

Mechatronics of vehicles
Examination Questions for the Final Exam

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Group A

- A1. Essential sensors used in vehicles
 - a.) number of revolutions, velocity
 - b.) temperature, distance, pressure
 - c.) mass and volume flow rate
 - d.) acceleration and angular acceleration

- A2. Philosophy and structure of engine control units, their influence on fuel injection
- A3. Central unit: input signals, types, corresponding sensors (impulse, analog...)
- A4. Central unit: output signals.
 - a.) types, corresponding actuators
 - b.) features of valve control and regulation

- A5. Conventional batteries ignition build-up
 - a.) the role and solution of pre-ignition
 - b.) modern, fully electrical ignition.

- A6. Switch on/off the RC and RL charging of direct current circuits
- A7. Characteristic voltage-levels of vehicles, trends of electric energy, one, two and three wires systems
- A8. Structure of generators
- A9. Electronic voltage regulators
- A10. Batteries
 - a.) types, typical nominal voltage values per cell
 - b.) explanation of capacity, charging and discharging characteristics
 - c.) self-discharge, number of cycles, lifetime

- A11. One and three phase rectifiers, their use in vehicles
- A12. DC-DC converters (voltage reduction and increase in case of R and RL charging) (PWM)
- A13. DC drives – with electronically variable terminal voltage

- a.) realization of the start and the change of direction of rotation
- b.) possibilities of changing number of revolutions

A14. AC and BLDC drives (motor+electronics+software) – DC-AC converters

- a.) starting/braking/constant speed control – typical accelerations
- b.) possibilities of changing number of revolutions
- c.) structure and properties of the intermediate DC circuit frequency converters
- d.) effect of changing voltage-frequency

A15. Transmission cables, wire harnesses. Current capacity and voltage drop

Fuses, circuit breakers, surge arresters, chokes

Properties of signal transmission cables

A16. BUS systems

- a.) types and parameters (LIN, CAN...), advantages
- b.) fundamental terms of data transfer – communication of transmitter and receiver units, traits
- c.) general issues of signal transfer (speed-wire length, reflexion, transmitting medium)

A17. Sources of noise on board, internal and external noises

- a.) elements of protection against disturbance
- b.) overvoltage protection, ESD
- c.) electromagnetic compatibility, EMC

Group B

- B1. Elements of transmission from engine to wheels (gearbox, clutch, differential)
- B2. $T=f(n)$ characteristic curve of internal combustion engines
 - Gearbox influence on $T=f(n)$ characteristic
- B3. Driving resistances, tractive force need, tire grip
- B4. Sideward dynamics of the vehicle
 - Road holding in corners
- B5. Conventional brake systems
- B6. Basics of ABS
- B7. Shock absorption in vehicles
 - a.) dual-mass, quarter model
 - b.) conventional, semi-active and active dampers
- B8. Steering of vehicles
 - a.) power steering
 - b.) speed and required force
- B9. Basics of ESP
- B10. Sensors and actuators of ESP
- B11. Automatic tire pressure control
- B12. Air-bags, automatic seat belt tightening systems
- B13. Active lighting system – automatic adjustments, windscreen and headlamp wiper
- B14. Window regulators, power door lock
- B15. Climate control system. Cooling/heating/ventilating system components
- B16. Adaptive cruise control, reversing control
 - a.) Distance measuring system – radar and ultrasonic
 - b.) Camera systems