Name of the programme: **MECHANICAL ENGINEERING**
AUTOMOTIVE ENGINEERING

Type: Master

Entry requirements
Bachelor degree in the related field. / Completed recognized upper secondary school, being the equivalent of Polish Matriculation certificate.
Each application is assessed individually on its merits. If in doubt, please contact the Admission Officer.

English: We recommend a level equivalent to the Common European Framework of Reference for Languages of B2E

Mode of study
Full time

Duration: 3 semesters
Start date: 21 February 2011

Deadline for application
30 November 2010

Tuition fee
Non EU / EFTA students: 2000 EUR per semester
EU / EFTA students: no tuition fee

Application fee
Non EU / EFTA students: 200 EUR
EU / EFTA students: 22 EUR

Additional fee
All students will be required to pay 100 EUR to cover additional costs of excursions and visits to external laboratories.

More information: Admission Office
tel: +48 71 3203170, +48 71 3203719, +48 71 3204439
e-mail: admission@pwr.wroc.pl, web: www.pwr.wroc.pl

Programme coordinators: Anna Janicka PhD, Zbigniew J. Sroka, PhD

Description:

At the end of the Master program the students will have a sound base of general scientific knowledge in the field of Automotive Engineering.

- The students will be familiar with the scientific methodology and reporting.
- They will be able to function in an inter-national and multi-disciplinary context.
- The students will be prepared to implement their knowledge and to cooperate within an organization.
- The students will be sufficiently equipped and motivated for a life-long qualification in the field of Automotive Engineering.

In making decisions and performing their tasks, they will be guided by social, economical and ecological principles.

Structure of the programme (credits)

	Semester 1	Semester 2	Semester 3
1	BC	BC	AC
2	BC	BC	AC
3	BC	BC	AC
4	BC	BC	AC
5	BC	FL	AC
6	BC	FL	BC
7	BC	FL	BC
8	BC	FL	BC
9	BC	FL	BC
10	BC	FL	BC
11	BC	AC	DT
12	BC	AC	DT
13	BC	AC	DT
14	BC	AdAE	DT
15	BC	AdAE	DT
16	AdAE	AdAE	DT
17	AdAE	AdAE	DT
18	AdAE	AdAE	DT
19	AdAE	AdAE	DT
20	AdAE	AdAE	DT
21	AdAE	AdAE	DT
22	AdAE	AdAE	DT
23	AdAE	AdAE	DT
24	AdAE	AdAE	DT
25	AdAE	AdAE	DT
26	AdAE	AdAE	DT
27	AdAE	AdAE	DT
28	AdAE	AdAE	DT
29	AdAE	AdAE	DT
30	AdAE		DT
31			DT/FE

BC – Basic Courses;
FL (Humanities, Foreign Language) – Nontechnical courses;
AC – Advanced Courses;
AdAE – Advanced Courses in Automotive Engineering;
DT – Master Thesis;
FE – Final Exam

PLAN OF STUDIES

1st YEAR, SEMESTER 1

Nº	Code	Subject/Module	Contact hours/week					CHS	TSW	ECTS	Form of Assessment
			L	T	lab	p	s				
1.	MMM010471	Design of Engineering Materials	1		1			30	60	2	T/CW
2.	MMM010473	Modelling of Multi-body Systems				2		30	90	3	CW
3.	MMM010474	Analytical Mechanics	2	1				45	120	4	E/CW
4.	MMM010475	Strength of Materials	1		1			30	90	3	T/CW
5.	MMM010476	Machinery Design Process	1			2		45	90	3	T/CW
6.	MMM010460 W/L	Developing Engine Technology	2		2			60	150	5	E/CW
7.	MMM010461 W/L	Energy Efficient Design of Powertrain and Body	2		2			60	150	5	T/CW
8.	MMM010462 W/P	Alternative Drive Systems	2			2		60	150	5	T/CW
		TOTAL	11	1	6	6		360	900	30	

1st YEAR, SEMESTER 2

Nº	Code	Subject/Module	Contact hours/week					CHS	TSW	ECTS	Form of Assessment
			L	T	lab	p	s				
1.	MMM010477	CAD/FEM Construction Designing in Automotive Engineering				2		**30**	60	2	CW
2.	MMM010478	Methods of Non-Destructive Evaluation In Contemporary Manufacturing Systems	1		1			30	60	2	T
3.	MMM010479	Fluid Power Control Systems	2		1			45	90	3	T/CW
4.	MMM010463 W/L	Communication and Management for Engineers	1				2	45	90	3	T/CW
5.	MMM010464 W/L	Green Fuels	2		2			60	150	5	T/CW
6.	MMM010465 W/L	Trends in Vehicle Electronics	2		2			60	150	5	E/CW

7.	MMM010466 MMM010477	Project: 1. The Logistic System of End-of-Life Vehicle Recycling 2. Flows Modelling in Automotive Engineering				6		**90**	180	6	CW
8.		Foreign Language		4				60	90	3	E
		TOTAL	8	4	6	8	2	420	870	29	

