# Faculty of Transportation Engineering and Vehicle Engineering

The Faculty of Transportation Engineering and Vehicle Engineering is educating engineers since 1951 in fields of transportation and logistics processes, vehicle operation, planning, control and related complex technical requirements. The aim of the education is to qualify graduates, who will manage tasks in the fields of transport operation and management, enterprise logistics systems, supply-distribution network organization and manufacturing of industrial machines.

The Faculty of Transportation Engineering and Vehicle Engineering offers 3 BSc programmes.

- In the **Transportation Engineering BSc** we focus on transportation and shipping related processes and their control.
- Students will acquire knowledge on the transportation vehicles, machinery, material handling and building machinery in the **Vehicle Engineering BSc** programme.
- Meanwhile the **Logistics Engineering BSc** offers complex insight and knowledge in corporate logistics systems and supply chains and also helps with building up an analytical point of view.

The Faculty offers 3 MSc programmes:

- **Vehicle Engineering MSc,**
- **Transportation Engineering MSc,**
- **Logistics Engineering MSc.**

At the end of each programme the best graduates can take part in the PhD programme of the Faculty. The program is hosted by the **Kandó Kálmán Doctoral School**, which is one of the main sources for engineers in the fields of vehicle technology, transportation and logistics in the country.

## Departments:

Department of Material Handling and Logistics Systems
Department of Automobiles and Vehicle Manufacturing
Department of Vehicle Elements and Vehicle Structure Analysis
Department of Control for Transportation and Vehicle Systems
Department of Transport Technology and Economics
Department of Aeronautics, Naval Architecture and Railway Vehicles

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**Faculty of Transportation Engineering and**
**Vehicle Engineering**
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*Dean of the Faculty: Dr. István Varga*
*Vice-dean of the Faculty: Dr. Ádám Török*
*Program co-ordinator: Ms. Barbara Mag*


## Description of BSc training

**BSc in Vehicle Engineering**
**Length of study:** 7 semesters

**Program objectives:** The aim of the bachelor education programme is to train vehicle engineers, who will be able to maintain and operate road, railway, water, air, construction and material handling vehicles with appropriate knowledge in the fields of transportation and logistics. They will be able to fulfill roles of vehicle engineering tasks, like improvement, manufacturing and operation. The listed tasks are accomplished by taking into account safety, environment and energy management aspects. The gained knowledge provides the basics to continue their education in the MSc programmes of the Faculty.

**Specializations:** Automotive vehicle, Aerospace vehicle, Naval vehicle, Railway vehicle, Construction equipment, Automated material handling equipment and robotics, Vehicle manufacturing, Vehicle mechatronics, Vehicle structure

**Competencies and skills:** Possessing the basic certificate, the vehicle engineers - taking into consideration also the prospective specialisations - become able:

- to determine the necessary equipment for the realisation of transportation and logistic processes,
- to organize, arrange, control the safe, the powerful and environmental-protective operation of vehicles, vehicle systems, mobile machines, materials-handling machines and machine systems,
- to perform the basic engineering tasks related to the designing, manufacturing, repair, as well as organisation of vehicles and mobile-machinery,
- to provide and organize the official work related to installation and operation of vehicles and mobile-machinery.

**BSc in Transportation Engineering**
**Length of study:** 7 semesters

**Program objectives:** The aim of the bachelor engineering programme is to train transportation engineers, who will be able to organize and operate processes of passenger and goods transportation. They will learn how to choose proper measures for these tasks, how to operate and maintain such transportation systems, including elements of infrastructure, control and IT systems. The gained knowledge is sufficient to continue their education in the MSc programmes of the Faculty.

**Specializations:** Road transportation, Railway transportation, Air transportation, Waterborne transportation

**Competencies and skills:** The transportation engineers received a basic certificate (BSc) - taking into consideration also the specialisations - become able:

- to recognise the demands for transportation and transportation-logistics, to determine the relationships to be applied,
- to exert active detailed cognition of transportation-and transportation logistics processes, to manage the processes mentioned together with their technical realisation,
- to design processes in accordance with the function of transportation and transportation-logistics systems, to select the technical components and to manage the operation of the system,
- to keep in operation vehicles and mobile machines serving the transportation process, to make the control systems operated, to take into consideration the environmental factors,
- to perform designing, organising and keeping in operation duties,
- to carry out public service and marketing activities.

**BSc in Logistics Engineering**

**Length of study:** 7 semesters

**Program objectives:** The aim of the study is to train logistics engineers, who will be able to maintain and operate corporate logistics and good transportation systems. They will know modern supply chains and networks, their management and organizational basics, and transport control processes and workflows. Related logistics control and IT systems basics are also acquired. The gained knowledge is sufficient to continue their education in the MSc programmes of the Faculty.

**Specializations:** From the 5th semester every student will participate in one logistics engineer specialization, which covers all specific areas of logistics, and prepares the further MSc integration and specializations, and/or the specific logistics operating engineer work.

**Competences and skills:** Possessing the basic certificate, the logistics engineers - taking into consideration also the prospective specialisations - become able:

- to define the equipment necessary to realize logistics systems and processes,
- to organize, arrange, control logistics systems in a safe and environmentally-friendly way,
- to perform the basic engineering tasks related to the design, manufacture and repair, as well as the organization of material handling machines,
- to provide and organize the official work related to the installation and operation of logistics machinery.

Actually, due to changes in basic training (BSc) our Faculty can ensure training in English with tuition fee for the time being only part-time (attending term at other faculties, training exchange students). The list of optional subjects in the given term is on website: http://transportation.bme.hu/for-students/courses/

## Description of MSc training

**MSc in Vehicle Engineering**

**Length of study:** 4 semesters

**Program objectives:** The 4 semester long master education programme is a continuation of the bachelor vehicle engineering studies. Our aim is to provide the required knowledge to graduates, required to manage development, design, dimensioning, manufacturing and analyzing internal processes of different vehicles. The students will also be prepared to management tasks and to creatively participate in Research & Development related tasks. These studies prepare students for our PhD programmes.

**Specializations:** Automotive vehicle engineer, aerospace vehicle engineer, naval vehicle engineer, railway vehicle engineer, Mobile machinery and construction equipment engineer, automated material handling system, Vehicle manufacturing and repairing engineer, Vehicle system engineer, Road and traffic safety engineer, Vehicle automation engineer, Vehicle structure engineer.

**Competencies and skills:** Possessing the MSc degree, vehicle engineers are able:

- to integrate a system oriented and process analysing way of thinking directed on vehicles and mobile-machinery, having a role in transportation processes,
- connected with the specialization selected, to carry out assessments, to develop, design, organise and control complex systems of vehicle technology.

Basic specialization accepted to the input without any conditions:

- basic specialization of transportation engineering

Basic specialization accepted to the input under given conditions:

- mechanical engineering;
- mechatronics engineering;
- military staff, and safety technology engineering;
- agricultural and food industrial engineering;
- engineering informatics.

**MSc in Transportation Engineering**

**Length of study:** 4 semesters

**Program objectives:** The 4 semester long master education programme is a continuation of the bachelor studies. Our aim is to train graduates, who will be able to analyze, plan, organize and control transport related processes in an integrated way considering economic, safety, environmental and human resource aspects. Graduates will be able to deal with tasks of transport administration and transport authorities, choice and operation of vehicles and facilities of passenger and good transportation systems and related infrastructural, control and IT system elements. The students will also be prepared to higher management tasks, to creatively participate in research & development tasks. These studies prepare students for our PhD programme.

**Specializations:** Transportation systems, Transportation automatization, Transportation engineer manager, Freight forwarding management, Air Traffic Management.

**Competencies and skills:** Possessing the MSc degree, transportation engineers are able:

to recognise connections between systems and processes of transportation, to evaluate and to handle them in the framework of system theory, as well as to apply the related principles and methods,

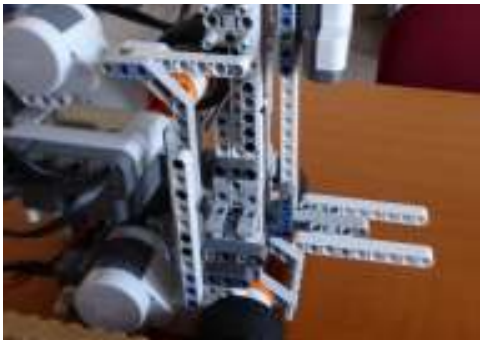
connected with the specialization selected, to carry out state assessments, to develop, design, organise and control complex transportation systems.

Basic specialization accepted to the input without any conditions:

- basic specialization of transportation engineering

Basic specializations accepted to the input under given conditions:

- mechanical engineering;
- mechatronics engineering;
- military staff and safety technology engineering;
- civil engineering;
- engineering informatics;
- light industry engineering.



**MSc in Logistics Engineering**

**Length of study:** 4 semesters

**Program objectives:** The 4 semester long MSc study is a continuation of the BSc studies. Our aim is to train graduates, who will be able to plan, organize and control corporate logistics systems, good transport systems and supply and distribution networks. Furthermore they will be able to join to developing logistics systems related machines and tools. The students will also be able to deal with complex logistics system modeling and optimization, they understand operation and planning principles of corporate logistics systems, distribution networks and supply chains. The students will also be prepared to manage leading tasks, to creatively participate in R&D related problem, and continue their studies later on our PhD programme.

**Specializations:** Corporate logistics and operations planning, Technical logistics, Freight forwarding management.

**Competencies and skills:** Possessing the MSc degree, logistic engineers are able to interconnect the component-processes of logistic systems and the component-units performing the physical realisation of the former relationships.

Basic specialization accepted to the input without any conditions:

- basic specialization of transportation engineering

Basic specialization accepted to the input under given conditions:

- mechanical engineering;
- mechatronics engineering;
- military staff, and safety technology engineering;
- agricultural and food industrial engineering;
- engineering informatics;
- light industry engineering.

Admittance to master courses (MSc) ensured by the announced training, partly in English language, is possible in case of meeting the input conditions, passing entrance examination and in case of at least 5 students' participation.

## Description of the Doctoral training

The highest level of the faculty's education is represented by the Kandó Kálmán Doctoral School, where the PhD students are being prepared for scientific research and a possible career as a professor and researcher. The programme's tasks deal with transportation, vehicle industry and logistics related questions, which actual topics are frequently updated.

The 4 year program lets the students take part in professional subjects and courses, teaching activities and individual scientific research tasks. The programme will deepen the students' knowledge in 3 main fields: high level natural science, foundation of profession and specialist subjects in vehicles and mobile machines, transportation and logistics sciences. Furthermore they will gather knowledge through specific optional subjects.

The high quality of the education is guaranteed by the well recognized core members of the programme. Research activity is being lead by a professional supervisor, and the PhD students will show their results through their publications and later in their dissertation.

# Curriculum of MSc in Vehicle Engineering

| Subject | | Lecture / Practice / Laboratory / Exam type / Credit | | | | Prerequisites | |
|---|---|---|---|---|---|---|---|
| Name | Code | 1 | 2 | 3 | 4 | Compulsory | Recommended |
| Advanced Driver Assistance Systems | BMEKOGGM657 | 2/0/2/v/4 | | | | - | - |
| Advanced Flight Theory | BMEKORHM620 | 2/1/0/v/4 | | | | - | - |
| Advanced materials and technologies | BMEKOGGM601 | 3/2/0/f/5 | | | | - | - |
| Aircraft design and production I. | BMEKOVRM629 | 2/0/2/v/4 | | | | - | - |
| Computer aided design | BMEKOJSM605 | 2/0/2/v/4 | | | | - | - |
| Control theory | BMEKOKAM142 | 2/1/0/v/3 | | | | - | - |
| Environment Sensing in the Vehicle Industry | BMEKOKAM656 | 2/0/2/v/4 | | | | - | - |
| Instrumental tests for motor vehicles, measurement technology | BMEKOGGM668 | 0/0/4/f/4 | | | | - | - |
| Machine Intelligence | BMEKOALM644 | 2/2/0/v/4 | | | | - | - |
| Measurement techniques and signal processing in vehicles | BMEKOKAM635 | 4/0/2/v/8 | | | | - | - |
| Mechanics of superstructure materials | BMEKOJSM663 | 2/0/2/v/4 | | | | - | - |
| Numerical methods | BMEKOVRM121 | 2/0/1/f/4 | | | | - | - |
| Operation of railway vehicles | BMEKOVJM409 | 2/0/0/v/3 | | | | VJM402 | VJM109 |
| Practice in technology of manufacturing and materials in vehicle industry | BMEKOGGM648 | 0/2/2/v/4 | | | | - | - |
| Programming in C and Matlab | BMEKOKAM603 | 2/0/2/f/4 | | | | - | - |
| Railway vehicle system dynamics | BMEKOVRM608 | 3/1/0/v/5 | | | | - | - |
| Requirements for superstructure designers | BMEKOJSM662 | 0/2/2/v/4 | | | | - | - |
| Road safety, legislative environment, human factors | BMEKOGGM653 | 2/0/2/v/4 | | | | - | - |
| Ship design | BMEKOVRM615 | 2/2/0/v/5 | | | | - | - |
| Simulation of technical systems | BMEKOALM645 | 2/1/1/v/4 | | | | - | - |
| Surface Engineering | BMEKOGGM647 | 2/0/2/v/4 | | | | - | - |
| Suspension design | BMEKOGJM613 | 2/0/2/v/4 | | | | - | - |
| Theory of Ships III. | BMEKOVRM616 | 2/1/0/v/3 | | | | - | - |
| Vehicle operation, reliability and diagnostics | BMEKOVRM602 | 2/0/0/f/2 | | | | - | - |
| Accident analysis I., forensic processes | BMEKOGGM654 | | 2/0/2/v/4 | | | - | - |
| Aircraft analysis I. | BMEKOVRM631 | | 2/0/2/v/4 | | | - | - |
| Aircraft design and production II. | BMEKOVRM630 | | 2/0/2/v/4 | | | - | - |
| Computational fluid- and thermodynamics | BMEKOVRM606 | | 2/0/2/v/4 | | | - | - |
| Construction of vehicle manufacturing systems I. | BMEKOGGM649 | | 2/0/2/v/4 | | | - | - |
| Design methods of drive systems | BMEKOALM646 | | 2/0/1/v/3 | | | - | - |
| Design of material handling machine design | BMEKOKAM627 | | 2/2/1/v/5 | | | - | - |
| Design of pleasure craft | BMEKOVRM625 | | 2/1/0/v/4 | | | - | - |
| Diesel and electric traction | BMEKOVRM610 | | 3/1/0/v/5 | | | - | - |

# Curriculum of MSc in Vehicle Engineering (Contd.)

| Subject | | Lecture / Practice / Laboratory / Exam type / Credit | | | | Prerequisites | |
|---|---|---|---|---|---|---|---|
| Name | Code | 1 | 2 | 3 | 4 | Com-pulsory | Recom-mended |
| Discrete Control Design | BMEKOKAM658 | | 2/0/2/v/4 | | | - | - |
| Dynamics of vehicle, active- and passive safety | BMEKOGJM641 | | 2/0/2/v/4 | | | - | - |
| Electronics – electronic measurement systems | BMEKOKAM103 | | 2/1/0/f/4 | | | - | - |
| Engine design I. | BMEKOGGM670 | | 2/0/2/v/4 | | | - | - |
| Fixing and sealing | BMEKOGGM650 | | 2/0/2/v/4 | | | - | - |
| Machines of construction material production | BMEKOALM672 | | 2/2/1/v/5 | | | - | - |
| Mechatronics, microcomputers | BMEKOKAM604 | | 2/0/2/f/4 | | | - | - |
| Ship motions | BMEKOVRM624 | | 2/1/1/v/4 | | | - | - |
| Structural vibrations | BMEKOJSM665 | | 2/0/2/v/4 | | | - | - |
| Structure analysis | BMEKOJSM609 | | 2/0/2/v/4 | | | - | - |
| Superstructure preliminary design | BMEKOJSM664 | | 2/0/2/v/4 | | | - | - |
| System technique and analysis | BMEKOVRM129 | | 2/2/0/f/4 | | | - | - |
| Traction mechanics | BMEKOVRM619 | | 2/1/0/v/3 | | | - | - |
| Transmission system design | BMEKOGJM612 | | 2/0/2/v/4 | | | - | - |
| Vehicle automation systems | BMEKOGGM659 | | 2/0/2/v/4 | | | - | - |
| Vehicle system dynamics and control | BMEKOVRM636 | | 3/2/1/v/8 | | | - | - |
| Accident analysis II., simulation methods | BMEKOGGM655 | | | 2/0/2/v/5 | | GGM654 | - |
| Analysis of Aircraft II. | BMEKOVRM632 | | | 3/0/2/v/7 | | - | - |
| Computer aided manufacturing | BMEKOGGM618 | | | 2/0/2/v/4 | | JSM605 | - |
| Construction machinery design - project | BMEKOALM674 | | | 2/2/0/v/5 | | - | - |
| Construction mechanization project planning methods | BMEKOALM673 | | | 1/2/1/v/5 | | - | - |
| Construction of vehicle manufacturing systems II. | BMEKOGGM651 | | | 2/0/2/v/5 | | - | - |
| Design and testing of railway vehicle systems | BMEKOVRM607 | | | 4/0/2/v/10 | | - | - |
| Design methods of material handling systems | BMEKOALM642 | | | 1/2/1/v/5 | | - | - |
| Design of material handling machines - project | BMEKOALM643 | | | 2/2/0/v/5 | | - | - |
| Design of Vehicle Automation Systems | BMEKOKAM661 | | | 2/0/4/v/7 | | KAM658 | - |
| Engine design II. | BMEKOGGM671 | | | 2/0/2/v/5 | | GGM670 | - |
| Measurement systems in vehicle manufactur-ing | BMEKOGGM652 | | | 2/0/2/v/5 | | - | - |
| Mechatronic design of vehicle systems | BMEKOGGM622 | | | 2/0/2/v/5 | | - | - |
| Production process quality assurance in the vehicle industry | BMEKOGGM611 | | | 2/0/0/f/2 | | - | - |
| Project | BMEKOVRM633 | | | 0/1/2/f/3 | | - | - |
| Project work | BMEKOVRM628 | | | 0/1/1/f/2 | | - | - |
| Projectmanagement in automotive industry | BMEKOKKM617 | | | 2/0/0/f/2 | | - | - |
| Reliability, Safety and Security in the Vehicle Industry | BMEKOKAM660 | | | 2/0/0/v/3 | | - | - |
| Research and devlopment process in the vehicle industry | BMEKOGGM614 | | | 2/0/0/f/2 | | - | - |
| Ship hydrodynamics | BMEKOVRM626 | | | 1/1/1/v/4 | | - | - |
| Ship strength | BMEKOVRM621 | | | 1/1/1/v/4 | | - | - |
| Superstructure control technics | BMEKOJSM666 | | | 2/0/2/v/5 | | - | - |
| Vehicle evaluation, traffic environment | BMEKOGJM640 | | | 2/0/2/v/5 | | - | - |
| Vehicle simulation and optimisation | BMEKOVRM638 | | | 2/2/0/v/5 | | - | - |
| Vehicle superstructure design | BMEKOJSM667 | | | 2/0/2/v/5 | | JSM664 | - |
| Vehicle system informatics | BMEKOVJM437 | | | 2/0/2/v/5 | | - | - |
| Thesis work | | | | | 0/30/0/f/30 | - | - |

