

# BULLETIN

**Budapest University of Technology and Economics**  
**2006–2007**

An ECTS Guide



M Ű E G Y E T E M 1 7 8 2

**Engineering Programs in English**  
**<http://www.tanok.bme.hu>**

# FACULTY OF TRANSPORTATION ENGINEERING



The Faculty of Transportation Engineering was established in 1951 as an independent faculty based in Szolnok. It dealt with different branches of transportation and offered specialisations in railway engineering and transportation operations.

By 1956, it functioned as the University of Civil and Transportation Engineering. After several reorganisations, it merged with the Budapest University of Technology and Economics in 1967. The current organisation of the Faculty was developed in 1970, and the Faculty of Transportation Engineering now offers degree programs with concentrations in transportation and mechanical engineering.

The transportation engineering program provides the essential scientific foundations and the most up-to-date technical knowledge available so that engineers who graduate from this faculty can go on to design road, railway, waterway, air, industrial and trade transportation systems. Graduates of this faculty will also be able to develop and monitor these systems reliably and economically, using the latest in management theory and informatics.

Within the framework of education in transportation engineering, students can make their choice from the following specialisations:

- railway transportation;
- road transportation;
- waterway transportation;
- air transportation;
- industrial and trade transportation.

The mechanical engineering concentration aims to give students a thorough scientific foundation for development and design work, production control, and the operation and maintenance of mobile machines at an advanced level. Further specialisations are offered in vehicle engineering and in mechanisation engineering.

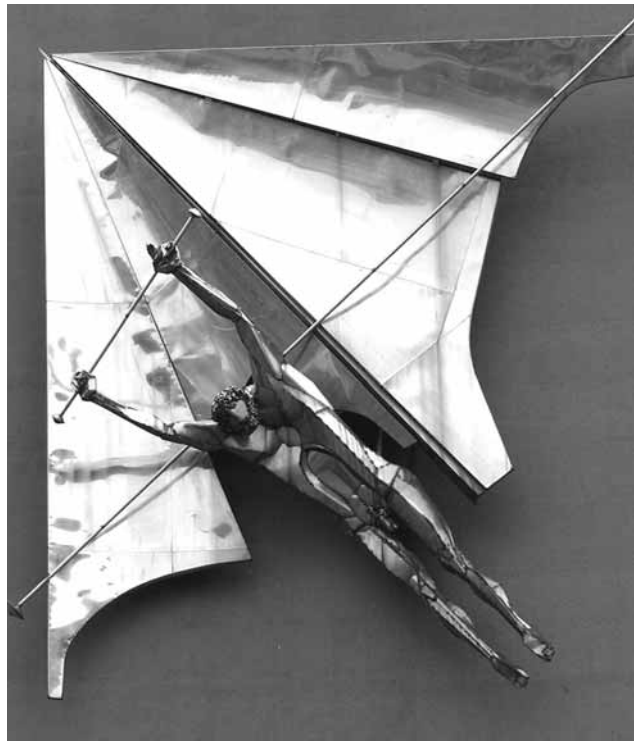
Vehicle engineering offers five areas of specialisation:

- Road vehicles – cars, vans, lorries, and buses.
- Railway vehicles – locomotives, rail cars, and carriages.
- Ships – inland waterway vessels and sea-going ships.
- Aircraft – airliners, air freighters and helicopters.
- Manufacturing and repair of vehicles

Areas of specialisation in mechanisation engineering focus on the following machines:

- Materials handling machines – cranes and conveyors.
- Building machines – earth work machines and concrete mixers.

The Faculty of Transportation Engineering offers a four year B.Sc. program, a two year M.Sc. program, and postgraduate courses that cover certain subjects thoroughly and allow for the pursuit of a Ph.D. degree.





## Departments

Department of Building Machines, Materials Handling Machines and Manufacturing Logistic,  
 Department of Vehicles Parts and Drives,  
 Department of Maintenance and Repair of Vehicles,  
 Department of Chassis and Lightweight Structures,  
 Department of Transport Automation,  
 Department of Transport Economics,  
 Department of Transport Operation,  
 Department of Aircraft and Ships,  
 Department of Road Vehicles,  
 Department of Railway Vehicles.



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Course directors:

Dr. Lajos Borbás Dr. Péter Mészáros

Program Co-ordinator: Ms. Ágnes Kormos

## Curriculum of B.Sc. Courses General Courses

Subject			Working hours / semester							
Name	Code	Credits	1	2	3	4	5	6	7	8
<b>General courses</b>										
Mathematics A1		6	5v							
Mathematics A2		6		5v						
Mathematics A3		4			4v					
Physics		3	3v							
Mechanics		4	4v							
Mechanics II.		4		4v						
Mechanics III.		4			3v					
Eng Chemistry		3	3v							
Fluid Mechanics and Thermotechnics I		3			3v					
Fluid Mechanics and Thermotechnics II		3				3v				
Fundamentals of material science		4		4v						
Electrotechnics and electronics I		4			4f					
Electrotechnics and electronics II		2				3v				
Micro and Macro economics		4		4v						
Management and microeconomics		4			4v					
Business law		2						2v		
Human Politics I		2		2f						
Human Politics II		2			2f					
Human Politics III		2					2f			
Human Politics IV		2							2f	
Labour safety		2								2f
Basic theory of vehicle engineering		3	3f							
Quality in the road traffic		2	2f							
Transport Systems		2	2f							
Vehicle systems		2		2f						
Logistics Systems		2		2f						
Transportation systems of production		2			2f					
Transportation paths		2			2f					
Programming I		3	3f							
Programming II		3		2f						
Engineering Drawing I.		4	4f							
Engineering Drawing II.		3		3f						
Material of vehicles and manufacturing I.		2			2f					
Material of vehicles and manufacturing II		3				2v				
Vehicle and drive elements I		3			3f					
Vehicle and drive elements II		4				4v				
Control and automation I		3				3f				
Control and automation II		3					3v			
Transport Technology		3				3f				
Vehicle Dynamics and Drive Technics		4				4f				
Transport statistics		2					2f			
Transport automation		3					3v			
Work Organisation		4					3f			
Production and maintenance of vehicles		4					4v			
Transport economics		2						2f		
Vehicle frame systems		2						2f		



## Curriculum of B.Sc. Courses Logistics

Subject			Working hours / semester							
Name	Code	Credits	1	2	3	4	5	6	7	8
Informatics in logistics I		5				4f				
Informatics in logistics II		2					2f			
Logistics management		3				3f				
Transport Logistics		5					5v			
<b>Logistics - Industrial Logistics Module</b>										
Machines and devices of logistics I.		3					3f			
Machines and devices of logistics II.		5						5v		
Control and automation techniques of logistic systems I.		4						4v		
Control and automation techniques of logistic systems II.		3							3f	
Robotics		4						4f		
Materials Handling Processes		3						2f		
Production logistic		4						4v		
Identification systems		4								4f
<b>Logistics - Organisation of Logistics Processes Module</b>										
Machines and devices of logistics I.		3					3f			
Machines and devices of logistics II.		5						5v		
Material Handling and warehousing processes			6							6v
Material Supply and Distribution		6						5v		
Manufacturing logistic		3							3f	
Packaging Technologies		3						3f		
Corporate logistics management		4								4f
<b>Logistics - Shipment Module</b>										
Forewarding management I		3					3f			
Forewarding management II		5						5v		
Manager training		5						5f		
Marketing		3						3v		
Decision making methods		5						4f		
Trade, financial, accounting technics		3							3f	
Logistic processes		2						2v		
Logistic processes II		4								4f



## Curriculum of B.Sc. Courses Transportation Processes

Subject			Working hours / semester							
Name	Code	Credits	1	2	3	4	5	6	7	8
Transport Technique		3				3f				
Transport Network Planning		4					4f			
<b>Transportation Processes - Air Traffic Transportation Module</b>										
Control and communication systems of aviation I		3					3f			
Control and communication systems of aviation II		5						4v		
Control and communication systems of aviation III		4							4f	
Flight Operation		7						7v		
Airtransport Management I		2						2f		
Airtransport Management II		3							3f	
Air Transport Informatics		3						3v		
Airspaces, airports		3						3f		
<b>Transportation Processes - Railway Transportation Module</b>										
Railway control and communication systems I		3					3f			
Railway control and communication systems II		5						4v		
Railway control and communication systems III		4							4f	
Railway Traffic Operation Technology		7						7v		
Rail transport management I		2						2f		
Rail transport management II		3							3f	
Railway Informatics		3						3v		
Railway tracks		3						3f		
<b>Transportation Processes - Road Transportation Module</b>										
Road Traffic control and communication systems I		3					3f			
Road Traffic control and communication systems II		5						4v		
Road Traffic control and communication systems III		4							4f	
Road Traffic Operation Technology		3						3f		
Traffic Technology		4						4v		
Road transport management I		2						2f		
Road transport management II		3							3f	
Planning of Road Transport Information System		3						3v		
Roads		3						3f		
<b>Transportation Processes - Waterway Transportation Module</b>										
Water transport control and communication systems I		3					3f			
Water transport control and communication systems II		5						4v		
Water transport control and communication systems III		4							4f	
Operation of ships		7						7v		
Waterway Transport Management I		2						2f		
Waterway Transport Management II		3							3f	
Waterway Transport Informatics		3						3v		
Waterways and waterway objects		3						3f		



## Curriculum of B.Sc. Courses Vehicle Engineering

Subject			Working hours / semester							
Name	Code	Credits	1	2	3	4	5	6	7	8
Fluid- and Thermo-Machines in Vehicles I		4				3f				
Fluid- and Thermo-Machines in Vehicles II		2					2v			
<b>Vehicle Engineering - Aircraft Module</b>										
Aerodynamics and Flight Mechanics I.		3					3f			
Aerodynamics and Flight Mechanics II.		4						4v		
Aircraft Engines I		4						3v		
Aircraft Engines II		3							3f	
Aircraft Structures		3						3v		
Aircraft Structures II		3						3f		
Aircraft Structures III		3						3f		
Airport and Aircraft Operation I.		3						3f		
Airport and Aircraft Operation II.		4							4f	
<b>Vehicle Engineering - Mobile Building Machines Module</b>										
Construction processes		3					3f			
Construction processes		3						2f		
Machines and devices of logistics I.		4						5v		
Hydraulic drives		3						3f		
Machines of the building industry I.		5						5v		
Machines of the building industry II		4							4f	
Control systems of the building industry		5						4v		
Logistic of the building industry		3							3f	
<b>Vehicle Engineering - Railway Vehicle Module</b>										
Constructions of railway vehicles I.		3					3f			
Constructions of railway vehicles II.		4						4v		
Diesel motive power		8						7v		
Electric railways I.		6						6v		
Electric railways II.		3							3f	
Operation of railway vehicles		2						2f		
Laboratory practice for measuring railway vehicles		4							4f	
<b>Vehicle Engineering - Road Vehicle module</b>										
Automobile engines, engine diagnostics I		3					3f			
Automobile engines, engine diagnostics II		6						5v		
Road vehicles suspensions		6						6v		
Automobile transmissions		4						4v		
Automotive Electronics		4						4f		
Maintenance and diagnostics		7							7f	
<b>Vehicle Engineering - Ships Module</b>										
Ship Propulsion and Stability I.		3					3f			
Ship Propulsion and Stability II.		6						5v		
Ship Machinery and electrical system		8						9v		
Shipbuilding		6						5f		
Deck equipments		7							7f	
<b>Vehicle Engineering - Vehicle Manufacturing Module</b>										
New structural materials in vehicle industry		3					3f			
Materials and devices in sensorics		2						2f		
Processes of vehicle-production		12						12v		
Assembly, quality-assurance		6						5v		
Automation of production		4							4f	
Vehicle diagnostics		3							3f	



