THESIS SUPERVISOR'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Epidemiological Modeling and Control**
Author's name:	**Harun Zalihic**
Type of thesis:	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Control Engineering, (13135)
Thesis reviewer:	Kristian Hengster-Movric
Reviewer's department:	Department of Control Engineering, (13135)

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment — **ordinarily challenging**

How demanding was the assigned project?

Assigned project required familiarity with *compartmental systems*, epidemiological modeling and analysis methods. Those fields are fairly well explored and described in available literature. Numerical simulations required standard familiarity with MATLAB, Simulink.

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 student adequately fulfilled the assigned tasks. All set primary goals have been achieved. Following the study of batch and networked compartmental models, including possible non-pharmacological and pharmacological interventions, (*i.e.*, contact restrictions, quarantine and isolation and vaccination models, respectively), the thesis focuses specifically on models developed for CoViD-19 and assesses the efficacy of the proposed control methods. Thesis also addresses the robustness of the models used, in light of incomplete information and imperfect effect of the measures taken.

Activity and independence when creating final thesis — **A - excellent.**

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

The student worked on the thesis regularly. Weekly meetings took place during this whole period, for which the student was well prepared each time. Progress was steady and clearly seen. The student independently worked on the models, analysis and numerical simulations presented in the thesis.

Technical level — **A - excellent.**

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

The thesis presents technically sound results. The student successfully used his wider background in Systems and Control to employ a special set of methods and results particularly pertaining to compartmental systems modelling epidemics. The work is clearly explained and commented.

Formal level and language level, scope of thesis — **B - very good.**

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 employed formalisms and notation are used properly throughout the thesis. The thesis is organized in a clear and logical way. The exposition is satisfactory and the thesis is well-presented. The language is generally understandable, although there are a few rather minor issues with some sentences. The level of English could be somewhat improved upon.

THESIS SUPERVISOR'S REPORT

Selection of sources, citation correctness	**A - excellent.**
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 thesis makes adequate references to the existing literature and the reference list is up-to-date. The selection of sources was adequate and the reference list meets the bibliographic standards. Student's own original work and conclusions are clearly distinguished from existing results.	

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.
The topic of the thesis is certainly current, fitting into the present trend of increased interest in epidemiological models and their control, following the start of the CoViD-19 pandemic, in a hope of informing the public health decision makers. Moreover, the thesis sets its topic in a broader historic context, spanning centuries of scientific interest in epidemics. Thesis focused on a few relatively simple models which were analyzed and numerically simulated with reference to the actual conditions taking place during the still ongoing pandemic. Although relatively simple, these models offer qualitatively interesting results, providing insights into the efficacy of different public health measures undertaken during the CoViD-19 pandemic in Italy and Czech Republic. The student used novel analysis methods specific to compartmental systems to conduct qualitative analysis of the investigated dynamics. Extensive numerical analysis was also undertaken. If the available time period were longer, a more thorough and systematic study could have been done along these lines.

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

Summarize your opinion on the thesis and explain your final grading.

During his work on the thesis, the student showed he can independently investigate and analyze compartmental models of mathematical epidemiology and assess the various possibilities of controlling this class of systems, thereby employing appropriate advanced methods of qualitative analysis. The methods showcased in the thesis and the conclusions obtained are interesting and useful in the current situation of the still ongoing CoViD-19 pandemic. For these reasons I would suggest the grade A be awarded.

The grade that I award for the thesis is **A - excellent.**

Date: **31.5.2022** Signature:

THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Epidemiological modeling and control**
Author's name:	**Harun Zalihic**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Control Engineering
Thesis reviewer:	Ing. Tomáš Báča, Ph.D.
Reviewer's department:	Department of Cybernetics

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment — ordinarily challenging

How demanding was the assigned project?

In my opinion, this work's assignment is average, mainly thanks to no need for real-world control integration and implementation.

Fulfilment of assignment — unfulfilled

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.

All except the last point of the assignment seem to be fulfilled. The last point was supposed to focus on testing the designed controls' applicability on incomplete data. The respective chapter 6 in the thesis only contains 7 sentences of text with figures that convey almost no information. The figures lack detailed captions and any axis labels. Moreover, the figures contain color-coded overlapping curves that can not be interpreted without a legend. Therefore, I find this chapter unsatisfactory. Moreover, I would expect the testing methodology for incomplete data to be described in more detail since this is one of the two assignment subtasks that were supposed to be the student's own work.

Methodology — partially applicable

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

The chosen methodology for testing the stability of the controlled models seems to be feasible. However, similarly to my objections to the fulfillment of the last point, I have concerns about the chosen methodology in that case.

Technical level — F - failed.

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?

The main output of the thesis and the bulk of the author's own work are the plots of the models' variables. However, all of the 28 figures are missing axis labels, making them almost impossible to interpret. Moreover, the figures in Chapter 6 are missing legends as well. Furthermore, some figures are missing captions for subfigures (e.g., figure 5.4, 5.5., 5.6), making them even harder to interpret. I consider those mentioned above as a significant drawback in technical writing, which should not be present (in such large numbers) in a master's final work. Moreover, the mathematical typography of this work could benefit from better distinguishing scalars, vectors, and matrices, e.g., by using bold style and by aligning multi-line equations.

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 thesis is written using clear and understandable English, without too many typos or grammatical errors. The text itself can be followed easily.

I have concerns about the scope of the work. The work is written using quite large margins, and the majority of the figures are very wasteful with the surrounding space. For example, figures on pages 30 to 33 could easily fit on a single page. Moreover, pages such as 15, 20, 26, 37, and 40 are half-empty, mainly due to overly large figures and poor proportion of text to figures. This suggests that some figures might have been included in appendices or might need to be re-scaled to fit the text correctly. After adjusting the margins and the figures to fit the text better, I fear that the content could fail to meet the minimal 40-page limit.

Selection of sources, citation correctness F - failed.

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 list of bibliographic references is insufficient for a Master's diploma thesis. The student failed to conduct an independent search for adequate up-to-date sources. From the total of 20 references, the supervisor in the assignment suggested 3, 7 are poorly-cited Wikipedia pages (with malformed addresses and without the page access date), 2 are more than 100 years old, and the last 5 seem to be incomplete citations with unclear source.

Judging from just the visual side of the list of references and the lack of citation style, the author did not pay much attention to this important aspect of technical and scientific work.

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.

Page 8: The nSIR model is introduced at the bottom of the page by a set of equations out of a paragraph. Did the author forget to add a description?

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

Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.

After careful evaluation, due to the numerous concerns regarding the submitted text and the fulfillment of the last task, I suggest awarding the thesis with the mark F - failed..

In my opinion, this work is on the borderline. I think the student have a chance to defend it in front of the committee. For the defense, I have the following questions:

1. *How was the inaccurate detection of infected modeled in Chapter 6?*
2. *What is the time step for the discretized model in 3.4? How did you choose it?*

Date: **2.6.2022** Signature: