

# Study plan

## Name of study plan: 03 103 NSTI PTE 2012 základ

Faculty/Institute/Others:

Department:

Branch of study guaranteed by the department: Welcome page

Garantor of the study branch:

Program of study: Mechanical Engineering

Type of study: Follow-up master

Required credits: 122

Elective courses credits: 0

Sum of credits in the plan: 122

Note on the plan:

Name of the block: Compulsory courses in the program

Minimal number of credits of the block: 103

The role of the block: P

Code of the group: 12NS\*1P-PTE

Name of the group: 2012 NSTI 1.sem povinné PTE

Requirement credits in the group: In this group you have to gain 29 credits

Requirement courses in the group: In this group you have to complete 5 courses

Credits in the group: 29

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
2183011	<b>Project I.</b> Lukáš Krátký	Z	5	0P+5C	*	P
2371519	<b>Means of Automatic Control I.</b>	Z,ZK	6	3P+0C+2L	*	P
2161004	<b>Environmental engineering</b>	Z,ZK	6	3P+2C	*	P
2181136	<b>Processing Equipments Design</b> Lukáš Krátký	Z,ZK	6	3P+2C	*	P
2151026	<b>Energy Sources and Conversions</b>	Z,ZK	6	3P+2C	*	P

### Characteristics of the courses of this group of Study Plan: Code=12NS\*1P-PTE Name=2012 NSTI 1.sem povinné PTE

2183011	Project I.	Z	5
At the beginning of the master's study, the student chooses a specific topic from the offered framework topics according to his / her focus. Each topic has a supervisor and also the maximum number of students who can solve projects within the topic (usually 1 to 3). Subjects Project I serves as the first insight to the solution of the selected issue. It focuses mainly on the evaluation of the current state of the issue, on possible procedures for the future and on practical proposals for simple systems and solutions to the issue. The following Project II and Project III develop the assigned topic using knowledge and findings from theoretical and preparatory subjects attached to these projects. The last Project IV is actually a diploma project in which the student is already working on his / her diploma thesis. Each student receives their own assignment and individually develops individual projects, which they then defend at the end of each semester. Consultations are held regularly each in a group of 2 to 3 students with a corresponding focus.			
2371519	Means of Automatic Control I.	Z,ZK	6
Various categories of means for automatic control according to the different criterions. Main features in each category. Air and hydraulic fluid as a medium for information transfer. Symbols and descriptions in pneumatic and hydraulic diagrams. Pneumatic control systems design. Pneumatic actuators, valves, special pneumatic, electropneumatic devices. Control valves, categories, dimensioning, design, applications. Intelligent pneumatics as an integration of pneumatic, electronic and control components and systems. Valve islands and terminals, standard, with industrial buses communication, programmable. Pneumatic positioning systems.			
2161004	Environmental engineering	Z,ZK	6
Application of a theory in environmental engineering			
2181136	Processing Equipments Design	Z,ZK	6
PEs classification, their parameters and criteria of their rating. Ways of PEs design according their purpose and utilization. Materials used for PEs, welding, corrosion mechanisms and anticorrosion prevention. Dimension of shafts, beams, supports, pipes, heat exchangers and pressure vessels. Sealing and packing of fix parts (flanges) and moving parts (rotating shafts etc.). Practical examples of proper and improper designs of apparatuses. Example of heat exchanger design (heat transfer area calculation, its arrangement, head loss calculation, thermal dilatation, strength calculation, low cycle fatigue (thermal dilatation)).			
2151026	Energy Sources and Conversions	Z,ZK	6

Code of the group: 12NS\*2P-PTE

Name of the group: 2012 NSTI 2.sem povinné PTE

Requirement credits in the group: In this group you have to gain 22 credits

Requirement courses in the group: In this group you have to complete 4 courses

Credits in the group: 22

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
2181030	<b>Applied Physical Chemistry</b> <i>Radek Šulc, Jaromír Štancl Radek Šulc Radek Šulc (Gar.)</i>	Z,ZK	5	3P+17C+0L	*	P
2181129	<b>Hydromechanical Unit Operations</b> <i>Tomáš Jirout</i>	Z,ZK	6	3P+1C	*	P
2183012	<b>Project II.</b> <i>Tomáš Jirout</i>	Z	5	0P+5C	*	P
2181128	<b>Heat Processes</b> <i>Martin Dostál</i>	Z,ZK	6	3P+1C	*	P

**Characteristics of the courses of this group of Study Plan: Code=12NS\*2P-PTE Name=2012 NSTI 2.sem povinné PTE**

2181030	Applied Physical Chemistry	Z,ZK	5
Basic principles of physical chemistry in the field assuming real behavior especially that are demonstrated on technical applications. Volumetric properties of fluids. Thermodynamic properties of fluids. Phase equilibria. Solution Thermodynamics. Thermochemistry. Chemical reaction equilibrium.			
2181129	Hydromechanical Unit Operations	Z,ZK	6
Theory and basic calculations of the following processes and equipment: flow in pipes and pipe networks, flow in porous and packed beds, filtration, sedimentation and bubbling, separation of mixtures by centrifugal force, fluidization, liquid mixing, storage and transport of particulate materials, crushing and milling, separation and granulation, mixing of particulate solids.			
2183012	Project II.	Z	5
2181128	Heat Processes	Z,ZK	6
Fundamentals of heat processes focused on heat processes in process engineering, i.e. heat exchangers, evaporators and dryers. Small review of fundamentals of thermodynamics and heat transfer (internal energy, enthalpy, entropy, thermodynamic diagrams, heat conduction, heat convection, dimensionless criteria). Heat exchanger thermal design and rating. Thermal effectiveness method, Roetzel-Spang method. Description of evaporators with natural and forced convection, falling and climbing film evaporators. Mass and enthalpy balance. Multistage evaporators and evaporators with mechanical and thermal recompression of vapours and with heat pump. Drying and dryers. Description of contact, convective, radiation and spray dryers. Basic properties of dried material (sorption isotherms) and drying media (humid air). Static and kinetics of drying (drying curve).			

Code of the group: 12NS\*3P-PTE

Name of the group: 2012 NSTI 3.sem povinné PTE

Requirement credits in the group: In this group you have to gain 23 credits

Requirement courses in the group: In this group you have to complete 4 courses

Credits in the group: 23

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
2181127	<b>Diffusion Separation Processes</b> <i>Radek Šulc</i>	Z,ZK	5	3P+1C	*	P
2181141	<b>Numerical Analysis of Processes</b> <i>Jan Škorpil</i>	Z,ZK	4	2P+1C	*	P
2183013	<b>Project III.</b> <i>Radek Šulc, Lukáš Krátký, Stanislav Solna, Tomáš Jirout, Jiří Moravec, Martin Dostál, Jan Škorpil, Karel Petera Lukáš Krátký Lukáš Krátký (Gar.)</i>	Z	10	0P+10C	*	P
2181071	<b>Computer Aided Design</b> <i>Pavel Dittl</i>	Z,ZK	4	2P+1C	*	P

**Characteristics of the courses of this group of Study Plan: Code=12NS\*3P-PTE Name=2012 NSTI 3.sem povinné PTE**

2181127	Diffusion Separation Processes	Z,ZK	5
Classes from Equipment for diffusion separation processes are giving a basic knowledge of processes and equipments where gas or liquid mixture is been separated due to principals of physical-chemical equilibria or on the basis of mass transfer mechanisms. They are used for concentrating of products from dilute solutions or in turn for purification of diluted gasses or liquid solutions.			
2181141	Numerical Analysis of Processes	Z,ZK	4
Aim of numerical solutions in structural analysis and computer fluid dynamics. Overview of methods(finite differences, finite volumes, finite elements, boundary elements, meshless methods). Special attention is concentrated to FEM. Model parameter identification - optimisation methods. Examples solved using MATLAB and FLUENT.			
2183013	Project III.	Z	10
The aim of the project is to apply gained theoretical knowledge to design an engineering task from the branch of chemical, food, or process industries, i.e.: - design of brandly new operating sets or processing lines for chemical, food, or process industries, - design of advanced equipment and operating sets for both classical and decentralized energy systems with an emphasis on improving their parameters and using renewable or alternative sources - optimization of existing systems in the terms of intensification of transport phenomena, increase in productivity, heat recovery, reduction in energy demand, minimization of waste generation and ecological impacts, etc. - design and optimization of equipment for new systems with an emphasis on the use of modern R & D trends - experimental and CFD analysis of processes in equipment to optimize transport phenomena in the terms of energy requirement and processing time, including the definition of suitable scale-up parameters. The topic of project can be scoped to the future topic of the master thesis.			

2181071	Computer Aided Design	Z,ZK	4
Project management. Project making methodology with PC support. Flowsheeting. Mass and enthalpy balances of process lines, unique methodology for balancing in EXCEL, structure and usage of professional project making software PRO II (SimSci Co.-USA). Assumption of PRO II and solution of own project case. Basic design. Project optimization, cost engineering, choice of proper equipment type, investment and operation cost structure, cost assessment.			

Code of the group: 12NS\*4P-PTE

Name of the group: 2012 NSTI 4.sem povinné PTE

Requirement credits in the group: In this group you have to gain 29 credits

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

Credits in the group: 29

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
2181105	<b>Cleaning of Waste Water and Gases</b> <i>Radek Šulc</i>	Z,ZK	4	2P+1C	*	P
2183998	<b>Diploma Thesis</b> <i>Jaromír Štancl, Lukáš Krátký, Tomáš Jirout, Jiří Moravec, Martin Dostál, Jan Škořilas, Karel Petera, Pavel Hoffman, Pavel Dítl Tomáš Jirout Tomáš Jirout (Gar.)</i>	Z	10	0P+10C	*	P
2163073	<b>Hygiene and Physiology of Work</b>	Z	2	1P+1C	*	P
2181006	<b>Industrial Chemistry</b> <i>Radek Šulc</i>	Z,ZK	5	2P+2C	*	P
2383062	<b>Budget and Project Economic Assessment</b> <i>Miroslav Žilka Miroslav Žilka (Gar.)</i>	Z	2	1P+2C	*	P
2181100	<b>Processing Lines</b> <i>Pavel Hoffman</i>	Z,ZK	6	3P+2C	*	P

**Characteristics of the courses of this group of Study Plan: Code=12NS\*4P-PTE Name=2012 NSTI 4.sem povinné PTE**

2181105	Cleaning of Waste Water and Gases	Z,ZK	4
Waste water = WW pollution, amount of sewage, determination of pollution, self-purification of surface water, principles (processes) of waste water treatment, mechanical and biological treatment (aerobic and anaerobic), sludge management, examples of typical equipments and types of various waste water treatment plants = WWTP (mechanical + aerobic + anaerobic; mechanical + anaerobic + aerobic). Renewable sources of energy, places of emissions origin, methods and equipments of emissions reduction. Mechanical waste gases cleaning (dust etc. separation) = dry and wet separators, filters, electro-filters. Processes and equipments for harmful gaseous substances collecting and treatment (SO <sub>2</sub> , volatile organic compounds ...).			
2183998	Diploma Thesis	Z	10
Diploma thesis is final individual work. This work checks ability of logical independent technical thinking and treatment with technical materials. There is applied acquired knowledge from previous study periods.			
2163073	Hygiene and Physiology of Work	Z	2
The subject allow student to get knowledge about relations between human being and living (working) environment. It offers basic orientation in problematic of ergonomic load of living respectively working environment.			
2181006	Industrial Chemistry	Z,ZK	5
Thermodynamics of industrial chemistry (reaction kinetics, thermochemistry, mass and enthalpy balance, entropy and Gibbs-energy balance, chemical equilibrium). Basic inorganic and organic substances. Electrochemistry. Crude oil treatment and petrochemistry. Plastic and rubber. Glass and ceramics. Cellulose and paper. Tensides. Biotechnology.			
2383062	Budget and Project Economic Assessment	Z	2
The goal of the course is to improve the knowledge gained within the basic bachelor's degree course Management and Economics of the Enterprise. The course focuses primarily on deepening of basic knowledge and skills in the creation and evaluation of the operational budget, proper preparation and evaluation of costing model for manufactured products and the economic evaluation of an investment project, as it corresponds to contemporary knowledge and the development of management methods and techniques. Students specify a simple fictional industrial or engineering company or its sub-section (preferably inspired by their practical experience, internships or training program in real company). The first student's task is to prepare a detailed plan and budget of a project (e.g. new product development, product or process innovation, etc.) focused on improvement of profitability, competitiveness or effectiveness of the company. The second task is cost calculation for chosen calculation unit. Last task within this course is the evaluation of economical effectiveness of the project described within the first task. The dynamic methods like Net Present Value (NPV), Internal Rate of Return (IRR) or Discounted Payback Period (DPP) are used for this evaluation. The quality of realization and presentation of the task's outputs together with the results of the test decides on granting / denial of credit.			
2181100	Processing Lines	Z,ZK	6
Philosophy of PL design, complex lines solution in relationship with other plants, wastes, energy economy, living environment. Marketing and PL design. Practical experience from PL design and service. PL of following branches: brewery, sugar industry, dairy industry, mills, bakeries, fat industry, starch industry, cooling plants etc.			

Name of the block: Compulsory elective courses

Minimal number of credits of the block: 19

The role of the block: PV

Code of the group: 12N\*\*3Q--JV

Name of the group: 2012 N 3.sem povinná jazyková výuka

Requirement credits in the group: In this group you have to gain 2 credits

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

Credits in the group: 2

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
2043081	<b>English - Preparatory Course / FME</b> <i>Eliška Vítková, Ilona Šimice, Michaela Schusová, Veronika Kratochvílová, Hana Volejníková, Nina Procházková Ayyub Nina Procházková Ayyub</i>	Z	2	0P+2C	*	PV
2043086	<b>Czech - Preparatory Course</b> <i>Michaela Schusová, Hana Volejníková, Petr Laurich</i>	Z	2	0P+2C	*	PV
2043083	<b>French - Preparatory Course / FME</b> <i>Michaela Schusová, Dušana Jirovská Michaela Schusová Michaela Schusová (Gar.)</i>	Z	2	0P+2C	*	PV
2043082	<b>German - Lower Intermediate Course</b> <i>Eliška Vítková, Michaela Schusová, Petr Laurich, Jaroslava Kommová Jaroslava Kommová</i>	Z	2	0P+2C	*	PV
2043085	<b>Russian - Preparatory Course / FME</b> <i>Eliška Vítková, Michaela Schusová, Hana Volejníková, Dušana Jirovská Eliška Vítková</i>	Z	2	0P+2C	*	PV
2043084	<b>Spanish - Preparatory Course / FME</b> <i>Eliška Vítková, Michaela Schusová, Jaime Andrés Villagómez Eliška Vítková</i>	Z	2	0P+2C	*	PV

Characteristics of the courses of this group of Study Plan: Code=12N\*\*3Q--JV Name=2012 N 3.sem povinná jazyková výuka

2043081	English - Preparatory Course / FME	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language. European level A1 - A2.			
2043086	Czech - Preparatory Course	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			
2043083	French - Preparatory Course / FME	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			
2043082	German - Lower Intermediate Course	Z	2
Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.			
2043085	Russian - Preparatory Course / FME	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			
2043084	Spanish - Preparatory Course / FME	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			

Code of the group: 12N\*\*3Q--JZ

Name of the group: 2012 N 3.sem povinná jazyková zkouška

Requirement credits in the group: In this group you have to gain 1 credit

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

Credits in the group: 1

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
2041081	<b>English - Master Exam</b> <i>Eliška Vítková, Ilona Šimice, Michaela Schusová, Veronika Kratochvílová, Hana Volejníková, Nina Procházková Ayyub Nina Procházková Ayyub</i>	ZK	1	0P+0C	*	PV
2041086	<b>Czech- Master Exam</b> <i>Michaela Schusová, Hana Volejníková, Petr Laurich</i>	ZK	1	0P+0C	*	PV
2041083	<b>French - Master Exam / FME</b> <i>Eliška Vítková, Michaela Schusová, Dušana Jirovská Dušana Jirovská Michaela Schusová (Gar.)</i>	ZK	1	0P+0C	*	PV
2041082	<b>German - Master Exam / FME</b> <i>Eliška Vítková, Michaela Schusová, Petr Laurich, Jaroslava Kommová Jaroslava Kommová</i>	ZK	1	0P+0C	*	PV
2041085	<b>Russian - Master Exam / FME</b> <i>Eliška Vítková, Michaela Schusová, Hana Volejníková, Dušana Jirovská, Petr Zitko Eliška Vítková</i>	ZK	1	0P+0C	*	PV
2041084	<b>Spanish - Master Exam / FME</b> <i>Eliška Vítková, Michaela Schusová, Jaime Andrés Villagómez Eliška Vítková</i>	ZK	1	0P+0C	*	PV