## Curriculum of M.Sc. Courses

Name	Subject	Code	Credits	Working hours / semester				Requisites
				1	2	3	4	
<b>Mechanical Engineering</b>								
Mathematics		BMETKKOM101	6	6				
Computer-Aided Design		BMETKKOM102	4	4				
Mechanics I		BMETKKOM103	4	4				
Mechanics II		BMETKKOM201	4		4			
Fluid Mechanics and Thermotechniques I		BMETKKOM104	4	4				
Fluid Mechanics and Thermotechniques II		BMETKKOM202	4		4			
Engineering System Theory		BMETKKOM203	4		4			
Contemporary Physics I		BMETKKOM204	4		4			
Contemporary Physics II		BMETKKOM301	4			4		
Reliability Theory		BMETKKOM302	4			4		
Lightweight Structures		BMETKKOM303	4			4		
Automatic Control		BMETKKOM304	4			4		
Diploma Thesis		BMETKKOM401	30					
<b>Transportation Engineering</b>								
Mathematics		BMETKKOM101	6	6				
Vehicle Dynamics		BMETKKOM105	4	4				
Computer and Information Systems I		BMETKKOM106	4	4				
Computer and Information Systems II		BMETKKOM205	4		4			
Traffic Technology I		BMETKKOM107	4	4				
Traffic Technology II		BMETKKOM206	4		4			
Transport Planning I		BMETKKOM108	4	4				
Transport Planning II		BMETKKOM207	4		4			
Transport Planning III		BMETKKOM305	4			4		
Control and Transport Automation I		BMETKKOM109	2	2				
Control and Transport Automation II		BMETKKOM208	2		2			
Control and Transport Automation III		BMETKKOM306	6			6		
Engineering System Theory		BMETKKOM203	4		4			
Statistics		BMETKKOM209	2		2			
Transport Management Information Systems I		BMETKKOM210	4		4			
Transport Management Information Systems II		BMETKKOM307	4			4		
Reliability Theory		BMETKKOM308	4			4		
Transport Economics		BMETKKOM309	4			4		
Loading Technology and Logistics		BMETKKOM310	4			4		
Diploma Thesis		BMETKKOM401	30				4	
<b>M.Sc. Elective Subjects</b>								
Road Vehicle Design and Research I		BMETKKOM110	6	6				
Railway Vehicle Design and Research I		BMETKKOM111	6	6				
Aircraft Design and Research I		BMETKKOM112	6	6				
Ship Design and Research I		BMETKKOM113	6	6				
Design and Research of Material Handling and Building Machines I		BMETKKOM114	6	6				
Materials Handling, Loading and Storage I		BMETKKOM115	6	6				
Road Vehicle Design and Research II		BMETKKOM217	8			8		
Railway Vehicle Design and Research II		BMETKKOM211	8			8		
Aircraft Design and Research II		BMETKKOM212	8			8		
Ship Design and Research II		BMETKKOM213	8			8		
Design and Research of Material Handling Machines II		BMETKKOM214	8			8		
Design and Research of Building Machines II		BMETKKOM215	8			8		
Materials Handling, Loading and Storage II		BMETKKOM216	8			8		
Road Vehicle Design and Research III		BMETKKOM311	8			8		
Railway Vehicle Design and Research III		BMETKKOM312	6			6		
Aircraft Design and Research III		BMETKKOM313	8			8		
Ship Design and Research III		BMETKKOM314	8			8		
Design and Research of Materials Handling Machines III		BMETKKOM315	8			8		
Design and Research of Building Machines III		BMETKKOM316	8			8		
Materials Handling, Loading and Storage III		BMETKKOM317	8			8		



## Description of B.Sc. Subjects

### Fundamentals of material science

*Dr. Antal Lovas*

The aim of this subject is to give an introduction to the knowledge of engineering materials. After an overview of basic structural concepts (crystal and electronic structure), the categorization of engineering materials (metals and alloys, ceramics, composites and the important plastics) will be presented. The global environmental problems arising from increasing material consumption, as well as the alternatives of material recycling will also be treated (4 credits)

### Material of vehicles and manufacturing I.

*Dr. Ödön Szabadits*

The subject deals with the materials of vehicles, the manufacturing process of parts of vehicles, among others the plastic deformation, the welding, the heat treatment and their equipment. The part of the subject are the laboratory tests. (2 credits)

### Material of vehicles and manufacturing II.

*Dr. János Takács*

Role and systematization of the machining processes in the vehicle industry. Elements of the machining. Characteristics of the cutting tool (edge geometries, chip formation) etc. Cutting force and cutting heat. Wearing of the tools. The quality of the machined surfaces. Tools and technologies of the cutting processes (turning, drilling, milling, planning (shaping and slotting), sawing, broaching, gear machining, grinding, finishing). Cutting of different materials: steel, wood, plastic. Special machining processes (high pressured water and high power laser beam). Automation possibilities of the cutting processes.

(3 credits)

### Production and maintenance of vehicles

*Dr. János Takács*

Present the up-to-date methods of vehicle manufacturing. Review the efficiency and quality by production. Present the typical brake down of vehicle parts and repairing technologies. Selection the technologies. Quality assurance by vehicle industry. Determination the appropriate materials and technologies. Automatisation by vehicle industry. Set-up of machine tool systems. MKGSI system. Optimisation of cutting technologies. Measuring processes. (4 credits)

### Mechanics I.

**BMEKOME1**

*Dr. Péter Berke*

Basic concept of statics. Statics of particles: forces in plane, forces in space. Equilibrium of a particle, of rigid bodies. Distributed forces: centroids and centre of gravity. Analysis of structures: trusses, frames and machines, beams. Friction. Distributed forces: moments of inertia. (4 credits)

### Mechanics II.

**BMEKOME2**

*Dr. Péter Berke*

Second moment of inertia. Mohr's circle. Basic concepts.

Uniaxial tension and compression, bending, torsion of beams. Equation of the elastic curve. Stress and strain under combined loading. Transformation of stress and strain. Generalised Hooke's law. Principal stresses maximum shearing stress. Energy methods, strain energy. Deflection and slope of the beams. Statically indeterminate structures. Force method. Design of beams and shafts for strength. (4 credits)

### Mechanics III.

**BMEKOME3**

Basic concepts of kinematics. Different kinds of motions. Velocity, acceleration of rigid bodies. Kinematic analysis of mechanisms. Newton's second law of motion. Linear momentum, angular momentum of a particle. Kinetic energy. Principle of impulse and the momentum of rigid bodies. Angular momentum, kinetic energy. Moment of inertia of masses. Momentum, impulse and kinetic energy. Direct central and oblique central impact of rigid bodies. (4 credits)

### Vehicle frame systems

**BMEKOME4**

*Dr. Sándor Horváth*

Fundamentals of vehicle frame systems (indeterminacy, non-linearity). Bending and torsion of thin-walled beams. Warping of cross sections of thin-walled beam in torsion. Torsion of thin-walled of open section with warping. Plates and shells. Reinforced shells. Analysis of statically indeterminate frame systems by the force method. Finite element method (FEM). Maximum stresses under moving loads. Three dimensional frames. Stability of frames. (2 credits)

### Vehicle Dynamics and Drive Technics

**BMEKOME5**

*Dr. Sándor Horváth*

Different kind of mechanisms and driving systems of vehicles, their building blocks. Degree of freedom, determination of the degree of freedom. Kinematic modelling of steering mechanisms, systems. Interaction between the steering geometry and wheel alignment, over/under steering, self steering. Dynamics of drive systems. Principal motions of vehicles, equations of motion. Articulated vehicles, trailers. Interaction of vehicles and roads. Elastic systems, eigen-modes, forced motion, excitations, non-linearities. (2 credits)

### Engineering Drawing I.

**BMEKOGE1005**

*Dr. Lajos Borbás*

History and development. Principles of descriptive geometry. Projection methods. Orthographic parallel in 1st angle and in 3rd angle. Pictorial projection methods. System of positioning of picture planes. Auxiliary elevation. Geometry of solids, cutting with planes, intersection of solids. Curves and curved features, helices, projection and intersection. True shape and presentation. Short construction task weekly, to be made in the classroom in small groups. Homework in connection with the lecture themes. (4 credits)

### Engineering Drawing II.

**BMEKOGE1006**

*Dr. Lajos Borbás*

Projection methods of engineering drawing. Drawing means. Drawing office practices. Layout, formats, sizes of



drawing sheets, line types and application, lettering. Representation by symbols. Views and sections. Dimensioning. Threads and screws. Representation of gears and springs. Tolerances generally. ISO tolerances. Fits. Surface roughness and texture. Screw bolts, pins, nuts, washers, joints. Representation of welded structures. Short construction and drawing tasks weekly, elaborated in the classroom. Homework in connection with lecture themes. (3 credits)

## Vehicle and Drive Elements I.

**BMEKOGE2028**

*Dr. János Márialigeti*

Structural analysis of the main construction elements of vehicles. Classification of machine elements. Stress analyses, safety and reliability. Load analysis, phenomena of fatigue. Joining elements, screw bolts, rivets, pins, welded joints; shape and material, calculation, application. Joining of shaft and hub, mechanism and calculation. Fundamental principles of tribology, friction and wear. Types of lubrication, viscosity. Design considerations. Pressure fed bearing. Heat balance. Bearing types, materials, design. Thrust bearings, boundary lubricated bearings. Rolling contact bearing types. Principles of bearing life and load capacity. (3 credits)

## Vehicle and Drive Elements II.

**BMEKOGE3029**

*Dr. János Márialigeti*

Classification of springs. Gear drives classification, types and application. Profile curves construction. Base definitions and designations. Standard requirements. Spur, helical and bevel gears. Profile modification. Gear materials and manufacture. Sliding condition. Failure analysis, strength and temperature analyses and gear wheels. Calculation of tooth strength, surface durability and temperature resistance. Screw gears. Fits, tolerances and measuring of gearing. Wave drives and cyclo-drives, V-belt drives. Roller chains, rope drives. Pipes, fittings, valves and tanks. Hydraulic and pneumatic control and driving elements. Calculations based on CA methods. Intelligent machine elements. (4 credits)

## Fundamentals of Vehicle Design and Investigation I.

*Dr. András Eleöd*

Fundamentals of probability theories in vehicle industry. Qualitative and quantitative methods of the probability analysis. Connection of life-time and fatigue curves. The safety factor interpretation on probability theories. The failure probability in case of different loading models. Fundamentals of linear-elastic fracture mechanics. Determination of the crack propagation and the remaining life-time. Theories of different wear mechanism. Connection of wear and lubrication. Theory hydrodynamic lubrication. Different kind of lubricants. Viewpoints of environment. Design using catalogues. (4 credits)

## Fundamentals of Vehicle Design and Investigation II.

*Dr. András Eleöd*

Techniques of 3D modelling. Set-up of a graphical design system. Techniques of surface and volume modelling. Generation a 2D drawing documentation based on volume models. Rudiments of concurrent engineering. Connection of computer aided modelling and computer aided manufacturing.

Virtual prototype production. The practical application of FEM in vehicle techniques. The possibilities of construction optimization. Structure of design process, function analysis, solution principles. Methodology of the communication in between design teams. (5 credits)

## Programming I.

**KOVJB000**

*Dr. Károly Gyenes*

The goal of the course is to learn a algorithmic programming language, and use it for improving problem solving skills. The use of Object Pascal for solving applied mathematical and engineer-ing problems. (3 credits)

## Programming II.

**KOVJB000**

*Dr. Károly Gyenes*

The course helps solving the problems of other courses using high level computational environment. Delphi is an event-oriented programming language. Borland Delphi is an integrated development environment. The use of component based programming. Applications from the field of transport. (3 credits)

## Electrotechnics and electronics I.

**KOVJB000**

*Dr. Ferenc Parádi*

Elements, units, basic models of electrotechnics in general. Parameters and features of basic electronic components. Principles and design of electronic switching circuits. Special transportation applications. (4 credit)

## Electrotechnics and electronics II.

**KOVJB000**

*Dr. Ferenc Parádi*

Features, principles, important user parameters and typical applications of electric engines and traction motors used in transportation. Principles, operation and design of analogue circuits. Special transportation applications. (2 credits)

## Control and Automation I.

**KOVJB000**

*Dr. József Bokor*

The base of system-theory, the criterion of system classification. The tools of system modeling playing an important role in transportation engineering practice. The functions of digital technique, and implementation. Introduction to logic-circuit design. Transportation applications. (3 credits)

## Control and Automation II.

**KOVJB000**

*Dr. József Bokor*

Introduction to system-theory and control theory, using classical and modern tools; for the application of Transportation Engineering Control Problems. (3 credits)

## Transport automatation

**KOVJB000**

*Dr. Géza Tarnai*

The course provides the students knowledge on the safety and reliability of traffic control systems. Beside the theory, numerous transportation examples are discussed. (3 credits)



## Road control and communication systems III.

KOVJB000

*Dr. Tamás Péter*

The aim of the course is to provide the students up-to-date knowledge of telecommunication systems. Students will learn how specify the requirements of telecommunication systems, and how to co-operate with telecommunication experts. (4 credits)

## Transport economics

*Dr. Lászlóné Tánccs*

Specialities of transport. Economical and efficiency analysis of transport. Operation of transport companies. Cost and tariff calculation methods (2 credits)

## Transport statistics

*Dr. Lászlóné Tánccs*

Basic statistics and mathematical statistics. Application in transportation. Index calculation. Correlation. Regression. Trends (2 credits)

## Logistics management

*Dr. István Magyar*

Logistics activities and processes. Logistics strategy. Controlling, resource planning (3 credits)

## Management and microeconomics

*Dr. Lászlóné Tánccs (Botond Kóvári)*

Types of companies. Corporate resources. Productivity, costs, revenues. Externalities. Financing. Controlling system. Corporate strategy (4 credits)

## Business Law

*Dr. István Békési*

Basic terms of constitution. Terms of business law. Types of companies. Contracts. Legal responsibilities. Law of competition. Labour law (2 credits)

## Transport Systems

BMETKKOB000

*Kövesné dr. Gilicz Éva*

Historical basis of transportation systems. System property and system connection of transportation. Fundamental principle of transport policy. Planning process of transportation. Description and operating of subsystems. Passenger and goods transport systems. Rudiment of transport technology. Functions of subsectors. Environment fluencies, sustainability. Quality of supply of transportation, evaluation methods of systems. Integrated Hungarian and European transportation. (2 credits)

## Logistics Systems

BMETKKOB000

*Dr. Júlia Tarnai*

Idea of Logistics. Logistic processes. General properties and parts of the logistic systems. Development areas of logistics. Description and parts of enterprise logistic systems. Logistics organisation of the enterprises. Development properties, purposes and levels of enterprise logistic systems.

Properties of packing materials, products and containers. Role of unit load systems in logistics. Logistics services. Purposes of material handling, warehousing and goods transportation systems. Logistics services, logistic service centres. Methods, techniques, services and application of integrated logistic information systems. Logistic services of ERP systems. Demonstration of ERP software solutions. (2 credits)

## Transport Technology

BMETKKOB506

*Dr. Péter Havas*

Review of the Hungarian transport system. General and special features of transport technology processes. Technology of the passenger transport on roads. Technologies of road haulage. Typical parameters of the road operation. Technology of the railway transport. Operation on stations, organisation of the trains' flow. Typical parameters of transportation of passengers and goods. Technology of operation on inland waterways. Technology of air traffic. Models of designing transport technology processes in space and in time. Determination of the shortest way, transportation problem, round-trip problem, model of organizing the service. Use of queuing model in design of transport technology flows. Determination and coordination of capacity of mobile and immobile equipments. Possibilities for increasing capacity by using technical and organization method. Solving the problems from the domain of the road operations and railway transport. Practising of mathematical models in designing transport technology processes. (3 credits)

## Work Organisation

BMETKKOB503

*Dr. Péter Kovács, Dr. Csaba Csizsár, János Csizsár, Péter Mándoki*

Objects, basic theories of organisation theory; applicable fields of other sciences. Basics of store systems. Methods of process analyses. Determination of capacity and utilisation of capacity. Basics of organisation production systems: contact between production types and systems, automation and integration of production processes. Flexible production systems. Computer-aided planning of production processes. Planning technological transmit time. Methods of network theory. Importance of supply and distribution logistics in direction of production processes. Mathematical methods of optimisation of logistic systems. Most modern tendencies of organisation theory. Application of calculations and other methods like a seminar. Video and computer laboratories are able to show and effect modern solutions and methods. (4 credits)

## Transport Technique

BMETKKOB605

*Dr. Júlia Tarnai, Dr. Péter Kovács, Krisztián Bóna*

Characterisation of logistic processes making contact between producers and consumers. Significance and part of loading, materials handling and storage. Main groups of transported products. Stresses on products during loading, materials handling and storage. Methods of load fixing. Equipment of unit load handling. Equipment and machines of loading technology. Materials handling with unit loads, containers and combi equipment (road- railway, road-ship).

Establishments according to loading of transport vehicles. Analysis of work load places and transport load places (between railway and road, ports, airports etc.). Fundamental knowledge of storage technology.

Calculations to determine of stresses on products, working of loading machines, construction of buildings in loading places. (3 credits)



## Transport Network Planning

BMETKOB603

*Kövesné dr. Gillicze Éva Dr. János Tóth, Dr. Csaba Csiszár*

Method and main elements of the transport planning. The purpose and process of the network planning. The main characteristic of the transport demands from the point of view of network planning. Modelling of transport network. Trip generation models, trip distribution models, modal split models. Calibration techniques. Settlement: theoretical bases, main characteristics of town, vicinity of town and settlement system. Models of settlement coverage. Improvement tendency. Connection between settlement and transport network. Principles of construction of road-, city-, railway-, water- and air-transportation networks. Calculations concerning to lectures. (4 credits)

## Transport Logistics

BMETKOB000

*Dr. Júlia Tarnai, Dr. Jen? Tokodi*

Role of transportation in logistics. Types, services, objects of logistic service centres. City-logistics. Tools of goods transportation. Basics of GIS. Ideas of tour planning systems. Disposition methods. Demonstration of tour planning programs. (5 credits)

## Machines of the building industry II.

437

*Dr. Kornélia Rác*

Survey of earthwork technologies. Earthwork machines, including sectional and continuously operating baggers, construction of excavating and earth moving machines. Theory of earth compacting. Requirements for the choose of compacting machines, comparison of the compaction modes. Determination of technological parameters of road building machines. Examination of human-machine environment using founding technologies and building public utilities. Modern environment friendly building technologies. Structure of drive system of mobile hydraulic machines, methods for the diagnostics. Technical, ecological and environmental aspects of choosing earthwork machines. (3 credits)

## Transportation paths

118

*Dr. Kornélia Rác*

Role of roads and tracks, factors of transport policies. Interaction of transportation system and environment. Classification and development tendencies of roads and tracks. Basic aspects of planning transportation paths (amount of traffic, layout, traffic junctions). Accessories of transportation paths (bridges etc.). Construction of substructure, factors of sole physics and mechanics. Technological processes of earthworks, basic types of earthwork machines. Superstructure of roads and railway tracks. Basic materials, solutions for the technology. Requirements of traffic safety during operations, maintenance and repairs of transportation paths. Environmental orders and organizations and institutes. (2 credits)

## Logistic machines

434

*Dr. István Keisz*

Classification of materials handling machines. Structure and production and steel-ropes. Rope ends, sleeves, rope drums. Crane hooks and their dimensioning, hook fixing. Mechanic magnetic and pneumatic lifting elements, pallets, containers. Mechanic and hydraulic grabs Determination

closing force of a grab. Running wheels and rollers, dimensioning of brakes and opening mechanisms. Chains and chain drives. Electric motors: connections and characteristics. Planetary gears, hydrodynamic clutches, eddy current brakes and their characteristics. External and internal drive resistances, efficiency. Inertia reduction and determination of wind force. Tower crane parts, parameters and control. Dimensioning of steel structures of cranes. Mobile cranes. Bucket elevators.

Classification of materials handling machines. Structure and production and steel-ropes. Rope ends, sleeves, rope drums. Crane hooks and their dimensioning, hook fixing. Mechanic magnetic and pneumatic lifting elements, pallets, containers. Mechanic and hydraulic grabs Determination closing force of a grab. Running wheels and rollers, dimensioning of brakes and opening mechanisms. Chains and chain drives. Electric motors: connections and characteristics. Planetary gears, hydrodynamic clutches, eddy current brakes and their characteristics. External and internal drive resistances, efficiency. Inertia reduction and determination of wind force. Tower crane parts, parameters and control. Dimensioning of steel structures of cranes. Mobile cranes. Bucket elevators. (4 credits)

## Labour safety

111

*Dr. István Keisz*

Concepts of labour safety, shapes of dangers. Ideas and actual level of labour safety. Processes and reasons of work accidents, progress and consequence of accidents. Areas and limitations of labour safety. Protection of labour environment, labour hygiene. Basics of ergonomics. Features of safety devices. Environmental effects of safe functioning of machines. Formulating and professional handling of ergonomical problems. Electrical safety and relating orders. Electric shock protection classes. General principles of rooms' ventilation. Regarding human factors during construction of technical systems. Illumination of workplaces. Noise reduction at workplaces. Noise sources of streaming. Influencing factors of human power in human-computer systems. (2 credits)

## Transportation systems of production

*Dr. Jen? Frank*

Basic function of transportation systems in manufacturing. History of materials handling machines, a role of logistic. Transport machines' classification in manufacturing. Intermittent and continuous operating materials handling machines. Work cycles and energetics of materials handling machines. Requirements of intermittent materials handling machines. Load collection, working class number. Features of moved materials: piece goods and bulk materials. Flexible drive elements: rope, chain, belt. Construction of wheels, rollers and tracks. Construction and classification of brakes. Construction and loading of drive units (lifting, tractional, rotational, auxiliary gears). Control of transport systems. Basics of reliability theory. Safety and orders of transportation systems in the production. (2 credits)

## Fluid Mechanics and Thermotechnics I

KORHA104

*Dr. Imre Sánta*

Thermodynamic systems. Properties. Equation of the state of ideal gases. Interactions between systems and surroundings. First law of thermodynamics. Heat, works, internal energy, enthalpy, entropy. P-v and T-s diagrams. Analyses of thermodynamic processes occur in vehicles. Second law of thermodynamics. Thermal efficiency. Cycles take place in inter-



nal combustion engines of vehicles. Comparison of cycles.

Physical characteristics of fluids. Fields, potential, hydrostatics, floating. Description of fluid motions. Law of mass conservation. Two-dimensional potential flow of ideal incompressible fluid. Law of energy conservation - Bernoulli equation. Equations of momentum- and angular momentum conservation. Elements of compressibility. Newtonian fluid. Basic laws of viscous flow. Navier-Stokes equation. Elements of similarity theory. Viscous flow in pipes and ducts. Characteristics of pipelines. (3 credits)

## Fluid Mechanics and Thermotechnics II

KORHA105

*Dr. Imre Sánta*

Viscous flow around immersed bodies, boundary layer. Vortex motion. Forces acting on the immersed bodies. Flows around the vehicles. Propulsion devices. Ship motion in water. Propelling of the ships. Subsonic, transonic and supersonic flows. Gas dynamics. Elements of aircraft aerodynamics. Fundamentals of numerical methods in fluid mechanics (CFD). Adaptability of principles of fluid mechanics in simulation of the transport and logistical processes. Cycles of aircraft engines. Water vapor and steam. Gas and gas-vapor mixtures. Humid air. Steam processes and steam power cycles in vehicles. Refrigeration, heat pumps. Fundamentals of heat transfer. Heat conduction. Differential equation of heat conduction and conditions of its solution. Heat convection, heat radiation. Overall heat transfer. Heat transfer processes in vehicles. (3 credits)

## Fluid- and Thermo-Machines in Vehicles I

KORHA401

*Dr. Imre Sánta*

Classification of fluid machinery and heat engines, principles and characteristics, their function in means of transport. Fundamentals of fluid mechanics and heat transfer. Actual adiabatic processes. Adiabatic and polytropic efficiencies. Working processes of reciprocating internal combustion engines. Energy conversion in internal combustion engines and their importance from the point of view of the engine quality. Indicator diagram of the petrol and diesel engines. Operation and characteristics of hydraulic torque converter and coupling. Centrifugal compressors. Basic types. Prewhirl before the impeller. Energetic processes in impeller. Vaned and vaneless diffusers, design of volute. Calculation of main sizes.

Characteristics. Axial compressors. Operation of stage, fundamentals of its calculation. Multistage compressors. Unstable operational mode (surge) of compressors. Axial turbines (types, operation and degree of reaction). Energy conversion in stator and rotor blades. Multistage turbines. Radial-flow turbines in vehicles. Gas turbines in vehicles. Ideal and actual cycles of gas turbines, optimal parameters, determination of losses and efficiencies. (4 credits)

## Fluid- and Thermo-Machines in Vehicles II

KORHA402

*Dr. Imre Sánta*

Positive displacement machines in vehicles. Theory and thermodynamic calculation of reciprocating compressors. Design and control of reciprocating compressors. Rotary positive displacement compressors and blowers. Heat exchangers in vehicles (calculation and design). Refrigeration. Gas, vapour-compression and absorption refrigeration. Fundamentals of air-conditioning of vehicles. Turbomachines in vehicles. Construction and types of turbo pumps. Energy conversion in impeller. Main parameters. Determination of main sizes of the radial, semi axial, and axial pumps. Characteristics of pumps. Methods of connection and control. Starting of pumps. Suction ability. Operation and typical data of vehicle fans. Methods of control. Noise sources. Measurement of characteristics. (2 credits)

## Ship maintenance and control

KORHA427

*Dr. József Rohács*

Ship types, navigation modes, specialities of the pushing and towing navigation. The control of the ships from the engineer point of view. Special navigation situations. Tasks of the crew. Works on the ship in the port. Ship maintenance. International and national rules of the navigation. Authorities of the inland waterway navigation. (7 credits)

## Basic theory of vehicle engineering

KOVJA112

*Dr. István Zobory*

Physical quantities used in the theory of vehicle engineering. Fundamentals of measuring technique, evaluation of measurement results. Work done and power exertion with vehicles and machines in steady and transient operation. Simple power transmission equipments. Efficiency and energy optimal load of machines. Periodic motion of vehicles and machines. Rudiments of hydrostatics, simple hydrostatic machines. Floating and stability of ships. Flow of fluids, energetics of pumps and pipe-systems. Operation principles of simple turbines. Rudiments of heat engines on the basis of thermo-dynamics. Performance curves, combined operation and operational-stability of machines. Fundamentals of vehicle and machine control. (3 credits)

## Vehicle dynamics and drive technique

KOVJA130

*Dr. István Zobory*

Main factors influencing the vehicle motion: tractive effort, braking force- and traction resistance performance curve systems. Characteristics of the transportation route, determination of the track resistance forces. Vehicle control. Dynamics of the fundamental motion of controlled vehicles. Solution to the motion equation, computations of scheduling. Dynamics of rolling contact. Parasitic motions of vehicles. Eigenfrequencies and stability reserves. Drive systems of vehicles. Characteristic mechanism with vehicle drive systems. Construction, components and operation of mechanical, hydraulic and electric power transmission systems. Jet and turbo propulsion. Energetics and loading condition analysis of drive systems. (4 credits)



## Logistics

### Materials Handling Processes

BMETKKOB000

*Dr. László Molnár, Dr. Péter Kovács,*

Principles, role and purposes of the materials management systems. Main parts of the materials management systems. Determination of time necessity and power in materials management processes. Reliability of materials management processes. Fields and methods of analysis in materials management processes. Safety aspects of materials management. (3 credits)

### Identification systems

325

*Dr. Gábor Bohács*

Requirements of use and history of identification systems. Position of identification systems in the logistic system of a company. Structure, components and application of barcode identification systems. Information content of barcodes, barcode types (one- and two-dimensional barcodes). Standardization of barcode information content (ODETTE etc.). Comparison of operation of barcode readers. Structure and use of radio frequency identification systems (RFID). Databases of RFID systems. Processing RFID information using PCs and PLCs. Structure, components and use of visual identification systems. Fields of use of visual identification systems (pattern recognition, character recognition, measurements). (4 credits)

### Control and automation techniques of logistic systems I.

320

*Dr. Béla Kulcsár*

Automation levels of materials handling systems, and their requirements. Features of sensors used in materials handling systems, aspects of application. General features and control of actuators used in the above systems. Principles of automatized work- and motion cycles. Structure of a PLC: functional unit, features of the various memory domains, addressing, programming principles of PLCs. Programming basics of PLCs type OMRON CQM1 using SYSWIN and CX Programmer software. Functioning of Syswin and CX Programmer commands (through application examples). Principle of programming - ladder diagram. Principles and application examples of editing sub-routines. Elements of a Fa ID System. Programming identification systems using SYSWIN and CX Programmer software (4 credits)

### Control and automation techniques of logistic systems II.

321

*Dr. Béla Kulcsár*

General principles of network control systems. Multi-level control architectures, protocols. Questions of building a network from PLC-s at the low control level. Managing networks using PLC programming software LSS: master-slave connection RS-232 and RS-485 line ADAM Interface. Automated protocols between two OMRON CQM1 PLCs and between an OMRON C200 HS and an OMRON CQM1 PLC. Host-link protocol for the above PLC pairs. Protocol structure, control of data read and write. Host-link protocol for Master (OMRON CQM1) and two slave (OMRON CQM1) PLCs. Creation a network from more PLCs Operating PCs and PLSs in the same network. Visualizing software tools. (5 credits)

## Robotics

322

*Dr. Béla Kulcsár*

Evolution and background of robotics: general introduction. Conceptual definition and classification of robots. Robots' architecture, coordinate systems. Workspace of robots and its constraints. Mechanical construction of robots. Robot drives, control of driven shafts. Robot grabs and is safety, depending on the robot kinematics. Robot programming and information processing, programming basics (Teach In, world coordinate system). Description of robot motion using programming languages (VAL programming language). General principles of path generation, linear interpolation, circular interpolation. Connection of path generation and drive control to dynamics, control upon computed torque. Application of robots and its planning. Materials handling applications, combined systems, questions of synchronization. (4 credits)

### Production logistic

324

*Dr. Béla Kulcsár*

Manufacturing structures and processes. Logistical concepts of manufacturing processes. Physical and management functions of logistical processes. Classification of suppliers, auditing methods. Structure of production logistic systems. Administrative and dispositive logistic functions. Supply chains. Operative logistic functions: material flow systems, warehousing processes and stores, information systems, logistic control. Logistical objects. Mapping of industrial systems, system structures. Strategic conceptions of PPS: Just in Time principle, optimized manufacturing technologies, logistical concepts. KANBAN principle, decentralized fine-programming. Concept and methods of fine programming. Basics of Petri nets, and its use in manufacturing processes. (4 credits)

### Corporate Logistics Management

*Dr. István Magyar*

Logistics controlling

Costs

Revenues

Benchmarking

Quality management

Return on investments

Efficiency analysis

Optimisation of logistics processes (4 credits)

### Material Handling and warehousing processes

BMETKKOB000

*Dr. László Molnár, Dr. Péter Kovács, Krisztián Bóna,*

Principles, problems and significance of material management and warehousing processes in logistics. Description, views, power and reliability of material management systems. Methods of validation for measurement and analysis of material management systems. Working processes of traditional, high-stores and automated systems AS/RS. Methods of commissioning. Informatics and control systems in warehouses. Safety rules of materials management and warehousing systems. (6 credits)

### Material Supply and Distribution

BMETKKOB000

*Dr. Júlia Tarnai, Krisztián Bóna,*

Principles, role and purposes of distribution systems in logistics. Ideas of purchasing. Analysis methods and strategies for purchasing. Choosing of the purchasing partners. Basics of



set control processes in the stores. Deterministic and stochastic set models. Information and control systems in the warehouses. The ECR-concept. Waste logistics. Outsourcing in the supply and distribution logistics. (6 credits)

## Packaging Technologies

**BMETKOB000**

*Dr. László Molnár*

Principles, problems in packaging. Kinds of packaging materials and tools. Common components of packaging and logistics. Technological-economical aspects for development of packages. Judgement, environmental and technical conditions for packaging. Safety principles. (3 credits)

## Manufacturing logistic

**309**

*Dr. Béla Kulcsár*

Manufacturing structures and processes. Logistical concepts of manufacturing processes. Physical and management functions of logistical processes. Restructuring of production processes using logistical principals. Classification of suppliers, auditing methods. Structure of production logistic systems. Main functions of production control. Problems of planning the production program. Influencing factors on the production. Quantity planning, control of materials. Time and capacity planning. Time and capacity analysis using various simulation and fuzzy techniques. Strategic conceptions of PPS: Just in Time principle, optimized manufacturing technologies, logistical concepts. KANBAN principle, decentralized fine-programming. connections between Caxx techniques and PPS, database structures. Production control, methods and infrastructure of data collection at the production. (3 credits)

## Machines and devices of logistics II.

**305**

*Dr. Béla Kulcsár*

Roller conveyor systems. Gravitational roller conveyors. Entry of unit loads onto a roller conveyor. Construction and operation of driven roller conveyors. Determination of drive power. Auxiliary equipment of automation of roller conveyor systems. Continuously operating materials handling machines with endless traction element. Structure and layout of overhead conveyors. Drives of overhead conveyors, determination of power consumption. Materials handling machines of assembly lines. Construction and operating features of assembly conveyors. Control logic of assembly conveyors. Construction and functioning of belt conveyors. Placing the drive and the tensioning units. Construction and functioning of bucket elevators. Vibrating machines. Pneumatic transportation. Complex materials handling systems. (5 credits)

## Machines and devices of logistics I.

**305**

*Dr. Béla Kulcsár*

Electric hoists. Operational features of overhead cranes. Safety requirements of crane building. Examinations of cranes before putting into operation. Automation of cranes. Construction and operation of forklifts. Main constructional questions and safety of forklifts. Stability and steering of forklifts. Guidance of unmanned forklifts. Construction of frequency guided induction forklift trucks. Communication methods and control systems of induction guided forklifts. Operation and automation of warehouse rack stackers. Construction, kinematics, work-cycles and dimensioning of rack stackers. Layout and automation of overhead rail transporters. Requirements of unit loads. Dimensioning of lifting tables (mechanics, hydraulics, safety). (3 credits)

## Decision making methods

*Dr. Lászlóné Tánczos*

Typical decision making methods supported by computer  
Individual project evaluation  
Mathematical statistics  
Group decision methods (5 credits)

## Trade, Financial, Accounting Technics

*Dr. Zoltán Bokor*

Financial market. Controlling. Stock exchange. Annual reports. Balance sheet. Audits. Bank activities (3 credits)

## Marketing

*Dr. István Magyar*

Marketing mix. Information system. Competition analysis  
Applied marketing in transport service industry (3 credits)

## Manager training

*Dr. Zoltán Bokor*

Social psychology. Corporate structure. Corporate culture  
Conflicts. Communication, team work, project management (5 credits)

## Forwarding management I.

*Dr. Zoltán Bokor*

Contracts on forwarding  
Legal issues of rail, road, water and air transport  
Customs, taxes (3 credits)

## Forwarding management II.

*Dr. Zoltán Bokor*

Bi and multilateral agreements on rail, road, water and air transport. Dangerous goods transport. Tariffs, insurances (5 credits)



## Transportation

### Control and Communication Systems of Aviation I.

KOVJB000

*Dr. Tamás Péter*

Airspace Control systems. Control centres, flow management. Measurement systems. Landing Systems. Speed measurement. TCAS. Air Traffic Management. Airspace organisation. Flight information service. Alerting Service. (3 credits)

### Control and Communication Systems of Aviation II.

KOVJB000

*Dr. Tamás Péter*

Satellite Positioning systems GPS, GLONASS, EGNOS, GALILEO. WAAS system. MATIAS, Budapest control centre. EUROCAT 2000 standardized description system. The changing ten-dencies of aviation. Increasing capacity. Implementation of RVSM system. United European control centres (CEATS). (5 credits)

### Control and Communication Systems of Aviation III.

KOVJB000

*Dr. Tamás Péter*

The goal is to teach the students communication skills for dealing with specification problems generated by communication systems, and interact with communication experts (3 credit)

### Air transport management I.

*Dr. Enikő Legeza*

Market of air transport. Strategy. Marketing. Controlling. Charges. Airlines and airports (2 credits)

### Air transport management II.

*Dr. Enikő Legeza*

Fleet of an airline. Alliances, low cost airlines. Crew management. Ground handling. Revenue management (3 credits)

### Air Transport Informatics

BMETKKOB821

*Dr. Gábor Debreczeni*

The importance of informatics through control of air transport. International regulations for the development of the information system of air transport. The structure of the computer networks for data processing and transmitting in the international practice of air transport. The action and use of the network. The data processing systems by SITA. Information system parts based on SITA network. Seat reservation, ticketing systems, system for passenger handling, passenger registration. Data processing systems connected to goods transport by the air traffic. Data processing and accounting system. Further information systems for development by air transport. (3 credits)

### Airspaces, airports

BMETKKOB000

*Dr. Gábor Debreczeni*

Interconnections between air traffic and airspace. Airports: domestic, international, great junctions. Infrastructure of airport: runway, taxiway and foregrounds. Traffic adaptations. Airport basis, terminals, service, functions. International passenger service. Categories of tower and landing systems. Services inside the airport. Flying security inside the airport. Environment protect, checking conditions. Operation technology of airport. Traffic fulfilment methods, moving aircrafts and vehicles on field of work. (3 credits)

### Flight Operation

KORHA225

*Dr. József Rohács*

Lectures: Aircraft development philosophies. Introduction to the flight theories: aerodynamics, lift generation, drag and its components, flight at high and supersonic speed, flight performance, stability and controllability. Aircraft Structures. Aircraft systems. Aircraft engines, gas turbines. Fluid and thermal technics of gas turbines. Engine structures. Special aircraft, helicopters. Aircraft operation. Airworthiness. Organization of flights. Flight safety and security. Effects of aviation on the environment.

Practices: Calculation of the aircraft and engine characteristics. Design and simulation of the aircraft operation. Risk analysis. Calculation of the effect of aviation on the environment. Visits at airlines and airports. (7 credits)

### Railway control and communication systems I.

KOVJB000

*Dr. Géza Tarnai*

Functions, structures, principles and operation of railway control systems. Classification, com-parison and analysis of various European systems. Controlling and tracking train movements. Analysis and comparison of European signalling systems. Methods and devices for train detection and positioning. Controlling and interlocking elements of signalled routes. (3 credit)

### Railway control and communication systems II.

KOVJB000

*Dr. Géza Tarnai*

Evolution and operation of railway interlocking systems. Indoor and outdoor elements and their relations. Principles of signalled routes. Devices and methods of man-machine interfaces. Automatic operation. Remote control and centralized traffic control. Automatic train control systems. (5 credit)

### Railway control and communication systems III.

KOVJB000

*Dr. Géza Tarnai*

The aim of the course is to provide the students up-to-date knowledge of telecommunication systems. Students will learn how specify the requirements of telecommunication systems, and how to co-operate with telecommunication experts. (4 credits)

### Rail transport management I.

*Dr. Lászlóné Táncoz*

Transport policy. Liberalisation in rail transport. Rail transport market. Externalities. Planning of investments (2 credits)



## Rail transport management II.

*Dr. Lászlóné Tanczos*

Rail transport strategy  
Development of structure and operation in rail transport  
Managing the jobs of railways  
Charges of using railways  
Managing passenger and goods transport  
Controlling system (3 credits)

## Railway Traffic Operation Technology

**BMETKKOB000**

*Dr. Péter Havas*

Reloading time, as the main process of railway service. Modelling the operations on centre-, disponent-stations, on shifting yard, on passenger- and goods-stations and railway junctions. Design of capacity of stations and their utilization. Analysis of operations of railway stations. Designing the service and technology of railway stations and platforms (7 credits)

## Railway Informatics

**BMETKKOB805**

*Dr. Csaba Csiszár*

The importance of informatics by the railway, international practices. Special information system of the railway for passenger transport. Standardisation in Europe. Centralised and decentralised time-table information supplied by the railway. International extended seat reservation system for the railway. Information supply of passengers on stations and trains. Ticketing information system. Goods transport control information systems by the different railways (TOPS, ITS...). Goods transport control information system by MÁV, subsystems. Information system for checking traffic at the border. Railway junction control information system. Line control system. District control information system. Further railway information systems. (3 credits)

## Railway tracks

**221**

*Dr. Kornélia Rác*

Construction and main parts of railway superstructures. Rails, rail joints and fastenings: types and solutions. Requirements of the tracks, dimensioning. Role and materials of embedment, requirements of the embedment from broken stones. Typical machinery of embedment laying, repair and compaction. Works of railway track's maintenance. structural specialities of railway bridges and other railway culverts. Authority and role of railway track supervision. Function and examination methods of track diagnostics. Various track and rail geometry errors, and their consequences for the safety. Universal track building and maintaining equipments: technological processes, special machinery. Effect of railway superstructure on the noise and vibration emission, possibilities of vibration damping. Interconnections of roads and railways. (3 credits)

## Road traffic control and communication systems I.

**KOVJB000**

*Dr. Tamás Péter*

Principles and operation of road traffic control systems. Relay and electronic traffic signal controllers. Combined road and railway traffic control systems. Structure and operation of road traffic control centres. City public transportation traffic control systems. (3 credits)

## Road traffic control and communication systems II.

**KOVJB000**

*Dr. Tamás Péter*

Basic principles of designing road traffic control systems. Theory of road traffic measurements. Automatic traffic monitoring systems. Principles of static and dynamic measurements. Vehicle detection. Devices of road traffic controlling and management. Passenger information systems. Intelligent road traffic control. Influencing traffic in car parks and highways. On-board control systems. (5 credits)

## Road transport management I.

*Dr. Zoltán Bokor*

Specialities in road transport. Legal issues of road transport. Operation of road transport. Tariffs, contracts (2 credits)

## Road transport management II.

*Dr. Zoltán Bokor*

Passenger and goods transport on road. Efficient operation of road transport companies. Insurance. Externalities (3 credits)

## Road Traffic Operation Technology

**BMETKKOB810**

*Dr. Péter Havas, Péter Mándoki*

Traffic of automobiles as a part of transport system. Description of goods and passenger flow on the road. Equipment and establishment of automobile transport operation. Operating processes of buses. Traffic workshops, bus stations. Choice of vehicles. Factors, which are able to characterise transport-operation processes. Planning of achievement and capacity utilisation of bus stock. Routing. Preparing of route plans and time-tables. Contact between bus transport respectively air- and railway transport. Properties of international and tourist routes. Control of bus operation. Operating processes of trucks. Choice of the vehicles. Establishment on the workshops and operating processes. Transport operation processes, and the factors for validation. Achievement and planning of capacity utilisation of truck stock. Planning of route plans and time-tables. Optimal transport preparation of products of different kinds. Combi transport technologies. Technological problems of city distribution. Transportation of dangerous products. Technological requirements of international truck transport. Control of truck transport operation. Technological planning of a traffic-technical workshop. Adaptation of the modern combi transport technologies. Calculation of routes, time-tables, and staff routes in bus and truck transport. (3 credits)

## Traffic Technology

**BMETKKOB710**

*Kövesné dr. Giliczé Éva, Dr. Gábor Debreczeni*

Components of urban traffic, travelling persons, characteristics and interactions of the vehicle and roadway. Main space and time characteristics of urban traffic flow, measurement methods of characteristics, examination of relation among them, modelling possibilities. Dimensioning and control of urban traffic, performance concepts of roadway and transport vehicle in different subsystem of urban transportation including the question of stationary traffic. Control methods of urban traffic. Tasks of traffic safety and the protection of human environment in urban traffic. Calculations concerning to lectures, visiting to transport services. (4 credits)



## Planning of Road Transport Information Systems

BMETKKOB812

*Dr. János Tóth*

The structure of the organisation of road transport. The information system for the planning of road transport. Operative information system for the organisation of transport by parking place. Operative information system for the control of long-distance road transport. Integrated road transport informatics for the operative control of goods transportation. Operative informatics of the passenger transport by road transportation. Computer-aided information system for control of piece-goods transport. Computer integrated control system of container transport. Computer aided information system for the control of repair work. Different data-files for the checking of road transport. The design of information systems for the different road transportation jobs. Preparing system-conception of different information systems for road transport. (3 credits)

## Roads

213

*Dr. Antal Balpataki*

Solutions for road structures, materials and dimensioning. Function of roads. Structure of city, agricultural, industrial and special roads. Requirements against road surface, development tendencies. Steps of layout determination. Modern equipment of road building machinery. Aspects of choose of road building machines. Techniques of road maintenance and repair. Structure, building and machines of auxiliary bridges, tunnels etc. Aspects of chose of communal machines. Technologies of building communal facilities. Environment friendly processes. (3 credits)

## Water transport control and communication systems I.

KOVJB000

*Dr. Tamás Péter*

Operation of ship traffic (loading, navigation, communication). Basic elements of navigation. Navigation control logics. Control and discrete model of navigation. Areas and tendencies of water transport automation. Electronic navigation systems. Automatic collision avoidance systems (ARPA). (3 credits)

## Water transport control and communication systems II.

KOVJB000

*Dr. Tamás Péter*

Satellite navigation systems. The NAVSTAR GPS GLONASS and the GALILEO system. The MSAS, WAAS and the EGNOS system. Electronic mapping and information system (ECDIS). Communication systems in river and maritime navigation. The Global Maritime Distress and Safety System (GMDSS). The COSPASS-SARSAT and the INMARSAT system. Management and control of water traffic. The VTS, VTMS, EUTELTRACS systems. The automatic ship identification system (AIS), and the river information system (RIS). (5 credits)

## Water transportation control and communication systems III.

KOVJB000

*Dr. Tamás Péter*

The aim of the course is to provide the students up-to-date knowledge of telecommunication systems. Students will learn how specify the requirements of telecommunication systems, and how to co-operate with telecommunication experts. (4 credits)

## Waterway transport management I.

*Dr. Enikő Legeza*

Sea and inland waterway transportation  
Intermodal connections, harbours  
Information systems  
Rules and regulations (2 credits)

## Waterway transport management II.

*Dr. Enikő Legeza*

Special management system in water transport (fleet, tankering). Crew management. Meteorology. Insurance. Charges (3 credits)

## Waterway Transport Informatics

BMETKKOB815

*Munkácsiné dr. Lengyel Erzsébet*

The structure of applied information system of the shipping transport. The informatics features of river goods transport. The cargo fixture's information system. The computerized recording of river transport's participants. Files of barges and motor vessels. (Pushing and towing vessels.) The information system of ship's maintenance. The information management system of river transport's planning and operational direction. The contents and handling of sailing and position lists.

The information management system of ocean shipping. The computerized data management of river and sea passenger transport.

Training of the computerized shipping database planning, organization and management. (3 credits)



## Vehicle Engineering

### Logistic of the building industry

439

*Dr. Ferenc Tóth*

Logic, logistic, reason-result concept, cognition-possibility of causality. Determinable or stochastic methods, models, condition of their uses. Concept of requirements and methods of collections from sources, calculations. Calculation- and minimizing-methods of instruments, personnel, materials, energy consumption, capital cover and time needed for tasks prescript into of time done. Maintenance and spare parts-need in the future solved by spare parts strategies. Methods of quality-assurance. Selection, schooling- and control-methods of operators, maintenance-persons. Requirements formal and law of procedure for contracts, guarantee, warrantee, compensation, references according GATT-prescription at trade of machines. (3 credits)

### Machines of the building industry I.

436

*Dr. Kornélia Rác*

Components of concrete and asphalt, influencing factors. Preparation process and machines of additives. Methods for additives classification, basic types of machines for classification. Determination of operating parameters of vibrating screens. Classification of concrete mixers and their specific constructional variants. Technological processes and machines of concrete and asphalt mixing plants. Determination of operating parameters of concrete pumps. Methods of concrete compaction, aspects for determining vibration features. Calculation vibrating factors of concrete vibrators. Modern technologies and machines of the pre-made concrete elements construction. Possibilities for recycling of construction industry waste. (5 credits)

### Control systems of the building industry

438

*Dr. Ferenc Pápai*

Control systems. Repetition of control basics. Control using Programmable Logic Controller (PLC). Continuous and sampling controls. Personal computers in control techniques. Data structures of PLC programming, commands, program structures. Sensors of automation. Analog and digital sensors. Pneumatic, hydraulic and electric signals. Measurement error. Pressure sensors. Thermometers. Electrical principle of temperature measurement. Weight measurement (mechanical, electronic). Force measurement using tensometer stamps, and piezoresistive and piezoelectric sensors. Rpm measurement using mechanical or electric signals. Measuring quantity of liquid materials. Basics and use of optic sensors. Actuators. Lights and sound signals. Contactors. Magnetic valves. Hydraulic and pneumatic cylinders. Electric motors, frequency transformers. (5 credits)

### Hydraulic drives

435

*Dr. Antal Balpataki*

Summary of physical (heat and flow theory) rudiments that found practical applications of hydraulic drives. Special drawing symbols. Presentation of construction, features and special parameters of the drive elements (energy transformers, way-, pressure- and flow valves, auxiliary machines) using theoretical lectures and measurements. Basic hydraulic circuits. Methods of hydraulic system planning. Applications, requirements for the operation, systems' comparison and aspects of choose. Diagnostics. (3 credits)

### Diesel motive power

KOVJA413

*Dr. András Szabó*

General review of railway Diesel engines. Work-cycles, losses, efficiencies and fuel consumption. Performance curves, RPM and charge control. Supercharging systems. Combined operation of the engine and the charger. Fuel injection systems, combustion process, energy conversion, air pollution. Constructional layout of Diesel engines. Balancing of the rotating masses. Torsional vibrations. Speed governors. Cooling and lubricating systems. Power transmission systems with Diesel traction units. Exertion of tractive effort, wheel/rail force connection coefficient. Mechanical gear-boxes and final drives. Hydrodynamic power transmission, torque converters and fluid couplings. Combined operation of the engine and the hydrodynamic power transmission system. Diesel electric transmissions, DC and AC generators and traction motors, controlled combined operation. Tractive effort vs. speed performance curve. (8 credits)

### Constructions of railway vehicles I.

KOVJA411

*Dr. István Zobory*

Interaction of the rolling stock with the railway track. Special requirements with railway vehicles. Me-chanics of driving and braking. Running gears: wheel-sets, axle-boxes, spring suspension systems, dampers, bogie constructions, connection with the vehicle body. Strength dimensioning of vehicle body structures. Buffer- and draw gears. Doors, windows and passenger comfort purpose equip-ments. Heat and noise isolation. (3 credits)

### Constructions of railway vehicles II.

KOVJA412

*Dr. István Zobory*

Brake systems with the railway vehicles. Mechanical, pneumatic, electro-mechanical and electro-pneumatic brake actuation. Block brakes, disc brakes and drum brakes. Brake leverage. Hand operated brakes. Driver's brake valve and distributor valves. Pneumatic load-proportional braking equipment. Allocation of brake fittings. Electromagnetic and eddy-current brakes. Anti-slip devices. Heat generation and rise in temperature with baking. Computation of stopping distance. Braking of long trains and high speed trains. Longitudinal dynamics of braking. (4 credits)

### Aircraft Structures

KORHA422

*Dr. József Rohács*

Lectures: Aircraft load calculation (load factor, load envelope, maneuver, gust and asymmetric loads). Airframes, light-weight structures. Applied materials. Composite technologies. Aircraft systems. Working of the systems and their elements. Practices: Stress analysis of the structural elements. Modeling of the systems and system elements. Laboratory: Functioning, static and dynamic tests of the structural and system elements. Course work. (9 credits)



### Airport and Aircraft Operation I.

KORHA423

*Dr. József Rohács*

Lectures: Role of aviation in economy. Effects of aviation on the society and environment. Use of airspace. Airports and ground infrastructures. Different services. Terminals. Services for passengers. Logistics. Services for connecting business. Air traffic control and management. Safety and security on the airports. Coordination of the services. Practices: Problem

solving with use of system engineering, logistics. Modeling. Use of different software. Visits on the airports. Course work for team. (3 credits)

## Airport and Aircraft Operation II

KORHA424

*Dr. József Rohács*

Lectures: Basic elements of the theory of operation. Classification of failures. Methods of operation. Modeling the aircraft operational processes. Damage theories. Equivalent damages and tests. Monitoring and diagnostic systems. Measurements and data processing. Organization and control of the operational processes. Practices: Problem solving. Visits at the maintenance and repair companies. Team work. (4 credits)

## Aerodynamics and Flight Mechanics I.

KORHA418

*Dr. József Rohács*

Foundations of Fluid Mechanics. Complex Potential. Flow patterns. Flow and Circulatory Flow about a Cylinder in a Uniform Stream, Lift Force. Airfoil Theories. Theoretical aspects of the Lift Generation. High Lift Devices. Finite Wing Theory. Drag and its components. Viscous Flow. The Kármán Integral Relation. Laminar and Turbulent Boundary Layers along a Flap Plate. Basics of Gas Dynamics. Mach Waves and Large Amplitude Waves. Characteristics of Subsonic, Transonic and Supersonic Flights. Propeller Analysis. Rotor Aerodynamics. Methods of Numerical Investigation. Unconventional Flight (3 credits)

## Aerodynamics and Flight Mechanics II.

KORHA419

*Dr. József Rohács*

Airplane Performance: Takeoff, Climb, Cruising, Descent, Landing, Maneuvers. Flight Envelope, Maneuvering Envelope. Optimal Trajectories, Dynamic Programming. Equations of Motions. Euler Angles. Linearization of the Equations. Longitudinal and Lateral- Directional Motions. Stability and Control. Autopilot. Special Aircraft, Helicopters. Aeroelasticity. Aerodynamic and Dynamic Characteristics of the Elastic Airplane. (4 credits)

## Aircraft Engines I

KORHA420

*Dr. Imre Sánta*

Thermodynamic and energetic principles. Gas turbine cycles. Operation analysis and calculation of processes in components: Inlet diffusers (subsonic, supersonic), compressors (centrifugal, axial), combustion chambers, turbines, nozzles, and afterburners. Characteristics.

Operation, analysis and calculations of thermogasdynamic parameters of aircraft engines: turbojet. Turbofan, turbo-prop, turboshaft, propfan, ramjet, scramjet engines. Speed-altitude characteristics. Twin and three spool engines. Auxiliary turbines. Aircraft engines with variable cycles. Off-design operation of the engines. Transient behaviour of gas turbine engines. (4 credits)

## Aircraft Engines II

KORHA421

*Dr. Imre Sánta*

Control of aircraft gas turbine engines. Rule of the control. Control of turbojet. Control of inlets, compressors, nozzles. Control of afterburning operational modes. Control of gas turbine engines by one, two, three and four parameters. Control of turboprop and turbofan engines. Thrust reversal. Starting of

gas turbine engines. Analysis of control systems of gas turbine engines. Operation of reciprocating internal combustion engines for aircraft. General description and classification of engines. Comparison of ideal and actual cycles. Efficiencies, losses. Four- and two-stroke engines. Actual processes. Indicated and effective power. Turbocharging and supercharging of engines. Cooling and lubricating systems. Balancing of mass. Design of engines, Operating of engines. (3 credits)

## Automotive Electronics

KOGJ5175

*Dr. Zsolt Szalay*

The objective of the subject is the systematization of the Automotive Electronics knowledge and the demonstration of the theoretical and practical relevancies, based on a mechanical engineering approach. It gives an introduction into the basic elements, the specific sensors and actuators but also covers the current and future intelligent systems of the vehicle. The students - besides the acquirement of the basics - can start the preparation for a future R&D activity in the Automotive industry. (4 credits)

## Deck equipments

KORHA429

*Dr. Imre Sánta*

Basic knowledge on hydraulics. Hydraulic pumps, motors. Anchoring equipments: anchors, chains, breaks, machines. Mooring equipments: ropes, machines, bollards. Pushing and towing equipments. Safety equipments: lifeboats and davits, personal and collective safety equipments. Cargo handling equipments: types of cranes, winches, steel ropes. (7 credits)

## Shipbuilding

KORHA428

*Dr. Tamás Gausz*

Basic knowledge of the economic structure and the manufacturing process of the shipyards.

Forces on the hull. Longitudinal stress calculation. Special loads on the hull: sideway and longitudinal launching, docking. Transverse stress calculation. Local loads on the hull. Structural units of a ship. Official rules.

Special technological requirements of the shipyards. Shipyard layout. Loft works. Pre manufacturing, module building. Hogging and bending. Welding technology. Boatyard works. Shaft system installation. Painting, corrosion protection. Works after launching, maintenance. Experiments and trials. (6 credits)

## Ship Machinery and electrical system

KORHA427

*Dr. Imre Sánta*

Main propulsion systems: engines, foundation, control, shaft, bearings. Auxiliary machinery. Piping systems: fuel oil, lubrication oil, cooling water, exhaust, bilge water, ballast water, air conditioning and ventilation. Steering machinery.

Electrical generation. Electrical distribution systems. Electric engines, starting. Batteries. Protection against shock. Control and driving system of auxiliaries. Driving and control of the rudder. Electric gauges on the ship. Automation. Navigation equipments. Radar. (8 credits)

## Ship Propulsion and Stability I.

KORHA425

*Dr. Tamás Gausz*

Flow and wave pattern around the ship. Floatation of ships during motion. Planing. Resistance of the ships. Methods for



determination of resistance and thrust. Model testing. Propeller types and design. Propeller data. Efficiency of propulsion. Ship and propeller interaction. (3 credits)

## Ship Propulsion and Stability II.

KORHA426

*Dr. Tamás Gausz*

Types of ships. Floatation and trim. Lines plan. Hydrostatic curves and calculation of hydrostatic data. Flotation of damaged ships. Stability definition. Initial and complete stability. Techniques of calculation. Cross curves of stability, curves of statical stability. Dynamical stability. Effect of free liquid surfaces on stability. The inclining experiment. Damaged stability. Launching and docking. Ship motions and seakeeping. Exercises: inclining experiment on a model, stability calculations. (6 credits)

## Assembly, quality-assurance

*Dr. Balázs Göndöcs*

Requirements of assembly compatibility for planning process of product. Technological content of assembly operations (fastening methods, screwing, riveting, welding, brasing, bonding, etc.). Tools and fixtures. Assembly machines and systems. Assembly methods of bearing structures. Assembly automation in vehicle industry. Quality assurance in assembly process of vehicles. (6 credits)

## Automation of production

*Dr. János Takács*

Fundamentals of automation. NC, CNC, DNC. Methods and machines of automation: robots, AGV (automated guided vehicles). CAD, CAM, CAPP, CIM. Measuring methods in process. Rapid prototyping: methods and machines. Adaptive control. Flexible Manufacturing System. (4 credits)

## Processes of vehicle-production

*Dr. János Takács*

Basics of process-planning in vehicle-production. Production technology of typical components and units of vehicles. Special technologies of preparation for manufacturing of components. Changing methods of surface-characteristic. Methods of tool-management. Fixtures for manufacturing. Typical measuring methods and instruments. Repairing methods and devices of car-bodies. (12 credits)

## New structural materials in vehicle industry

*Dr. Antal Lovas*

The aim of this subject is to summarize the modern structural materials used in the new constructions, directed to the weight decrease of vehicles. Various methods of surface treatments and surface modifications will also be treated, which are often applied in order to increasing the endurance of vehicle parts. (3 credits)

## Materials and devices in sensorics

*Dr. Antal Lovas*

This subject is an introduction to the fundamentals physical and chemical processes and materials which are widely used in the practice of automatization in the field of transportation engineering. (basic knowledge of magnetism, resistometry, metal-gas interactions etc.) and the important metallic and semiconductor materials. (2 credits)

## Vehicle diagnostics

*Dr Balázs Göndöcs*

Present the basic knowledge of diagnostics and repairing processes of vehicles. Review the methods of failure analysis. Fundamentals. Examination of vehicle safety. Confidence and economic by vehicle operation. Methods and equipment of diagnostics: thermovision, endoscope, vibration analysis, eddy current analysis, ultrasonic. (3 credits)



## Description of M.Sc. Subjects

### Mechanical Engineering (Vehicles and Mechanization)

#### Mathematics

BMETKKOM101

*Dr. Ferenc Wettl*

Differentiation and integration of complex functions. Taylor's and Laurent's series. Laplace and inverse Laplace transformations with applications. Fourier's transformation. Spectral functions. Ordinary differential equation systems. Linear and quasi-linear partial differential equations. Basis of stability theory. Stochastic, stationary, and ergodic processes. Markoff processes. Spectral theory of stochastic processes. Wiener processes. Chapman-Kolmogoroff equation. Stochastic differential equations and their applications. (6 credits)

#### Computer-Aided Design

BMETKKOM102

*Dr. Sándor Horváth*

Classification of computers. Principles of operation and applications for program-controlled digital computers. Main units and the operation of program-controlled electronic digital computers. Neumann principle for representing numbers and statements. Memory organisation and addressing techniques. Concept and levels of programming. FORTRAN language. Characteristics of recent digital computers. Concept, function, and kinds of operating systems. General description of CAD/CAM systems and their functions and relationship. Hardware backgrounds of CAD: graphic peripheries and plotters. Software backgrounds of CAD: specification of models and screen representation. (4 credits)

#### Mechanics I

BMETKKOM103

*Dr. Péter Berke*

Vibration of finite degree-of-freedom systems. Differential equation system of motion. Free vibration, eigen frequencies and eigen modes. Excitation of linear multi-degree-of-freedom system. Solution in the frequency of time. Vibration of vehicles. Non-linear systems. Stability of vibrations. Stochastic excitation. Dynamic design of vehicle structures. (4 credits)

#### Mechanics II

BMETKKOM201

*Dr. Péter Berke*

Basic equations of elasticity theory. Equations of equilibrium, compatibility, and the material law. Solution of the equations system and boundary conditions. Solution in the plane; the state of plane stress and the state of plane strain. Airy's stress function. Theory of plates and shells. Finite element method. Variation principles of mechanics. (4 credits)

#### Fluid Mechanics and Thermotechniques I

BMETKKOM104

*Dr. Tamás Gausz*

Review of the basic equations of fluid mechanics. Steady state of one-dimensional compressible flow. Fluid flow around immersed bodies. Aerodynamic drag of ground vehicles. Numerical methods in fluid mechanics and their meas-

urements. Basic equation of non-Newtonian fluids. Measurements in non-Newtonian fluids. (4 credits)

#### Fluid Mechanics and Thermotechniques II

BMETKKOM202

*Dr. Imre Sánta*

Kinetic theory of gases and introduction to statistical thermodynamics. Actual adiabatic processes. Some advanced problems in heat transfer. Transient conduction. Similarity and simulation of convection heat. General theory of transport. Thermal radiation. Calculation of heat exchangers. Numerical methods in thermodynamics and heat transfer. Measurements. (4 credits)

#### Engineering System Theory

BMETKKOM203

*Dr. István Zobory*

Aspects and methods of analysis in systems theory. Deterministic and stochastic systems. Input/output relations. Transfer properties of system elements and derivation of the resulting system characteristics. General theory of linear systems. SISO, SIMO, MISO, and MIMO systems. Determination of system response for deterministic and stochastic inputs and system parameters. Stability analysis for linear systems. Basic methods of system identification. Matching machine conditions to achieve stable co-action. Basic relations of optimum control of machines and vehicles. Stochastic operation processes of machine and vehicle systems. (4 credits)

#### Contemporary Physics I

BMETKKOM204

*Dr. András Tóth*

Basic laws of the electromagnetic field and electromagnetic waves. Principle of relativity and the velocity of light. Postulates of the special theory of relativity and the Lorentz transformation. Relevant kinematics and dynamics. Fundamentals of classical statistical mechanics. Quantum statistics. Basic principles of statistical thermodynamics. (4 credits)

#### Contemporary Physics II

BMETKKOM301

*Dr. András Tóth*

Wave-particle duality. Fundamentals of quantum mechanics. Quantum atom and quantum molecule. Solid state of matter. Semiconductor devices. Lasers. Basic concepts of opto-electronics. Fundamentals of nuclear physics. Radioactivity. Nuclear fission and fusion and practical nuclear energy. (4 credits)

#### Reliability Theory

BMETKKOM302

*Dr. István Zobory*

Summary of the probability theory and mathematical statistics. Characteristics of reliability such as overall lifetime, failure rate, the mean of time between failures, the availability factor, and the failure subset. Estimation of reliability characteristics based on experimental results. Hypothesis test concerning reliability. Redundancy with or without renewal. Analysis of the reliability of machine and vehicle systems. Synthesis of systems with a prescribed reliability level. (4 credits)



## Lightweight Structures

BMETKKOM303

*Dr. Sándor Horváth*

General internal reactions of beam structures. Cross sections of thin walls. Open and closed cross sections. Checked twist. Deformation of structures. Theory of redundant structures. Force method, compatibility equations, and the basic structure. Frame structures and reinforced shells. Kinematic load. Stability problems of lightweight structures. (4 credits)

## Automatic Control

BMETKKOM304

*Dr. József Bokor*

Basic concepts of the state-space theory of continuous-time dynamic systems. Construction of canonic forms. Sampling of continuous-time systems. Relationship of transfer between continuous-time and sampled data models. General transformation of different systems in the state-space form. Controllability, reachability, observability, and constructibility of continuous and discrete time systems. Frequency domain analyses of dynamic systems. Application of Laplace and Z transforms in the analysis of continuous and state-space representations. Computer simulation of dynamic systems. (4 credits)

## Diploma Thesis

BMETKKOM401

Task to be completed in the framework of the Diploma Thesis is assigned by the department of the institute concerned. Consultation is offered by the project supervisor. (30 credits)

## Transportation Engineering

### Mathematics

BMETKKOM101

*Dr. Ferenc Wettl*

Differentiation and integration of complex functions. Taylor's and Laurent's series. Laplace and inverse Laplace transformations with applications. Fourier's transformation. Spectral function. Linear programming. Simplex method. Elements of graph theory, simple graphs, directed graphs, and flows. Stochastic, stationary, and ergodic and Markoff processes. Spectral theory of stochastic processes. Wiener process. Chapman-Kolmogoroff equation. Stochastic differential equations and their applications. (6 credits)

### Vehicle Dynamics

BMETKKOM105

*Dr. Sándor Horváth*

Scope and objectives of vehicle dynamics. Factors of vehicle motion. Characteristics of vehicles equipped with mechanical, hydraulic, or electric power transmission systems. Possibilities of power control. Calculation of vehicle resistances, braking forces, and inertia forces. Solution of motion equations. Determination of speed timing and energy consumption diagrams. Brake application regulations for vehicles. Stability and steerability of road vehicles. (4 credits)

## Computer and Information Systems I

BMETKKOM106

*Dr. Jenő Tokodi*

Purpose of computer and information systems. Connection between software and hardware. Generations of computers. Structure of a typical computer. Arithmetic and logic unit (ALU). Central processing unit (CPU). Computer memories. Addressing modes in the computer. Execution of statements. Input/output systems (IOCS). Channel control units. Classification of peripheral devices. Minimal computer configurations. (4 credits)

## Computer and Information Systems II

BMETKKOM205

*Dr. Jenő Tokodi*

Computer operating systems. Microcomputer systems. Personal and special microcomputers. Use of microcomputers in transportation. Microcomputer operating systems. (4 credits)

## Traffic Technology I

BMETKKOM107

*Dr. Gábor Debreczeni*

Components of traffic, commuters, and the characteristics and interactions of vehicles and the road. Traffic flow theory. Main space and time characteristics of traffic flow. Studies based on methods used to measure traffic characteristics and to examine the relationship between space and time. Modelling traffic flow. (4 credits)

## Traffic Technology II

BMETKKOM206

*Dr. Gábor Debreczeni*

Highway capacity and levels of service. Methods for estimating capacity and forecasting. Traffic signs and markings. Using traffic signals for dimensioning; methods of controlling traffic. Urban transit systems and their characteristics, performance, and transit operations. Causes, problem areas, and solutions related to transport safety. Study of environmental considerations such as air, noise, and visual pollution. Technological approaches to improving the environment. (4 credits)

## Transport Planning I

BMETKKOM108

*Dr. Gábor Debreczeni*

Historical background and general comprehensive studies of transport. Connection between land use and transport planning. Main tasks and elements of transport planning. Influencing factors of transport demands. Kinds of transport demands; forecasting models of projected growth factors and analytic-synthetic models. Trip generation; distribution and modal split models. Calibration techniques. Process of forecasting traffic. (4 credits)

## Transport Planning II

BMETKKOM207

*Dr. Gábor Debreczeni*

Transport networks and process models, including those for roads and public transport; network elements and parameters. Computation of traffic delays as a function of volume and regulations. Routing techniques. Traffic assignment methods. Main effects of transport developments and their economic, social, and environmental impacts. Development targets. Quantification of effects. Evaluation techniques. (4 credits)



**Transport Planning III**

BMETKKOM305

*Dr. Gábor Debreczeni*

Practical planning. Selection of strategies and models; details of how they work. (4 credits)

**Control and Transport Automation I**

BMETKKOM109

*Dr. Géza Tamay*

Urban traffic control and systems-control strategies. Electromechanical, electronic, and microprocessor-controlled local equipment. Questions of safety techniques. Coordinated systems. Data collection methods and systems of road traffic flow. Equipment to measure statics and dynamics. Use of microcomputers in collecting data. Vehicle identification systems. Microcomputer-controlled dispatch centres for bus terminals and vehicle courts. (2 credits)

**Control and Transport Automation II**

BMETKKOM208

*Dr. Géza Tamay*

Fundamental concepts of automating railway transport. Technology of safety in transport automation. Components and systems. Track-side devices such as points, point machines, signals, and track circuits. Electromechanical, push-button, and geographic push-button interlockings. (2 credits)

**Control and Transport Automation III**

BMETKKOM306

*Dr. Géza Tamay*

Computerised and fully electronic interlocking. Equipment for level-crossing protection. Automatic train routing. Train describer systems. Hierarchical structure and operating principles of automatic train control. Automatic train control with intermittent transmission and continuous control. Resonant coupled circuit principle. Onboard units. Coupling coils and the principle of transmission. Principles of line signalling. Two-way, high-capacity communication. Train detection independent of the wheel-rail contact. Automatic train supervision. (6 credits)

**Engineering System Theory**

BMETKKOM203

*Dr. István Zobory*

Scientific and historical background. Relationship of mathematical system theory and control science. Elementary introduction to deterministic linear dynamic system theory. Stochastic systems and models; identification of nonparametric and parametric linear systems. State space models. Parameter estimation. Kalman filters. Non-linear models and identification methods. Control theory problems. Applications of control theory to transportation engineering. (4 credits)

