Óbuda University Bánki Donát Faculty of Mechanical and Safety Engineering	*Institute of Mechatronics and Vehicle Engineering*

Subject title and code: **System and Control Theory (BMXRIE2MNF)** **Credits:** *4*

Full-time study 2026/26 *ac. year* *Semester* **II**

The course is available at: mechatronical engineering

Supervised by: Prof. László Pokorádi **Instructors:** Prof. József Tar

Prerequisite (neptun code): Applied Mathematics (BTXAME1MNF)

Weekly number of lessons

Lecture: 2	Group seminar: 0	Lab: 1	Consultation: 0

Way of assessment: Midterm mark (Written)

Online consultation *(in case it's required):* ***https://bbb3.banki.hu/rooms/rgp-lv2-gv5-mqv*** *(BBB link)*

Edu. goal: *Theoretical and simulation-based studies on modern adaptive and robust control methods.*

Schedule

Education week	**Topics**
1.	Historical antecedents; The "Canonical Form" of the Equations of Motion of the LTI Systems; Generalizations of the LTI Form: LPV, qLPV, Globally Linearizable Models.
2.	Cayley-Hamilton theorem, Jordan's Canonical Form, Sability, Controllability, Observability.
3.	Stabilization of Unstable Systems by Tracking Error Feedback Terms, Pole PLacement.
4.	Introduction of the Frequency Domain; The Laplace Transform for the Initial Condition $f(t_0) = 0$; The Function Class $\varnothing$; Distributions;
5.	Classical Stability Proofs for LTI Systems: Bode Plot, Nyquist Plot, Nyquist-Strecker Criterion;
6.	Robust Control Design Methodologies for the Stable LTI Systems in the Frequency Domain: the H∞ Controllers;
7.	The "Computed Torque Control" (CTC) for Robots;
8.	The Robust, Variable Structure / Sliding Mode Controller;
9.	Fixed Point Iteration-based Adaptive Controllers; The Model Reference Adaptive Controller (MRAC);
10.	On Lyapunov's 2nd Method; The Adaptive Inverse Dynamics Controller for Robots (AIDC);
11.	Julia language as simulation tool; LATEX as documentation tool.
12.	Laboratories.
13.	Laboratories.
14.	Final consultations.

Mid-semester requirements

Test		Assignment to be submitted		Szöveg beírásához kattintson vagy koppintson ide.	
amount	dates	amount	deadlines	amount	dates

Irrelevant in this subject area.	---	Submission of documented simulation of a particular control solution for a particular physical system on the basis of sample programs and documentation templates.	Till the end of the semseter. In the worst case in an signature substitute exam.		

According to the HKR attendance of group seminars and lab exercises are mandatory.

Other requirements for participation in sessions not covered by the regulations and restrictions on substitutions:

Test		Assignment to be submitted		Szöveg beírásához kattintson vagy koppintson ide.	
maximum points available	minimum score required to pass /test	maximum points available	minimum score required to pass / assignment	maximum points available	minimum score required to pass /lab
…points	…points	…points	…points	…points	…points

Total number of points achievable in semester: …points				
Grading thresholds	**satisfactory** … choose	**average** … choose	**good** … choose	**excellent** … choose

Other evaluation criteria:
The evaluation of the assignment happens in the presence of the student that resembles the classic colloquium.

Receive a signature denied entry: If the student does not take part in the lectures and labs without respectable proof.

Required references: „System and Control Theory 2026.pdf" lecture notes, sample programs in Julia and model library (available free of charge)

Recommended references:

József K. Tar, László Nádai, Imre J. Rudas: System and Control Theory with Especial Emphasis on Nonlinear Sytems. Typotex Electronic Publishing Ltd., Budapest, Hungary, 2012, ISBN: 978-963-279-676-5 (Avaiable free of charge for the students due to the support by the National Development Agency and the Hungarian Scientifc Research Fund OTKA CNK 78168)

Atinga, Awudu; Kósi, Krisztián; K. Tar, József: Novel Metric to Quantify the Consequences of Modeling Imprecisions in Adaptive Dynamic Control
ACTA POLYTECHNICA HUNGARICA 22 : 9 pp. 51-77. , 27 p. (2025)
https://doi.org/10.12700/APH.22.9.2025.9.3 (open access)

Bence, Varga; Richárd, Horváth; József, Kázmér Tar: FPI-Based Adaptive Control with Simultaneous Noise Filtering and Low Frequency Delay
ACTUATORS 14 : 10 Paper: 490 , 22 p. (2025)
https://doi.org/10.3390/act14100490 (open access)

Varga, Bence; Tar, József K; Horváth, Richárd: Fractional order inspired iterative adaptive control
ROBOTICA 42 : 2 pp. 482-509. , 28 p. (2024)
https://doi.org/10.1017/S0263574723001595 (open access)

Quality assurance methods of the subject:	Students can request individual or small group (based on student-initiated email requests) personal or online consultations outside of the timetable if they have questions regarding the material acquisition.

Things, that are not included, can be found within the regulations of Óbuda University.