# Curriculum of MSc in Transportation Engineering

| Subject | | Lecture / Practice / Laboratory / Exam type / Credit | | | | Prerequisites | |
|---|---|---|---|---|---|---|---|
| Name | Code | 1 | 2 | 3 | 4 | Compul-sory | Recom-mended |
| Control theory | BMEKOKAM142 | 2/1/0/v/3 | | | | - | - |
| Decision making methods | BMEKOKKM221 | 3/1/0/f/5 | | | | - | - |
| Intelligent transport systems | BMEKOKUM205 | 2/0/2/v/5 | | | | - | KUM203 |
| Mathematics MK | BMETE90MX59 | 2/2/0/f/4 | | | | - | - |
| Road Safety | BMEKOKKM222 | 2/1/0/f/3 | | | | - | - |
| Transport automation | BMEKOKAM202 | 2/1/0/v/4 | | | | - | - |
| Transport Economics | BMEKOKGM201 | 2/1/0/v/4 | | | | - | - |
| Air Traffic Management (ATM) | BMEKOVRM224 | | 1/0/1/f/3 | | | - | - |
| Communications, Navigation and Surveil-lance (CNS) I. | BMEKOKAM226 | | 2/1/0/f/3 | | | - | - |
| Controlling systems in transportation | BMEKOKGM215 | | 4/0/0/v/6 | | | KGM201 | KGM201 |
| Electronics – electronic measurement systems | BMEKOKAM103 | | 2/1/0/f/4 | | | - | - |
| Forwarding Management 1 | BMEKOKKM132 | | 2/2/0/v/5 | | | - | - |
| I+C technologies | BMEKOKAM104 | | 2/1/0/f/3 | | | - | - |
| Information connection of the vehicle and the track | BMEKOKAM232 | | 2/0/0/f/3 | | | - | - |
| "Material handling and warehousing processes<br>" | BMEKOALM225 | | 2/1/0/f/4 | | | - | - |
| Meteorology | BMEKOVRM231 | | 2/0/0/v/3 | | | - | - |
| Modelling and control of vehicles and traffic systems | BMEKOKAM233 | | 2/3/0/v/6 | | | - | - |
| Numerical methods | BMEKOVRM121 | | 2/0/1/f/4 | | | - | - |
| Smart City | BMEKOKKM227 | | 2/0/0/f/3 | | | - | - |
| Transport informatics | BMEKOKKM223 | | 2/0/2/v/5 | | | - | - |
| Transport Infrastructure Management | BMEKOKKM228 | | 2/0/0/f/3 | | | - | KGM201 |
| Transport modelling | BMEKOKKM229 | | 1/0/3/v/6 | | | - | - |
| Transport operation | BMEKOKUM206 | | 2/2/0/v/5 | | | - | KUM203, KAM202 |
| Air Traffic Control | BMEKOVRM235 | | | 2/0/1/v/4 | | - | - |
| Case study | BMEKOVRM237 | | | 0/2/0/f/3 | | - | - |
| City logistics | BMEKOALM244 | | | 2/2/0/v/5 | | KKM227 | - |
| Communications, Navigation and Surveil-lance (CNS) II. | BMEKOKKM239 | | | 3/0/0/v/4 | | - | - |
| Engineering of transport automation systems | BMEKOKAM234 | | | 2/0/3/v/6 | | KAM233 | - |
| Environmental effects of transport | BMEKOKKM230 | | | 2/1/0/f/4 | | - | - |
| Financing techniques in transportation | BMEKOKKM236 | | | 1/0/3/v/5 | | KGM201 | - |
| Forwarding Management 2 | BMEKOKKM133 | | | 3/1/1/v/5 | | KKM132 | - |
| Forwarding marketing | BMEKOKKM135 | | | 1/0/2/f/4 | | - | - |
| Human resource management in trans-portation | BMEKOKKM238 | | | 1/0/2/f/3 | | KGM201 | - |
| Management of transport and logistic services | BMEKOKGM217 | | | 2/2/0/v/6 | | KGM201 | - |
| Passanger transportation | BMEKOKUM208 | | | 2/0/2/v/5 | | - | KUM204 |
| Project | BMEKOKAM242 | | | 0/2/0/f/3 | | KAM233 | - |
| Projectmanagement in transportation | BMEKOKKM241 | | | 2/0/0/f/2 | | - | - |
| Safety in air traffic control | BMEKOKAM243 | | | 2/0/0/f/3 | | - | - |
| Signal processing in transport | BMEKOKAM211 | | | 2/2/0/v/5 | | KAM104 | - |
| Supply and distribution processes | BMEKOALM240 | | | 1/1/0/f/2 | | - | - |
| Trade, Financial, Accounting Techniques | BMEKOKKM138 | | | 1/1/1/v/3 | | - | - |
| Traffic flow | BMEKOKUM204 | | | 2/1/0/v/4 | | - | - |
| Thesis work | | | | | 0/30/0/f/30 | - | - |

# Curriculum of MSc in Logistics Engineering

| Subject | | Lecture / Practice / Laboratory / Exam type / Credit | | | | Prerequisites | |
|---|---|---|---|---|---|---|---|
| Name | Code | 1 | 2 | 3 | 4 | Compul-sory | Recom-mended |
| Control theory | BMEKOKAM122 | 2/1/1/v/5 | | | | - | - |
| Lean management | BMEKOALM322 | 2/1/0/f/4 | | | | - | - |
| Logistics controlling | BMEKOKKM330 | 2/0/0/f/3 | | | | - | - |
| Logistics information system planning | BMEKOALM321 | 2/0/2/f/5 | | | | - | - |
| Mathematics ML | BMETE90MX60 | 2/2/0/v/5 | | | | - | - |
| Planning of extra-logistics networks | BMEKOALM337 | 2/1/0/v/4 | | | | - | - |
| Algorithm Design | BMEKOKAM326 | | 2/0/2/f/5 | | | - | - |
| Automation of logistics systems | BMEKOALM325 | | 2/0/2/v/5 | | | - | - |
| Demand planning and inventory manage-ment | BMEKOALM328 | | 2/1/1/v/5 | | | - | - |
| Enterprise logistics project 1. | BMEKOALM339 | | 0/4/0/f/4 | | | - | - |
| Forwarding Management 1 | BMEKOKKM132 | | 2/2/0/v/5 | | | - | - |
| Forwarding project 1. | BMEKOKKM338 | | 0/4/0/f/4 | | | - | - |
| Logistics planning softwares | BMEKOALM336 | | 0/0/2/f/3 | | | - | - |
| Numerical optimization | BMEKOVRM334 | | 3/0/1/v/5 | | | - | - |
| Process planning | BMEKOALM331 | | 2/1/0/v/3 | | | - | - |
| Simulations planning | BMEKOALM335 | | 1/1/1/f/3 | | | - | - |
| Technical logistics project 1. | BMEKOALM333 | | 0/4/0/f/4 | | | - | - |
| Construction of logistics machinery | BMEKOALM324 | | | 2/1/0/v/3 | | - | - |
| Control of transport logistics | BMEKOALM341 | | | 2/0/1/v/3 | | - | - |
| Enterprise logistics project 2. | BMEKOALM343 | | | 0/7/0/f/7 | | ALM339 | - |
| Forwarding Management 2 | BMEKOKKM133 | | | 3/1/1/v/5 | | KKM132 | - |
| Forwarding marketing | BMEKOKKM135 | | | 1/0/2/f/4 | | - | - |
| Forwarding project 2. | BMEKOKKM342 | | | 0/2/0/f/2 | | KKM338 | - |
| Integrated material flow systems | BMEKOALM332 | | | 2/1/0/v/4 | | - | - |
| Planning of plant logistics systems | BMEKOALM327 | | | 2/2/0/v/5 | | ALM331 | ALM335 |
| Planning of warehousing systems | BMEKOALM323 | | | 2/2/0/v/5 | | ALM331 | ALM335 |
| Production planning & scheduling | BMEKOALM329 | | | 2/0/1/v/4 | | ALM328 | - |
| Technical logistics project 2. | BMEKOALM340 | | | 0/7/0/f/7 | | ALM333 | - |
| Trade, Financial, Accounting Techniques | BMEKOKKM138 | | | 1/1/1/v/3 | | - | - |
| Thesis work | | | | | 0/30/0/f/30 | - | - |

# Description of M.Sc. Subjects
# Master Section in Vehicle Engineering

## Advanced Driver Assistance Systems

**BMEKOGGM657**

*Dr. Zsolt Szalay*
(4 credits)

## Advanced Flight Theory

**BMEKORHM620**

*Dr. József Rohács*
Basic summary of aerodynamics, flight performance, stability, flight dynamics and control. Modeling the aerodynamic coefficients and derivatives, non-steady aerodynamics. Non-linear and statistical flight dynamics and control. Critical flight regimes. New control methods. Use of biological principles. Aircraft active, endogenous subjective control. Less-skilled pilots and safety philosophy of the small and personal aircraft. Use of MEMS (micro-electro-mechanical systems) in flow and flight control. Rendezvous control. Hypersonic flights. (4 credits)

## Advanced materials and technologies

**BMEKOGGM601**

*Dr. Krisztián Bán*

(5 credits)

## Aircraft design and production I.

**BMEKOVRM629**

*Dr. Dániel Rohács*
Aircraft development philosophies.: the role of aviation in economy, major problems of aviation and aeronautical industry, goodness factors and their changes during development processes, general development process, technology transfer, development and design methods, control of the development processes.
Computer aided design processes. Specific aspects of using the CATIA. Surface modeling.
Development and design of the aircraft gas turbines. and their parts. (4 credits)

## Computer aided design

**BMEKOJSM605**

*Dr. László Lovas*
Advanced computer aided design (CAD) methods. Kinematic and kinectic analysis. Surface modelling. Modelling and measuring of stochastic loads. Numerical lifetime expecation using probalistic methods. Load collective. Fatigue of parts. Linear elasctic fracture theory, remaining lifetime. (4 credits)
Control theory
**BMEKOKAM142**

*Dr. József Bokor*
The course provides deepening of knowledge in control theory. Provides theoretical knowledge, and discusses modern tools, which are necessery in later eingineering practice. This is introduced through different examples, taken from vehicle and transportation systems. (3 credits)

## Environment Sensing in the Vehicle Industry

**BMEKOKAM656**

*Dr. Tamás Bécsi*
The course aims the introduction of the main sensor technologies of the vehicle industry. Amng these, Ultrasonic, radar, Lidar, and camera based methods are discussed. (4 credits)

## Instrumental tests for motor vehicles, measurement technology

**BMEKOGGM668**

*Dr. Bálint Szabó*
Based on the requirements of the current vehicle engineer education this subject gives a deep knowledge on methods of vehicle tests and measurement systems. Methods and tools of vehicle dynamical tests are introduced. It focuses on the dynamical measrements of the vehicle subsystems like brake system, steering system and the suspension. According to the present requirements of vehicle developments the demonstration of the testbench based HIL tests are part of the education. Besides the vehicle dynamical measrements, it is essential to get familiar with the fuel consumption measurements and with the emission tests performed on roller test bench. To intoduce the modern engine testing methods, engine test bench mearements will be carried out during the course. Alongside the development related test, the latest diagnostic measurement methods will be introduced as well. (4 credits)

## Machine Intelligence

**BMEKOALM644**

*Dr. Tamás Szirányi*
This subject teaches the students basics of machine intelligence in order to understand and be capable to apply them. (4 credits)

