Transilvania University of Braşov, Romania

Study program: Automotive Engineering (in English)

Faculty: Mechanical Engineering
Study period: 4 years (bachelor)

1st Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mathematical Analysis	ANAMe	5	3	2	-	-

Course description (Syllabus): SEQUENCES OF REAL NUMBERS (sequences of real numbers, limits, properties); SERIES OF REAL NUMBERS (series of real numbers, convergence/divergence of series, Cauchy's theorem, Cauchy's condensation theorem, series with non-negative terms, Leibniz's alternating series theorem, convergence criteria); CONTINUOUS FUNCTIONS (limits of functions $f:E\subset R\to R$, properties of limits, the continuity of functions of one real variable; properties of continuous functions. Extensions to the case of functions $f:E\subset R\to R^m$, $f:E\subset R^n\to R$ and $f:E\subset R^n\to R^m$); DIFFERENTIABLE FUNCTIONS (differentiability of functions $f:E\subset R\to R$, properties of differentiable functions, Rolle's, Lagrange's and Cauchy's theorems. Higher order derivatives, Taylor's formula and applications. Extension to the case of functions $f:E\subset R^n\to R^m$: partial derivatives, Schwarz's theorem, higher order partial derivatives, Taylor's formula and applications; INTEGRABLE FUNCTIONS (Riemann integral: definition, computation methods, and properties. Antiderivatives, the fundamental theorem of Calculus. Line integrals: definitions, properties, applications. The double integral: definition, properties, its relationship to the line integral (Green's theorem), applications. The surface integral: definitions, properties, applications. The triple integral: definitions, properties, its relationship to the surface integral (Gauss's divergence theorem and Stokes's theorem), applications.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Descriptive Geometry	GDe	4	2	-	2	-

Course description (Syllabus): Introduction; Projecting a point on two and three planes of projection; Projecting a straight line; Graphic representation of the plane; The methods of the descriptive geometry; Polyhedrons; Solids of revolution; The sphere; Intersections of solids.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Applied Informatics	InfAe	5	2	-	2	-

Course description (Syllabus): – arrays and structures – definition and operation; functions – program, special and user defined; differential and integral calculus; linear algebraic equations; 2D and 3D plotting in Matlab; advance plotting – special functions; symbolic calculus – Matlab and MuPad; applied engineering problems in Matlab – numerically and symbolically.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Comunication and Academic Writing	Come	3	1	1	-	-

Course description (Syllabus): The quick and easy access to the technical and scientific information, whether it is classical or modern, or to any other kind of information, represents a characteristic of the modern life, lived at the beginning of the third millennium. The first part of the course, "Traditional documentation", represents an orientation

guide for those who benefit from the services the college libraries offer. The second part of the course, "New documentation and communication technologies", refers to the new communication and information technologies, mainly to the miracle of our times, the INTERNET. Synthetic references are being made regarding the presentation, utilization of the INTERNET services, the on-line communication, and the steps taken to search information.
Specific competences: Communication ability; Documentation skills; Making conceive a CV, intention letter, invitation, etc. Organization of papers and scientific projects; Achieving personal and professional development, using their resources efficiently and modern learning tools; Easy integration within a group, assuming specific roles and achieving a good collective communication.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Technical Drawing and Infographics - I	DT1e	4	2	-	2	-

Course description (Syllabus): Introduction. Drawing standards; Graphic representations used in technical drawing; Sectional views and sections; Dimensioning; Representation of the machine parts and components. Designation of surface characteristics. Limits of size. Assembly drawing

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Physics	FIZIe	4	2	-	1	-

Course description (Syllabus): Introduction; Kinematics and dynamics of the material point; Mechanical oscillations; Mechanics of continuum medium; Thermodynamics and statistical physics; Electricity and magnetism; Optics; Structure of matter. Elements of quantum physics

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mechanics – I	MEC1e	5	3	1	1	-

Course description (Syllabus): Introduction, principles of mechanics, fundamental notions, history; Statics of the Material Point; System of Forces, Screw; Gravity (Mass) Center; Statics of the Rigid Body; Friction; Statics of Mechanical Systems. Truss Systems; Technical Applications of the Statics; Analytical Mechanics

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Programming and Programming Languages	PCLPe	5	2	-	1	-

Course description (Syllabus): Introduction; Programming languages and GUI; Buttons, Menu, Tools bar (simple controls); Advanced controls; Design and 2D animation; Data bases; Debugging programs; Complex programming; Project management

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electrical Engineering		4	3		2	

Course description (Syllabus): Introduction; Direct-Current Circuits: Elements, symbols, electric diagrams, Ohm's Law, Kirchhoff's Laws, Work, Energy and Power in DC, series-parallel connections, Superposition theorem; Sinusoidal AC Circuits; Three Phase Circuits; Magnetic Circuits; Transformers; Signals, Analog and Digital. Modulation and Demodulation. A/D, D/A Converters; Semiconductors, Diodes and Power Supplies. Transistor Fundamentals. FET-MOSFET fundamentals. Logic gate. Common Source Amplifiers. BJT fundamentals. The NOT logic gate. The common Emitter Amplifiers; Small signal amplifiers. Integrated circuits; Power Electronics. Rectification. Single phase bridge inverter. 3 ph bridge inverters: PAM, PWM.

2nd Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Economics	ECONe	3	1	1	0	0

Course description (Syllabus): The Economics course provides and introduction to general economy, highlighting the main economic instruments, market elements (needs, resources, property, types of costs, profit), macroeconomic concepts (economic growth, GDP, unemployment, inflation, crises, foreign trade, online marketing concepts, national and European non-reimbursable funds, savings (interest rates, dividend yields, mutual funds and cryptocurrency), and more, all in one practical approach.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Technical drawing & Infographics– II	DT2e	4	2	-	2	-

Course description (Syllabus): Introduction in AutoCAD: About drawing in AutoCAD. Screen Layout. Drawing visualization. Creating views and slides; Creating drawings. Type of coordinates. Drawing aids. Fixing the limits and units. Interrogations; Object properties. Changing properties; Layer functionality. Creating layer structure. Associating objects to a layer; Drawing items. Drawing simple items. Drawing complex items; Modifying items. Selection modes. Modifying simple items. Modifying complex items; Block creation and editing. Defining attributes. Block and attributes inserting. Attributes editing; Hatch creation and editing. Text creation and editing. Text Style. Annotations; Dimensioning. Dimension Styles; 3D visualization. Systems of coordinates WCS and UCS. Elevation and Thickness. Surfaces and Objects

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mechanics – II	MEC2e	6	2	2	2	-

Course description (Syllabus): Particle Kinematics; Rigid Body Kinematics; Relative Motion of a Particle; Basic Concepts in Dynamics; Main Theorems in Dynamics; Forces of Inertia; Rigid Body Dynamics

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Numerical Methods	MNUMe	3	2	-	2	-

Course description (Syllabus): – solving linear and nonlinear equations – iterative and decomposition methods, eigenvalues problems, over and undetermined systems; differentiation and integration; differential equations (e.g. trapezoidal, Runge-Kutta, predictor-corrector, etc.); fitting function to data; optimization problems (linear programming, genetic algorithms); boundary value problems; specific issues for particular engineering applications.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Strength of Materials – II	RM2e	4	3	1	1	-

Course description (Syllabus): Failures Theories; Deflections of Beams under Transverse Loading; Stress under Compound Loads; Curved Beams; Energy Methods for Linear-Elastic Displacements Calculus; Indeterminate structures; Stability of Structures; Dynamic Loads.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Mechanisms		5	42		14	14

Course description (Syllabus): Links, kinematic pairs (joints), mobility analysis of linkages. Structural analysis and synthesis of planar and spatial linkages. Kinematic analysis of mechanisms (position, velocity and acceleration), graphical and analytical methods. Analysis of forces action on mechanisms, balancing, static and dynamic equilibrium

of mechanisms. Gears, gear trains and planetary gears. Geometry of gears, the involute profile. Cam and follower mechanisms.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Machine Elements – I	OM1e	4	2	-	1	1