Characteristics of the courses of this group of Study Plan: Code=12N\*\*3Q--JZ Name=2012 N 3.sem povinná jazyková zkouška

2041081	English - Master Exam	ZK	1
Mapped to the level of Common European Framework of Reference: A2. Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			

2041086	Czech- Master Exam	ZK	1
2041083	French - Master Exam / FME Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.	ZK	1
2041082	German - Master Exam / FME Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.	ZK	1
2041085	Russian - Master Exam / FME Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.	ZK	1
2041084	Spanish - Master Exam / FME Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.	ZK	1

Code of the group: 12NS\*2Q-PTE

Name of the group: 2012 NSTI 2.sem 2povvol PTE

Requirement credits in the group: In this group you have to gain at least 8 credits (at most 9)

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
2181135	<b>Basic Equipment Design</b> <i>Jiří Moravec</i>	Z,ZK	4	2P+2C	*	PV
2181096	<b>Modelling and process control</b> <i>Karel Petera</i>	Z,ZK	4	2P+1C	*	PV
2151157	<b>Principles of Refrigerating Technology and Heat Pumps</b>	Z,ZK	5	2P+2C	*	PV

Characteristics of the courses of this group of Study Plan: Code=12NS\*2Q-PTE Name=2012 NSTI 2.sem 2povvol PTE

2181135	Basic Equipment Design Basic methodology of process equipment design. Used materials and their properties. Corrosion and mechanical wear of process equipment, corrosion prevention. Equipment design from the technological point of view. Dimensioning of basic equipment parts - oscillation, pressure stress. Welding solutions - welding methods, weld types and their usage. Piping system calculations.	Z,ZK	4
2181096	Modelling and process control Mathematical modeling, simulation and process control, specific examples of technical applications, basic principles of control, continuous and discrete system models, control elements. Computer simulation using MATLAB and SIMULINK, system responses to changes of various parameters and disturbances, system stability, analysis and optimization of model parameters with respect to the quality of control.	Z,ZK	4
2151157	Principles of Refrigerating Technology and Heat Pumps	Z,ZK	5

Code of the group: 12NS\*3Q-PTE

Name of the group: 2012 NSTI 3.sem 2povvol PTE

Requirement credits in the group: In this group you have to gain at least 8 credits (at most 9)

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
2322056	<b>Corrosion- and creep-resistant materials</b> <i>Jakub Horváth, Jiří Janovec Jiří Janovec (Gar.)</i>	KZ	4	2P+1C	*	PV
2181112	<b>Reactor and bioreactor design</b> <i>Karel Petera</i>	Z,ZK	5	2P+2C	*	PV
2181123	<b>Fundamentals of Process Technology</b>	Z,ZK	4	2P+1C	*	PV

Characteristics of the courses of this group of Study Plan: Code=12NS\*3Q-PTE Name=2012 NSTI 3.sem 2povvol PTE

2322056	Corrosion- and creep-resistant materials Principles and mechanisms of corrosion, types of corrosion attacks. Heat-resistant materials, steels resistant against atmospheric corrosion. Martensitic, ferritic, austenitic and duplex corrosion-resistant steels, nickel and cobalt alloys, their development and use. Nonmetallic corrosion-resistant materials, corrosion resistance tests. Principles and mechanisms of creep resistance, characteristics of creep-resistant materials	KZ	4
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2181112	Reactor and bioreactor design	Z,ZK	5
These lectures belong to the group of unit operations and processes. Students should utilize knowledge gained in hydraulic, diffusion and heat operations, physical chemistry and transfer phenomena. Lectures enlarge knowledge to equipment design of in which components are changed by means of chemical or biochemical reactions. Basis of chemical and biochemical kinetics and equilibrium are explained for homogeneous and heterogeneous reactions as well as the basis of reactor and bioreactor design. Furthermore lectures contain the introduction to non-ideal reactor behavior and reactor multiple systems operation. Utilization of gained information and knowledge aims to chemical, pharmaceutical, polymer and food industry for equipment design and designing of operation lines and its operation and optimization. Design of the batch continuous and plug flow reactors and its combinations with homogeneous and also heterogeneous reactions. Application for classical chemical food environmental and energy producing production technologies. Basis of reaction kinetics. Enlargement of the gained knowledge to bioreactors including enzymatic ones with applications for pharmaceutical and food fermentors, biogas production and wastewater treatment. Basis of bioengineering-cultivation of microorganisms, aerobic and anaerobic systems, downstream processing.			
2181123	Fundamentals of Process Technology	Z,ZK	4
Rheology and rheometry. Basic processing unit operations: transport of viscous and granular materials, mixing of highly viscous fluids, convective heat transfer in non-Newtonian fluids, melting. Design, principles and basic calculations of following equipment and processes: extrusion, calendering, injection molding, blow molding, compression molding. Fundamentals of synthetic fiber production			

