PROGRAM ROZWOJOWY
POLITECHNIKI WARSZAWSKIEJ

Warsaw University of Technology

Faculty of Power and Aeronautical Engineering

CATALOGUE OF COURSES

Undergraduate studies (B.Sc. degree)
TOK 2006

Warsaw 2011

KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

UNIA EUROPEJSKA
EUROPEJSKI
FUNDUSZ SPOŁECZNY

FIELDS OF STUDIES AND SPECIALIZATIONS

The undergraduate studies last 7 semesters and conclude with the Bachelor of Science degree. They are offered in two specializations. Please see the table below:

Field of Studies	*Specialization*
Aerospace Engineering	Aerospace Engineering
Power Engineering	Power Engineering

The program of B.Sc. studies is the same for all specializations during the first two semesters. The studies within a particular specialization can be launched when a sufficient number of students have been admitted by the Dean of the Faculty.

Heads of specializations:

- Aerospace Engineering – prof. Cezary Galiński
- Power Engineering – prof. Tadeusz Skoczkowski

Regulations of Studies

Students must comply with the „Regulations of Studies of Warsaw University of Technology" accepted by the University Senate. Please see the following sections for more details.

Dean of the Faculty decides in matters not specified by the Regulations.

Course of studies

From the second semester students must design an individual study plan for next semesters, which includes the obligatory courses, especially the specialization courses that must be repeated, and possibly the courses included in the program for higher semesters of studies.

When designing the individual study plan for the next semester, students must decide on:

- Electives - if included in the programme. There is no separate list of electives. An elective can be any course which is not included in the programme of other fields of studies given in English. Dean of the Faculty approves optional electives, e.g. lectured by the Visiting Professors.
- Division and subject of intermediate projects.
- Division and scope of diploma seminar. The seminar provides knowledge and skills required in diploma project preparation.

- Division and subject of diploma project. The division is the same as in case of diploma seminar.

Students can also select from a range of foreign language or physical education courses.

Individual study plan for the next semester must be prepared according to the prerequisites given in the catalogue, i.e. courses which must be completed before the beginning of the current course.

After each semester, the student performance is assessed and the registration procedure for the next semester is performed. At the end of the study program all the requirements for graduation must fulfilled.

Registration procedures for each semester

ECTS Credit System

During each course a certain number of ECTS points are earned in accordance with the course significance, difficulty and the student workload required. The total number of credit points that can be earned for all courses in each semester is 30.

Evaluation System

1. At the end of each semester, students obtain one final grade for each course (regardless of the course division into lectures, tutorials and laboratory work).
2. The grading scale starts with a failing grade 2 and consists of five passing grades: 3, $3^{1/2}$, 4, $4^{1/2}$, 5.
3. In exceptional cases, students may obtain "condition" *N* final grade, which means that the student performance during the semester is evaluated positively, but the student is not allowed to take the final exam (due to valid reasons). The lecturer defines the procedures in case of "condition" *N*. This grade obliges the student to complete the course by the end of the following semester the latest, so that he does not need to repeat it and pay extra fee. If the student fails to complete the course during the following semester, the course must be repeated. Consequently, the student is obliged to cover the costs of the course repetition according to University Regulations. There are no credit points for "condition" *N*.

Requirements for registration for each semester

1. In order to register for the next semester, students are required to have a sufficient number of credit points as given in the table below.

B.Sc. Programme						
Registration for semester	II	III	IV	V	VI	VII
Number of collected credits	17	38	68	98	130	170

2. Students who fail to collect the required number of points are removed from the study programme, with the exception of the last two semesters of studies, for which the student can re-register.
3. Students must repeat the failed course during the next available semester. Courses can be repeated twice. Students who fail to complete the course three times will be removed from the Faculty. Students are obliged to cover the costs of course repetition according to University Regulations.
4. Dean can approve student sick leave or leave of absence. First year students may obtain sick leave only.
5. In some cases, the Dean can grant a student who is on the leave, the right to take certain courses "in advance".
6. Duration of undergraduate studies must not be longer than nine semesters. In case the student is granted the leave, duration of studies is prolonged accordingly.

Requirements for graduation

Requirements for graduating with the B.Sc. degree are as follows:

- Completion of all courses in the study program,
- 4-week internship (in industry)
- Collecting 210 ECTS points including the preparation of B.Sc. thesis
- Writing B.Sc. thesis and passing the final exam.

The final grade for the completed study program is an average of grades received for each course. Failing grades are not included in the average.

$$Average\ grade = \frac{\sum_{i \in Z} g_i \cdot O_i}{\sum_{i \in Z} g_i}$$

Z – number of completed courses,

g_i – number of ECTS points allocated to the course,

O_i – grade for the course.

Final examinations are held four times a year – in January, March, June and October.

Brief study schedule

Brief study schedule includes information on the course title and the number of hours per semester and week. Information about a course division into lectures, tutorials, laboratory work and projects as well as the number of credit points can be found in a table for each semester.
Complete information about courses can be found in the last part of the catalogue on courses contents.

LEGEND for the list of courses (following pages)

In the following section the list of courses is given, divided into suggested sequence during standard semesters of study.

In each semester the standard set of courses gives 30 ECTS points. In the case the required (named and specified) courses do not fill standard 30 ECTS points – then ELECTIVE courses should be taken in the amount summing the semester load to 30 ECTS. Compare remarks on elective courses in the section "Course of Studies".

In the headers of tables the following abbreviations/acronyms are used:

Lc – Lecture
T – Tutorial
Lb – Laboratory
P – Project
S – Seminar

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Date 15.04.2011

Field of Study Lotnictwo i Kosmonautyka

Aerospace Engineering	Semester 1
	Semester 2
	Semester 3
	Semester 4
	Semester 5
	Semester 6
	Semester 7

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Field of Study Lotnictwo i Kosmonautyka
Field of Specialization Aerospace Engineering
Semester 1

List of common courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANW101	Algebra and geometry	0	3	0	0	0	4
2.	ANW102	Calculus 1	2	3	0	0	0	7
3.	ANW106	Computer science 1	2	0	2	0	0	5
4.	ANW105	Engineering graphics	1	0	1	0	0	2
5.	ANW104	Engineering physics	1	2	0	0	0	3
6.	ANW109	Environment protection	2	0	0	0	0	2
7.	ANW71	Health and Safety Training	0	1	0	0	0	0
8.	ANW72	Library Training	0	1	0	0	0	0
9.	ANW107	Materials 1	2	0	0	0	0	2
10.	ANW108	Mechanics 1	1	1	0	0	0	3
11.	ANWF1	Physical Education and Sports 1	0	2	0	0	0	0
12.	ANPL1	Polish Language 1	0	2	0	0	0	0
13.	ANW103	The Wittgenstein's Philosophy - Ethics	2	0	0	0	0	2

