



University of Tehran
School of Electrical and Computer Engineering

Course:	8101 – Advanced industrial control									
Course type:	EE*						CE*			Credit: 3
	Com	E	P	B	Con	D	SW	HW	IT	
	Required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Elective	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Level:	■ Graduate									
Co-requisite(s):	None.									
Prerequisite(s):	Linear control systems - 8101224									
Prerequisite by topic:	None									
Textbook(s):	<p>[1]- J. Love, Process Automation Hand Book, Springer, 2007.</p> <p>[2]- Fundamentals of Industrial Instrumentation and Process Control, William C. Dunn, McGraw-Hill, 2005.</p> <p>[3] Process Dynamics and Control, Seborg et al. 3rd edition, WILEY, 2011.</p> <p>[4] Principles and Practice of Automatic Process Control, Smith & Corripio, Wiley 1997</p>									
Coordinator:	Behzad Moshiri, Professor, School of ECE									
Goals:	<p>This course reviews the traditional control systems techniques followed up by introducing the advanced control options such as adaptive, predictive, hybrid and intelligent control systems. This course also introduces the requirements for cost effective and better quality control of systems through advanced automation systems. The development trends of different automation systems such as direct digital control (DDC), distributed control systems (DCS), Field control systems (FCS), supervisory control and data acquisition (SCADA) and PLC networking will be presented. This course gives a depth understanding of control performance improvements through the use of different industrial control networks/protocols such as Modbus, CAN, ASI, Profibus and Foundation Fieldbus.</p>									
Outcome:	<p>Upon successful completion of the course, students will be able how to choose the networking requirements for improving industrial control networks. They will also become familiar to use different industrial control networks/protocols based on nature, volume and speed of data needed for transmitting, receiving, controlling and monitoring of controlled variables in typical industrial processes.</p>									

Topics:

- 1- Review of traditional control systems: Review on different control systems such as Feedback, Feedforward, Cascade, Selective/Override, Ratio, Inferential techniques.
- 2- Advanced control systems design: Recent developments in applications of Adaptive, Predictive, Hybrid and Intelligent control systems in industries.
- 3- Soft Sensors: Development and industrial implementation of soft sensor for the measurement of difficult and hard to obtain process values.
- 4- Big Data: Making sense of large amounts of data for system identification, process monitoring, and fault detection and isolation.
- 5- Holistic Control: Development of a comprehensive control of a plant from start up to shut down.
- 6- Process Monitoring:
 - 6-1 Traditional Monitoring Techniques
 - 6-2 Quality Control Charts
 - 6-3 Extensions of Statistical Process Control
 - 6-4 Multivariate Statistical Techniques
 - 6-5 Control Performance Monitoring/Assessment
- 7- Batch Process Control:
 - 7-1 Batch Control Systems
 - 7-2 Sequential and Logic Control
 - 7-3 Control During the Batch
 - 7-4 Run-to-Run Control
 - 7-5 Batch Production Management
- 8- Introduction to networking:
 - 8-1 Arrangement of computers to communicate and share information using LAN (Local Area Network) or WAN (Wide Area Network)
 - 8-2 OSI model layers
 - 8-3 Communication of systems through OSI model
- 9- Development trends on industrial automation:
 - 9-1 Direct Digital Control
 - 9-2 Distributed Control Systems (DCS)
 - 9-3 Field Control Systems (FCS)
 - 9-4 Process Control System (PCS)

	<p>9-5 PLC Networking</p> <p>9-6 Supervisory Control & Data Acquisition (SCADA) and its applications in energy dispatching (Electricity/ Gas/ Water and etc.).</p> <p>10- <u>Industrial Control Networks / Protocols:</u></p> <p>10-1 Modbus</p> <p>10-2 CAN (Control Area Network)</p> <p>10-3 ASI (Actuator Sensor Interface)</p> <p>10-4 Profibus</p> <p>10-5 Foundation Fieldbus</p> <p>11. <u>Typical Applications:</u></p> <p>11-1 Biosystems Control Design</p> <p>11-1-1 Process Modeling and Control in Pharmaceutical Operations</p> <p>11-1-2 Process Modeling and Control for Drug Delivery</p> <p>11-2 Intelligent Hydrocarbon reservoir operation</p> <p>11-2-1 Modeling, control and optimization concepts in reservoirs</p> <p>11-2-2 Suitable instruments for upstream applications</p> <p>11-3 Electric Arc Furnace (EAF) Fault Detection Framework</p> <p>11-4- Concepts of Security of Industrial networks against cyber-attacks in critical industrial plants</p>
Computer usage:	MATLAB, SIMULINK, PLC Networking, LabVIEW (National Instruments), SIMATIC STEP7- Engineering Software (Siemens), SIMATIC WinCC-HMI Software (Siemens)
Assignments:	None
Projects:	1 Final project
Grading:	<p>Projects: 40 %</p> <p>Final exam: 60 %</p>
Further readings:	<p>[1] Technologies, Practical SCADA Systems for Engineers and Technicians (SX), IDC, 2006.</p> <p>[2] Technologies, Practical SCADA for Industry (SC), IDC, 2007.</p> <p>[3] Technologies, Practical Programmable Logic Controllers (PLCs) for Automation and Process Control, IDC, 2007.</p> <p>[4] Technologies, Practical Distributed Control Systems (DCS) for Engineers and Technicians, IDC, 2008.</p> <p>[5]- Adaptive Control Tutorial, P. A. Ioannou and B. Fidan, SIAM, 2006.[6]- Model Predictive Control, Camacho, Eduardo F., Bordons Alba, Carlos, 2007.</p> <p>[7]- Hybrid Systems: Modeling, Analysis and Control, John Lygeros, Shankar Sastry, and Claire Tomlin, 2008.</p>

Prepared by:	Behzad Moshiri, Professor, School of ECE Farzad Hourfar, Ph.D. Graduated, School of ECE
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*EE: Electrical Engineering		CE: Computer Engineering	
Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics		
Con	Control		
D	Digital System		