## Measurement techniques and signal processing in vehicles

**BMEKOKAM635**

*Dr. Alexandros Soumelidis*
Provides knowledge about the instrumental measurment and evaluation of the vehicle paramaters. Furthermore introducing sensing and measurement principles, signal processing, traffic measurment. Theory of sensorfusion, sensor networks of the vehicle dynamics measurment. State estimation, parameter estimation, Kalman-filter. Applications in vehcile control systems. (8 credits)

## Mechanics of superstructure materials

**BMEKOJSM663**

*Dr. Péter Béda*
Modeling of materials. Role of the constitutive equation, principles of its building. Types of material laws, typical behavior issue from experiments. Presentation and study of elastic and plastic bodies. Rheological models. Application examples. (4 credits)

## Numerical methods

**BMEKOVRM121**

*Dr. Rohács József*
Introduction. System modeling. General model, assumptions, errors. Solving the non-linear equation, Newton iteration. Polynomial equations, Horner, Newton methods. Systems of linear equations: Gauss elimination, Matrices, enginvalues. Linear programming. Simplex Method. non-. linear optimization, gradient method. Interpolation. New-

ton's, Lagrange Hermite methods, spline. Approximation: Chebyshev, Padé. Fast Fourier transformation. Numerical differentiation, integration. Solving the differential equations. Euler, Runge-Kutta, predictor-corrector methods. Systems of partial differential equations. finite differences, finite volumes methods. Stochastic modeling. (4 credits)

## Operation of railway vehicles

**BMEKOVJM409**

*Dr. József Csiba*
Service processes for railway vehicles. Vehicle input, the actual service timing and vehicle output as componenets of a random service process. Inventory problems in the operation of railway vehicles, the theory of minimum cost-storing and purchase. Statistical theory of the operating system of railway vehicles based on the technical state. Analysis of the operation reliability of railway vehicles, reliability-based operation/maintenance (RCM system). Railway vehicle diagnostics, vehicle diagnostics and stationary equipments, stations. Systems for identifying of vehicles and their operational modes. Operational properties of braked trains, braking-difficulties, dynamical- and thermal processes. (3 credits)

## Practice in technology of manufacturing and materials in vehicle industry

**BMEKOGGM648**

*Dr. Krisztián Bán*
(4 credits)

## Programming in C and Matlab

**BMEKOKAM603**

*Dr. Tamás Bécsi*
The course aims the introduction to programming in C and Matlab languages. (4 credits)

## Railway vehicle system dynamics

**BMEKOVRM608**

*Dr. Zoltán Zábori*
The railway vehicle as a dynamical system. Main motion and parasitic motions. Railway vehicle vibration analysis. The spring and damper elements. The wheel-rail rolling contact. Eigen-frequencies and stability reserves, limit cycles and chaotic motions. The non-linear models. The wheel-rail wear process. The track-vehicle system dynamics. Definition and measurement of track irregularities. Spectral characteristics of the track irregularities. Parameter sensitivity of the track-vehicle system. Parameter optimization. Measurement procedures for examining the vehicle-track system processes. (5 credits)

## Requirements for superstructure designers

**BMEKOJSM662**

*Dr. Péter Béda*
Manufacturer's requests for vehicle superstructure designers. Manufacturer's rules for superstructures and assembling. National and international laws. Preparation for manufacturing. (4 credits)

## Road safety, legislative environment, human factors

**BMEKOGGM653**

*Dr. Gábor Melegh*
Legal studies: an extract from the constitutional law, substantive and procedural civil law, criminal law, criminal procedural law, driving offences, issues of damages claims. Human factors in road traffic: personality characteristics, behaviours, human health protection, generational problems, effects of weather and seasons, special related questions of vegetation and fauna, damages caused by wild animals.
Personal injuries: the human body, physiological particularities, classification of injuries, examination of accidents in the light of injuries, examination of blood alcohol concentration, examples of medical investigation of accidents. (4 credits)

## Ship design

**BMEKOVRM615**

*Dr. Győző Simongáti*
The course aims at introduction of the process of ship design, the design spiral, determination of main particulars, lines planning, optimisation techniques, conceptual design, preliminary design methods, tonnage calculation, etc. (5 credits)

## Simulation of technical systems

**BMEKOALM645**

*Dr. Gábor Bohács*
The subject intruduces to the students software background which can be used as a virtual reality to support engineering decisions. (4 credits)

## Surface Engineering

**BMEKOGGM647**

*Dr. Tamás Markovits*
Interpretation of surface properties and function. Tribology. Surface preparation and modification technologies. Creation of thin surface layers (CVD, PVD, ion implantation). Plasma processes, laser technology (laser sources, laser material interaction, laser cutting, welding, drilling, surface treatment, rapid prototyping). (4 credits)

## Suspension design

**BMEKOGJM613**

*Dr. Bálint Szabó*
Analysis of forces acting on wheel using modern tyre-models, knowing objective functions of static and dynamic geometrical parameters of tyres, necessary for design. Geometrical design of tyre suspension, structural design of each parts of suspension (rods, arms, ball joints, rubber mountings). Vibration analysis of vehicle, geometrical and structural design of elements of suspension (coils, springs, shock absorbers, stabilizers, motion boundary elements) in regard to requirement systems of suspensions. Dynamical analysis of braking vehicle in order to determine design requirements; methods for proportioning brake force between axles; design of conceptual schema of brake system; geometrical, structural, thermo- and fluid dynamical design of each parts. Determination of initial data needed to design the steering system using dynamical analysis of steering; design of steering mechanism; geometrical and structural design of elements of steering systems (tie rod, track rod, steering-gear, steering wheel and axle, ball joints). (4 credits)

## Theory of Ships III.

**BMEKOVRM616**

*Dr. Győző Simongáti*
The aim of the course is to introduce the special cases of stability to the students. Topics are: deterministic and probabilistic damaged stability methods, grounding, docking, stability of floating cranes, split barges. (3 credits)

## Vehicle operation, reliability and diagnostics

**BMEKOVRM602**

*Dr. József Csiba*
Time frame, maintenance, energy-, material and information technological environment of the vehicle operation. Characteristic uncertainties in the vehicle operation and vehicle dimensioning. Basics of probability analysis. Practical methods of reliability analysis: block -diagram method and fault-tree analysis. Random faults and defects in vehicle operation. Methods of determining reliabilty and availability. Availability definitions. Renewal processes. Modelling of operation processes by semi-Markovian approach. Application of the theory of mass service systems. Queueing problem. Optimum storing processes. Elements of material damages, leading to component failures. General approach to system diagnosis. Vehicle diagnosis based on dynamical simulation for ensureing the criteria presribed by transportation safety rules. Identification of the weak-spots using diagnostic tests. (2 credits)

## Accident analysis I., forensic processes

**BMEKOGGM654**

*Dr. Gábor Melegh*
Technical causes of road traffic accidents, malfunctions of vehicles and engines: the most occurring malfunctions of vehicles and its engines, causing great damages. Identifying the root causes of accident from incurred damages. ascertainment of the technical responsibility, conclusions, options of accident avoidances. Role of vehicles, explanation of technical malfunctions,
analysis of road traffic accidents occurred for technical reasons, contribution of subjective causes.
Evaluation of accident forms: Main forms of accident and conclusions deductible from conditions after accident. Accidents attendant on hitting pedestrians, fundamental calculation methods, evaluation of hitting pedestrian overstepping form covering,
accidents occurred in reduced visibility, experimental reconstruction of traffic accidents.
Vehicle collision: substantial formulas of crashes, crash-calculation by analytical and graphical methods; deformations of vehicles and pictures of damages, energy grid. (4 credits)

## Aircraft analysis I.

**BMEKOVRM631**

*Dr. Károly Beneda*
The aim of the course is to introduce the analysis techniques of aircraft and powerplants. (4 credits)

## Aircraft design and production II.

**BMEKOVRM630**

*Dr. Balázs Gáti*
Aircraft Design II. (4 credits)

## Computational fluid- and thermodynamics

**BMEKOVRM606**

*Dr. Árpád Veress*
The goal of the present subject is to prepare students for the state of the art application of CFD calculation methods in the vehicle engineering with including thermodynamics and heat transfer. (4 credits)

## Construction of vehicle manufacturing systems I.

**BMEKOGGM649**

*Dr. Tamás Markovits*
(4 credits)

## Design methods of drive systems

**BMEKOALM646**

*Dr. Gábor Bohács*
This subject aims to introduce the construction and materials handling machines' specific drive systems, construction and examination methodology. (3 credits)

## Design of material handling machine design

**BMEKOKAM627**

*Dr. Gábor Bohács*
Design and norming of material handling machines. Capacity and power requirement calculation for machines of bulk materials. Design of material handling machines for unit loads, especially forklifts and cranes. (5 credits)

## Design of pleasure craft

**BMEKOVRM625**

*Dr. Győző Simongáti*
The course aims at introduction of the specialities pleasure craft design. (4 credits)

## Diesel and electric traction

**BMEKOVRM610**

*Dr. András Szabó*
Design properties of railway Diesel engines, dynamical processes of injection and control systems. Turbocharging systems of railway diesel engines. Design properties of Diesel-hydraulic and Diesel-electric powertrain system design, machine-group optimization, transient operation processes. Drive dinamics of electric traction units, electromechanical, controlled systems. Analysis of the work done and energy-consumption, hydraulic/electro-dynamic braking of trains of Diesel and electric traction units, and their optimization. (5 credits)

## Discrete Control Design

**BMEKOKAM658**

*Dr. Péter Gáspár*
The course aims the presentation of discrete control theory. Besides the theoretical and mathematical design aspects, implementation issues are also discussed. (4 credits)

## Dynamics of vehicle, active- and passive safety

**BMEKOGJM641**

*Dr. Gábor Melegh*
Analysis of the forces acting on the wheels, state of the art tyre-models, static and dynamic geometric characteristics of tyre from the point of view of traffic safety. Analysis of force and moment conditions of transmission systems, examination of dynamic parameters of mechanical and hydrodynamical torque converter.
Geometry of tyre suspension, load of each elements of suspension.Vibration theory of vehicle, parts of suspension. Dynamic analysis of vehicle braking; methods for proportioning brake force
between axles of vehicle; conceptual schema of different types of brake systems; geometrical-, mechanical-, heat-

and hydrodynamics loads of single part.
Dynamical analysis of steering, geometrical and mechanical design of parts os steering systems (tie rod, track rod, steering gear, steering wheel and axle, ball joints).
Rreview of software solutions applicable for making vehicle dynamic models; examination of longitudinal and transverse vehicle dynamics, methods for controlling vehicle dynamics. Dynamical examination and modelling of vehicle's roll over process.
Active and passive components of vehicle safety: control systems of vehicle dynamics, introducing systems which are suitable to mitigating consequences of accidents. Detailed review of sensors and actuators which are parts of these systems. Uses of data stored in these systems' ECUs for reconstruction
of an accident. (4 credits)

## Electronics – electronic measurement systems

**BMEKOKAM103**

*Dr. Géza Szabó*
The subject gives basic knowledge of electronics and electronic measurements and their application in different areas of transportation. It summarizes the operational modes of basic components and basic circuits and describe how one can design and apply them. It gives an overview of electric and mechanical measurements and how the results of measurements can be processed
(4 credits)

## Engine design I.

**BMEKOGGM670**

*Dr. Huba Németh*
Grouping of engine simulation methods. Wave action engine models and its equations. Flow filed, pressure drop and heat transfer in the intake and exhaust systems. Flow splits. Flow on intake and exhaust valves. Constructional and geometrical design of combustion chambers. Set up of bore-stroke ratio, valve diameters, and compression ration values. Modelling of combustion processes, and its main parameters. Wall heat transfer models. Mechanic losses and friction models. Determination of charger pressure and fuel rate for given performance targets. Set up of the charger and its cooperation with the engine. Reduced charger maps. Control of charging systems.
Mechanical and thermal loads of the reciprocating engine pistons. Geometric and construction design of pistons. Wrist pin design. Dimensioning methods. (4 credits)

## Fixing and sealing

**BMEKOGGM650**

*Dr. Krisztián Bán*
(4 credits)

## Machines of construction material production

**BMEKOALM672**

*Dr. Gábor Bohács*
Computer aided construction of crushing machines. Motion equations of vibrating sieves. Construction of concrete mixers. Reinforcing steel processing equipment sizing and system control features. (5 credits)

## Mechatronics, microcomputers

**BMEKOKAM604**

*Dr. Péter Gáspár*
Introducing the modern computer systems and the operating principles of robots. Numeral systems CPU arithmetics, operations and algorithms with binary numbers. CPU architectures, tasks and operation. Computer networks: protocols, devices for wired and wireless communication. (4 credits)

## Ship motions

**BMEKOVRM624**

*Dr. Győző Simongáti*
The course aims to introduce students to the dynamics and transient phenomena of ship motions, and to the dynamics of equipments which may effect on ship motions. (4 credits)

## Structural vibrations

**BMEKOJSM665**

*Dr. Péter Béda*
The second order Lagrange equation equation for holonomic and scleronomic conservative systems. The existence of stable equilibrium. Small oscillations, frequencies approximate definition. Vibrations of rods, axes, strings and membranes. Basics of modal analysis. Methods for nonlinear oscillation problems. (4 credits)

## Structure analysis

**BMEKOJSM609**

*Dr. Péter Béda*
Theory and practice of the finite element method. Linear, elastic and plastic material modeling. Mechanical and thermal analysis. Eigenfequencies and vibrations. Topological structure optimisation. Study and verification of the optmized model. (4 credits)

## Superstructure preliminary design

**BMEKOJSM664**

*Dr. László Lovas*
Construction, special links. Connections among square tubes, sheet metal and elastic covers. Connection between vehicle frame and rigid superstructure with given function. (4 credits)

## System technique and analysis

**BMEKOVRM129**

*Dr. István Zobory*
Vehicle and machine analysis using system theoretical approach. System characterisation by means of graphs. Hierarchy of system structures: ements, element-groups, machine, machine group. Characterisation of complex engineering systems by block-diagrams, structure graps and sigjnal-flow graphs. Desciption of the system connections. Construction of the input-output system equations by using the system operator. Application of Lagrangean and Hamiltonean procedure. The general theoryh of linear dynamic systems. Weighting function, transition function in the time domain. Convolution theorem. Complex frequency function in the frequency domain. Periodic, aperiodic and stationary stochastic excitations, widht SISO and MIMO systems. Determination of the system response. Analysis of the coherency conditions. (4 credits)

## Traction mechanics

**BMEKOVRM619**

*Dr. István Zobory*
Factors of train motion. Tractive effort, braking force, track force. The tractive and braking forces applied in the control system influencing the torque conditions of the rotating components. Determining the train-weight that can be started, the construction Koreff-figure. Detreming the speed-timing diagrams by means of simulation using dynamical models. Taking into account the limit force that can be transferred through the rolling contact, without macroscopic sliding. The longitinal dynamics of trains. Dynamics of train-tearing. Dynamics of special train motions: shunting, marshalling, hump. Energy demand of train motion, simulation of energy consumption with Diesel- and electric traction. Outlook to the sphere of problems of energy optimum train control, basic principle for the application of traction and braking forces, the numerical layuot of the optimum train control. (3 credits)

## Transmission system design

**BMEKOGJM612**

*Dr. Huba Németh*
Main parameters of vehicle mechanics. Construction of an arbitrary selected transmission component (clutch, gearbox or final drive), set-up of functional dimension based on vehicle dynamic calculations, geometrical construction of all components, structural dimensioning of gears, shafts and bearings for load and lifetime, construction and dimensioning of actuation mechanisms, design of housings and fixation points. (4 credits)

## Vehicle automation systems

**BMEKOGGM659**

*Dr. Zsolt Szalay*
(4 credits)

## Vehicle system dynamics and control

**BMEKOVRM636**

*Dr. István Zobory*
Analysis of dynamical models apt for examining the main motion of vehicles and vehicle-strings, as well as traffic flows. The non-linear dynamic model of the force transfer in rolling contact with regard to stochasticity coming from tribological properties. Motion equations of lumped parameter models capable for vibrations describing vehicle system. The forces and motion excitation, as well as parametric excitations. The stochastic ordinary differential equation system of the discrete dynamical system. Constraction of motion equation systems of distributed parameter vehicle systems. The stochastic partial differential equation system of the distributed parameter dynamical system. The vehicle dynamical systems as a controlled or regulated section. Formulation of some typical vehicle dynamical task for control, with operation-technical explanation of the control signals. The vehicle control problem formulated by model based methods. Methods apt for designing vehicle control. Failure detecting in the vehicle control system. Design of vehicle control of reconfigurating and fault-toleranting character. Design of integrated control and inspection control. Case studies concerning controlled vehicle dynamical systems. (8 credits)

## Accident analysis II., simulation methods

**BMEKOGGM655**

*Dr. Gábor Melegh*
Description of crash-models used in software solutions for accident reconstruction. Examination and analysis of complete regular and irregular vehicle motion process with simulation methods.
Specifying the parameters which are necessary for simulation; confinement the circle of questions
answerable by available parameters and data in a concrete case. Interpretation of probabilistic ascertainments. Parameter sensitivity analysis of simulation results.
Evaluation, analysis and explanation of results provided by simulation software; plausibility of results. (5 credits)

## Analysis of Aircraft II.

**BMEKOVRM632**

*Dr. Balázs Gáti*
(7 credits)

## Computer aided manufacturing

**BMEKOGGM618**

*Dr. Zoltán Pál*
(4 credits)

## Construction machinery design - project

**BMEKOALM674**

*Dr. Gábor Bohács*
Theory of mechanical construction of the building machines. Handling special load cases of the building industry's tasks. Preparation of a complex task relating construction machines. (5 credits)

## Construction mechanization project planning methods

**BMEKOALM673**

*Dr. Gábor Bohács*
Management of construction projects from mechanization aspects. Compilation of machine chains and systems. Capacity planning and scheduling. Determining operational parameters of earthwork machines and other construction machinery. (5 credits)

## Construction of vehicle manufacturing systems II.

**BMEKOGGM651**

*Dr. János Takács*
(5 credits)

## Design and testing of railway vehicle systems

**BMEKOVRM607**

*Dr. András Szabó*
Rail vehicle construction and design of mechanical equipment. Systemtechnical analysis of railway vehicles. Optimization of the components in the vehicle system. On board condition monitoring and data collection systems. Design of systems with prescribed reliability. Computer-assisted vehicle tests. Strainth analysis of railway vehicles by usind finite elemet methods. Dynamical simulation to predict the loading conditions of structural elements. Computer based measurement evaluation methods. Numerical methods for parameter optimization. Real-time simulation methods. Railway vehicle design project. (10 credits)

## Design methods of material handling systems

**BMEKOALM642**

*Dr. Gábor Bohács*
Characteristics of structure and operation of material handling systems. Mechanical connections and communicational issues among the systems' components. Identification methods for bottlenecks. Planning operational strategy of material handling system. Safety in material handling systems. (5 credits)

## Design of material handling machines - project

**BMEKOALM643**

*Dr. Gábor Bohács*
During the classes students learn most relevant issues of materials handling equipments' mechanical construction. Construction of a selected materials handling machine is also carried out by students. (5 credits)

## Design of Vehicle Automation Systems

**BMEKOKAM661**

*Dr. Tamás Bécsi*
The course aims the strengthening of project design skills through a large indivudal student project. (7 credits)

## Engine design II.

**BMEKOGGM671**

*Dr. Huba Németh*
Theoretical aspects of internal combustion engine design for road vehicles. Crankcase material selection, design and dimensioning. Setup of the cranktrain mechanism. Applied cranktrain solutions. Dimensioning process of crankshafts and fly wheels. Mass balance calculations. Dimensioning, material selection and design of bearings, bearing covers, bed plates. Conrod wrist pin, piston and piston ring design. Cylinder head design and material selection. Design of charge exchange control components. Intake, exhaust valve, camshaft, rocker and roller finger follower design and calculations. Engine cooling and lubrication system calculation and design. Main ingredients of the technical design documentation: calculations and drawings. (5 credits)

## Measurement systems in vehicle manufacturing

**BMEKOGGM652**

*Dr. Pál Bánlaki*
Basic concepts of measurement methods, measurement errors, systematic errors, random errors. Measuring tools and measurement systems. Typical measurement tasks and assets: shape meas-urement error, position error measurements, surface-based characteristics, coordinate measurements. Automatic size control. Surface digitization. Process measurement technology. Measuring in-struments calibration, validation. Statistical process control (SPC). Measuring device management. (5 credits)

## Mechatronic design of vehicle systems

**BMEKOGGM622**

*Dr. Zsolt Szalay*
System design methods. SIL and HIL simulation methods in system design and testing. Printed circuit board design introduction. Main loads on meachtronic components. Vibration loads and its design methods. Thermal loads and its design methods. Electronic loads and its design methods. Sesons types, selction and design. Actuator types, selection and design. Pnaumatic, hydraulic and electro-mechanic actuations. Selection and design of actuators. (5 credits)

## Production process quality assurance in the vehicle industry

**BMEKOGGM611**

*Dr. Zsolt Stukovszky*
(2 credits)

## Project

**BMEKOVRM633**

*Dr. Árpád Veress*
In this subject the students have the possibility either to work as a trainee at an aircraft design office or get involved in a project running at our department. (3 credits)

## Project work

**BMEKOVRM628**

*Dr. Győző Simongáti*
In this subject the students have the possibility either to work as a trainee at a ship design office or get involved in a project running at our department. (2 credits)

## Projectmanagement in automotive industry

**BMEKOKKM617**

Zoltán Nagy
Project management can play an important role in the current wave of product development reengineering taking place in the automotive industry. In this course those special project management processes and tools can be studied which are necessary during automotive product development. (2 credits)

## Reliability, Safety and Security in the Vehicle Industry

**BMEKOKAM660**

*Dr. Balázs Sághi*
The aim of the course is to provide the students with theoretical and practical knowledge about the approach and methods for designing reliable, safe and secure vehicle systems. (3 credits)

## Research and devlopment process in the vehicle industry

**BMEKOGGM614**

*Dr. Zsolt Stukovszky*
(2 credits)

## Ship hydrodynamics

**BMEKOVRM626**

*Dr. Győző Simongáti*
The subject aims to introduce the basic analytical and numerical methods for calculation of ship resistance, water velocity and pressure distribution around hull. International and practical recommendations for numerical calculations of ship hydrodynamics. (4 credits)

## Ship strength

**BMEKOVRM621**

*Dr. Győző Simongáti*
The course aims to explain numerical methods for calculating ship strength, and to introduce the verification calcula-

tion methods of ship strength according to the legal regulations, international standards and classification societies. (4 credits)

## Superstructure control technics

**BMEKOJSM666**

*Dr. Ferenc Pápai*
Traditional hydraulic drives. Electrohydraulic drives, sensors, actuators. Presentation of the onboard electronic devices. Definition of stability and overload criteria. Accident prevention. (5 credits)

## Vehicle evaluation, traffic environment

**BMEKOGJM640**

*Dr. Gábor Melegh*
Students know the basics tasks and expectations connected to making damage survey, determination of the repair costs and depreciation after repairs (or betterment). They are informed of the related disciplines, which directly or indirectly connected to these questions. Knowledge about different types of vehicle insurances.
Detailed review of catalogue systems used for vehicle evaluation and calculating repair coast.
Examination of special questions of maintainability and deterioration of vehicles.
Solving specific vehicle evaluation problems with statistical methods.
Human factors of driving road vehicles, reaction time, perception and perceivability. (5 credits)

## Vehicle simulation and optimisation

**BMEKOVRM638**

*Dr. Vilmos Zoller*
The real vehicle system and its investigation model. The discrete and distributed parameter models, hybrids. Formulation of the system model giving the basis of the simulation procedura. Typical techniques: linearization, considering the non-linearities. Parameter space, state space, and excitation space. The stair-like simulation technology. Possibilities for the solution of the system equations: time-domain and frequency-domain analyses. Numerical solutions by using digital simulation. Special solvers for differential equations and their subroutines. Real-time simulations. Prediction of the motion and loading conditions of vehicles. Statistical analysis of the simulation results. Stochastic simulation. The problem of system optimization. Selection of the optimization objective function, action-parameters and constraint conditions. Analytical and numerical optimization techniques. Problems leading linear programming (LP). Algorithm and suroutine of the generalized gradient method . Procedure in case of a random variable valued objective function (stochastic field). (5 credits)

## Vehicle superstructure design

**BMEKOJSM667**

*Dr. László Lovas*
Superstructure construction regarding the needs of manufacturable design and tooling. Optimization of duperstructures (weight, rigidity, manufacturing). (5 credits)

## Vehicle system informatics

**BMEKOVJM437**

*Dr. Ferenc Kolonits*
Vehicle Computing System as info. storage, transmission, grouping, sorting, processing: data representation, data input, storage, retrieval, transmission, distribution. Determining document structure. Document description of the main tools: SGML, HTML, XML and DTD. XSL. DTD: name structure, syntax, terminal descriptors. Standard and generic items. Attribute syntax. Namespace applications. Application type descriptor (entity). Vehicle-document hierarchical structure and structural levels battery unit, structure, group, division, sub vehicle. Enlargement of the structure. The event codes ordering parts. XML editors: XML mind morph, Xerlin, Web download software use. Clarity. Document Processing: XSL various tools: Finding the XML document elements, navigating structural axes. Implementation mechanism of the template. Targeted info. Extraction. Processing Software: COOKTOP (free downloadable software) review of the principal lines. Using XSL-generator program. The Xtract software. Vehicle Document Management: performing elementary operations XSLT routines scenarios and bills of withdrawal of the document specified. Description of vehicle structural links: contact and containment relations. The functional areas and roads setting - the possibilities and the processing pathes. Graph theoretical analysis of the failure groups. Production data structures for vehicle system reliability analysis. The statistical processing programs to connect preparation. (5 credits)

# Description of M.Sc. Subjects
# Master Section in Transportation Engineering

## Control theory

**BMEKOKAM142**

*Dr. József Bokor*
The course provides deepening of knowledge in control theory. Provides theoretical knowledge, and discusses modern tools, which are necessery in later eingineering practice. This is introduced through different examples, taken from vehicle and transportation systems. (3 credits)

## Decision making methods

**BMEKOKKM221**

*Dr. Zoltán Békefi*
Introduction of the most important methods of operations research and their applications in the transport sector. (5 credits)

## Intelligent transport systems

**BMEKOKUM205**

*Dr. János Tóth*
The components of intelligent transport systems. The application of ITS on higways and in urban transport. Supporting private and public transport by road and passenger information systems. Traffic management systems. Geographical Information Systems (GIS) in transport. The features and planning pinciples of GIS databases in transport. The methods of positioning, tracking systems. The vehicle detection and identification systems. Route planning methods. Fleet management. (5 credits)

## Mathematics MK

**BMETE90MX59**

*Dr. Sági Gábor*
(4 credits)

## Road Safety

**BMEKOKKM222**

*Dr. János Juhász*
Indicators of Traffic Safety. Evaluation of PIN in EU and in Hungary. Attributes of the traffic elements (human, infrastructure, vehicles), their influences to traffic safety. Pedestrians and cyclists behaviours. Driver's training. Self explaining roads. Passive and active vehicle safety systems. (3 credits)

## Transport automation

**BMEKOKAM202**

*Dr. Balázs Sághi*
Main topics of the subject include: Basic principles of safety.
Development of safety-critical systems
System life cycle models
Safety requirement specification, safety criterion
Hazard and risk analysis techniques
Safety integrity of systems
Safety analysis
Failure management of safety critical systems
Introduction to formal techniques, Petri nets
(4 credits)

## Transport Economics

**BMEKOKGM201**

*Dr. Ferenc Mészáros*
Analysis of EU transport strategies in different modes. Monetarising and internalising of transport externalities. (4 credits)

## Air Traffic Management (ATM)

**BMEKOVRM224**

*Dr. Dániel Rohács*
The course aims at introduction to the basic principles of air traffic control, the categories of airspaces and the main methods and support systems of ATC. The course examine the most important human factors and the main researches. (3 credits)

## Communications, Navigation and Surveillance (CNS) I.

**BMEKOKAM226**

*Dr. Dóra Meyer*
The aim of the subject is to provede deeper knowlegde on planning and operating of air transportation related navigation systems, facilities or devices that have been
operationally released to be used either by airspace users (e.g. ground navigation facilities) directly, or are used in the provision of operational air traffic management services. (3 credits)

## Controlling systems in transportation

**BMEKOKGM215**

*Dr. Ferenc Mészáros*
Intorduce the technical, legal, economic, financial, social and institutional frameworks and directives that control operation and improve integration, development of transportation system in European Union. Promoting their domestic adaptation and application. (6 credits)

## Electronics – electronic measurement systems

**BMEKOKAM103**

*Dr. Géza Szabó*
The subject gives basic knowledge of electronics and electronic measurements and their application in different areas of transportation. It summarizes the operational modes of basic components and basic circuits and describe how one can design and apply them. It gives an overview of electric and mechanical measurements and how the results of measurements can be processed
(4 credits)

## Forwarding Management 1

**BMEKOKKM132**

*Dr. Ferenc Mészáros*
History and attibutes of freight forwarding, international agreements, different contract types, rules of extra ordinary freight forwarding, legal framework of customs, tasks of national and international forwarding services. (5 credits)

## I+C technologies

**BMEKOKAM104**

*Dr. Tamás Bécsi*
The course aims at introduction to the basic principles of modern computer architectures, and especially computer systems and communication techniques which are of high importance in transportation. (3 credits)

## Information connection of the vehicle and the track

**BMEKOKAM232**

*Dr. Géza Szabó*
The subject gives an overview of information transmission between infractructure and vehicles, both logically and phicically. Examples are given for railway, road and air transportation sectors. (3 credits)

## Material handling and warehousing processes

**BMEKOALM225**

*Dr. Gábor Bohács*
The specific properties and main groups of the materials in the logistics systems. The functions of the packaging, packaging nation's economic role. The classification of packaging, packaging materials - different materials, packaging materials, packaging accessories. Cargo unit creation. Characteristics of the material handling systems, the main groups, material handling tasks, material flow characteristics. The main groups of material handling machines and techniques. Performance and reliability of the material handling systems. Calculation of the material handling time. Material handling process examination. Secondary analysis, layout planning. Conventional storage systems, high bay warehouse systems. Order picking. Statistical sampling procedures. Tenders. (4 credits)