**Statistics**

BMETKKOM209

*Dr. Péter Várlaki*

Statistical analysis as a scientific method. General statistical methods. Statistical samples and the theory of representative methods. Test procedures: test for means;  $t$ ,  $x$ , and  $F$  tests. Simple and multiple regression and correlation analysis. Stochastic (time) series analysis. Methods for measuring trends. Methods for measuring seasonal and cyclic variations. Forecasting. (2 credits)

**Transport Management Information Systems I**

BMETKKOM210

*Dr. Jeno Tokodi*

Scientific and historical background of the development of transport information systems. Informatics and applied transport informatics. Information and actions taken because of the information. Transport management information in a systems approach. Information and its function in management. Control functions in transportation organisations. Complex analytic structure models of information systems. Main parameters of applied technical equipment. (4 credits)

**Transport Management Information Systems II**

BMETKKOM307

*Dr. György Westsik*

Applied transport management information systems. Micro, mesa, and macro information systems in transportation. Information systems for the control of passenger and freight transportation. Interactive mesa-information system. Information systems for production control. System analysis and design methodology for transportation management information systems. (4 credits)

**Reliability Theory**

BMETKKOM308

*Dr. Géza Tarnai*

Fundamental concepts. Reliability of units and the whole system. Boolean and Markoff reliability models. Redundancy. Repairable systems. Special systems for transportation, repair, and maintenance theories. De-rating model. Worst-case design. Reliability tests. Reliability assurance. Quality assurance. (4 credits)

**Transport Economics**

BMETKKOM309

*Dr. Katalin Tancos*

Analysis of transport from macro- and microeconomic aspects. Calculations. Economy investments. Transport infrastructure. Country transport network. Road pricing. Quality indicators of transport performance. Numerical analysis of work share in transport. Application of decision making methods for economy and for enterprises (different transport branches). Cost calculations, pricing. Financing. Up to date efficiency evaluation methods by P.C. Semester project. (4 credits)

**Loading Technology and Logistics**

BMETKKOM310

*Dr. Jeno Tokodi*

Elements of logistics; structure and classification of logistical systems. Interactions of loading transportation. Loads during transportation and loading; methods for protection against overloading. Viewpoints of unit load formation. Arrangement of loads. Material handling devices used in transportation; characterisation of machines from an operational viewpoint. Design of loading sites; determining their main parameters. Construction of transportation transfer stations. (4 credits)

**Diploma Thesis**

BMETKKOM401

Task to be completed in the framework of the diploma thesis is assigned by the department of the institute concerned. Consultation is offered by the project supervisor. (30 credits)



## Description of M.Sc. Elective Subjects

### Road Vehicle Design and Research I

BMETKKOM110

*Dr. László Palkovics*

Concept and methodology of technical design. Application of principles related to the design and use of road vehicles. Theory of retirement. Designing approaches for accident prevention and environmental protection. Methods and means of vehicle research. Evaluation of laboratory and road investigations. Mechanics and dynamics of road vehicles. Performance curves, effort, and different resistances of traction. (6 credits)

### Railway Vehicle Design and Research I

BMETKKOM111

*Dr. István Zobory*

Main factors to consider in railway vehicle design. Matching operational concerns and riding comfort with economic requirements. Phases of the design process. Application of CAD. Design of running gear and suspension systems. Bounds of wheel diameter and spring characteristics. Analysis of railway vehicle vibrations and the stability of running. Strength calculations of load-bearing structures based on the theory of an undetermined framework. Design of the internal layout of passenger carriages. Design of special equipment for freight cars. (6 credits)

### Aircraft Design and Research I

BMETKKOM112

*Dr. József Rohács*

Design process for a flying craft. "Life-equation" of the craft. Main tasks and methods of design; initial design data; requirements. Searching for optimum data. Aircraft layout and balance calculations. Calculating the size of the main parts of aircraft. Stress calculation of the main parts of aircraft. Stress calculation of engine mountings. "Man-machine-man" system. (6 credits)

### Ship Design and Research I

BMETKKOM113

*Dr. József Rohács*

Optimal tonnages of ships. Tonnage regulations. Rules of classification. Weight estimation. Systematic model series. Determination of optimal length. Discussion of Froude's methods. Telfer's method. Application of 3-dimensional extrapolators. Results of various investigations. Resistance of appendages. Choice of resistance and speed parameters. Optimal speed. Effect of form on residual resistance. Bulbous bow. Properties of various ship forms. Line drawings. Investigation of stability. Preliminary calculation of resistance. (6 credits)

### Design and Research of Materials Handling and Building Machines I

BMETKKOM114

*Dr. Ferenc Tóth*

Basics of designing material handling equipment. Main steps in design; standards. Aims and possibilities of design calculations and model formation. Load spectrum. Means of choosing material. Technical risks and design of safe machinery. Stress dimensioning based on probability calculations. Stress estimation by simulation. Reliability. Dynamic simulation. (6 credits)

### Materials Handling, Loading and Storage I

BMETKKOM115

*Dr. Jenő Tokodi*

Elements of logistics. Rudiments and basic relations of materials handling. Systematic interpretation of materials handling. Logistic systems of loading, transportation, and storage. Introduction to the relationship of materials handling and production, with references to selected branches of industry. Materials handling tasks. Survey of the main parts of materials handling systems. Process of designing materials handling systems. Industrial robots. Materials handling robots, special vehicles, loading and storage equipment. (6 credits)

### Road Vehicle Design and Research II

BMETKKOM217

*Dr. László Palkovics*

Theoretical cycles of internal combustion engines. Combustion process and characteristics and reactions. Composition and analysis of exhaust gases. Specific output of internal combustion engines and power control. Mixture formation. Design of engines and their major components. Instrumental investigation of engines. Evaluation of road and laboratory research. (8 credits)

### Railway Vehicle Design and Research II

BMETKKOM211

*Dr. István Zobory*

Internal combustion engines. Analysis of energy flow. Recovery of heat losses. Complex analyses of fuel injection and combustion processes. Advanced supercharging systems of two-stage, hyperbar, and complex supercharging. Thermal load in the internal combustion engine. Heat transfer in different situations. Thermal stresses. Power transmission systems used in diesel traction vehicles. Design of mechanical and hydraulic power transmission systems. Hydraulic torque converters and fluid couplings. Hydrostatic power transmission systems. Design of diesel-electric transmission systems. Dynamic processes in main and auxiliary power transmission systems. (8 credits)

### Aircraft Design and Research II

BMETKKOM212

*Dr. József Rohács*

Calculating the size of aircraft for dynamic loads. Strength control of aircraft via testing. Fatigue-life control. Fail-safe systems. Flight trials of aircraft. Airworthiness of aircraft. Using flight trials to determine airworthiness. Design of aircraft control systems. Calculation of derivative factors. Design of air transportation systems. Search for suitable aircraft. Optimum transportation system. Optimum maintenance system and stochastic control. (8 credits)

### Ship Design and Research II

BMETKKOM213

*Dr. József Rohács*

Necessary testing models; analysis of model test results. Effects of scale. Choosing the optimal propeller using the standardised propeller series. Screw design for uniform and non-uniform wake. Velocities induced by the propeller. Condition of minimum energy loss. Dimensions of the blade section. Screw design for nozzle-propeller and water-jet propulsion. Strength and materials of propeller blades. Design of paddle wheels. Trial and service predictions. (8 credits)



## Design and Research of Material Handling Machines II

BMETKKOM214

*Dr. Ferenc Tóth*

Stress calculation of the steel structures of cranes. Load spectrum and frequency number. Calculation of the wheel pressure and dynamic behaviour of cranes. Differential equations of hoisting and travelling mechanisms and their solutions. Luffing mechanisms of cranes. Designing overhead travelling mechanisms. (8 credits)

## Design and Research of Building Machines II

BMETKKOM215

*Dr. Antal Balpataki*

Basic theory of vibration machinery. Designing vibration screens. Kinetic, energetic, and dynamic design of vibrators. Design of concrete mixers and pumps. Basic theories of hand-tool design for inner construction works. Design of equipment for making concrete elements. (8 credits)

## Materials Handling, Loading and Storage II

BMETKKOM216

*Dr. Jeno Tokodi*

Logistic systems and their design. Methods of graphic representation in process design. Two- and three-dimensional models. Design of the plant site and its inner arrangement from materials handling and transportation viewpoints. Survey and evaluation methods for given materials handling situations. Basic principles of designing a materials handling process and choosing the technical elements. Methods to determine the time needed for a materials handling operation. Linear programming and other operational research methods. Examination of random phenomena in materials handling and logistical systems. Calculation of state probabilities of materials handling systems. Determining the number of materials handling machines needed. Reliability of materials handling systems. Design of continuous and periodic materials handling systems. Control problems in materials handling processes. (8 credits)

## Road Vehicle Design and Research III

BMETKKOM311

*Dr. László Palkovics*

Calculating the strength of a transmission and its major parts. Mechanics of brakes used in motor vehicles. Analytical determination of brake torque. Evaluation of the effects of braking. Vibration and the use of suspensions in road vehicles. Design of suspensions. Compensated suspension systems. Vibration of steered wheels. Stability of road vehicles. Steerability and its investigation. Design and analysis of steering gears and power steering. Investigation of "off-roadability." Strength calculation and the investigation of frames. Selection and auxiliary parts for road vehicles. (8 credits)

## Railway Vehicle Design and Research III

BMETKKOM312

*Dr. András Szabó*

Combined analysis of motion equations and the characteristics of electric traction vehicles. Electric consequences of wheel-slipping processes. Loadability of traction motors. Determination of thermal and electric loading limits. Analysis of DC traction systems. Construction and operation of DC choppers. Electric braking with DC choppers. Single-phase AC vehicles. Rectifier traction vehicles. Asynchronous traction motors and inverters. Numerical solution of train motion equations. Applications of analog and digital computers. Calculation of energy demand of traction. Energy/optimal-

speed timing diagrams. Longitudinal dynamics of trains. (6 credits)

## Aircraft Design and Research III

BMETKKOM313

*József Rohács*

Complex analyses of aircraft performance. Basic principles of modelling aircraft performance. Essence of modelling. Mathematical modelling of aero-elastic phenomena. Modelling aircraft operation. Reliability models. Research of structural operational differences and sensitivity. Statistical flight mechanics. Models of automatic control. Definition of control system data. Diagnostic models. (8 credits)

## Ship Design and Research III

BMETKKOM314

*Dr. József Rohács*

Strength and materials of ships' hulls. Rules and regulations for classification. Design of shafting, bearing, coupling, and rudders. Necessary model tests; analysis of model test results. Design of deck machinery and launching. Onboard measurement of ships on trial and in service. Modification of propellers. (8 credits)

## Design and Research of Materials Handling Machines III

BMETKKOM315

*Dr. András Pristyák*

Design of the slewing mechanisms of cranes. Special structural parts and their dimensioning. Mobile cranes. Dynamic modelling of stacking cranes. Elevators; dynamic modelling of elevators; drive and control of elevators. Design of mine hoists and their drive and brake systems and conveyors. Dynamic problems of starting long belt conveyors. Dynamic properties of robots and manipulators. (8 credits)

## Design and Research of Building Machines III

BMETKKOM316

*Dr. Antal Balpataki*

Theoretical questions of earth trimming and scarping. Choice of optimal geometric parameters for machine parts of excavators. General questions related to designing excavators. Dynamic problems of mechanical and hydraulic excavators. Theory of earth compacting. Earth compacting machinery: parameters and choice. Design of vibrating rollers used in compacting machines. (8 credits)

## Materials Handling, Loading and Storage III

BMETKKOM317

*Dr. Jeno Tokodi*

Planning of loading and storage systems. Packing problems. Basic methods for handling control and management problems. (8 credits)