2nd YEAR, SEMESTER 3

Nº	Code	Subject/Module	Contact hours/week					CHS	TSW	ECTS	Form of Assessment
			L	T	lab	p	s				
1.	MMM010467	Machine and Device Control	2		2			60	150	5	E/CW
2.	MMM010468	Testing of Vehicle Elements and Assemblies			2			30	90	3	CW
3.	MMM010469	Surface Engineering	1		1			30	60	2	T/CW
4.	MMM010470	Diploma Seminar					2	30	30	1	CW
5.	MMM010472	Master Thesis							600	20	FE
		TOTAL	3		5		2	150	930	31	

L	T	lab	p	s

L – Lecture T – Tutorials, **lab** – laboratory, **p** – project, **s** – seminar,

CHS	TSW

CHS – Contact Hours (organized), **TSW** – Total Student Workload (h), **E** – Exam, T – Test, CW – Course Work

FE – Final Examination

Job prospects:

They will have acquired insight in the technological principles and will have a thorough knowledge of more specialized subjects and will be well aware of energy and environmental issues.

Description of the courses

1st YEAR, SEMESTER 1

CODE: MMM010471	DESIGN OF ENGINEERING MATERIALS

Language: English **Course:** ~~Basic~~/**Advanced**
Year (I), semester (1) **Level:** II **Obligatory/**~~Optional~~
Prerequisites: basics of materials science, basics of strength of materials **Teaching:Traditional/**~~Distance~~ L.
Lecturer: Krzysztof Widanka, PhD

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	15		15		
Exam / Course work/T:	T		CW		
ECTS	1		1		
Workload (h)	30		30		

Outcome: Ability to material design of products with desired structure and performance properties.
Content: Effects of composition, processing, and structure on properties of engineering materials, the role of alloy phase diagrams in design of materials, structure-property relationships in engineering materials, manufacturing aspects of design, failure analysis combined with materials selection, sources of materials properties data and information, computer-aided examination of materials structure.
Literature:

1. J.P. Schaffer, A. Saxena, S.D. Antolovich, T.H. Sanders, S.B. Warner: The science and design of engineering materials, WCB/McGraw-Hill, 1999.
2. D. Henkel, A. W. Pense: Structure and properties of engineering materials, McGraw-Hill, 2002.
3. Thomas H. Courtney: Mechanical Behaviour of Materials, 2th ed., McGraw-Hill, 2000.
4. Wyatt, Oliver H.: Metals, ceramics and polymers: an introduction to the structure and properties of engineering materials, Cambridge University Press Cambridge ,1974

CODE: MMM010473	MODELING OF MULTIBODY SYSTEMS

Language: English **Course:** ~~Basic~~/**Advanced**
Year (I), semester (1) **Level:** II **Obligatory/**~~Optional~~
Prerequisites: basics of classical mechanics **Teching:Traditional/**~~Distance~~ L.
Lecturer: Jacek Bałchanowski, PhD

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)				30	
Exam / Course work/T:				CW	
ECTS				3	
Workload (h)				90	

Outcome: The course teaches students principles of creating models helpful in design of kinematic systems used in machines, robots, vehicles and devices. Models and simulation tests are worked out using a proffesional computer dynamic analysis system.
Content: The course acquaints its listeners with bases of creating discrete models of machines' kinematic systems. The principles of modeling and simulation researches of machines in computer dynamics analysis systems are presented. The problems of kinematic and dynamic analysis concern plane and spatial linkages, planetary gear trains, cam mechanisms and manipulators. The created models have the real geometry and

mass parameters of links. The stiffness of links and friction at joints as well as some control force problems are also considered.

Literature:

1. Haug E.J.: *Computer Aided Kinematics and Dynamics of Mechanical Systems*. Allyn and Bacon, Boston 1989
2. Norton R., L.: *Design of Machinery, An introduction to the synthesis and analysis of mechanisms of machines*. WCB, McGraw-Hill, Boston, 1999.
3. Shabana A. Ahmed: *Computational Dynamics*, . A Wiley-Interscience Publications, NewYork, 1994.
4. Tsai L-W: *Robot analysis: The Mechanics of Serial and Parallel Manipulators*, John Willey & Sons Inc, 1999
5. Waldron J., Kinzel G.; *Kinematics, dynamics and design of machinery*, John Wiley & Sons, Inc. New York, 1999

CODE: MMM010474 **ANALYTICAL MECHANICS**

Language: English **Course: Basic/~~Advanced~~**
Year (I), semester (1) **Level:** II **Obligatory/~~Optional~~**
Prerequisites: basics of classical mechanics **Teching:Traditional/~~Distance~~** L.
Lecturer: Prof. Marek Rybaczuk D.Sc

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	30	15			
Exam / Course work/T:	E	CW			
ECTS	3	1			
Workload (h)	90	30			

Outcome: Ability to solve engineering problems, especially dynamics, basing on principles of mechanics and to analyze structural components of machines

Content: Dynamics, Newtons laws, motion of centre of mass, vibration of a particle with one degree of freedom, d'Alembert's principle, Coriolis acceleration and force, conservation of energy. Rigid bodies: equations, degrees of freedom, calculation of the inertia tensor, kinetic energy, general rotation of a rigid body fixed at one point, precession, Euler's equations, Lagrangian mechanics, Lagrange's equations, Eulerian angles.