## Meteorology

**BMEKOVRM231**

*Dr. Rohács Dániel*
The course aims at introduction to meteorological phenomenas and conditions, the structure of the atmosphere and other important aviation weather informations. (3 credits)

## Modelling and control of vehicles and traffic systems

**BMEKOKAM233**

*Dr. István Varga*
Design of road traffic systems and traffic modeling practice with state-of-the-art design software:
- microscopic modeling with VISSIM,
- advanced use of VISSIM via COM programming with MATLAB,
- macroscopic traffic planning (classical four-step approach) with VISUM
- application of MATLAB for freeway traffic modeling and control,
- introduction to the application of QGIS. (6 credits)

## Numerical methods

**BMEKOVRM121**

*Dr. Rohács József*
Introduction. System modeling. General model, assumptions, errors. Solving the non-linear equation, Newton iteration. Polynomial equations, Horner, Newton methods. Systems of linear equations: Gauss elimination, Matrices, enginvalues. Linear programming. Simplex Method. non-. linear optimization, gradient method. Interpolation. Newton's, Lagrange Hermite methods, spline. Approximation: Chebyshev, Padé. Fast Fourier transformation. Numerical differentiation, integration. Solving the differential equations. Euler, Runge-Kutta, predictor-corrector methods. Systems of partial differential equations. finite differences, finite volumes methods. Stochastic modeling. (4 credits)

## Smart City

**BMEKOKKM227**

*Dr. János Tóth*
Smart city introduction, land use functions and models, city planning, utilization of social media, Internet of Things, wireless sensor networks, Smart Grids, lighting, best practices. (3 credits)

## Transport informatics

**BMEKOKKM223**

*Dr. Csaba Csiszár*
The subject is based on Transport information systems I. and II. Main topics: modelling of con-cepts, relations and regularities in information systems and applying of these models in trans-portation. The structure and operation of the transportation organizations and operational con-trol processes (preparation, execution and accounting) are also lectured. (5 credits)

## Transport Infrastructure Management

**BMEKOKKM228**

*Dr. Ferenc Mészáros*
Role of transportation networks and regulatory policies. Asset valuation, asset management techniques and systems. Operation contracts, risk sharing and management. Tasks in adaption to climate change and sustainability principles. (3 credits)

## Transport modelling

**BMEKOKKM229**

*Dr. János Tóth*
Basic theory of transport modelling. Transport network planning by software VISUM. The fundamentals of the program. Network model, Demand model, Impact model. Traffic assignment methods on private transport and on public transport. Microscopic modells, fundamentas of VISSIM software. Modelling the traffic in a junction. (6 credits)

## Transport operation

**BMEKOKUM206**

*Dr. Péter Mándoki*
Plannig of intermodal node. Infrastructure and vehicles of different transport modes. (5 credits)

## Air Traffic Control

**BMEKOVRM235**

*Dr. Dániel Rohács*
The course aims at introduction to the basic principles of air traffic management, the history and the main methods of ATM. The course examine the most important elements of the management sytsem, the advanteges and disdvanteges and the researching of ATM. (4 credits)

## Case study

**BMEKOVRM237**

*Dr. Dániel Rohács*
The students have to participate in one of the R+D projects of the faculty. (3 credits)

## City logistics

**BMEKOALM244**

*Dr. Bóna Krisztián*
The main types of transport goods in the city supply networks. The rule of city logistics in the global logistics networks, the definition of last mile problem. The application of transporting systems in the city logistics. Loading technology in the city logistics. The rule of logistics providers in the city supply, the integration of city logistics in the gateway conception. The urban consolitation centres ans x-docks. The control and organisation of city logistics in big cities. Best practises in worldwide. Application of modelling techniques is the organisation and operation of city logistics systems. Informatics in city logistics. (5 credits)

## Communications, Navigation and Surveillance (CNS) II.

**BMEKOKKM239**

*Dr. Rita Markovits-Somogyi*
The course aims at introduction to the systems of navigation, surveillanceand data process. The course examine the basic principles of voice communication, the data technologies of air traffic control and complement of the knowledge of course CNS I. (4 credits)

## Engineering of transport automation systems

**BMEKOKAM234**

*Dr. Balázs Sághi*
The aim of the subject is to provede deeper knowlegde on planning of transportation systems. Rules, legislation basics, guidelines for different domains are introduced, planning phases are touched and project work is expected from students. (6 credits)

## Environmental effects of transport

**BMEKOKKM230**

*Dr. János Tóth*
Transport- environment, factors of environmental impact, the problem of sustainability. Mitigation of environmental impacts of transport, regulations, policies, tendencies, practices. Local and international case studies. EIA, decision making, preparation of decisions on the field of transport infrastructure development. Integration of transport and land use. Environmental conflicts of freight transport, intermodality and transit policies. Environmental costs of transport, the case of externalities, prices and charges. Urban transport, opportunities of sustainable urban environmental management, integration of environmentally sound mobility forms. Demand management, parking and road charges. Requirements of fuel efficiency, alternative fuels, energy efficient and environmentally enhanced vehicles. (4 credits)

## Financing techniques in transportation

**BMEKOKKM236**

*Dr. Zoltán Békefi*
Concepts of financing: financing goals (development, operation); financing options: budget, private or public-private partnerships (PPP); loan, bond, lease and their characteristics. Project analysis and evaluation methods. Project identification, technical preparation, traffic forecast and modeling. Risk assessment needs. Feasibility studies, cost-benefit analysis, financial, social, legal, regulatory and technical compliance criterias. The identification of project risks. Definition of government, regional and local priorities. The role of the partners in the project financing. Communication tasks. The media's role for accepting the project financing methods by the society. Optimizing fees and tariffs. Financial structures and models. Contracts. (5 credits)

## Forwarding Management 2

**BMEKOKKM133**

*Dr. Ferenc Mészáros*
Mode specific knowledge of freight forwarding management (road, rail, aviaton, inland waterway and maritime, combined and LTL transport). (5 credits)

## Forwarding marketing

**BMEKOKKM135**

*Dr. Botond Kővári*
Marketing concepts, overview of resources. Market analysis methods. Product mix reviews. Advertising strategies. (4 credits)

## Human resource management in transportation

**BMEKOKKM238**

*Dr. Botond Kővári*
Applied human resource challenges, especially in transportation. Motivation, team working, carrier planning
(3 credits)

## Management of transport and logistic services

**BMEKOKGM217**

*Dr. Botond Kővári*
The main aim of this course is to develop and implement performance measurement in a transport or logistic organization with the help of a balanced KPI (key performance indicator) system. (6 credits)

## Passanger transportation

**BMEKOKUM208**

*Dr. Csaba Csiszár*
Characterization of passenger transportation systems, properties, planning process. Evaluation of system. Modelling of motion process in regional area. Qualitative system of passenger transport, service levels. Planning of system elements of passengers transport (local and inter-town), in individual and public transport. Overview and summary of properties of the advanced, so called "transitional" passenger transportation modes (e.g. car-sharing, bike-sharing, car-pooling, chauffeur service, demand responsive transport) in system and process-oriented approach. (5 credits)

## Project

**BMEKOKAM242**

*Dr. Balázs Sághi*
Project work
(3 credits)

## Projectmanagement in transportation

**BMEKOKKM241**

Zoltán Nagy
This course is an introduction to project management in the transportation sector and basic concepts and tools for developing the student's skills. During this course are presented the most relevant concepts on the formulation and preparation of different transport developing projects and their scheduling and control techniques. Students work with different models and tools for setting professional goals, time management, teamwork and communication techniques. (2 credits)

## Safety in air traffic control

**BMEKOKAM243**

*Dr. Dóra Meyer*
The aim of the subject is to provide deeper knowlegde on planning of safety certficication in air traffic control. Rules, legislation basics, guidelines for different domains are introduced, planning phases are touched. (3 credits)

## Signal processing in transport

**BMEKOKAM211**

*Dr. József Bokor*
Introducing the microcontroller architectures used extensively in transportation systems. Embedded system design, and software development. Digital signal processing: A/D and D/A conversion, filtering and DSPs. Safety critical hardware and software design and implmentation. (5 credits)

## Supply and distribution processes

**BMEKOALM240**

*Dr. Gábor Kovács*
The basics of organizing supply chains (SCM), enterprise logistics system. The organization of the material supplies, material analysis methods (ABC, XYZ), supply strategies (synchronized, by stocking, on request), material planning methods (Gozinto graph, BOM). The inventory systems and processes (rotation indicators), inventory valuation (FIFO), inventory model (EOQ). Distribution systems, demand forecasts (simple methods). Production logistics (MRP, APS, Kanban, Lean). The definition and main tasks of the reverse logistics. (2 credits)

## Trade, Financial, Accounting Techniques

**BMEKOKKM138**

*Dr. Ferenc Mészáros*
General principles of international trade, stakeholders and their relationships, trade transactions. Set and elements of the banking system, frequent financial transactions of freight forwarders. Accounting obligations and techniques of freight forwarding companies, balance sheet and profit and loss statement. (3 credits)

## Traffic flow

**BMEKOKUM204**

*Miklós Kózel*
Analysing, modelling and planning of traffic flow on road transportation network, in consideration of passenger and goods transport. Probability distributions, vehicle in winding way, phasing of traffic lights, road markings, traffic signs, pedestrian flow, traffic calming zones
(4 credits)

# Description of M.Sc. Subjects
# Master Section in Logistic Engineering

## Control theory

**BMEKOKAM122**

*Dr. Péter Gáspár*
The course provides deepening of knowledge in control theory. Provides theoretical knowledge, and discusses modern tools, which are necessery in later eingineering practice. This is introduced through different examples, taken from vehicle, transportation and logistics systems. (5 credits)

## Lean management

**BMEKOALM322**

János Kosztolányi
Methods of continuous improvement. The teamwork, establishment of suggestion systems, the role of motivation. Main brainstorming methods, the advantages and disadvantages of each method. Introduction and application of problem finding tools, methods for failure analysis, applicability of the main methods. Data request for failure analysis methods. The basics of standardization, the steps of making standard processes, the zeri failure concept (Jidoka, Poka-Yoke), production equalization in lean menedzsment: mathematical methods for Heijunka. Process development methods, and techniques. The importance of changeover time, methods for the reduction os changeover time in the companies. The basics of ergonomics, types of workplaces from the aspect of ergonomics, the steps of REBA analysis. Lean office methods and tools. The basics of Six Sigma method, mathematical background, the levels of quality. Description of six sigma analysis, evaulation of the results. The relationship between six sigma and lean. (4 credits)

