SUPERVISOR'S OPINION OF FINAL THESIS

I. IDENTIFICATION DATA

Thesis name:	**Test Stand for Measurement and Sampling of Brake Wear Particle Emissions**
Author's name:	**Arjun Chettiyattil Pankaj**
Type of thesis :	M.S. thesis
Faculty/Institute:	Faculty of Mechanical Engineering
Department:	Department of Automotive, Combustion Engine and Railway Engineering
Thesis supervisor:	Michal Vojtíšek (3/2018-1/2019)
Supervisor's department:	Department of Automotive, Combustion Engine and Railway Engineering

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **Ordinary**

Evaluation of thesis difficulty of assignment.

The thesis topic is a part of a larger interdisciplinary effort to develop a brake wear particle testing stand. The part assigned to the student, design of a ventilated enclosure and a dilution tunnel, is a typical mechanical engineering design project, with key specifications (range of acceptable temperatures, flows, distances, requirements for sampling point geometry, etc.) provided as a part of the assignment.

Satisfaction of assignment **Fulfilled in major parts**

Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.

The core of the assignment has been fulfilled, but with considerable amount of unfinished work and improvements to be made.

Activity and independence when creating final thesis **E – Satisfactory**

Assess that student had positive approach, time limits were met, conception was regularly consulted and was well prepared for consultations. Assess student's ability to work independently.

Mr. Pankaj has been introduced to the subject in March 2018 and has, as a relatively slow pace, worked under my guidance for two semesters, with the intended outcome of the experimental apparatus being designed, fabricated by local technicians, and tested. This task was not accomplished and the assignment was changed to a straight design project, with Jindrich Horenin becoming the new supervisor for the design part. Mr. Pankaj has consulted sporadically and has shown relatively little initiative.

Technical level **E – satisfactory to marginal**

Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.

The thesis presents a seemingly extensive set of technical information. However, much of this is drawings/descriptions of standardized parts (such as U-profile). The student was specifically instructed to use common, standard, locally available components (pipes, elbows, quick couplings, HEPA filter) and subsystems (variable speed drive centrifugal blower). The description of these should be given in the appendix, or as a short summary with reference to additional documentation. An overview showing the overall setup and identifying major components (along with their location) that will be discussed later would be highly beneficial. Likewise, a material/parts list summarizing components or subsystems available commercially and material needed for in-house/custom fabrication, would be beneficial in fabricating the work. There is a relatively serious technical error in calculations: the length of the Artemis cycle is given as 1082 s, about a third of the actual length, so the average heat dissipation is about a third of the presented value. By a series of coincidences and omissions, this error does not propagate throughout the work. Multiple variants were given, and several improvements suggested to be done in the future are described. These variants should have been discussed and only viable ones kept. Improvements, such as a window to observe the brake disc and caliper assembly (a highly desirable

feature of the test design, already discussed early in the project), should have been incorporated and not left as unfinished work.

Formal and language level, scope of thesis	**E – Marginal to unsatisfactory**
Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.	
The scope of the thesis is appropriate. The thesis contains all requisite parts and is reasonably structured. The language is cumbersome at times due to syntax errors, starting with the first sentence of the abstract. Some sentences are incomprehensible (i.e., "front-wheel vehicles contribute more than 60% of the tyre emission per vehicle", page 13). In many cases, punctuation is missing or is misplaced, and space is missing between the numerical value and the associated engineering unit. In many cases units are not used correctly (i.e., total dissipated energy given in kJ, distance given in "Km").	

Selection of sources, citation correctness	**F – unsatisfactory**
Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.	
The references appear to be chosen mostly correctly, going beyond the set of references given to the student as a part of the assignment. The references are generally relevant and form a consistent set. Some references are not well chosen, such as estimate of the number of tires used in 2021 from a 1999 reference attributed to 'Environment Agency'. Unfortunately, the citation format is inconsistent, mixing sequentially numbered approach with {author; year} format. Many works cited are not listed in the reference list (virtually all citations following the {author; year} format). The work referred to as 'Environment Agency, 1999', with no details in the reference list, is so ambiguous that it does not serve its purpose, which should be its location and peruse by the reader of the work. In some cases, sources of images are not given – this is, for example, the case with Graphs 3, 4 and 5, which are, in my opinion, taken from www.dieselnet.com, which is referred to several times in the text, but no explicit acknowledgement is given for the figures.	

Additional commentary and evaluation
Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.
It is my opinion that he has gained the necessary skills over the time and has advanced towards accomplishing enough engineering work to produce a defendable thesis. In my opinion more frequent consultations, and especially asking the advisor for a periodic review of the thesis, would have been highly beneficial as many of the deficiencies could have been addressed.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Mr. Pankaj has been, following several discussions and as the outcome of a mutual agreement, assigned the design of a ventilated enclosure and air duct serving as a dilution and sampling tunnel for a brake wear test stand, to be built by technicians and other students, and tested. He has worked on the project intermittently, at a relatively slow pace, consulting infrequently and showing limited, but positive, progress. Later, his assignment was changed to a design assignment only, without the validation part. Over time, Mr. Pankaj has shown considerable progress and it is my opinion that he is on a good path to produce satisfactory engineering work. I would characterize his thesis as unfinished, with many issues, each of them being relatively minor on its own, throughout the work: semantic and grammatical errors, errors in the use of engineering units, mixing up citation styles, missing references in the reference list, unfinished work such as missing overview or items left for "future suggestions". Ideally, I would recommend that at least the most grave formal errors, such as citations and semantics, can be corrected before submitting the thesis and before the thesis is accepted. This was also the case with the first submission of the thesis during the previous semester, which I have accepted only after strong insistence of the student, with unsatisfactory grade being subsequently awarded in all reviews. Overall, Mr. Pankaj

may pass as a satisfactory engineer and convince the commission in this matter, and the thesis appears to have some solid core, however, I have reservations against the thesis, in the present form as submitted, being a showcase of engineering work of a successful absolvent of the program.

Overall, I classify the thesis with grade E – Satisfactory, with a strong suggestion that at least major formal errors are corrected.

Date: **27.8.2019** Signature: