| | | | | |
|---|---|---|---|---|
| **Óbudai Egyetem**<br>Neumann János Informatikai Kar | | | *Alkalmazott Matematika Intézet* | |
| **Tantárgy neve és kódja: System and Control Theory (NMXSC1EMNF)** **Kreditérték*: 5***<br>*/Alkalmazott Matematikus szak*<br>*Jelöljön ki egy elemet. szak* *Nappali (Daytime) tagozat 2025-26-2 tanév II. félév* | | | | |
| | | | | |
| Tantárgy oktató: Prof.Dr. Tar József | | | | |
| Előtanulmányi feltételek: (kóddal) | NMXDE1EMNF Differential Equations | | | |
| Heti óraszámok: | Előadás: 2 | Tantermi gyak.: 0 | Laborgyakorlat: 2 | Konzultáció: 0 |
| Számonkérés módja: | *Vizsga / Examination* | | | |
| **A tananyag** | | | | |
| *Oktatási cél*: After acquiring the foundations of systems theory and classical control theory, students are introduced to the various methods of modern control theory. | | | | |
| Tematika:Brief historical introduction. The “Canonical Form” of the Equations of Motion of the LTI Systems. Asymptotic stability, Controllability, Observability. Stabilization of Unstable Systems by Tracking Error Feedback Terms: Model Formalization for Single Variable Higher Order LTI Systems. Introduction of the Frequency Domain: The Laplace Transform, the function class D; The Use of the Frequency Domain in the Control of LTI Systems; Robust Control Design Methodologies for the Stable LTI Systems in the Frequency Domain: the H infinity Controllers; The H_ Sensitivity Measure; Application Example: Two Mass-points Coupled by Linear, Damped Springs; The “Computed Torque Control” (CTC) for Robots. PID error feedback terms in general. Utilization of the Available Dynamic Model in the CTC Control; Application example: control of a 3 DoF robot arm. On The Realization of the Fixed Point Iteration. The “Control Lyapunov Function” Method. The “Backstepping Control”. Simultaneous Noise Filtering and Realization of Low Frequency Delay; The Model Reference Adaptive Controller (MRAC); On Lyapunov’s 2nd Method; Limitation of the Lyapunov Function by Functions in Class kappa; Quadratic Lyapunov Functions; The Adaptive Inverse Dynamics Controller for Robots; Optimal Control; Receding Horizon Control. | | | | |

| Féléves ütemezés: | |
|---|---|
| Oktatási hét (konzultáció) | Témakör |
| 1. | Brief historical introduction. The “Canonical Form” of the Equations of Motion of the LTI Systems.. |
| 2. | The Jordan Canonical Form; Asymptotic stability; . |
| 3. | Controllability, Observability.. |
| 4. | Stabilization of Unstable Systems by Tracking Error Feedback Terms: Model Formalization for Single Variable Higher Order LTI Systems.. |
| 5 | Introduction of the Frequency Domain: The Laplace Transform, the function class D; The Use of the Frequency Domain in the Control of LTI Systems;. |
| 6. | Robust Control Design Methodologies for the Stable LTI Systems in the Frequency Domain: the H infinity Controllers; The H_ Sensitivity Measure; Application Example: Two Mass-points Coupled by Linear, Damped Springs; . |
| 7. | The “Computed Torque Control” (CTC) for Robots. PID error feedback terms in general. Utilization of the Available Dynamic Model in the CTC Control; Application example: control of a 3 DoF robot arm. |
| 8. | On The Realization of the Fixed Point Iteration. The “Control Lyapunov Function” Method. The “Backstepping Control”. |
| 9. | Simultaneous Noise Filtering and Realization of Low Frequency Delay;. |
| 10. | The Model Reference Adaptive Controller (MRAC); . |
| 11. | Lyapunov’s 2nd Method; Limitation of the Lyapunov Function by Functions in Class kappa; Quadratic Lyapunov Functions; The Adaptive Inverse Dynamics Controller for Robots;. |

2026. 02. 02.

| | |
|---|---|
| 12. | Optimal Control; Receding Horizon Control. |
| 13. | Consultation for preparing semester assignments. |
| 14. | Consultation for preparing semester assignments. |

**Félévközi követelmények**

Szöveg beírásához kattintson ide.

**Zárthelyi dolgozatok**

| Oktatási hét (konzultáció) | Témakör |
|---|---|
| Jelöljön ki egy elemet. | Irrelevant in this subject.. |
| Jelöljön ki egy elemet. | Szöveg beírásához kattintson ide. |
| Jelöljön ki egy elemet. | Szöveg beírásához kattintson ide. |

**A *félévzáró érdemjegy* kialakításának módszere**

Irrelevant in the case of examination..

**Pótlás módja**

Development of a prompt simulation task for the signature replacement exam..

**Vizsga módja**

Classical oral examination or prompt solving a simulation task.

**Vizsgajegy kialakítása**

| Eredmény | Érdemjegy |
|---|---|
| 85%-100% | jeles (5) |
| 76%-84% | jó (4) |
| 63%-75% | közepes (3) |
| 51%-62% | elégséges (2) |
| 0%-50% | elégtelen (1) |

**Irodalom**

Kötelező:

Lecture notes available in PDF free of charge, and available sample programs in Julia language.

Ajánlott:

J. Somló, B. Lantos, and P.T. Cát. Advanced Robot Control. Akadémiai Kiadó, Budapest, 2002.

J.K. Tar, J.F. Bitó, L. Nádai, and J.A. Tenreiro Machado. Robust Fixed Point Transformations in adaptive control using local basin of attraction. Acta Polytechnica Hungarica, 6(1):21–37, 2009. (open access)

Bence Varga, Richárd Horváth, and József Kázmér Tar. Fpi-based adaptive control with simultaneous noise filtering and low frequency delay. Actuators, 14(10), 2025. (open access)

Egyéb segédletek:

A dynamic model library in Julia language and descriptions in a PDF file.

2026. 02. 02.