## Logistics controlling

**BMEKOKKM330**

*Dr. Szabolcs Duleba*
The primary task of logistics controlling is managing all logistics activities using comprehensive measures on all levels of a company with the provision of information processing systems based on the management's information needs. After the completion of this module, the graduate will have the knowledge and an understanding of the fundamentals and characteristics of reporting systems for logistics, logistics accounting and cost accounting, activity-based costing, strategic logistics controlling and logistics benchmarking. (3 credits)

## Logistics information system planning

**BMEKOALM321**

*Dr. Jenő Tokodi*
Logistics information system (LIS) databases. LIS planning. IT representation of system elements, purchase orders, sales, production, quality assurance. System and software planning methods. IT representation of data formats, schemes, process description. Service oriented architecture, webservices, interfaces, Enterprise Service Bus, Orchestrating. ERP webservices, workbench, dictionary, business warehouse, reporting. BI systems. Transactional database. (5 credits)

## Mathematics ML

**BMETE90MX60**

*Dr. Gábor Sági*
(5 credits)

## Planning of extra-logistics networks

**BMEKOALM337**

*Dr. Krisztián Bóna*
Architecture and mathematical representation of extra-logistics networks. Key preformance indicators of extra-logistics networks, methodology of network-performance measurement. Criteria set of network optimization. Optimization methods of network topology, one or more region centre searching techniques. Logistics performance based optimization methods. The rule of inventories in the topology optimization of extra-logistics network. Multi-echelon inventory networks. (4 credits)

## Algorithm Design

**BMEKOKAM326**

Dr.Tamás Bécsi
The course aims the introduction of algorithm theory and numerical complexity.
(5 credits)

## Automation of logistics systems

**BMEKOALM325**

*Dr. Gábor Kovács*
This subject introduces integration of logistics automation into the higher levels of corporate governance. Communication possibilities in PLC networks are also addressed. Introduction of industrial communication protocols and interfaces. Effects of humans, identification and quality checking on automation. (5 credits)

## Demand planning and inventory management

**BMEKOALM328**

*Dr. Krisztián Bóna*
Specific resource planning areas in the enterprise logistics. Mathematical modeling in the demand planning process, model identification and parameter optimisation. Mathematical modeling in the inventory planning process, select inventory models, optimisation of control parametrers, inventory control systems. Measurement of demand and inventory planning efficiency. Specific planning tools of ERP systems. The rule of inventory and demand planning in the S&OP process. (5 credits)

## Enterprise logistics project 1.

**BMEKOALM339**

Norbert Antal
Within the framework of the course, project groups are formed from the students, which are led by mentors. The project topics may include: operations management, complex project tasks, R&D tasks, based on the interests of student's. During the contact hours, the students consult with their mentors, moreover, each week brief report is held. The students present the problems and the suggested solutions, they practice the techniques of discussion, argumentation, and persuasion. (4 credits)

## Forwarding Management 1

**BMEKOKKM132**

*Dr. Ferenc Mészáros*
History and attibutes of freight forwarding, international

agreements, different contract types, rules of extra ordinary freight forwarding, legal framework of customs, tasks of national and international forwarding services. (5 credits)

## Forwarding project 1.

**BMEKOKKM338**

*Dr. Ádám Török*
Executive knowledge in managing freight forwarding companies. (4 credits)

## Logistics planning softwares

**BMEKOALM336**

*Dr. Jenő Tokodi*
Classification of softwares in logistics planning. Introduction of software tools in corporate process planning, including designing flow chart (EPC, BPMN), Gannt chart, Fishbone diagram. The functions of computer aided design softwares, basic components, transformations, dinamic blocks, scaling, managing layers. Standard symbols of logistics components. Basic of spatial designing. Project management softwares. (3 credits)

## Numerical optimization

**BMEKOVRM334**

*Dr. József Rohács*
Introduction. System modeling. General model, assumptions, errors. Solving the non-linear equation, Newton iteration. Polynomial equations, Horner, Newton methods. Systems of linear equations: Gauss elimination, Matrices, enginvalues. optimization. Linear programming. Transformation to standard forms. Simplex Method. Sensitivity analysis. Transport logistics. Supply chain and production processes, distributing systems. Genetic algoritm. Non-linear optimization, gradient method. Specific cases. Theory of play. Stockpiling. Interpolation. Newton's, Lagrange Hermite methods, spline. Approximation: Chebyshev, Padé. Fast Fourier transformation. Numerical differentiation, integration. Solving the differential equations. Euler, Runge-Kutta, predictor-corrector methods. Systems of partial differential equations. Finite differences, finite volumes methods. Stochastic modeling. Markov models.
(5 credits)

## Process planning

**BMEKOALM331**

*Dr. Gábor Kovács*
Interpretation the process, parts, contacts, activities, events and processes. Standard methods for the description of the processes. Process Charting Techniques. Process Description levels. Top-down modeling. Standard process description languages. Standard Operating Procedure. Cross-Functional Flowchart. Petri net. Event Driven Process Chain (EPC). Business Process Modeling Notation (BPMN). Integrated Definition Methods (IDEF). Logistics processes modelled by using the standard languages: goal-oriented application. (3 credits)

## Simulations planning

**BMEKOALM335**

*Dr. Krisztián Bóna*
The types of modells, the basics and mathematical rudiments of modelling. Stochastic and deterministic processes, and the main process properties. The definition of computer based simulation modelling and the application in the logistics system planning. Simulation algorithms and programming. Simulation and optimization, simulation based optimization methods. The simulation softwares and simulators. Application of simulation based optimization methods in logistics. Application of artificial intelligence in specific logistics optimization problems. Development of simulation systems and models in intra- and extra logistics systems. (3 credits)

## Technical logistics project 1.

**BMEKOALM333**

*Dr. Gábor Bohács*
During the classes students of the technical logistics specialization learn advanced engineering planning systems, and their relation to the expert field of logisticians. (4 credits)

## Construction of logistics machinery

**BMEKOALM324**

*Dr. Gábor Bohács*
Introduction of main constructional issues of continuous and discontinuous operating materials handling machines. (3 credits)

## Control of transport logistics

**BMEKOALM341**

*Dr. Gábor Bohács*
The components of the transport logistics control systems. Summary of GIS funds. Operational control problems and tasks of the transport logistics systems. Mathematical modelling techniques, decision supporting of transport logistics control systems. The mathematical model of transportation network. The shortest path search methods. The exact and the provisional planning. Modelling of routes: direct routes, collecting and distributing routes. The traveling salesman problem (TSP) and the vehicle routing problem (VRP). Soft computing methods. The IT architecture of the freight control systems. The mobile devices. The connection between the freight exchanges and the transport logistics control systems. (3 credits)

## Enterprise logistics project 2.

**BMEKOALM343**

*Norbert Antal*
As the continuation of the Enterprise logistics project 1., the project groups get operations management tasks, complex project tasks or R&D tasks, based on the interests of student's. The task can be the continuation of what are launched in Enterprise logistics project 1., however, a new task also can be started. During the contact hours, the students consult with their mentors, moreover, each week brief report is held. The students present the problems and the suggested solutions, they practice the techniques of discussion, argumentation, and persuasion. (7 credits)

## Forwarding Management 2

**BMEKOKKM133**

*Dr. Ferenc Mészáros*
Mode specific knowledge of freight forwarding management (road, rail, aviaton, inland waterway and maritime, combined and LTL transport). (5 credits)

## Forwarding marketing

**BMEKOKKM135**

*Dr. Botond Kővári*
Marketing concepts, overview of resources. Market analysis methods. Product mix reviews. Advertising strategies. (4 credits)

## Forwarding project 2.

**BMEKOKKM342**

*Dr. Ferenc Mészáros*
Executive knowledge in managing freight forwarding companies. (2 credits)

## Integrated material flow systems

**BMEKOALM332**

*Dr. Gábor Bohács*
Traditionally materials handling systems are separated from technology. There are however special applications, such as assembly lines in the electronic industry where the material handling systems are in strong integration with the technological equipment. During the classes these special machines are addressed. (4 credits)

## Planning of plant logistics systems

**BMEKOALM327**

*Dr. Krisztián Bóna*
The specific properties and planning process of plant logistics systems. The main steps and tasks of logistics planning. The plant layout planning techniques and methods. The specific plant layout topologies. Optimization and heuristic methods in plant layout design. How to create a logistics system plan in case of a plant logistics system? The material flow system architecture in a plant. The planning steps of the material flow systems in a plant. The methodology of material flow system planning, the main heuristic an optimization modells. Analitical queueing theory and simulations methods in the planning of plant logistics systems. Integration of the basic arguments of lean in the planning process. (5 credits)

## Planning of warehousing systems

**BMEKOALM323**

*Dr. Krisztián Bóna*
The main material flows and processes in a warehouse. Specific logistics system planning methodology of warehousing systems. The typical logistics technology variations of storing. Planning of transporting connections and loading technology. Planning the dimensions of loading bays, and preparation areas of warehouses. Order picking methods and systems. The technology of order picking. Planning of order picking process. Planning the topology and layout of storage systems. How to create a logistics system plan of a warehousing technology? (5 credits)

## Production planning & scheduling

**BMEKOALM329**

*Dr. Krisztián Bóna*
Theory of production planning and scheduling. Main topics, goals and constraints in the production systems, the system arichetecture of production control. Modelling of products and production technology. Connection points to the customer orders and forecasts. Then main production strategies. Production and capacity planning. The time view of production scheduling, the long, middle and short term planning. The informatics of the production planning and scheduling. Production planning and scheduling algorithms. The rule of production planning in the S&OP process. (4 credits)

## Technical logistics project 2.

**BMEKOALM340**

*Dr. Gábor Bohács*
During this subject students perform and complete a technical logistics project in groups. These can originate from either the industry or from defined research and innovation tasks. (7 credits)

## Trade, Financial, Accounting Techniques

**BMEKOKKM138**

*Dr. Ferenc Mészáros*
General principles of international trade, stakeholders and their relationships, trade transactions. Set and elements of the banking system, frequent financial transactions of freight forwarders. Accounting obligations and techniques of freight forwarding companies, balance sheet and profit and loss statement. (3 credits)