I. IDENTIFICATION DATA

Thesis title:	**Development and optimization of a control algorithm for multi-mode hybrid powertrain**
Author's name:	**Bc. Štěpán Pance**
Type of thesis :	master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Automotive, Combustion Engine and Railway Engineering
Thesis reviewer:	Ing. Jolana Heřmanová
Reviewer's department:	Department of Automotive, Combustion Engine and Railway Engineering

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	**challenging**

How demanding was the assigned project?

The aim of the thesis is to research, develop and optimize a control algorithm for multi-mode hybrid powertrain. Based on simulation results from kinematic model with built-in optimal control methods in GT-Suite, the dynamic model with heuristic control strategy was developed and optimized.

Fulfilment of assignment	**fulfilled**

How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.

The assigned task was fulfilled. The energy consumption minimization potentials for multi-mode HEV in GT-Suite were studied and the heuristic algorithm developed and optimized.

Methodology	**correct**

Comment on the correctness of the approach and/or the solution methods.

The theoretical part consists of the research of hybrid vehicles classifications and hybrid vehicle control strategies.

One optimal control strategy and one heuristic strategy was simulated. The optimal control strategy used was Dynamic programming, which is strategy built-in the GT-Suite. The results served as a guideline for development of heuristic rule/map-based strategy.

Technical level	**B - very good.**

Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?

Student employed his expertise in the field of study very well. The theory described in theoretical chapters were used properly in the practical chapters of the thesis.

Formal and language level, scope of thesis	**E - sufficient.**

Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?

The text is organized in logical order and the extent of the thesis is sufficient.
The notations are mostly used properly.
The text contains a lot of grammatical errors that in some cases reduce the comprehensibility.

Selection of sources, citation correctness	**B - very good.**

Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?

The use of references and citations is adequate. A large number of scientific articles focused on hybrid vehicles control strategies are used.

Additional commentary and evaluation (optional)
Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.

I appreciate student's approach to the optimization of components using MATLAB. The student calculated the spline of the highest efficiency of the ICE and EM power combination dependent on RPM. The spline called series operation line is then used in the simulations.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

The theoretical part contains the research of hybrid vehicles classifications and hybrid vehicle control strategies, heuristic and optimal control algorithms.
The practical part describes the development process of kinematic model and dynamic model of multi-mode HEV. The kinematic model is based on dynamic programming control strategy, then the conclusions from the simulation results are taken and used in a subsequent development of the dynamic model with rule and map-based control strategy. The heuristic control strategy is then optimized and the results are discussed.

Question:
How the fuel consumption of this multi-mode HEV would be determined according to the EU legislation?
Did you think of the control strategy in charge depleting mode? If not, why?

The grade that I award for the thesis is **D - satisfactory.**

Date: **31.8.2020**   Signature: