

Code	Name of the course	Completion	Credits
B3M33ARO	Autonomous Robotics	Z,ZK	7
The subject teaches principles allowing to build/explore robots perceiving surrounding world and understanding activities in it including the abilities to modify it. Various architectures of robots with cognitive abilities and their realizations will be explained. Students will experiment with cognitive robots in practical assignments. Studied material is applicable more widely while building intelligent machines.			
B3M37KIN	Space Engineering	Z,ZK	6
The subject acquaints students with the basics of physics of the space environment and the technologies used in space systems, satellites, spacecrafts and launchers and methods used for the design and preparation of space missions. Subject matter includes a detailed description of the instrumentation of satellites and spacecrafts and its resistance to external influences of the space environment, and analysis of instruments and systems for spacecrafts and methods of their testing. It provides a basic overview of the trajectories of spacecrafts and their applications. The course also covers optoelectronics in space systems, sensors used, their modeling and description. It discusses the principles of underlying calculations, simulations and their processing.			
B3M37LRS	Aeronautical radio systems	Z,ZK	6
The course introduces students to the aeronautical radio engineering, aeronautical analogue, digital and satellite communication systems, aeronautical radio navigation including satellites navigation, primary secondary and passive radiolocation. The course gets students theoretical and practical knowledge of the operation of the aeronautical radio systems and their integration to the aircraft systems.			
B9M35OFD	Estimation, Filtering and Detection	Z,ZK	4
This course will cover description of the uncertainty of hidden variables (parameters and state of a dynamic system) using the probability language and methods for their estimation. Based on bayesian problem formulation principles of rational behavior under uncertainty will be analyzed and used to develop algorithms for parameter estimations (ARX models, Gaussian process regression), filtering (Kalman filter) and detection (likelihood ratio theory) . We will demonstrate numerically robust implementation of the algorithms applicable in real life problems for the areas of industrial process control, robotics and avionics.			
B9M35SRL	Flight Control Systems	Z,ZK	6
The course is devoted to classical and modern control design techniques for autopilots and flight control systems. Particular levels are discussed, starting with the dampers attitude angle stabilizers, to guidance and navigation systems. Next to the design itself, important aspects of aircraft modelling, both as a rigid body and considering flexibility of the structure, are discussed.			
B9M36BEP	Unmanned Vehicles	Z,ZK	4
Course is focused on area of unmanned systems. The focus will be primarily on unmanned aerial systems, but topics will cover unmanned surface and ground vehicles as well. Course will in details cover structural design, propulsion, sensors for navigation, stabilization and control and telemetric systems. Topics will cover modern methods for navigation, flight control, including trajectory following and target tracking. Besides this students will gain knowledge about trajectory planning and areas of application from the perspective of user payload. Legal issues related to unmanned systems operation will be discussed as well.			

B9M38AML	Aerodynamics and Mechanics of Flight	Z,ZK	6
The course provides overview of key findings from aircraft aerodynamics and flight mechanics. In the first part, students are familiar with models and equations for the flow of an incompressible fluid. In the second part there are derived equations describing force and rotating effects of flow on the surface of the airfoils and wings. The important relations for effects of compressibility are derived in the next part. These findings are applied on flow around the airfoils and wings at high subsonic and supersonic speeds in last part. In the subject there are discussed basic modes of flight mechanics and basic design methods of air propellers.			
B9M38EML	Experimental Methods in Aeronautics	KZ	4
Introduction to the basic methods of measuring non-electrical quantities, procedures for conducting engineering experiments, evaluation and processing of data. Introduction to basic methods of aircraft specifics testing. Processing of individual labs and practical demonstrations of experimental techniques and procedures.			
B9M38INA	Integrated Avionics	Z,ZK	6
Integrated Modular Avionics (IMA) course focuses on the latest concept used to the development and design of aircraft electronics (avionics), which is building on software units instead of a distributed hardware systems. The IMA concept uses high-speed data links to exchange data in scheduled air transport services. The current regulatory basis and shared airspace define the requirements for accuracy, reliability and functionality of electronic systems and their behavior in case of a failure. Students will learn the details regarding the requirements of the safety-critical multi-sensor systems, methods of data processing of overdetermined systems, fault detection algorithms, the method of primary/secondary system switching of a control system in parallel architectures, data bus technologies and methods of avionics testing/certification.			
B9M38LKS	Aircraft Structures and Materials	Z,ZK	5
The course is an introduction lecture for structure branch aerospace technology/avionics and air traffics. The course acquaints with fundamental types of aircraft structures, forces acting on the aircraft structures and aircraft materials. It further acquaints with functions of aircraft control surfaces. Philosophy of the safety, reliability, strength certification, and airworthiness as well as the aviation regulations is given.			
B9M38POL	Aircraft Propulsion	Z,ZK	5
This course gives basic knowledge of the aircraft propulsion theory, thermal cycles of aircraft powerplants and basics of aero- and thermodynamics of aircraft powerplants components. The influence of design parameters on propulsion system efficiency, specific fuel consumption and thrust is analyzed for the given flight velocity. Design layouts of the aerospace propulsion units are introduced and function of their components is described. The focus is given on the comparison of various systems and the choose of the appropriate one. Environmental aspects are mentioned together with the common and alternative fuels and energy sources.			
B9M38PRM	Project Management and Marketing	Z,ZK	2
Currently it is in enterprises carried out much of the work in the form of one-off projects. These projects are often a crucial part of the strategic management of the business. The aim of the project might be, for example, the rapid introduction of new products into production and its subsequent application in the market and helps to project management, and marketing.			
B9M38PSL	Aircraft Avionics	Z,ZK	6
The subject is focused into a field of aircraft avionics including principles, sensors, measurement and evaluation systems and signal/data processing methods. The subject goes into details of studied systems, i.e. engine and aircraft monitoring systems, power systems, pressure-based systems, low-frequency navigation means, and flight recorders. The subject introduces currently used technology and methodology on aircraft and thus serves to understand fundamentals of avionics. Inertial navigation systems are discussed in more details as well as their aiding systems and sensors. The course focuses on both small and large aircraft as well as on UAV suited avionics.			
B9M38TYP	Team Project	KZ	6
B9M38VBM	Videometry and Contactless Measurement	Z,ZK	4
This course focuses on CCD and CMOS video sensors, and optoelectronic sensors in general and their use in contactless videometric measurement systems. Further optical radiation, its features, behavior and its use for acquiring object parameters, optical projection system, design of measurement cameras and processing of their signal will be presented. Students will design, realize and debug an independent project - 'Optoelectronic reflective sensor', during labs.			
BDIP30	Diploma Thesis	Z	30
Independent final comprehensive work for the Master's degree study programme. A student will choose a topic from a range of topics related to his or her branch of study, which will be specified by branch department or branch departments. The diploma thesis will be defended in front of the board of examiners for the comprehensive final examination.			
BE9M04AKP	Academic Writing	KZ	2
ACADEMIC WRITING COURSE (BE9M04AKP) Objective(s): The overall aim of this course is not to increase the student's level of English, but to improve the student's skills and abilities of writing academically (in English). This course is not simply an opportunity for students who have registered to have someone (the instructor) simply proofread and correct their texts - the ultimate goal of the course will be that the student is able to write (better) in English at an academic level. If a student's level of English is not up to the expected level of this course (B2 Upper-Intermediate), it is the student's responsibility to take action to improve it (outside of this course). It is hoped that by working and writing in English on a regular basis throughout this course that participants will, naturally, improve their level of English in one way or another.			
BE9M04PRE	Presentation Skills	KZ	2
The overall aim of this course is to develop communication and language skills in order to plan and deliver an effective presentation. Students will be taken systematically through the key stages of giving presentations, from planning and introducing to concluding. Students are guided, using interactive methods, to communicate their thoughts and ideas in a logical and structured order - and in as brief or succinct a way as possible. Emphasis is placed on independent, critical thinking and the correct formulation of presenting ideas; throughout this course students will practice skills that will enable them to become better speakers and presenters.			
BEZM	Safety in Electrical Engineering for a master's degree	Z	0
The course provides for students of all programs periodic training guidelines for health and occupational safety and gives knowledge of electrical hazard of given branch of study. Students receive indispensable qualification according to the current Directive of the Dean.			

For updated information see <http://bilakniha.cvut.cz/en/f3.html>

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