Course description (Syllabus): Introduction (object; place in development of mechanical engineer; history of calculation and construction of machine elements; evaluation; references, general consideration on design of machine elements). Joints (screw joints and screw transmissions; feather and key joints; spline joints; pins and bolts, safety rings; profiled joins; fit joints). Springs (elastic characteristics, helical cylindrical compression spring; helical cylindrical traction spring; helical cylindrical torsion spring; torsion bar spring; plane spiral spring, leaf springs, disc spring, rubber spring). Gears (materials; tooth failure; spur gear; helical and gears; straight and curved bevel gears; permissible stress; gear forces). Gear transmissions (gear ratios, forces in speed reducers).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Tolerances and Dimensional Control	TCDe	3	2	-	1	-

Course description (Syllabus): Mechanical instruments for measurements. Optical instruments for measurements. Limits and fits for cylindrical smooth parts. Surface texture measurements. Geometric dimensioning and tolerancing. Tolerances and fits for part threads. Tolerances and fits for gear pairs. Tolerances and fits for keys and splines. Angle measurements. Pneumatic gauging. Measuring machines.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Special Mathematics and Statistics	MSSMe	4	2	2	-	-

Course description (Syllabus): Differential equations. Differential systems. First-order partial differential equations. Vector field theory. Theory of complex functions. Applications. Laplace transformation. Applications. Fourier series. Equations of mathematical physics. Probability and statistics.

3rd Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Thermodynamics and Thermal Machines	TMTe	5	2	1	2	-

Course description (Syllabus): Thermodynamics. Fundamental measures. First principle of thermodynamics. Ideal gas. Mixture of ideal gases. Ideal gas state transformations. Second principle of thermodynamics. Thermodynamic cycles. Entropy. Fuel combustion. Internal combustion engines. Reciprocating compressors. Gas turbine installations. Heat transfer. Conduction, convection, radiation.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Vibrations	VIBRe	5	2	1	1	-

Course description (Syllabus): Elastic elements and damping elements. System representation (mathematical model). Systems with one degree of freedom. Systems with two degrees of freedom. Systems with multiple degrees of freedom. Approximate methods used to study discrete systems. Introduction to finite element method used for vibrations study. Continuous systems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Machine Elements – II	OM2e	5	2	-	1	1

Course description (Syllabus): Shafts (stresses and cycles; forces; calculations). Couplings and clutches (classification; permanent rigid couplings; mobile couplings; elastic couplings; clutches). Tribology and sleeve bearings

(friction; usage; lubricants; constructions – body, sleeves; hydrodynamic bearings; bearings with limit friction). Ball and roller bearings (kinds of bearings; failures; calculation; ball and roller bearing mountings). Sealing devices. Chain drives (constructive types; geometric calculation, kinematic elements; contact calculation; maintenance). Belt drives (constructive types; geometric calculation, kinematic elements; forces and stresses; traction diagram, strength calculation, maintenance). Friction drives. Variable speed drives (failures, calculation).

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Vehicle Dynamics – I	DA1e	5	3	-	2	-

Course description (Syllabus): Wheel – ground interaction; Rolling resistance; Grade resistance; Aerodynamic resistance and lift; Longitudinal ground reactions; Self-propulsion requirements; On-board energy storage and conversion; Motor vehicle layouts; Power transmission; Distribution of power to the wheels; General equation of vehicle motion; Motor vehicle tractive performances characteristics; Calculation of vehicle gear ratios and tractive performances

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Vehicle Dynamics – II	DA2e	4	2	-	-	2

Course description (Syllabus): Vehicle braking; Vehicle fuel consumption and chemical pollution; Hybrid propulsion systems; Overall vehicle performances; test cycles; Vehicle vibrations and ride; Vehicle steering; Vehicle stability; Driver behavior; Vehicle handling; Particularities of special vehicles.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Processes and Characteristics of Internal Combustion Engines - I	PCM1e	5	2	-	2	1