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Field of Study Lotnictwo i Kosmonautyka
Field of Specialization Aerospace Engineering
Semester 2

List of common courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANW90	Calculus 2	2	2	0	0	0	5
2.	ANW114	Computer science 2	1	0	1	0	0	2
3.	ANW112	Economics	2	0	0	0	0	2
4.	ANW113	Electric Circuits 1	2	1	0	0	0	3
5.	ANW118	Engineering graphics - CAD 1	0	0	2	0	0	2
6.	ANJ1	English Language 1	0	2	0	0	0	2
7.	ANW115	Mechanics 2	2	2	0	0	0	5
8.	ANW117	Mechanics of structures 1	2	1	0	0	0	4
9.	ANWF2	Physical Education and Sports 2	0	2	0	0	0	0
10.	ANPL2	Polish Language 2	0	2	0	0	0	0
11.	ANW116	Thermodynamics 1	2	2	0	0	0	5

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Field of Study Lotnictwo i Kosmonautyka
Field of Specialization Aerospace Engineering
Semester 3

List of common courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANW123	Basics of automation and control 1	2	1	0	0	0	4
2.	ANW91	Calculus 3	1	2	0	0	0	3
3.	ANJ2	English Language 2	0	2	0	0	0	2
4.	ANW122	Fluid mechanics 1	2	1	0	0	0	4
5.	ANW124	Machine design 1	1	1	0	0	0	3
6.	ANWF3	Physical Education and Sports 3	0	2	0	0	0	0

List of specialization courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANK467	Aeronautical systems 1	2	0	0	0	0	3
2.	ANK431	Engineering graphics - CAD 2	0	0	2	0	0	2
3.	ANK466	Introduction to aerospace	1	0	0	1	0	2
4.	ANK399	Manufacturing technology 1	2	0	0	0	0	2
5.	ANK335	Materials in aerospace technology	2	0	0	0	0	3
6.	ANK427	Mechanics of structures 2	1	1	0	0	0	2

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Field of Study Lotnictwo i Kosmonautyka
Field of Specialization Aerospace Engineering
Semester 4

List of common courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANW135	Electronics 1	1	1	0	0	0	2
2.	ANJ3	Foreign Language 3	0	2	0	0	0	2
3.	NJAC1	Languages - C1_Egzam (English)	0	0	0	0	0	0
4.	ANW125	Machine design 2	1	1	0	0	0	3
5.	ANWF4	Physical Education and Sports 4	0	2	0	0	0	0

List of specialization courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANK473	Aerodynamics 1	2	0	0	0	0	2
2.	ANK468	Astronautics	2	0	0	0	0	4
3.	ANK316	Electronics 2 (lab)	0	0	1	0	0	1
4.	ANK436	Integrated CAD/CAM/CAE systems 1	0	0	2	0	0	2
5.	ANK471	Integrated Laboratory (AE)	0	0	2	0	0	3
6.	ANK400	Manufacturing technology 2	0	0	2	0	0	2
7.	ANK472	Mechanics of flight	0	0	1	1	0	4
8.	ANK433	Propulsion systems 1	2	1	0	0	0	5

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Field of Study Lotnictwo i Kosmonautyka
Field of Specialization Aerospace Engineering
Semester 5

List of common courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANJ4	Foreign Language 4	0	4	0	0	0	2
2.	ANWF5	Physical Education and Sports 5	0	2	0	0	0	0

List of specialization courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANK458	Aeronautical Systems 2	1	0	1	0	0	3
2.	ANK307	Aircraft Design 1	2	0	0	1	0	4
3.	ANS619	Aircraft Engine Design 1	2	0	0	0	0	3
4.	ANK359	Chemistry of combustion	1	1	0	0	0	3
5.	ANK365	Machine design 3	1	1	0	0	0	3
6.	ANK457	Mechanics of Flight 2	1	0	0	1	0	3
7.	ANS611	Risk and reliability in aviation	1	1	0	0	0	3
8.	ANS609	Rotorcraft Aeromechanics	2	1	0	0	0	5
9.	ANS630	Spacecraft Design	1	0	0	0	0	1

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Field of Study Lotnictwo i Kosmonautyka
Field of Specialization Aerospace Engineering
Semester 6

List of common courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANJ5	Foreign Language 5	0	4	0	0	0	2
2.	ANW127	Intermediate Engineering Project	0	0	0	4	0	6
3.	ANWF6	Physical Education and Sports 6	0	2	0	0	0	0
4.	ANW126	Physics 1	2	0	0	0	0	3

List of specialization courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANK308	Aircraft desing 2	1	0	0	2	0	4
2.	ANS631	Aircraft Engine Design 2	0	0	0	2	0	2
3.	ANK315	Aircraft Maintenance	2	0	0	0	0	2
4.	ANK342	Finite element method 1	2	0	1	0	0	4
5.	ANK368	Machine design 6	0	0	0	2	0	2
6.	ANS614	Simulation of Aeronautical Systems	0	1	0	1	0	3
7.	ANK401	Structure and Assebling of Airframe	2	0	0	0	0	2

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Field of Study Lotnictwo i Kosmonautyka
Field of Specialization Aerospace Engineering
Semester 7

List of common courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANW128	Engineering Diploma Seminar	0	0	0	2	0	2
2.	ANW136	Engineering Diploma Thesis	0	0	0	12	0	15

List of specialization courses:

No.	Course number	Course name	Lc	T	Lb	P	S	ECTS points
1.	ANS613	Aeronautical Regulations	1	0	0	0	0	1
2.	ANS608	Aircraft Engines Maintenance	2	0	0	0	0	2
3.	ANK348	Computational fluid dynamics	2	0	1	0	0	3
4.	ANK479	Finite element method 2	1	0	1	0	0	2
5.	ANS627	Simulators	1	1	0	0	0	2
6.	ANK459	Vibrations and Aeroelasticity	1	1	0	0	0	3

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Date 15.04.2011

SYLLABUS

Course name:	**Aerodynamics 1**
Course name in other language:	**Aerodynamika 1**
Short name:	**AEROA1**
Course number:	**ANK473**
Course language:	**English**
Responsible for the course:	**dr inż. Krzysztof Kubryński**

ECTS:	**2**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2,** 0, 0, 0, 0]
Form of grading:	**Exam**	by semester:	[**30,** 0, 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**4**
Mechanika i Budowa Maszyn	**Computer Aided Engineering**	**undergraduate, full time**	**6**

Contents - short:

Good knowledge of the fundamental concepts and principles of the Aerodynamics of airplane.

Bibliography:

1) Bertin J.J., Smith M.L., Aerodynamics for Engineers, Printice Hall, 1989
2) Anderson Jr. J.D. - Fundamentals of Aerodynamics, McGraw-Hill International, 2006.
3) Kuethe A.M., Chow C-Y, Fundations of aerodynamics: bases of aerodynamic design, John Wiley and Sons, 1998.

Detailed contents:

1. Elements of Gas Dynamics. Energy equation. Bernouli equation for compressible flow. Normal and oblique shock wave. Supersonic flow over convex corner (Prandtl-Mayer flow)
2. Potential flow. Conformal mapping. Kutta-Joukowski condition. Joukowski formula for lift. Pressure distribution and flow around wing section. Aerodynamics coefficients. Airfoil polar. Thin airfoil theory (Glauert's). High lift devices.
3. Wing of finite span. Induced velocity. Induced angle. Induced drag.
4. Influence of compressibility on aerodynamic characteristics. Prandtl-Glauert correction.
5. Transonic flow. Critical flow parameters. Critical Mach number. Drag divergence Mach number. Wave drag. Transonic buffeting.

Supersonic flow over airfoil. Wave drag in supersonic flow. Supersonic airfoil.

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SYLLABUS

Course name:	**Aeronautical Regulations**
Course name in other language:	
Short name:	**AREG**
Course number:	**ANS613**
Course language:	**English**
Responsible for the course:	**Brak danych**

ECTS:	**1**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**1,** 0, 0, 0, 0]
Form of grading:	**Continous assesment**	by semester:	[**15,** 0, 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**7**

Contents - short:

Knowledge regarding certification, rules of maintenance management as well as continued airworthiness of aircraft according to ICAO and EASA standards and regulations. Preparing of students as quality and continuing airworthiness managers

Bibliography:

1. Convention on International Civil Aviation, Signed at Chicago, 7 December 1944 Annex 6 (ICAO): Operation of Aircraft, Annex 8 (ICAO): Airworthiness of Aircraft COMMISSION REGULATION (EC) No 2042/2003 of 20 November 2003 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks.
2. COMMISSION REGULATION (EC) No 1702/2003 of 24 September 2003 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production.

Grading criteria:

Exam scores, home work

Detailed contents:

Regulatory Framework: role of International Civil Aviation Organisation, role of EASA, role of the Member States; relationship between Part-145, Part-66, Part-147 and Part-M; relationship with other Aviation Authorities. Part-66 — Certifying Staff — Maintenance: Detailed understanding of Part-66. Part-145 — Approved Maintenance Organizations: Detailed understanding of Part-145. JAR-OPS — Commercial Air Transportation: Air Operators Certificates, operators responsibilities, documents to be carried, aircraft placarding (markings); Aircraft Certification; General: certification rules: such as EACS 23/25/27/29, type certification; supplemental type certification, Part-21 Design/Production Organization Approvals. Documents: Certificate of Airworthiness, Certificate of Registration, Noise Certificate, Weight Schedule, Radio Station License and Approval. Part-M detailed understanding of Part-M; Applicable National and International Requirements for (if not superseded by EU requirements Maintenance Programs,

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Maintenance checks and inspections, Master Minimum Equipment Lists, Minimum Equipment List, Dispatch Deviation Lists, Airworthiness Directives, Service Bulletins, manufacturers service information; Modifications and repairs; Maintenance documentation: maintenance manuals, structural repair manual, illustrated parts catalogue, etc.; Continuing airworthiness: test flights, ETOPS, maintenance and dispatch requirements, All Weather Operations, Category 2/3 operations and minimum equipment requirements.

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SYLLABUS

Course name:	**Aeronautical Systems 2**
Course name in other language:	**Systemy Pokładowe 2**
Short name:	**ASYS2**
Course number:	**ANK458**
Course language:	**English**
Responsible for the course:	**dr inż. Krzysztof Gajda**

ECTS:	**3**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**1,** 0, **1,** 0, 0]
Form of grading:	**Exam**	by semester:	[**15,** 0, **15,** 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**5**

Contents - short:

The presentation of basics of aeronautical systems: principles of operation and applications

Bibliography:

1) Grewal, Mohinder S., Global positioning systems, inertial navigation, and integration, 2001
2) Moir I., Aircraft Systems: Mechanical, Electrical, and Avionics Subsystems Integration, Third Edition, AIAA, 2008
3) Moir I., Seabridge A., Design and Development of Aircraft Systems: An Introduction, AIAA, 2004
4) Pallet E.H.J., Aircraft Instrument Systems, IAP, 1993
5) Spitzer, Cary R. Red., „The avionics handbook", 2001
6) Stevens B., Lewis F., Aircraft Control and Simulation, Second Edition, John Wiley, 2003

Course results:

After completing the course the students will be familiar principles of operation and applications of selected aeronautical systems:.

Grading criteria:

60% continuous assessment based on laboratory work, 40% on theory presented during lectures. 1 test at the end of lectures, all laboratory exercises completed (report and test).
Practical work: Measurements, data acquisition and processing.

Detailed contents:

Lectures: Flight instruments. Cockpit design. Aeronautical pneumatic systems (pitot-static system, Air Data Computer, low speed measurement). Sensor integration in aeronautical systems.
Laboratory: The familiarization with principles of operation of elements of pneumatic and hydraulic, systems, magnetic and inertial sensors, IMU, electromagnetic actuations.

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SYLLABUS

Course name:	**Aeronautical systems 1**
Course name in other language:	
Short name:	**ASYS1**
Course number:	**ANK467**
Course language:	**English**
Responsible for the course:	**dr inż. Maciej Zasuwa**

ECTS:	**3**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2,** 0, 0, 0, 0]
Form of grading:	**Exam**	by semester:	[**30,** 0, 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**3**

Contents - short:

the presentation of basics of aeronautical systems: principles of operation and applications

Bibliography:

1) Grewal, Mohinder S., Global positioning systems, inertial navigation, and integration, 2001
2) Kayton M., Fried W.R., Avionic Navigation Systems, Second Edition, John Wiley, 1996,
3) Moir I., Seabridge A., Aircraft Systems; Longman Scientific & Technical, London, 1992
4) Moir I., Civil Avionics Systems, 2003
5) Pallet E.H.J., Aircraft Instrument Systems, IAP, 1993
6) Titterton, David H., Strapdown Inertial Navigation Technology, 1997

Course results:

After completing the course students will be familiar with principles of operation and applications of main aeronautical systems.

Grading criteria:

2 tests in semester in writing and final oral exam

Detailed contents:

Foundations of navigation. Magnetic compass and other magnetic sensors. Radio navigation background. Radio navigation systems: NDB, LORAN, DOPPLER, VOR, DME, TACAN. Landing augmentation systems: ILS and MLS. Collision Avoidance and ground proximity warning systems: TCAS, (E)GPWS. Satellite navigation GPS and its augmentation systems: DGPS, GNSS. Strapdown navigation: sensors and systems: IRS, IMU, INS. Air data systems. RNAV. Flight recorders: flight data and cockpit voice recorders. Radio communication transmitters and receivers, transponder. Cockpit layout.

PROGRAM ROZWOJOWY POLITECHNIKI WARSZAWSKIEJ

FACULTY OF POWER AND AERONAUTICAL ENGINEERING
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Date 15.04.2011

SYLLABUS

Course name:	**Aircraft Design 1**
Course name in other language:	**Budowa i projektowanie obiektów latających 1**
Short name:	**ADES1**
Course number:	**ANK307**
Course language:	**English**
Responsible for the course:	**prof. dr hab. inż. Cezary Galiński**

ECTS:	**4**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2,** 0, 0, **1,** 0]
Form of grading:	**Continous assesment**	by semester:	[**30,** 0, 0, **15,** 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**5**

Prerequisits:

Aerodynamics 1 (ANK473) , Mechanics of flight (ANK472)

Contents - short:

To learn about creating the airplane concept

Bibliography:

1) Book 1 Raymer, Daniel P. “Aircraft design”
2) Book 2 Corke, Thomas C. „Design of Aircraft”
3) Book 3 Roskam, Jan. „Airplane design”
4) Documentation on http://itlims.meil.pw.edu.pl/zsis/index.htm

Further Readings:

5) - Book 3 Roskam, Jan. „Airplane design”
6) Documentation on http://www.itlims.meil.pw.edu.pl/index.php?lang=1&id_page=238 - will be provided by lecturer

Course results:

After completing his course the students will be able to specify technical requirements, analyse costs and weights, create initial sketches of the airplane and modify design parameters to achieve desired flight performances.

Grading criteria:

50% continuous assesment based on the project work, 50% colloquium

Practical work:

Guided Project, where each students will design his own airplane

Detailed contents:

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Analyses of: trends, costs, mission, weight, thrust and wing loading. Fuselage and ergonomics. Wings and empennages. High lift devices and control surfaces. Landing gear. Propulsion integration. Loads and handling qualities.

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SYLLABUS

Course name:	**Aircraft Engine Design 1**
Course name in other language:	
Short name:	**AEDES1**
Course number:	**ANS619**
Course language:	**English**
Responsible for the course:	**dr inż. Paweł Oleszczak**

ECTS:	**3**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2,** 0, 0, 0, 0]
Form of grading:	**Continous assesment**	by semester:	[**30,** 0, 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**5**

Prerequisits:

Lotnicze silniki turbinowe (NS607) , Zespoły napędowe 1 (NK433)

Contents - short:

Acquainting students with construction, operation, and application of aircraft engines; the selection and rational designing and calculation techniques for parts and units of aircraft engines

Bibliography:

1) J. Mattingly „Aircraft Engine Design”
2) Serie Napędy Lotnicze Wydawnictw Komunikacji i Łączności
Further Readings:
- Mattingly “Elements of Propulsion”
- Flight International, Awiation Week and Space Technology

Course results:

After completing his course the students will be able to specify and implement methods of design of aircraft engines and its elements.

Grading criteria:

100 % The subject is completed on the basis of the final written tests

Detailed contents:

Turbine aviation engines: scope of using, design schemas, overview of units, aerothermodynamics calculations techniques. Short overview of basic design problems, overview basic responsibilities of control, diagnostic and monitoring unit.

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Date 15.04.2011

SYLLABUS

Course name:	**Aircraft Engine Design 2**
Course name in other language:	
Short name:	**AEDES2**
Course number:	**ANS631**
Course language:	**English**
Responsible for the course:	**dr inż. Mirosław Muszyński**

ECTS:	**2**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[0, 0, 0, **2,** 0]
Form of grading:	**Continous assesment**	by semester:	[0, 0, 0, **30,** 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**6**

Prerequisits:

Aircraft Engine Design 1 (ANS619)

Contents - short:

Practical training based on the course “Design of Aircraft Engines I”

Bibliography:

1) Mattingly “Aircraft Engine Design”
2) Documentation on http://
Further Readings:
- Mattingly “Elements of Propulsion”
- Will be provided by lecturer

Course results:

After completing his course the students will be able to specify and implement methods of design of aircraft engines and its elements

Grading criteria:

e.g. , 100% assesment of the project
Practical work: e.g., Project classes where students learn application of modern design tools in aircraft engine design

Detailed contents:

Guided, individual or group project of aircraft engines or its elements

PROGRAM ROZWOJOWY POLITECHNIKI WARSZAWSKIEJ

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Date 15.04.2011

SYLLABUS

Course name:	**Aircraft Engines Maintenance**
Course name in other language:	
Short name:	**AEM**
Course number:	**ANS608**
Course language:	**English**
Responsible for the course:	**dr inż. Mirosław Muszyński**

ECTS:	**2**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2,** 0, 0, 0, 0]
Form of grading:	**Continous assesment**	by semester:	[**30,** 0, 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**7**

Contents - short:

To teach students about the basic principles of aircraft engines maintenance systems designing and implementing

Bibliography:

1) Boliński Benedykt, „Eksploatacja silników turbinowych”, Wydawnictwo Komunikacji i Łączności, Warszawa 1981
2) Rolls Royce plc. 1986. The jet engine. Birmingham, Renault Printing Co Ltd.
3) Documentation on http://
Further Readings:
- Krzysztof Buczko (s.d.), Maintenance and technical logistics, Warsaw, Polish Airlines LOT.
- will be provided by lecturer

Course results:

As a result of subject completion a student acquires knowledge in: basic aircraft engines maintenance systems, typical damages of aircraft engine parts and methods of engine testing.

Grading criteria:

The subject is completed on the basis of the final written tests – 100%

Detailed contents:

Aircraft engines maintenance systems, maintenance limits of aircraft engines, planning of aircraft engines overhauls, tasks of maintenance organizations, types of services, maintenance activities on an aircraft engines, ground testing of engine, typical damages of aircraft engine parts, methods of engine testing, the engine monitoring on the ground and in the flight, maintenance safety problems, maintenance documents and manufacture requirements

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Additional remarks (by course staff):

As the subject is of interdisciplinary character and is not based on a particular text book, students participation in lectures is highly recommended.

PROGRAM ROZWOJOWY POLITECHNIKI WARSZAWSKIEJ

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SYLLABUS

Course name:	**Aircraft Maintenance**
Course name in other language:	**Eksploatacja Statków Latających**
Short name:	**AIRM**
Course number:	**ANK315**
Course language:	**English**
Responsible for the course:	**dr inż. Kamila Kustroń**

ECTS:	**2**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2,** 0, 0, 0, 0]
Form of grading:	**Continous assesment**	by semester:	[**30,** 0, 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**6**

Contents - short:

Maintenance regulations. Dependences between design and maintenance philosophies from safety and cost-effectiveness point of view. Aircraft and airspace as elements in exploitations systems. Maintenance systems. Modeling of operation&maintenance process and effectiveness of exploitation system. Reliability, availability, durability, safety and security problems and their assessment . Maintenance of aging aircraft and novel aircraft. Reliability and maintenance characterization. Diagnostic methods: non destructive evaluation(NDE) and health monitoring (SHM, EHM, HUMS). Flight safety.

Bibliography:

Croes M, Watkns W., Delp F.: Aircraft Maintenance and Repair.
2010 maintemance Library, Publisher: Aircraft Technical Book Company. Edition 2010 (printable CD)
www.aviationtoday.com/am/, www.easa.eu.int/

Course results:

After completing this course the students will have skills to improve maintenance from safety and cost-effectiveness points of view

Grading criteria:

60% assessment of tutor marked assignment and 40% assessment of project (in presentation form)

Additional remarks (by course staff):

http://www.meil.pw.edu.pl/add/ADD/Teaching/Subjects/Aircraft-Maintenance

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SYLLABUS

Course name:	**Aircraft desing 2**
Course name in other language:	**Budowa i projektowanie obiektów latających 2**
Short name:	**ADES2**
Course number:	**ANK308**
Course language:	**English**
Responsible for the course:	**prof. dr hab. inż. Cezary Galiński**

ECTS:	**4**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**1,** 0, 0, **2,** 0]
Form of grading:	**Continous assesment**	by semester:	[**15,** 0, 0, **30,** 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**6**

Prerequisits:

Aerodynamics 1 (ANK473) , Aircraft Design 1 (ANK307) , Manufacturing technology 1 (ANK399) , Materials in aerospace technology (ANK335) , Mechanics of flight (ANK472) , Mechanics of Flight 2 (ANK457)

Contents - short:

To learn about developing the airplane concept

Bibliography:

1) Book 1 Niu, Chunyun. „Airframe structural design”
2) Book 2 Howe, Denis. „Aircraft loading and structural layout”
3) Documentation on http://itlims.meil.pw.edu.pl/zsis/index.htm
Further Readings:
1. Book 3 Megson, T. H. G. “Aircraft structures for engineering students”
2. will be provided by lecturer

Course results:

After completing his course the students will be able to manipulate with certain design parameters to achieve desired handling qualities, analyse loads and create the airframe concept.

Grading criteria:

50% continuous assesment based on project work, 50% colloquium
Practical work:
Guided Project, where each students will design his own airplane

Detailed contents:

Loads and handling qualities. Types of structures applicable in aircraft design. Wing and empennages components and their structures. Fuselage components and their structures. Simplified methods of

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strength calculations. Connections between fuselage, wing and empennages. Mechanical control systems.

Additional remarks (by course staff):

Students shall continue their projects from Aircraft Design 1

PROGRAM ROZWOJOWY POLITECHNIKI WARSZAWSKIEJ

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Date 15.04.2011

SYLLABUS

Course name:	**Algebra and geometry**
Course name in other language:	**Algebra i geometria.**
Short name:	**ALG**
Course number:	**ANW101**
Course language:	**English**
Responsible for the course:	**dr Ewa Lewińska**

ECTS:	**4**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[0, **3,** 0, 0, 0]
Form of grading:	**Exam**	by semester:	[0, **45,** 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Energetyka	**-**	**undergraduate, full time**	**1**
Lotnictwo i Kosmonautyka	**-**	**undergraduate, full time**	**1**
Mechanical Engineering	**-**	**undergraduate, full time**	**1**
Mechanika i Budowa Maszyn	**-**	**undergraduate, full time**	**1**

Contents - short:

to get students familiar with basic concepts of linear algebra and with some elements of 3-d analytic geometry; to introduce fundamental abstract definitions of linear spaces, algebraic bases, linear mappings and to reinterpret earlier material from this abstract point of view.

Bibliography:

Anton H., Rorres Ch.-Elementary Linear Algebra, John Wiley and Sons 2010,
also
Lay D.C.- Linear Algebra and its Applications, Addison-Wesley 2003,
Kolman B., Hill D.R.-Elementary Linear Algebra with Applications, Pearson/Prentice Hall 2008.

Course results:

After completing the course students will know basic concepts of linear algebra and 3-d analytic geometry .They will also see them in the deeper abstract setting of linear spaces and linear mappings. Thus they will be prepared for other mathematical courses where some algebraic background is required.

Grading criteria:

50% at a mid-semester class test, 50% at an exam,
if the class test is failed, then 100% at an exam.

Detailed contents:

1.Complex Numbers.

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Date 15.04.2011

Operations. Geometrical Representation. Polar Form and de Moivre's Theorem. Root Finding.
2.Polynomials.
Roots and their Multiplicity. The Fundamental Theorem of Algebra. Factorization of Complex Polynomials. Factorization of Real Polynomials.
3.Matrices and Determinants.
Matrix Operations and their Properties. Recursive Definition of a Determinant. Sarrus Method for an Evaluation of Determinants of Order 2 and 3. Laplace Expansion Theorem. Other Properties of Determinants. Cramer's Rule.
4.Inverse of a Matrix.
Definition and Properties. Classical Adjoint. Solving Matrix Equations with the Help of Inverses.
5.Systems of Linear Equations.
Matrix Representation. Elementary Operations on Equations in a System and Corresponding Elementary Row Operations on Rows in the Augmented Matrix of the System. Gauss Elimination Method for Systems with a Nonsingular Matrix.
Definition of a Rank of a Matrix and Operations which do not Change a Rank. The Kronecker-Capelli Theorem(the Consistency Theorem).
Gauss Elimination Method in a General Case. Homogeneous Systems.
6.Eigenvalues and Eigenvectors.
Definition. Characterisitc Polynomial. Definition of an Algebraic and a Geometric Multiplicity of an Eigenvalue. Theorem about Eigenvalues and Eigenvectors of a Real Matrix.
7.Elements of Analytic Geometry in Three Dimensions.
Vectors in the 3-d Cartesian Coordinate System. Scalar, Vector and Box Products. Area of a Parallelogram and Volume of a Parallelepiped. Angle between Vectors. Various Equations of Planes and Lines and Orthogonal Projections onto them.
8.Linear Spaces. Linear Operators.
Definition of a Linear Space and Examples. Linear Subspaces and Examples. Linear Combinations, Linear Independence and Linear Dependence of Vectors. Algebraic Basis and Dimension of a Linear Space. Examples.
Definition of a Linear Mapping, its Kernel and Image. General Linear Equations : a Relation between Solutions of Nonhomogeneous and Homogeneous Equations and Illustration of this Relation for Linear Algebraic Systems and Linear Differential Equations .
9.Inner Product Spaces.
Definition of an Inner Product. Orthogonality of Vectors. Gram-Schmidt Orthogonalization Procedure. Diagonalization of Matrices. Diagonalization of Real Symmetric Matrices.