## List of courses of this pass:

Code	Name of the course	Completion	Credits
2041081	English - Master Exam	ZK	1
Mapped to the level of Common European Framework of Reference: A2. Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			
2041082	German - Master Exam / FME	ZK	1
Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.			
2041083	French - Master Exam / FME	ZK	1
Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.			
2041084	Spanish - Master Exam / FME	ZK	1
Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.			
2041085	Russian - Master Exam / FME	ZK	1
Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.			
2041086	Czech- Master Exam	ZK	1
2043081	English - Preparatory Course / FME	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language. European level A1 - A2.			
2043082	German - Lower Intermediate Course	Z	2
Mapped to the level of Common European Framework of Reference A2 Aim: Understanding clearly spoken language about everyday situations which a student meets either at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. reading and comprehension of simple texts. Improvement of professional language.			
2043083	French - Preparatory Course / FME	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			
2043084	Spanish - Preparatory Course / FME	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			
2043085	Russian - Preparatory Course / FME	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			
2043086	Czech - Preparatory Course	Z	2
Aim: Understanding clearly what is spoken about everyday situations which a student meets at school or in his/her free time and speaking about them. Writing in a simple way about familiar topics. Reading and comprehension of simple texts. Improvement of professional language.			
2151026	Energy Sources and Conversions	Z,ZK	6
2151157	Principles of Refrigerating Technology and Heat Pumps	Z,ZK	5
2161004	Environmental engineering	Z,ZK	6
Application of a theory in environmental engineering			
2163073	Hygiene and Physiology of Work	Z	2
The subject allow student to get knowledge about relations between human being and living (working) environment. It offers basic orientation in problematic of ergonomic load of living respectively working environment.			
2181006	Industrial Chemistry	Z,ZK	5
Thermodynamics of industrial chemistry (reaction kinetics, thermochemistry, mass and enthalpy balance, entropy and Gibbs-energy balance, chemical equilibrium). Basic inorganic and organic substances. Electrochemistry. Crude oil treatment and petrochemistry. Plastic and rubber. Glass and ceramics. Cellulose and paper. Tensides. Biotechnology.			
2181030	Applied Physical Chemistry	Z,ZK	5
Basic principles of physical chemistry in the field assuming real behavior especially that are demonstrated on technical applications. Volumetric properties of fluids. Thermodynamic properties of fluids. Phase equilibria. Solution Thermodynamics. Thermochemistry. Chemical reaction equilibrium.			