Literature:

1. Louis N. Hand, Janet D. Finch, *Analytical Mechanics*, Cambridge University Press, 1998
2. Grant R. Fowles, George L. Cassiday., *Analytical Mechanics,* 4th edition, Prentice-Hall, 2002
3. Goldstein H., *Classical Mechanics*, 3rd ed., San Francisco, CA, Addison-Wesley 2002

CODE: MMM010475 **STRENGTH OF MATERIALS**

Language: English **Course: Basic/~~Advanced~~**
Year (I), semester (1) **Level:** II **Obligatory/~~Optional~~**
Prerequisites: basics of classical mechanics **Teching:Traditional/~~Distance~~** L.
Lecturer: Prof. Mieczysław Szata, DSc

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	15		15		
Exam / Course work/T:	T		CW		
ECTS	2		1		
Workload (h)	60		30		

Outcome: Ability to solve engineering problems based on principles of mechanics and to analyze structural components of machines

Content: Strength of Materials as an engineering discipline. Models of structural components. Internal forces, stress, strain, displacement. Experimental methods of evaluating mechanical properties of materials. Basic modes of member loading (tension–compression, torsion, shear, bending) – computational analysis and principles of strength design. Buckling. Introduction to computer-assisted methods of analysis.

Literature:

1. S. Timoshenko, *Strength of materials*, 3rd edition, Krieger Publishing Company, 1976
2. Mott, Robert L., *Applied Strength of materials*, 4th edition, Prentice-Hall, 2002

CODE: MMM010476 **MACHINERY DESIGN PROCESS**

Language: English **Course:** ~~Basic~~ **/Advanced**
Year (I), semester (1) **Level:** II **Obligatory/**~~**Optional**~~
Prerequisites: basics of strength of materials **Teching:Traditional /** ~~**Distance**~~ **L.**
Lecturer: Prof. F.W. Przystupa, DSc

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	15			30	
Exam / Course work/T:	T			CW	
ECTS	1			2	
Workload (h)	30			60	

Outcome: Basic practical experience for brainstorming, language methodology and synectics used in advanced creative designing.

Content: Review on the design of systems. Technical processes, technical tools with an emphasis on their evolution and the logic of development. Skills necessary in the design of technical processes based upon a definition of general design: a creation of tools for the realisation of aims. Refinement of the design objective, abstraction and embodiment in levels of the design system. Algorithmic and heuristic methods: theory and practice. Methods for the synthesis of systems evaluation, including technical systems. Evaluation of student's own design solutions and those of other students. Restoring student's own design algorithm.

Literature:

1. W. Gordon, W. *Synectics*
2. E.V. Krick, *An introduction to Engineering and Engineering Design*
3. R. Norton, *Machine Design*.
4. A.F. Osborn, *Applied Iimagination*.
5. J. Ullman, *The Mechanical Design Process*

CODE: MMM010460 W/L **DEVELOPING ENGINE TECHNOLOGY**

Language: English **Course:** ~~Basic~~**/Advanced in AE**
Year (I), semester (2) **Level: II** **Obligatory/**~~**Optional**~~
Prerequisites: basic knowledge of internal combustion engines **Teaching: Traditional/**~~**Distance L.**~~
Lecturer: Zbigniew J. Sroka PhD, Marek Kułażyński PhD, Krzysztof Miksiewicz PhD, Anna Janicka PhD

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	30	-	30	-	-
Exam / Course work/T:	E	-	CW	-	-
ECTS	3	-	2	-	-
Workload (h)	90		60	-	-

Outcome: Highly specialized knowledge of processes that occure in internal combustion engines
Content: Introduction to the engine, classifications of engines, short engine theory (the first and second laws of thermodynamics in engines, the operation of reciprocating internal combustion engines, Important engine parameters and performance features), combustion of the fuel-air mixture (essential features of the combustion process, characterization of combustion processes from cylinder pressure data), engine components and mechanical parts (cylinder banks, cylinders, pistons, connecting rods, crankshaft, cylinder head, valves, camshaft, manifolds, gasket), fuels and fuel systems (gasoline, diesel fuel, alternative fuels, fuel supply systems), facts about emissions from motor vehicles (complete combustion of hydrocarbon fuels, evaporative emissions, emission legislation, emission testing stages, European regulations for light-duty vehicles, European regulations for heavy-duty vehicles), exhaust systems (design, exhaust gas after treatment technologies, development of diesel oxidation catalysts, diesel DeNOx catalysts, mechanisms for lean NOx performance, carbon canisters, reduction of the engine sound level), trends in engine technologies (alternative fuels and their effects on engine technology, downsizing, homogenous or stratified mixtures)
Literature:

1. Ambrozik A,. Jankowski A., Slezak M., Thermodynamics of piston combustion engine work cycle, Journal of KONES Internal Cmbusiton Engines. Vol.12, No. 3-4, Warsaw 2005
2. Ramos J.I.; Internal Combustion Engine Modeling, Hemisphere Publishing Corporation, Londyn, 1989,
3. Waltzer P.; Progress in Car Powerplant Technologies, Fisita World, Barcelona 2004

CODE: MMM010461 W/L **ENERGY EFFICIENT DESIGN OF POWERTRAIN AND BODY**

Language: English **Course:** ~~Basic~~/**Advanced in AE**
Year (I), semester (1) **Level: II** **Obligatory/**~~Optional~~
Prerequisits: none **Teaching: Traditional/**~~Distance L.~~
Lecturers: Prof. Piotr A. Wrzecioniarz, Wojciech Ambroszko PhD, Aleksander Górniak