PROGRAM ROZWOJOWY POLITECHNIKI WARSZAWSKIEJ

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Date 15.04.2011

SYLLABUS

Course name:	**Astronautics**
Course name in other language:	
Short name:	**ANAUT**
Course number:	**ANK468**
Course language:	**English**
Responsible for the course:	**prof. dr hab. inż. Piotr Wolański**

ECTS:	**4**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2,** 0, 0, 0, 0]
Form of grading:	**Continous assesment**	by semester:	[**30,** 0, 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**4**

Prerequisits:

Mechanika 1 (NW108) , Termodynamika (ZNK414)

Contents - short:

Learn basics of rocket design, theory of space flights, types of satellites and spacecraft as well as with benefits from space exploration

Bibliography:

Written materials on the Department's Web site.

Course results:

Calculation of simple orbit parameters, basic estimation of parameters of rockets, determining of features and requirements for space missions

Grading criteria:

Two written tests are necessary to pass to get the credit

Detailed contents:

Design and rocket's flight; Types of rockers and their applications; Ciolkovski's formula of space flight; Single and multistage rockets; contemporary rockets; Satellites and spacecrafts; Manned spacecrafts; Reentry problem; Exploration of planets; Benefits from space exploration; future direction of Space Exploration

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Date 15.04.2011

SYLLABUS

Course name:	**Basics of automation and control 1**
Course name in other language:	**Podstawy Automatyki i Sterowania 1**
Short name:	**BAC1**
Course number:	**ANW123**
Course language:	**English**
Responsible for the course:	**dr inż. Tomasz Dziewoński**

ECTS:	**4**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2, 1,** 0, 0, 0]
Form of grading:	**Continous assesment**	by semester:	[**30, 15,** 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Energetyka	**-**	**undergraduate, full time**	**3**
Lotnictwo i Kosmonautyka	**-**	**undergraduate, full time**	**3**
Mechanical Engineering	**-**	**undergraduate, full time**	**3**
Mechanika i Budowa Maszyn	**-**	**undergraduate, full time**	**3**

Prerequisits:

Calculus 1 (ANW102) , Calculus 2 (ANW90)

Contents - short:

Basic introduction to the concept of Control Systems. Definition and interpretation of terms: CONTROL SYSTEM, FEEDBACK CONTROL, STABILITY of the system. Introduction to mathematical modelling - Laplace Transform as analysis and design tool for Control Systems. Transient and Frequency response analyses. Stability system analyses.

Bibliography:

[1] Ogata Katsuhiko: Modern Control Engineering, Prentice Hall;
[2] lecture notes/ materials provided by lecturer
[3] Zarys Dynamiki i automatyki układów, praca zbiorowa pod redakcją A.Olędzkiego, Wydawnictwo PW, Warszawa 1991 /position available vie WUT e-library/ - supporting references (in polish).

Course results:

The objective of the course is to gain the following abilities:
- ability to transform the functions using Laplace transform,
- ability to describe the control system in Laplace domain,
- ability to create and simplify the block diagrams of controled objects,
- ability to evaluate the typical system responses for standard inputs,
- ability to apply basic stability criteria,

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Date 15.04.2011

- ability to describe and analyse the control system in time and frequency domains.

Grading criteria:

100% continous assesment.
2 classworks during semester + individual activity and short tests assesment.

Detailed contents:

1) Basic introduction to the concept of Control Systems.
2) Definition and interpretation of terms: CONTROL SYSTEM, FEEDBACK CONTROL, STABILITY of the system.
3) Introduction and application of Laplace Transform as analysis and design tool for linear dynamical systems.
4) Transfer function definition.
5) Block diagram representation of physical systems.
6) Dynamic response analysis: transient response and performance indices.
7) Introduction of poles and zeros concept, dominant poles. Characterisic equation, steady state error, system types.
8) Basic principles of feedback control: PID controller.
9) Stability analyses, Routh-Hurwitz method.
10)Principles of frequency domain analysis; concept of frequency response, Bode plots, Nyquist plots and Nyquist stability.

PROGRAM ROZWOJOWY POLITECHNIKI WARSZAWSKIEJ

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Date 15.04.2011

SYLLABUS

Course name:	**Calculus 1**
Course name in other language:	
Short name:	**CALC1**
Course number:	**ANW102**
Course language:	**English**
Responsible for the course:	**prof. dr hab. inż. Andrzej Fryszkowski**

ECTS:	**7**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2, 3,** 0, 0, 0]
Form of grading:	**Exam**	by semester:	[**30, 45,** 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Energetyka	**-**	**undergraduate, full time**	**1**
Lotnictwo i Kosmonautyka	**-**	**undergraduate, full time**	**1**
Mechanical Engineering	**-**	**undergraduate, full time**	**1**
Mechanika i Budowa Maszyn	**-**	**undergraduate, full time**	**1**

Contents - short:

1. to convey and reinforce the knowledge on real number sequences, functions of one variable, the constant e, one-variable differential and integral calculus, definite and improper integrals, and their application,
2. to acquire thorough understanding of basic concepts and computational processes, and to master skills of using them,
3. to acquire the skill of correct mathematical reasoning and inference.

Bibliography:

1. Thomas “Calculus”
2. Robert A. Adams, Calculus. A complete course
3. Thomas G. Finney: Calculus, ed. Addison-Wesley

Course results:

After completing his course the students will be able to:

1. establish the convergence of sequences and evaluate limits of basic types of sequences;
2. establish the limits of functions and known basic types of functions;
3. evaluate derivatives of elementary functions, know basic rules of differentiation and apply derivatives in evaluations approximate values of expressions, tangent lines, finding the limits of undetermined expressions, finding local extrema of a function and drawing it’s graph;
4. calculate the indefinite integrals of elementary functions;

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Date 15.04.2011

5. know basic properties of definite integrals (proper and improper), methods of evaluations and implement definite integrals in to evaluation computing areas of planar figures, arc length of the curves, surface areas, volumes of revolved solids;
6. know basic properties of functions of two and three variables;
7. evaluate partial derivatives of arbitrary order and write down the Taylor expansion;
8. find local extrema of functions of two and three variables;
9. examine local extrema of implicit functions.

Grading criteria:

50% continuous assesment based on laboratory work and tests, 50% written final exam

Detailed contents:

1. Real sequences . Definition of sequence limit - convergent and divergent sequences. Indeterminate forms. Squeezing theorem. The constant e.
2. Function domain and counterdomain. Inversion and composition of functions. Elementary functions - linear, quadratic and rational functions. Properties of the exponential and logarithmic functions. Even and odd functions. Periodic functions. Trigonometric and cyclometric functions and their properties.
3. Function limit at a given point and at infinity. Horizontal, vertical and oblique asymptotes. Function continuity at a point and in the interval. One-sided continuity. Properties of continuous functions.
4. Function increment. Definition of the derivative of a function at a given point and its geometric interpretation. Derivatives of some common functions. The derivative of a sum, a product and a quotient of functions. The derivative of a composition. Tangent and normal lines at a point to a curve f(x).
5. De l'Hospital's rule. Function differential. Higher order derivatives and differentials. Taylor and MacLaurin formulas - approximate values of expressions.
6. Function extrema, necessary and sufficient condition. Rolle's theorem. The Lagrange Mean Value theorem. And it’s implications.
7. Derivatives of higher order with the use to identify extrema. Inflection points. Concave and convex functions. Necessary and sufficient conditions for inflection points. Examining the function and plotting its graph.
8. Indefinite integral - definition; antiderivative; integral of some common functions; properties. Techniques of integration.
9. Properties of definite integrals. The Fundamental Theorem of Calculus. Integration by parts and by substitution for definite integrals.
10. Definite integrals: definition and geometrical interpretation. Improper integrals of the first and the second kind. Applications of integrals; computing areas of planar figures, arc length of the curves, surface areas, volumes of revolved solids.
11. Convergence of an R2 sequences. Functions of two variables. Heine’s definition for function limit.
12. Gradient of a function at a point. Higher order partial derivatives. Taylor formula with the second and higher order.
13. Differential. Computing approximate values of expressions. Local extrema and necessary condition for them. Sufficient condition for an extremum. Functions of three variables: partial and directional derivatives and differentials. Taylor formula with the second order differential.
14. Implicit functions of one variable. Implicit function derivatives of first and second order. Extrema of implicit functions.

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15. Conditional extrema of the functions of two and three variables. Parametric representation of the two and three dimensional curves. Some common surfaces: sphere, cylinder, cone, paraboloid, hyperboloid. Planar regions in polar coordinates. Frenet trihedron.

PROGRAM ROZWOJOWY POLITECHNIKI WARSZAWSKIEJ

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Date 15.04.2011

SYLLABUS

Course name:	**Calculus 2**
Course name in other language:	
Short name:	**CALC2**
Course number:	**ANW90**
Course language:	**English**
Responsible for the course:	**prof. dr hab. inż. Andrzej Fryszkowski**

ECTS:	**5**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2, 2,** 0, 0, 0]
Form of grading:	**Exam**	by semester:	[**30, 30,** 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Energetyka	**-**	**undergraduate, full time**	**2**
Lotnictwo i Kosmonautyka	**-**	**undergraduate, full time**	**2**
Mechanical Engineering	**-**	**undergraduate, full time**	**2**
Mechanika i Budowa Maszyn	**-**	**undergraduate, full time**	**2**

Contents - short:

to convey and reinforce the knowledge on definite integrals (proper and improper) and their applications, series (numeric and functional), functions of many variables (sets, limits and continuity, multivariable calculus), ordinary differential equations, Frenet trihedron, line and surface integrals, Green, Stokes and Gauss Theorems.

2. to acquire thorough understanding of basic concepts and computational processes and to master skills of using them (labs) and to master the skill of correct mathematical reasoning and inference.

Bibliography:

1. Thomas “Calculus”
2. Robert A. Adams, Calculus. A complete course
3. Thomas G. Finney: Calculus, ed. Addison-Wesley

Course results:

After completing his course the students will be able to:

1. solve basic differential equations of 1st and higher order.
2. Implement differential equations to some practical problems in mechanics, biology etc.;
3. Evaluate double and triple integrals on bounded and unbounded regions.
4. Apply double and triple integrals in calculations of volume, area of surfaces, area of planar regions, moments of innertions and centers of the mass.
5. Know line integrals and basic applications of them.

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Grading criteria:

50% continuous assesment based on laboratory work and tests, 50% written final exam

Detailed contents:

1. First order ordinary differential equation. General and particular solutions. Initial value conditions. Existence and uniqueness. Separable equation and transformation a differential equat ion to that form. Linear equations of the first order. General solution.
2. Solving nonhomogenous linear differential equations by the method of integrating factor and the method of variation of a parameter. Linear equations of the higher order. General and particular solutions. Initial value problems. Linear equation of the second order transformable to equation of the first order.
3. Method of trial functions for nonhomogenous equation of the m-th order with constant coefficients.
4. Double integral on a rectangle; integrability theorem. Mean value and integral mean value theorem. Double integral and iterated integral. Double integral on a standard domain. The Fubini theorem.
5. Change of variable in a double integral. Region mapping: Jacobian determinant. Double integral in polar coordinates. Application of double integral to computation of areas and volumes of figures and solids.
6. Double integral application: surface area of a frustum. Triple integral on parallelepiped. Fubini theorem for triple integral on standard solids (standard 3D domains).
7. Changing of variables. Geometric application of a triple integral - volumes of solids, centers of mass.
8. Line integrals. Green Theorem. Potentials. Work of a vector field.

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Date 15.04.2011

SYLLABUS

Course name:	**Calculus 3**
Course name in other language:	
Short name:	**CALC3**
Course number:	**ANW91**
Course language:	**English**
Responsible for the course:	**prof. dr hab. inż. Andrzej Fryszkowski**

ECTS:	**3**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**1, 2,** 0, 0, 0]
Form of grading:	**Exam**	by semester:	[**15, 30,** 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Energetyka	**-**	**undergraduate, full time**	**3**
Lotnictwo i Kosmonautyka	**-**	**undergraduate, full time**	**3**
Mechanical Engineering	**-**	**undergraduate, full time**	**3**
Mechanika i Budowa Maszyn	**-**	**undergraduate, full time**	**3**

Contents - short:

1. to convey and reinforce the knowledge on real number sequences, functions of one variable, the constant e, one-variable differential and integral calculus, definite and improper integrals, and their application,
2. to acquire thorough understanding of basic concepts and computational processes, and to master skills of using them,
3. to acquire the skill of correct mathematical reasoning and inference.

Bibliography:

1. Thomas “Calculus”
2. Robert A. Adams, Calculus. A complete course
3. Thomas G. Finney: Calculus, ed. Addison-Wesley

Course results:

After completing his course the students will be able to:

1. Evaluate surface integrals.
2. Implement and Gauss Theorems to vector field calculus.
3. Establish the convergence of number series.
4. Find radius and area of convergence of power series, expand the basic elementary functions into power series.
5. Apply power series in evaluation of number series.

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6. Know trigonometric series and basic applications of them.

Grading criteria:

50% continuous assesment based on laboratory work and tests, 50% written final exam

Detailed contents:

1. Non oriented surface integrals and their applications
2. Oriented surface integrals.
3. Stokes and Gauss Theorems. Elements of vector fields calculus.
4. Infinite real and complex series – convergence and divergence, necessary condition for convergence. Tests for convergence. Absolute and conditional convergence.
5. Cauchy's root test, d'Alembert ratio test. Integral test. Convergence of the Dirichlet series. Alternating series. Absolute and conditional convergence of a series.
6. Power series – real and complex. Radius and interval of convergence. Power series integration and differentiation. Taylor and Maclaurin expansions of functions. Applications of power series.
7. Trigonometric series. Formulas for coefficients. Dirichlet conditions. Sum of a trigonometric series. Applications

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SYLLABUS

Course name:	**Chemistry of combustion**
Course name in other language:	**Chemia Spalania**
Short name:	**CHOC**
Course number:	**ANK359**
Course language:	**English**
Responsible for the course:	**prof. dr hab. inż. Rudolf Klemens**

ECTS:	**3**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**intermediate**	weekly:	[**1, 1,** 0, 0, 0]
Form of grading:	**Continous assesment**	by semester:	[**15, 15,** 0, 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**5**
Mechanika i Budowa Maszyn	**Computer Aided Engineering**	**undergraduate, full time**	**6**

Prerequisits:

Fluid mechanics 1 (ANW122) , Thermodynamics 1 (ANW116)

Contents - short:

Lectures on: basic properties of fuels and combustible mixtures; mechanisms of combustion and flame propagation including thermal dissociation; methods of limitation of toxic combustion products emission in engines

Bibliography:

1) J. Chomiak ”Combustion: A study in theory, fact and application”, Gordon and Breach Science Publisher, 1990:
2) J. H.S. Lee “The detonation phenomenon”, Cambridge University Press,2008;
3) R. Wilk “Low-emission combustion”, Wydawnictwa Politechniki Śląskiej, Gliwice,2002.
4) J. Jarosiński, B. Veyssiere: "Combustion Phenomena, Selected Mechanisms of Flame Formation, Propagation and Extinction", CRC Press, Taylor and Francis Group

Course results:

Completion of the course results in the knowledge in the domain of: fuel properties; mechanism of ignition and flame propagation; high temperature combustion; low emission combustion.

Grading criteria:

The subject is completed on the basis of the written examination.

Detailed contents:

Basic properties of fuels and combustible mixtures; fundamentals of chemical kinetics; thermal and chain theory of self-ignition; diffusion combustion-laminar and turbulent; kinetic combustion-laminar

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and turbulent, kinetic-diffusion combustion-laminar and turbulent; flame stabilization; mechanism of fuel droplets combustion, thermal dissociation, transition from deflagration to detonation, detonation combustion; dynamics of explosion development and suppression; toxic properties of combustion products

Additional remarks (by course staff):

As the subject is of an interdisciplinary character and is not based on a particular text book, students participation in lectures is highly recommended. The students absent from the lectures usually find it later difficult to comprehend courses in physical-chemical phenomena presented during the lectures and definitely attain poorer results at subject completion.

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SYLLABUS

Course name:	**Computational fluid dynamics**
Course name in other language:	
Short name:	**CFD**
Course number:	**ANK348**
Course language:	**English**
Responsible for the course:	**prof. dr hab. inż. Jacek Rokicki**

ECTS:	**3**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2,** 0, **1,** 0, 0]
Form of grading:	**Exam**	by semester:	[**30,** 0, **15,** 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Lotnictwo i Kosmonautyka	**Aerospace Engineering**	**undergraduate, full time**	**7**
Mechanika i Budowa Maszyn	**Computer Aided Engineering**	**undergraduate, full time**	**6**

Contents - short:

Knowledge about methods and tools of computational fluid dynamics

Bibliography:

1. Hirsch, Charles, Numerical computation of internal and external flows, 2007
2. Versteeg, Henk Kaarle, An introduction to computational fluid dynamics, 2007

Grading criteria:

2 tests on theoretical part, work and progress of each student are evaluated in the framework of the point system, individual semester project

Detailed contents:

Basic models in fluid mechanics. Conservative versus non-conservative formulation. Basic discretisation methods for model equations (boundary and initial conditions, stability, CFL condition, Godunov barier). General algorithms for nonlinear problems (pseudo-time iterations, frozen coefficients, quasi-linearisation). Simulation of incompressible flows (stream-function vorticity formulation, projection method and artificial compressibility). Finite volume method for compressible flows. Flux-vector splitting technique. Modelling of shock-waves. Basic information on spectral methods.

Additional remarks (by course staff):

The laboratory groups can consist of at most 12 students

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SYLLABUS

Course name:	**Computer science 1**
Course name in other language:	
Short name:	**CS1**
Course number:	**ANW106**
Course language:	**English**
Responsible for the course:	**prof. dr hab. inż. Jacek Rokicki**

ECTS:	**5**	Number of hours:	[Lc, T, Lb, P, S]
Course level:	**basic**	weekly:	[**2,** 0, **2,** 0, 0]
Form of grading:	**Continous assesment**	by semester:	[**30,** 0, **30,** 0, 0]

Field of Study:	Field of Specialization:	Study level:	Recommended semester:
Energetyka	**-**	**undergraduate, full time**	**1**
Lotnictwo i Kosmonautyka	**-**	**undergraduate, full time**	**1**
Mechanical Engineering	**-**	**undergraduate, full time**	**1**
Mechanika i Budowa Maszyn	**-**	**undergraduate, full time**	**1**

Contents - short:

Basic ability to write, compile and run programs in the C language

Bibliography:

1. Oualline, Steve, Practical C Programming, O Reilly, 1991

Grading criteria:

2 tests on theoretical part, work and progress of each student are evaluated in the framework of the point system, individual semester project.

Detailed contents:

Basic information related to operating systems and computer networks. Word-processing and spreadsheets used in typical engineering applications. Programming language C - variables and their types, arithmetical and logical operations, control statements, functions, tables and pointers, structures. Input and Output. Code examples. Basic algorithms (sorting), simple numerical methods. Practical programming skills.

Additional remarks (by course staff):

The laboratory groups can consist of at most 12 students