2181071	Computer Aided Design	Z,ZK	4
Project management. Project making methodology with PC support. Flowsheeting. Mass and enthalpy balances of process lines, unique methodology for balancing in EXCEL, structure and usage of professional project making software PRO II (SimSci Co.-USA). Assumption of PRO II and solution of own project case. Basic design. Project optimization, cost engineering, choice of proper equipment type, investment and operation cost structure, cost assessment.			
2181096	Modelling and process control	Z,ZK	4
Mathematical modeling, simulation and process control, specific examples of technical applications, basic principles of control, continuous and discrete system models, control elements. Computer simulation using MATLAB and SIMULINK, system responses to changes of various parameters and disturbances, system stability, analysis and optimization of model parameters with respect to the quality of control.			
2181100	Processing Lines	Z,ZK	6
Philosophy of PL design, complex lines solution in relationship with other plants, wastes, energy economy, living environment. Marketing and PL design. Practical experience from PL design and service. PL of following branches: brewery, sugar industry, dairy industry, mills, bakeries, fat industry, starch industry, cooling plants etc.			
2181105	Cleaning of Waste Water and Gases	Z,ZK	4
Waste water = WW pollution, amount of sewage, determination of pollution, self-purification of surface water, principles (processes) of waste water treatment, mechanical and biological treatment (aerobic and anaerobic), sludge management, examples of typical equipments and types of various waste water treatment plants = WWTP (mechanical + aerobic + anaerobic; mechanical + anaerobic + aerobic). Renewable sources of energy, places of emissions origin, methods and equipments of emissions reduction. Mechanical waste gases cleaning (dust etc. separation) = dry and wet separators, filters, electro-filters. Processes and equipments for harmful gaseous substances collecting and treatment (SO <sub>2</sub> , volatile organic compounds ...).			
2181112	Reactor and bioreactor design	Z,ZK	5
These lectures belong to the group of unit operations and processes. Students should utilize knowledge gained in hydraulic, diffusion and heat operations, physical chemistry and transfer phenomena. Lectures enlarge knowledge to equipment design of in which components are changed by means of chemical or biochemical reactions. Basis of chemical and biochemical kinetics and equilibrium are explained for homogeneous and heterogeneous reactions as well as the basis of reactor and bioreactor design. Furthermore lectures contain the introduction to non-ideal reactor behavior and reactor multiple systems operation. Utilization of gained information and knowledge aims to chemical, pharmaceutical, polymer and food industry for equipment design and designing of operation lines and its operation and optimization. Design of the batch continuous and plug flow reactors and its combinations with homogeneous and also heterogeneous reactions. Application for classical chemical food environmental and energy producing production technologies. Basis of reaction kinetics. Enlargement of the gained knowledge to bioreactors including enzymatic ones with applications for pharmaceutical and food fermentors, biogas production and wastewater treatment. Basis of bioengineering-cultivation of microorganisms, aerobic and anaerobic systems, downstream processing.			
2181123	Fundamentals of Process Technology	Z,ZK	4
Rheology and rheometry. Basic processing unit operations: transport of viscous and granular materials, mixing of highly viscous fluids, convective heat transfer in non-Newtonian fluids, melting. Design, principles and basic calculations of following equipment and processes: extrusion, calendaring, injection molding, blow molding, compression molding. Fundamentals of synthetic fiber production			
2181127	Diffusion Separation Processes	Z,ZK	5
Classis from Equipment for diffusion separation processes are giving a basic knowledge of processes and equipments where gas or liquid mixture is been separated due to principals of physical-chemical equilibriums or on the basis of mass transfer mechanisms. They are used for concentrating of products from dilute solutions or in turn for purification of diluted gasses or liquid solutions.			
2181128	Heat Processes	Z,ZK	6
Fundamentals of heat processes focused on heat processes in process engineering, i.e. heat exchangers, evaporators and dryers. Small review of fundamentals of thermodynamics and heat transfer (internal energy, enthalpy, entropy, thermodynamic diagrams, heat conduction, heat convection, dimensionless criteria). Heat exchanger thermal design and rating. Thermal effectiveness method, Roetzel-Spang method. Description of evaporators with natural and forced convection, falling and climbing film evaporators. Mass and enthalpy balance. Multistage evaporators and evaporators with mechanical and thermal recompression of vapours and with heat pump. Drying and dryers. Description of contact, convective, radiation and spray dryers. Basic properties of dried material (sorption isotherms) and drying media (humid air). Static and kinetics of drying (drying curve).			
2181129	Hydromechanical Unit Operations	Z,ZK	6
Theory and basic calculations of the following processes and equipment: flow in pipes and pipe networks, flow in porous and packed beds, filtration, sedimentation and bubbling, separation of mixtures by centrifugal force, fluidization, liquid mixing, storage and transport of particulate materials, crushing and milling, separation and granulation, mixing of particulate solids.			
2181135	Basic Equipment Design	Z,ZK	4
Basic methodology of process equipment design. Used materials and their properties. Corrosion and mechanical wear of process equipment, corrosion prevention. Equipment design from the technological point of view. Dimensioning of basic equipment parts - oscillation, pressure stress. Welding solutions - welding methods, weld types and their usage. Piping system calculations.			
2181136	Processing Equipments Design	Z,ZK	6
PEs classification, their parameters and criteria of their rating. Ways of PEs design according their purpose and utilization. Materials used for PEs, welding, corrosion mechanisms and anticorrosion prevention. Dimension of shafts, beams, supports, pipes, heat exchangers and pressure vessels. Sealing and packing of fix parts (flanges) and moving parts (rotating shafts etc.). Practical examples of proper and improper designs of apparatuses. Example of heat exchanger design (heat transfer area calculation, its arrangement, head loss calculation, thermal dilatation, strength calculation, low cycle fatigue (thermal dilatation)).			
2181141	Numerical Analysis of Processes	Z,ZK	4
Aim of numerical solutions in structural analysis and computer fluid dynamics. Overview of methods(finite differences, finite volumes, finite elements, boundary elements, meshless methods). Special attention is concentrated to FEM. Model parameter identification - optimisation methods. Examples solved using MATLAB and FLUENT.			
2183011	Project I.	Z	5
At the beginning of the master's study, the student chooses a specific topic from the offered framework topics according to his / her focus. Each topic has a supervisor and also the maximum number of students who can solve projects within the topic (usually 1 to 3). Subjects Project I serves as the first insight to the solution of the selected issue. It focuses mainly on the evaluation of the current state of the issue, on possible procedures for the future and on practical proposals for simple systems and solutions to the issue. The following Project II and Project III develop the assigned topic using knowledge and findings from theoretical and preparatory subjects attached to these projects. The last Project IV is actually a diploma project in which the student is already working on his / her diploma thesis. Each student receives their own assignment and individually develops individual projects, which they then defend at the end of each semester. Consultations are held regularly each in a group of 2 to 3 students with a corresponding focus.			
2183012	Project II.	Z	5
2183013	Project III.	Z	10
The aim of the project is to apply gained theoretical knowledge to design an engineering task from the branch of chemical, food, or process industries, i.e.: - design of brandly new operating sets or processing lines for chemical, food, or process industries, - design of advanced equipment and operating sets for both classical and decentralized energy systems with an emphasis on improving their parameters and using renewable or alternative sources - optimization of existing systems in the terms of intensification of transport phenomena, increase in productivity, heat recovery, reduction in energy demand, minimization of waste generation and ecological impacts, etc. - design and optimization of equipment for new systems with an emphasis on the use of modern R & D trends - experimental and CFD analysis of processes in equipment to optimize transport phenomena in the terms of energy requirement and processing time, including the definition of suitable scale-up parameters. The topic of project can be scoped to the future topic of the master thesis.			

