



## قسم هندسة الحاسبات ونظم التحكم



### المقررات الأساسية اللازمة للقبول لمرحلة الماجستير في تخصص

#### هندسة التحكم

##### 1. Artificial Intelligence and Machine Learning

Features of intelligence - AI search - level of intelligence - AI problems -intelligent agent – knowledge classification - search techniques - types of search algorithms - blind search - depth first search - breadth first search -iterative deepening - finding best solution -heuristic functions - probability in AI - Bayes rule - dependence - Bays network- Machine learning paradigms – Different learning algorithms.

References:

- W. Ertel, “*Introduction to Artificial Intelligence, 2nd edition,*” Switzerland, Springer, 2017.
- R. Neapolitan and X. Jiang, “*Artificial Intelligence With an Introduction to Machine Learning, 2nd edition,*”Boca Raton, CRC Press, 2018.

##### 2. Introduction to Automatic Control Engineering

Review of systems’ representation and their properties (transfer function and state variables) and root locus and the response in the frequency domain. Design using root locus and in the frequency domain with the use of MATLAB to solve some examples. Devising the transfer functions of SISO systems to achieve the dynamic and static attributes - Various examples of open loop systems that contain both poles and zeros.

References:

- K. Vamvoudakis and S. Jagannathan, “*Control of Complex Systems: Theory and Applications,*” Butterworth- Heinemann, Elsevier, 2016

##### 3. Modern trends of control

A brief explanation of various topics in modern control systems such as: LQR – self-tuning controllers – control systems design using fuzzy logic and neural networks. Deadbeat response-pole assignment with state and with output feedback. Use of observer. Introduction to advanced control topics: optimal control.

Adaptive control systems. System identification of dynamic systems, least squares, Theory and implementation for system estimation -.Types of dynamical systems are common in applications: those for which the time variable is discrete and those for which the time variable is continuous.

References:

- W. Mitkowski, J. Kacprzyk, K. Oprędkiewicz, and P. Skruch (eds.), “*Preview Trends in Advanced Intelligent Control, Optimization and Automation,*” Proceedings of KKA 2017— The 19<sup>th</sup> Polish Control Conference, Kraków, Poland, Springer, Volume 577, 2017.

#### 4. Mechatronics 2

Process Controllers (ON-OFF Controllers - PID Controllers - Pneumatic Controllers - Digital controller - adaptive controllers (- CNC Machine and Robotics -design of mechatronic systems- Real-time operating systems, requirements of real-time systems, deadlock, resource management, priority, preemption 14 Hard real-time scheduling algorithms: Rate monotonic and earliest deadline first, schedulability tests, real-time communication: introduction, necessity, hard and soft real-time, network topologies and main non-real-time protocols.

References:

- K. Deng, Z. Yu, S. Patnaik, and J. Wang, "Recent Developments in Mechatronics and Intelligent Robotics," Proceedings of International Conference on Mechatronics and Intelligent Robotics (ICMIR2018), Switzerland, Springer, Volume 856, 2019.

#### 5. Computer controlled systems 1

Introduction to the use of computers in control systems - Software and hardware components in computer control systems - Open and closed loop in computer-controlled systems – applications - Analyze observability and controllability of linear discrete-time control systems. -.Design digital control systems using pole placement state space approach. -.Design digital control systems using optimal control approach. -.Analyze stability of singular points of non-linear discrete-time systems

References:

C.L. Phillips and H.T. Nagle, Digital System Control Analysis and Design" Prentice Hall, 3rd Ed, 2017

#### 6. Modern control systems

State space representation of time invariant systems – eigen values – transfer functions to state space and vice versa – canonical form – solving state space equations - controllability and observability – duality - MISO systems - Lyapunov theory – Optimal control methods;, linear quadratic regulator, dynamic programming, Pontryagin's minimum principle. Robust feedback control of dynamical systems; controller design using linear matrix inequalities (LMIs). Adaptive control. Model-based predictive control (MPC) design. Model-free controller design. State observers; Combined controller observer compensators; Fault detection and isolation (FDI) using observers..

References:

- R. Dorf and R. Bishop, "Modern Control Systems, 12th edition," England, Pearson, 2017

#### 7. Mechatronics 1

Fundamentals laws and principles of mechanical engineering; introduction to problem layout and problem solving methods; simplified engineering modeling and analysis of mechanical systems; collection, manipulation and presentation of engineering data Measuring devices and sensors, displacement sensors, heat, speed, torque, Introduction to electronic devices (PN junction - Transistor - SCR - DIAC - TRIAC - OPTOCOUPLER). Pneumatic systems, Valves, all kinds of motor (Stepper - DC - AC - Induction Motor). Speed Control, Digital Systems, logic gates, Interfacing and data Acquisition systems.

References:

- F. Qiao, S. Patnaik, and J. Wang (eds.), "Recent Developments in Mechatronics and Intelligent Robotics," Proceedings of the International Conference on Mechatronics and Intelligent Robotics (ICMIR2017), Switzerland, Springer, Volume 1, 2018

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