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	30	-	30	-	-
Exam / Course work/T:	T	-	CW	-	-
ECTS	3	-	2	-	-
Workload (h)	90		60	-	-

Outcome: Knowledge of all essential factors affecting on dynamic performance of vehicles
Content: The aim of the lecture is presentation different systems which exist in almost every car and phenomena occurring during car designing, exploitation and recycling. Transmission system (clutch, gearbox, propeller shafts, universal joints, differential), vehicle dynamics (vehicle movement, coordinates systems, dynamic variables, vehicle dynamics standards, tyres, traction performance, braking performance, road loads, cornering) suspensions systems and steering systems, CAD/CAM/CAE software, noise, vibration and harshness (NVH) –(ride and comfort, acoustic disturbance in the vehicle), thermal comfort in vehicles, properties of different materials (life cycle design framework, materials production, manufacturing and assembly), vehicle use and service, end-of-life management, optimisation of vehicle mass (including material substitution).
Literature:

1. Victor Albert Walter Hillier.: Fundamentals of motor vehicle technology. Nelson Thornes, 1991
2. Malcolm James Nunney.: Light and heavy vehicle technology. Butterworth-Heinemann, 2007
3. Allan Bonnick.: Automotive science and mathematics. Elsevier, 2008
4. George Appel, International Correspondence Schools.: Automobile manual transmission systems. International Correspondence Schools, 1970
5. Lambert M. Surhone,Miriam T. Timpledon,Susan F. Marseken.: Transmission: Transmission (mechanics), Speed, Torque, Gear Ratio, Fuel. Betascript Publishers, 2009

CODE: MMM010462 W/P	ALTERNATIVE DRIVE SYSTEMS

Language: English **Course:** ~~Basic~~/ **Advanced in AE**
Year (I), semester (2) **Level: II** **Obligatory/**~~Optional~~
Prerequisites: none **Teaching: Traditional/**~~Distance L.~~
Lecturers: Maciej Pawłowski PhD, Krzysztof Kędzia PhD

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	30			30	
Exam / Course work/T:	T			CW	
ECTS	2			3	
Workload (h)	60			90	

Outcome: Comprehensive knowlegde in the field of classical and alternative automotive drive systems

Content: General introduction (electrical systems for automobile, system blocks and trends in car electrification, replacing conventional DC motors by BLDCs and PMSM), electrical machines in vehicles (basic principles of electrical drives, DC Motor, BLDC, induction machine, PMSM), power electronics in vehicles (components - capacitors, inductors, MOSFET's, IGBT's, DC-DC converters - step-down, step-up, full bridge converter, fly-back, forward, Inverters (single and three phases, pulse-width modulation), energy storage (batteries, ultracap's), on-board-power supply (standard generators, starter-generator in micro hybrids, on-board overall power supply concepts for hybrids drives, energy recuperation), drive train with electrical machines (fully electrical car powered by batteries, hybrid technologies - series and parallel systems), dynamic motion control (control of DC motor drives (conventional and brushless, vector control of PMSM), further applications of electrical drives in vehicles (roof window actuator, air condition compressor, power steering systems, fuel injection pump, fuel injector actuator- electrovalve, air ventilation fan), implementation of hybrids cars (real cases - case study: Toyota, Honda).

Literature:

1. Study material in hard copy and electronic version of Module_3 at the European Project Curriculum Development called CarEcology: "New Technological and Ecological Standards in Automotive Engineering"27876-IC-1-2005-1-BE-Erasmus-PROGUC-1,
website http://project.iwt.kdg.be/cdcarecology
2. U.S. Department of Energy: Energy Efficiency and Renewable Energy, Annual Progress Report: Hydrogen, Fuel Cells, and Infrastructure Technologies, Program. Office of Hydrogen, Fuel Cells, and Infrastructure Technologies, October 2003

1st YEAR, SEMESTER 2

CODE:	CAD/FEM CONSTRUCTION DESIGNING IN AUTOMOTIVE ENGINEERING

Language: English **Course: Basic/**~~Advanced~~
Year (I), semester (2) **Level:** II **Obligatory/**~~Optional~~
Prerequisites: Strength of Materials **Teaching: Traditional/**~~Distance~~ L.
Lecturers: Damian Derlukiewicz, PhD

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)				30	
Exam / Course work/T:				CW	
ECTS				2	
Workload (h)				60	

Outcome: Course introduce students to the modern CAD constructions designing methods of machines structures and elements with the usage of the professional CAD/CAE systems that base on the Finite Element Method. Students will be familiarize with designing principles on the examples of discrete models used in strength analysis. Improving the skills by conducting the different type of FEM analysis with building the calculation model as well as boundary conditions definition in static and dynamic range. Optimization of structures and machines elements. Visualization and interpretation of results.

Content: Introduction, terminology and general principles of the spatial CAD/FEM designing. Presentation of the basic constructions features used at the spatial designing. The modelling of the parametrical and 3D solid and surface models. Presentation of the assumptions of the discrete FEM models modelling (the material library). Principles of the numerical models of the load-carrying structures. Creation of the discrete models of the beam, shell and solid constructions. Definition of the boundary conditions, calculation parameters and the results visualization. Creation of assemblies and definition of contact in FEM model. Basic electronic documentation. The possibilities of the cooperation with other CAD/FEM systems. Final project as strength optimization of selected element.

Literature:

1. Rusiński E.: Principles of designing of supporting structures of automotive vehicles. Publishing House of Wrocław University of Technology 2002.
2. O. C. Zienkiewicz, R. L. Taylor. The finite element method for solid and structural mechanics.
3. Michael R. Gosz., Finite element method : applications in solids, structures, and heat transfer
4. CATIA Handbook

CODE: MMM010478	**METHODS OF NON-DESTRUCTIVE EVALUATION IN CONTEMPORARY MANUFACTURING SYSTEMS**

Language: English **Course: Basic/**~~Advanced~~
Year (I), semester (1) **Level:** II **Obligatory/**~~Optional~~
Prerequisites: none **Teaching: Traditional/**Distance L.
Lecturer: Marcin Korzeniowski PhD

	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)	15		15		
Exam / Course work/T:	T		CW		
ECTS	1		1		
Workload (h)	30		30		

Outcome: Understanding of philosophy and benefits of computer integrated manufacturing, its developing, basic components, software and hardware conditions, as well as criteria of applying high performance intelligent manufacturing.

Content: The course involves the most popular methods of non-destructive testing (NDT) of products manufactured in contemporary production systems including casting, forging, welding, normalization and quality standards in compliance with the valid EU regulation and directives. During lectures students find out the basics of non-destructive testing and its using in practice industrial application. The standardization including particular method will be presented in details as well. During laboratory students will perform some methods of NDT (ultrasonic, visual, magnetic, liquid penetrant) by themselves, prepare complete professional report based on real tested products.

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Literature:

NDT Handbook, third edition, The American Society of Non Destructive Testing, 2009. Hellier Ch., Handbook of Non Destructive Evaluation, 2001 . EN Standards.

CODE: MMM010479 **FLUID POWER CONTROL SYSTEMS**

Language: English **Course:** ~~Basic~~/ **Advanced**

Year (I), semester (2) **Level:** II **Obligatory/**~~Optional~~

Prerequisites: Analytical Mechanics **Teaching: Traditional/**~~Distance~~ L.

Lecturer: Wiesław Fiebig prof., Wacław Kollek prof, Piotr Osiński Ph.D., Michał Stosiak Ph.D., Grzegorz Łomotowski M.Sc., Marek Spławski M.Sc.

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	30		15		
Exam / Course work/T:	T		CW		
ECTS	2		1		
Workload (h)	60		30		

Outcome: The purpose of the course is to provide necessary information for the students to handle the fluid power control systems and components as it is used in machinery and devices. During the classes components of fluid power systems will be introduced and basic functions of electrohydraulic control valves and systems will be described.

Content: The the course comprises basics of hydraulic drive in machines and devices. The basics of elementary hydraulic elements will be shown – the structure, characteristics, principle of operation, control and liquids. The synthesis of hydraulic systems and basics of design on the basis of available computer programs. Individual subjects will be realise in laboratories.

Literature:

1. J. S. Stecki, A. Garbacik, *Design and Steady-state Analysis of Hydraulic Control Systems.* Fluid Power Net Publications, Cracow 2002 .
2. J. S. Stecki *Functional Approch to Design of Hydraulic Machines*. The BFPR Journal ,14, 1-6, 1981
3. J. Ivantysyn, M. Ivantysynova, *Hydrostatic Pumps and Motors*, Tech Books Int. New Delhi, India
4. *Design Engineers Handbook, Volome 1- Hydraulics, Motion Control Technology Series*, Parker Hannifin Co.
5. G.W. Younkin, Industrial Servo Systems Fundamentals, 2nd Edition

CODE: MMM010463 W/S **COMMUNICATION AND MANAGEMENT FOR ENGINEERS**

Language: English **Course:** ~~Basic~~/**Advanced** (nontech)

Year (I), semester (2) **Level: II** **Obligatory/**~~Optional~~

Prerequisits: none **Teaching: Traditional/**~~Distance L.~~

Lecturer: Henryk Chrostowski PhD, Zbigniew J. Sroka PhD; Krzysztof Kędzia PhD

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	15				30
Exam / Course work/T:	T				CW
ECTS	1				2
Workload (h)	30				60

Outcome: Knowledge of fundamentals in the field of communication and management for engineers allowing to menage industrial projects

Content: Communication Skills, Building a tower (communication background, Nasa-experiment, teambuilding, bad news-conversation, conflict handling), Human Resource Management (cross-cultural awareness, evaluation and functioning in an organization, internal communication, evolutions on the labor market, unions, anti discrimination initiatives), Industrial Management (quantifying production systems, knowledge about methods and time, on methods for Time Measurement (MTM), communication, flow

charting, value mapping, process mapping), Project Management (definition of a project, principles of project cycle management, stakeholder, problem, objective and strategy analyses, the logical framework approach and matrix, work plan, activities, tasks, resources, budgeting, EU funding mechanisms, project management software).