2183998	Diploma Thesis	Z	10
Diploma thesis is final individual work. This work checks ability of logical independent technical thinking and treatment with technical materials. There is applied acquired knowledge from previous study periods.			
2322056	Corrosion- and creep-resistant materials	KZ	4
Principles and mechanisms of corrosion, types of corrosion attacks. Heat-resistant materials, steels resistant against atmospheric corrosion. Martensitic, ferritic, austenitic and duplex corrosion-resistant steels, nickel and cobalt alloys, their development and use. Nonmetallic corrosion-resistant materials, corrosion resistance tests. Principles and mechanisms of creep resistance, characteristics of creep-resistant materials			
2371519	Means of Automatic Control I.	Z,ZK	6
Various categories of means for automatic control according to the different criterions. Main features in each category. Air and hydraulic fluid as a medium for information transfer. Symbols and descriptions in pneumatic and hydraulic diagrams. Pneumatic control systems design. Pneumatic actuators, valves, special pneumatic, electropneumatic devices. Control valves, categories, dimensioning, design, applications. Intelligent pneumatics as an integration of pneumatic, electronic and control components and systems. Valve islands and terminals, standard, with industrial buses communication, programmable. Pneumatic positioning systems.			
2383062	Budget and Project Economic Assessment	Z	2
The goal of the course is to improve the knowledge gained within the basic bachelor's degree course Management and Economics of the Enterprise. The course focuses primarily on deepening of basic knowledge and skills in the creation and evaluation of the operational budget, proper preparation and evaluation of costing model for manufactured products and the economic evaluation of an investment project, as it corresponds to contemporary knowledge and the development of management methods and techniques. Students specify a simple fictional industrial or engineering company or its sub-section (preferably inspired by their practical experience, internships or training program in real company). The first student's task is to prepare a detailed plan and budget of a project (e.g. new product development, product or process innovation, etc.) focused on improvement of profitability, competitiveness or effectiveness of the company. The second task is cost calculation for chosen calculation unit. Last task within this course is the evaluation of economical effectiveness of the project described within the first task. The dynamic methods like Net Present Value (NPV), Internal Rate of Return (IRR) or Discounted Payback Period (DPP) are used for this evaluation. The quality of realization and presentation of the task's outputs together with the results of the test decides on granting / denial of credit.			

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

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