Electronic control of aircraft engines PhD

1. Subject name	Electronic control of aircraft engines PhD				
2. Subject name in Hungarian	Repülőgép hajtóművek elektronikus szabályozása PhD				
3. Code	BMEKOVRD001	4. Evaluation type	exam grade	5. Credits	3
6. Weekly contact hours	2 (0) Lecture	0 (0) Practice	1 (0) Lab		
7. Curriculum	PhD Programme	8. Role	Specific course		
9. Working hours for fulfilling the requirements of the subject					120
Contact hours	42	Preparation for seminars	14	Homework	28
Reading written materials	8	Midterm preparation	0	Exam preparation	28
10. Department	Department of Aeronautics and Naval Architectures				
11. Responsible lecturer	Dr. Beneda Károly				
12. Lecturers	Dr. Beneda Károly				
13. Prerequisites					

14. Description of lectures

Objectives and methods of theoretical introductory mathematical modeling, considering the possibilities of modern nonlinear modeling, eg. neural network. Connecting the mathematical model and the subject of control: possibilities and methods of identification. Summary of the application of classical control theory in the design of control systems for gas turbine engines. Possibilities offered by modern control theory: state space representation from uniaxial gas turbine to tri-axial bypass jet engines. Design of control system with state feedback using linear quadratic and H∞ methods. Application of Loop Transfer Recovery method for gas turbines. Theoretical background and implementations of model-based adaptive controls, with particular reference to multi-input, multi-output systems (eg variable geometry jet drive). Stochastic and Markov modeling of bypass jet engines. General description of the mbed microcontroller development system and its application in the rapid prototype development of gear control systems.

15. Description of practices

16. Description of labortory practices

Measurements on gas turbine engines, testing of control algorithms

17. Learning outcomes

A. Knowledge

- The student is familiar with the theoretical background of electronic control systems for advanced gas turbine aircraft engines, current industry control solutions, and LQR, LQG / LTR, adaptive model-based controls.

B. Skills

- The student is able to investigate the operating characteristics of different engines on a theoretical level by performing simulations. Able to perform identification and control measurements to test control algorithms. The student is able to design, develop and achieve new industrial and scientific results after analyzing and evaluating the obtained test data.

C. Attitudes

- The student aims to complete his/her studies at the highest level, under the shortest time, by providing his/her knowledge and capacity at the best to obtain knowledge for deep and independent professional work; The student has strong professional commitment, has developed expectations for finding new, better solutions and has agreement on doing hard work.

D. Autonomy and Responsibility

- The student takes responsibility for guiding mates by the quality of his/her work and by keeping ethic norms; The student takes responsibility for applying the knowledge in line with the studied conditions, limitations and constraints; The student can friendly accept the well-established constructive criticism and can utilize that in future; The student is a creative constructor, proactive, and has leadership skills and argument techniques, capabilities with responsibility during the studies, research work.

18. Requirements, way to determine a grade (obtain a signature)

The criterion of the acceptance of the semester and so getting the signature is the completeness of the solution of a defined

problem in a specific area in the agreed time and quality. The exam is oral. The final mark of the exam is the mathematical average of the results for the own task and the exam.

19. Opportunity for repeat/retake and delayed completion

According to the TVSZ

20. Learning materials

G. G. Kulikov, H. A. Thompson: Dynamic Modeling of Gas Turbines. Identification, Simulation, Condition Monitoring and Optimal Control. Springer, London, 2004. ISBN 1852337842
H. Richter: Advanced Control of Turbofan Engines. Springer, New York, 2011. ISBN 978-1-4614-1170-3
A. Linke-Diesinger: Systems of Commercial Turbofan Engines. Springer, Berlin, 2008. ISBN 978-3-540-73618-9
E. Lavretsky, K. A. Wise: Robust and Adaptive Control – with aerospace applications. Springer, London, 2013. ISBN 978-1-4471-4396-3

Effective date	27 November 2019	**This Subject Datasheet is valid for**	Inactive courses