Course description (Syllabus): Engine Types and their Operation. Operating parameters and Engine Design. Ideal engine cycles. Gas Exchange Processes. Charge Motion within the Cylinder. Combustion in Spark Ignition Engines. Combustion in Compression Ignition Engines.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Construction and Calculus of Internal Combustion Engines - I	CCM1e	4	2	-	2	-

Course description (Syllabus): Calculus of engine kinematics and dynamics. Engine balance. Design of cylinder block and cylinder head. Design of piston. Design of rings. Design of piston pin. Design of connecting rod. Design of crankshaft and bearings.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Construction and Calculus of Automotive Vehicles - I	CCA1e	5	2	-	1	1

Course description (Syllabus): Transmission and driveline layout and functions. Couplings (friction, visco, hydrodynamic). Gearboxes. Axle's final drives and hub-mounted drives. Cardan and constant velocity joints. Shafts. Differentials (open, locking, limited-slip, active and torque-vectoring). Transfer cases. Rigid axles. Wheel hubs. Wheels. Hydrodynamic and friction transmissions. Transmission and driveline automation. Hybrid propulsion systems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Computer Aided Design	PACe	3	2	-	2	-

Course description (Syllabus): Framing aided design in engineering assisted. Current vehicle design requirements. Computer hardware and software features used in the design. Types of CAD models. Architecture and common

features of CAD programs. Notions - CAE, Rapid Prototyping. Introduction to Pro / Engineer, graphical user interface, menus. Module drawings (sketcher): drawings, dimensioning, constraints. Solid modeling module (part modeling) work plan, defining selection and orientation of planes, model tree, extruded shapes, form of revolution, sweep, blend, shapes placed, copying forms, advanced forms. Module assembly, foundations, types of constraints

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Autonomous Vehicles	VAut	2	14	14		

Course description (Syllabus): Introduction to the basic problems of autonomous vehicles. Vehicle localization in the environment, probabilistic models. The Bayes model for grid-based localization. Kalman filters for localization and information fusion. Path planning and search algorithms: breadth-first and A* algorithm. Motion planning: generation the smooth path, the pure pursuit model, PID control to follow the path. Obstacle avoidance and the potential field method. Introduction to digital image processing. Learning algorithms: neural networks and deep learning.

4th Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Construction and Calculus of Internal Combustion Engines - II	CCM2e	5	2	-	1	1

Course description (Syllabus): Design of gas exchange system. Design of fuelling system. Design of cooling system. Design of lubricating system. Design of supercharging system. Design of exhaust gas treatment device.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Processes and Characteristics of Internal Combustion Engines - II	PCM2e	5	2	-	1	1

Course description (Syllabus): Air pollution. Regulatory test procedures and limits of emission. Test equipment. Mechanisms of pollutant formation in engines. Influence factors of pollutant formation. Active methods of pollutant reduction. Passive methods of pollutants reduction.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Construction and Calculus of Automotive Vehicles - II	CCA2e	5	2	-	1	1

Course description (Syllabus): Suspension system (steering geometry; suspension linkages for independent, dependent and semi-dependent wheels; elastic elements; dampers; semiactive and active suspensions). Steering system (cornering methods; steering angles correlation mechanisms; actuation mechanisms; assistance modalities; active steering). Braking system (requirements; brakes; actuation subsystems). Bodyworks for cars and buses. Frames, cabins and bodyworks for trucks. Fundamentals of passive and active safety systems. By-wire driving systems. Special vehicles particularities.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Finite Element Method	MEFe	5	2	-	2	-

Course description (Syllabus): Introduction. The principle of the finite element method. The steps to solve a problem using the finite element method, shape functions, general considerations on the choice of elemental elements, meshing domain analysis for continuous structures, obtaining finite element numerical model. Using finite element method in engineering. Physical and Engineering Opportunities limits. Laws of behavior / criteria limits of elasticity. Approximation by finite elements. The finite element method in elasticity, led by displacement calculation,

deformation tensor, vector efforts, the element stiffness matrix. Types of finite elements and criteria of their choice. Practical problems using the finite element method. Influence of mesh, test case. Steps finite element analysis and flowchart solving process. Interpretation of finite element analysis results.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Electric and Electronic Systems for Automotive Vehicles	SEEAe	3	2	-	2	-