Literature:

1. McGregor D.; The Human Side of Enterprise, McGraw-Hill/Irwin, New York 2006

CODE: MMM010464 W/L **GREEN FUELS**

Language: English **Course:** ~~Basic~~/**Advanced in AE**

Year (II), semester (3) **Level: II** **Obligatory/**~~Optional~~

Prerequisites: basic chemistry **Teaching: Traditional/**~~Distance L.~~

Lecturer: Marek Kułażyński PhD, Elżbieta Beran PhD, Łukasz Łużny PhD

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	30		30		
Exam / Course work/T:	T		CW		
ECTS	3		2		
Workload (h)	90		60		

Outcome: Fundamental knowlegde in the field of modern alternative fuels.

Content: Course instructs students in proprieties and methods of investigations of green fuels as well as liquid and gas. Characterization, classification and methods of production of biofuels will be introduced. Biofuels in liquid form, use of the hydrogen, LNG, CNG and biogas as alternative fuels and the effects of green fuels on engines properties will be introduced. Application of green fuels and environmental effect. Problems of transport, storage and distribution green fuels. Profile of fuels under angle of qualitative requirements and their utilization be talked over becomes. In frames of course the student gets to know their usefulness methods (the normalized methods) of investigations of fuels as energetic material as well as for their utilization in technique also.

Literature:

1. Monagham M.L.; Future Gasoline and Diesel Engines, Fisita World, Seoul 2000
2. Pandit G.P.; Alternative Fuels for Future Vehicles, Automotive Engineering 1, 1996

CODE: MMM010465 W/L **TRENDS IN VEHICLE ELECTRONICS**

Language: English **Course:** ~~Basic~~/**Advanced in AE**

Year (II), semester (3) **Level: II** **Obligatory/**~~Optional~~

Prerequisites: none **Teaching: Traditional/**~~Distance L.~~

Lecturer: Radosław Wróbel PhD

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	30	-	30	-	-
Exam / Course work/T:	E	-	CW	-	-
ECTS	3	-	2	-	-
Workload (h)	90		60	-	-

Outcome: General knowlegde of the hardware and software used in the vehicle's systems control

Content: Automotive Electronic Architecture (overview of vehicle electronics, networked modules, principles of electronic control unit design); Fuel Control System (control system to fulfil the ecological standards, lambda sensor, fuel injectors); Automotive microprocessors, CAN (Controller Area Network), LIN (Local Interconnect Network); FlexRay (FlexRay physical layer, FlexRay communication, protocol operation, protocol services); MOST (Media Oriented Systems Transport); Fundamentals of environmental sensing

(RADAR sensor, video based automotive environmental sensing, short distance infrared(NIR)-systems, car to car communication); Lighting; Automotive Electronic Applications (braking control, adaptive cruise control, remote keyless entry and immobiliser system); Recycling (important terms concerning environmental technology, basic principles of environmental engineering, different approaches, legislation and European Standard; vehicle, production, recycling and waste disposal, possible problem solutions, electronic equipment, production, possibilities for a "greener" product).

Literature:

1. Study material in hard copy and electronic version of Module_5 at the European Project Curriculum Development called CarEcology: "New Technological and Ecological Standards in Automotive Engineering"27876-IC-1-2005-1-BE-Erasmus-PROGUC-1, website http://project.iwt.kdg.be/cdcarecology
2. Tracy Martin, "How to Diagnose and Repair Automotive Electrical Systems, Motorbooks Workshop series.

CODE: MMM010466

PROJECT:

THE LOGISTIC SYSTEM OF END-OF-LIFE VEHICLES RECYCLING

Language: English **Course:** ~~Basic~~**/ Advanced in AE**
Year (I), semester (2) **Level: II** ~~Obligatory~~**/Optional**
Prerequisites: basic knowledge of vehicle design **Teaching: Traditional/**~~**Distance L.**~~
Lecturer: Anna Janicka PhD, Zbigniew J. Sroka PhD,

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)				90	
Exam / Course work/T:				CW	
ECTS				6	
Workload (h)				180	

Outcome: Project is focused on End-of Life Vehicles (ELV's) recycling. Students will design the vehicle recycling system for chosen EU region. The project will contain statistic data and prognosis of ELVs for the chosen region, research on materials which are used for vehicles production (in past and nowadays trends) and potential of its recycling, legislation of ELVs in EU, technologies and methods which are used for ELVs management (including the after shredding residues, ASRs, which is the weak point of ELV recycling) and proposition of recycling system for chosen localization
Within project students, in groups 4-5 persons will practice teamwork. Each of the group will be consist of: leader, logistics engineer, designer(s), internet (library) worker. Students will define the problems, show targets, tasks and activities, prepare work plan, make SWOT analyze. A budget of investment will be defined at the end of project. Project Management software will be used, too

Content: Vehicles, essential to society, are continually increasing in use. However, throughout their life cycle vehicles impact the environment in several ways: energy and resource consumption, waste generation during manufacturing and use, and disposal at the end of their useful lives. About 75 percent of end-of- life vehicles, mainly metals, are recyclable in the European Union. The rest (~25%) of the vehicle is considered waste and generally goes to landfills. Environmental legislation of the European Union requires the

reduction of this waste to a maximum of 5 percent by 2015. The students will recognize the problems and create a project of vehicle recycling system for chosen EU region

Literature:

1. Lewis J.P.; *Fundamentals of Project Management*, AMACOM, New York 2002
2. Lewis J.; *The Project Planning, Scheduling and Control*, McGraw-Hill, New York 2001
3. The Ecology of Transportation: Managing Mobility for the Environment (Environmental Pollution) John Davenport, Julia L. Davenport
4. Society of Automotive Engineers, Vehicle Recycling, Regulatory, Policy, and Labeling Issues (Special Publications), ISBN: 0768003628,

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CODE: MMM010477

PROJECT:

FLOWS MODELING IN AUTOMOTIVE ENGINEERING

Language: English **Course:** ~~Basic~~**/ Advanced in AE**

Year (I), semester (2) **Level: II** ~~Obligatory~~**/Optional**

Prerequisites: basic knowledge of vehicle design **Teaching: Traditional/**~~Distance L.~~

Lecturer: Marcin Tkaczyk PhD, Zbigniew J. Sroka PhD,

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)				90	
Exam / Course work/T:				CW	
ECTS				6	
Workload (h)				180	

Outcome: Project is focused on solid, shell and beam modeling of supporting structure in working machines. Boundary conditions implementation in the static and dynamic analysis. Preparation of discrete models. Visualization and interpretation of results based on strength calculations.
Within project students, in groups 4-5 persons will practice teamwork. Each of the group will be consist of: leader, logistics engineer, designer(s), internet (library) worker. Students will define the problems, show targets, tasks and activities, prepare work plan, make SWOT analyze. A budget of investment will be defined at the end of project. Project Management software will be used, too

Content: The students will create the project of flow, turbulence, heat transfer for automotive applications: engines inlet tracks using Computational Fluid Dynamics tools (FLUENT software)

Literature:

1. Blair G.P., Design and simulation of four-stroke engines, Warrendale, Society of Automotive Engineers, 1999
2. FLUENT software guideline.

CODE:	FOREIGN LANGUAGE
Language: Foreign language	**Course: ~~Basic~~/Advanced** (nontech)
Year (I), semester (1) **Level:** II	**Obligatory**/~~Optional~~
Prerequisites: basic knowledge	**Teaching: Traditional/~~Distance~~** L.

Lecturer: somebody from Language Centre at Wroclaw University of Technology

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)		60			
Exam / Course work/T:		E			
ECTS		3			
Workload (h)		90			

Outcome: The Polish students can continue or start learning chosen language course on chosen level.

The foreign students should chose course of Polish language to study.

Content:. The courses requirements for each level are presented on a website of The Department of Foreign Languages: http://www.sjo.pwr.wroc.pl

Course of Polish language for foreigners:

The curriculum of learning Polish as a foreign language on the elementary level A includes subjects connected mostly with a person (personal data, education, general look, family relations, leisure time activities, health etc.). Subsequent themes contain: the surrounding of the man (both immediate: living place, students' hostel etc. and more distant: city and its institutions), every day routines, plants, animals, weather and climate

Literature:

1. Burkat A., Jasińska A., Hurra!!! Po polsku 1 (A1), Kraków 2005 [CD].
2. Drwal-Straszakowa Katarzyna, Martyniuk Waldemar, Powiedz to po polsku. Say it in Polish (A1), Kraków 2006.
3. Gałyga Danuta, Ach, ten język polski. Ćwiczenia komunikacyjne dla początkujących, Kraków 2001 [CD].

2nd YEAR, SEMESTER 3

CODE: MMM010467	MACHINE AND DEVICE CONTROL
Language: English	**Course: Basic/~~Advanced~~**
Year (I), semester (1) **Level:** II	**Obligatory**/~~Optional~~
Prerequisites: basics of classical mechanics	**Teching:Traditional/~~Distance~~** L.

Lecturer: Wiesław Fiebig prof., Piotr Osiński Ph.D., Michał Stosiak Ph.D., Grzegorz Łomotowski M.Sc., Marek Spławski M.Sc.

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	30		30		
Exam / Course work/T:	E		CW		
ECTS	3		2		
Workload (h)	90		60		

Outcome: Knowledge of fundamental industrial control systems with a special focus on control systems techniques for machines and production lines, real time industrial communication systems, wire and wireless communication systems, OPC based integration techniques and machinery safety systems. Basic

practical experience in configuration, programming and diagnostic programmable logic controllers and fieldbus networks.

Content: The course give students the knowledges about electrohydraulic drive and control systems. The proportional and servo valves will be introduced and described

Literature:

1. J. Stenerson, Fundamentals of programmable logic controllers, sensors, and communications, 2003
2. J. Stecki, A. Garbacik: Design and Steady-state Analysis of Hydraulic Control Systems, Fluid Power Net Publications, Cracow 2002
3. M. Ivantysynowa: Fluid Power Drives and Control
4. S. Stryczek: Napędy i Sterowania Hydrauliczne, PWN Warszawa
5. W. Kollek: Podstawy projektowania napędów i sterowań hydraulicznych , P. Wr., 2004 F. Dave, *Programmable logic controllers*, 2005
6. J. Stenerson, *Fundamentals of programmable logic controllers, sensors, and communications*, 2003

CODE: MMM010468	**TESTING OF VEHICLE ELEMENTS AND ASSEMBLIES**	
Language: English		**Course:** ~~Basic~~**/Advanced**
Year (I), semester (1)	**Level:** II	**Obligatory/**~~Optional~~
Prerequisites: none		**Teaching: Traditional/**~~Distance~~ L.