Course description (Syllabus): Introduction. Electricity Supply System (alternators and charging circuits; batteries). The Starting System. Electronic Engine Management of the Otto Engine (ignition systems; electronic devices for fuel control). Electronic Engine Management of the Diesel Engine. Active Safety Systems. Passive Safety Systems. Other Electronics Systems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Road Traffic Management	TRAFe	3	2	1	-	-

Course description (Syllabus): The course aimed to consolidate the basic concepts of road traffic system components and basic scientific investigation of the characteristics necessary to achieve any type of traffic study regarding the microscopic and macroscopic characteristics of traffic parameters, analysis of traffic volumes, the strings of waiting queues and delays. The course aims to develop skills in experimental research work and the capacity of analysing and interpretation of data.

- Students should be able to formulate hypotheses and to find solutions to the urban traffic problem for different situations;
- Students should demonstrate the ability to apply acquired knowledge and making augmented conclusions based on the results of the research steps (collection, processing and analysis data);
- Students should demonstrate the ability to identify problems appeared in the urban traffic and taking as example similar situations realise different case studies;
- Students should demonstrate: progress in acquiring new learning techniques, standing and conscious self-control skills on motivation for learning, the ability to distinguish between data, information and knowledge and to manage them;
- Students should be able to use correctly specialized language so they can communicate with others during team works, also to be able to read and discuss the contents of textbooks and specialized publications demonstrating that they understand and can pass on, to demonstrate teamwork skills for teaching projects and scientific, to demonstrate assimilation techniques within networking group, empathic capacities of interpersonal communication and assuming specific roles in teamwork.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Manufacturing and Assembling Technologies for Automotive Vehicles	TFAe	3	2	-	1	1

Course description (Syllabus): – ferrous and non-ferrous materials and alloys - manufacturing equipment and technologies for casting, forging, hot/cold extrusion, sintering and pressing, etc.; polymers and composites of thereof – properties, characterization, manufacturing (3D printing, injection, lay-up, etc.), advanced technical solutions; novel materials for automotive structural components (aluminum, glass, magnesium, etc.), flexible manufacturing technologies; surface treatments of automotive components; painting technologies deployed in automotive industry; integrative technologies.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Fuels	COMBe	3	2	-	2	-

Course description (Syllabus): Fuels –Definitions, classification. Characteristics of automotive fuels. Conventional automotive fuels. Main refinery processes. Petrol fuel. Characteristics. Diesel fuel. Characteristics. Gaseous fuels. Natural gas. Liquefied petroleum gas. Hydrogen. Reformulated fuels. Renewable fuels.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Special Automotive Vehicles	ASe	3	2	-	1	1

Course description (Syllabus): Classification of special destination vehicles. Generalities. Determination of tractors traction performances. Traction characteristics of tractors. Applications on tractors with wheels and tracks. Construction and calculation of tractors power take offs and suspension mechanisms. Industrial tractors. Construction and calculation elements of working equipment: bulldozers, graders, scarifiers, scrapers, excavators.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Hybrid-Electric Vehicles	AHEe	3	2	-	2	-

Course description (Syllabus): Introduction. Hybrid Systems, Fuels, Engines and Power Units. Fuel Efficiency, Economy and Distribution. Development of Batteries and Battery Electric Vehicles. Hybrid Electric Vehicles. Plug-in Hybrid Electric Vehicles (PHEVs). Life Cycle Analysis. Emissions. Environmental and Health Effects. Regulatory and Policy Frameworks Promoting Electric and Hybrid-Electric Vehicles. Short- and Long-term Development.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Life Cycle Analysis of Vehicle Components	ACVAe	2	2	-	1	-

Course description (Syllabus): Introduction. Product lifecycle. Lifecycle stages. PLM – Goal and Scope. Lifecycle inventory. Lifecycle impact assessment. Lifecycle Interpretation. Results Interpretation. LCA studies and usage. Environmental impact.