Lecturer: Ludomir Jankowski PhD, Dudek Krzysztof, Filipiak Jarosław, Krysztoforski Krzysztof, Nikodem Anna, Pezowicz Celina, Stosiak Michał, Szotek Sylwia, Ścigała Krzysztof

	Lecture	**Tutorials**	**Laboratory**	**Project**	**Seminar**
Hours / sem. (h)			30		
Exam / Course work/T:			CW		
ECTS			3		
Workload (h)			90		

Outcome: The purpose of the class is to enable the students to handle different equipment as it is used for various mechanical research and technological applications. The class will have its greatest benefit for students who are about to start their own research in an experimental field involving the presented methods and techniques.

Content: Introduction – vehicle and automotive elements testing, principles of the mechanical similarity and modern measurement techniques, thermovision application in thermal diagnostic of the vehicle assembly, acoustic holography application for noise diagnostic, testing of the brake system elements, holographic interferometry in pneumatic valve cover displacement testing, speckle photography in sandwich construction displacement measurements, detection of the defects in vehicle elements (tire, laminate element of the vehicle body) using holographic interferometry and shadow moire method, ESPI method for chassis frame's element testing, photoelastic coating technique for suspension element testing, photoelastic investigation of the towing hitch model, strain gauges method for inner forces determination in thin-walled chassis frame element, PIV (particle image velocimetry) method for liquid flow modeling in cooling system, determination of the car suspension elements characteristics, the rubber elements testing (large strains determination).

Literature:

1. Dally J.W., Riley W.F., Experimental Stress Analysis (3rd ed.), McGraw-Hill, Inc., 1991
2. Rastogi K., Optical Measurement Techniques and Applications, Artech House, 1997
3. Kreis T., Handbook of Holographic Interferometry: Optical and Digital Methods, Wiley-VCH, 2004
4. Figliola R.S., Beasley D.B., Theory and Design for Mechanical Measurement (4th ed.), Wiley, 2005

CODE: MMM010469	**SURFACE ENGINEERING**

Language: English **Course:** ~~Basic~~**/Advanced**
Year (I), semester (1) **Level:** II **Obligatory/**~~**Optional**~~
Prerequisites: none **Teching:Traditional/**~~**Distance**~~ L.
Lecturer: Janusz Szymkowski, PhD

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	15		15		
Exam / Course work/T:	T		CW		
ECTS	1		1		
Workload (h)	30		30		

Outcome: Konwledge of how to describe requirements for the surface, how to create a surface with proper features, how to measure the surface properties.

Content: Surface texture overview. Surface and outer layer properties required for various technical applications. Basic surface properties measurements. Traditional and innovative methods of surface technologies.

Literature:

1. G. T. Smith, Industrial Metrology – Surfaces and Roundness
2. E.P. Degarmo, Materials and Processes in Manfacturing
3. S. Kalpakjian, Manufacturing Engineering and Technology
4. M.P. Groover, Fundamentals of Modern Manufacturing

CODE: MMM010470 **DIPLOMA SEMINAR**

Language: English **Course:** ~~Basic~~**/ Advanced in AE**
Year (II), semester (3) **Level: II** **Obligatory/**~~**Optional**~~
Prerequisites: none **Teaching: Traditional/**~~**Distance L.**~~
Lecturer: Piotr Wrzecioniarz, DSc (Poland)

	Lecture	Tutorials	Laboratory	Project	Seminar
Hours / sem. (h)	-	-	-	-	15
Exam / Course work/T:	-	-	-	-	-
ECTS	-	-	-	-	1
Workload (h)	-	-	-	-	-

Outcome: The students will be familiar with reporting and presenting results of their final projects. Individual work. Experience with computer software to make presentation.

Content: The aim of the course is preparation of the students for presentation and discussion of the scope of M.Sc. Thesis. During introductional seminar examples of M.Sc. thesis finished in last year will be presented. Every student will have two presentations. During the first one student will present own subject, schedule of the work, literature survey, tasks and expected results.

In the second presentation received results of their M.Sc. will be discussed. Both presentations should prepare for final oral presentation at the end of M.Sc. program.

CODE: MMM010472 **MASTER THESIS**

Language: English **Course:** ~~Basic~~**/ Advanced in AE**
Year (II), semester (3) **Level: II** **Obligatory/**~~**Optional**~~
Prerequisites: none **Teaching: Traditional/**~~**Distance L.**~~
Lecturer: academic staff from Wroclaw University of Technology, Faculties: Mechanical Engineering or Chemistry

Hours / sem. (h)	
Exam / Course work/T:	E
ECTS	20
Workload (h)	600

Outcome and content: Master thesis has to be an individual work, pointed author qualification in Automotive Engineering specialization.
It can be a design project, labs research, operational tests in natural conditions etc. including: problem definition, literature analysis, proposals of solving, drawing or/and calculations, results analysis, conclusions.
In addition, supervisor will be graded students due to his/her activity and self-reliance.
The title of Master Thesis will be given at the end of first semester after proof by Institute Scientific Board.