University of Tehran
School of Electrical and Computer Engineering

Course:	**8101…… – Industrial Automation**
Course type:	EE*: Com ☐ E ☐ P ☐ B ☐ Con ☐ D ☐ — CE*: SW ☐ HW ☐ IT ☐ — Credit: 4= 3+1Lab Required ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Elective ☐ ☐ ☒ ☐ ☒ ☐ ☐ ☐ ☐
Level:	Undergraduate ■ ☐ Graduate
Co-requisite(s):	None
Prerequisite(s):	1- Linear Control Systems (8101….) 2- Instrumentation & Industrial Control Elements (8101..)
Prerequisite by topic:	
Textbook(s)	[1]- J. Love, Process Automation Hand Book, Springer, 2007. [2]- Practical Modern SCADA Protocols, Gordon Clarke, 2004 [3]- Practical Industrial Data Networks, Steve Mackay, 2004. [4]- Practical Data Acquisition for Instrumentation and Control Systems, John Park, 2003.
Coordinator:	Behzad Moshiri, Professor, School of ECE
Goals:	This course introduces 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. This course also reviews the different industrial control networks /protocols such as Modbus, CAN, ASI, Profibus and Foundation Fieldbus. Different logic and loop diagrams will be shown. Furthermore, the recent technologies in the field of industrial automation will be presented.
Outcome:	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.
Topics:	**1.** Introduction to Computer Based Control Systems: 1.1- Introduction to computer based measurement and control systems. 1.2- Role of computers in measurement and (process) control. 1.3- Basic components of computer based measurement and control systems. 1.4- Architecture – computer based process control system

	1.5- Human Machine Interface (HMI) 1.6- Hardware for computer based process control system 1.7- Interfacing computer system with process 1.8- Economics of computer based system for industrial application **2**. Principles of Industrial Data Communications: 2.1- Copper Cable 2.2- Fiber Optics 2.3- RS-232 Overview 2.4- RS-485 Overview 2.5- Current loop and RS-485 Converters Overview 2.6- TCP/IP Overview 2.7- Modbus Overview 2.8- Fundamentals of DNP3 2.9- Fundamentals of IEC 60870-5 2.10- Industrial Ethernet Overview 2.11- AS-interface (AS-i) Overview 2.12- DeviceNet Overview 2.13- Profibus PA/DP/FMS Overview 2.14- Foundation Fieldbus Overview 2.15- Modbus Plus Protocol Overview 2.16- Data Highway Plus/DH485 Overview 2.17- HART Overview 2.18- Wireless Technologies **3.** Introduction to trends of industrial automation technologies: DDC, DCS, PLC Networking, FCS, SCADA. **4.** Introduction to sub-systems in an industrial control system: Emphasizing on automation point of view considering different modules such as DCS, ESD, F&G, SIS, …. **5.** Introduction to different spec. diagram: including logic, loop and Hierarchy level diagram **6.** Introduction to PLC structures and corresponding languages: 6.1- Processors, Power Supply and Programming Devices. 6.2- Memory System and I/O Interaction. 6.3- Digital Input/Output Systems. 6.4- Analog Input/ Output Systems 6.5- Analog Input/ Output Systems 6.6- Fundamentals of PLC Programming 6.7- High Security PLC Systems 6.8- HMI (Human Machine Interface) **7.** An Overview of Distributed Control Systems (DCS): 7.1- Introduction 7.2- Basic concepts of Distributed Computing 7.3- Evolution of Distributed Computing System 7.4- Present market trends in DCS 7.5- Basic DCS specification 7.6- General description of a commercial DCS 7.7- Advantage of DCS systems 7.8- DCS selection criteria 7.9- DCS architecture 7.10- Programming of DCS systems 7.11- Alarm system management 7.12- Distributed control system (DCS) configuration 7.13- Distributed control system applications

	8. An overview of SCADA systems: 8.1- Introduction 8.2- Basics of SCADA system 8.3- SCADA key features 8.4- Remote terminal units (RTUs) 8.5- Typical requirements for an RTU system 8.6- PLCs used as RTUs 8.7- Consideration and benefits of SCADA system 8.8- DCS versus SCADA terminology 8.9- SCADA software package 8.10- Cmmunications for DCS & SCADA systems **9.** Typical distributed control systems and SCADA systems: 9.1- 1 Honeywell PlantScape system 9.2- Foxboro I/A series distributed control systems 9.3- Delta V system 9.4- Citect 9.5- Wonderware 9.6- Yokogawa 9.7- Simatic PCS 7 (Siemens) **10.** Design of Industrial Automation Functional Specifications for PLCs, DCSs and SCADA Systems: 10.1- Functional Design Specifications (FDS) 10.2- Standards and Conventions 10.3- DCS/PLC/SCADA 10.4- Data Communication Requirements 10.5- Graphical User Interface (GUI) Requirements 10.6- Security Aspects
Computer usage:	MATLAB, SIMULINK, PLC Networking, LabVIEW (National Instruments), SIMATIC STEP7- Engineering Software (Siemens), SIMATIC WinCC-HMI Software (Siemens)
Assignments:	6 to 8 assignments (Theoretical & Practical) At "Industrial Automation and Intelligent information Processing Lab"
Projects:	1 project
Grading:	Assignments: 30 % Projects: 20 % Final exam: 50 %
Further readings:	[1] - Technologies, Practical SCADA Systems for Engineers and Technicians (SX), IDC, 2006. [2] - Technologies, Practical SCADA for Industry (SC), IDC, 2007. [3] - Technologies, Practical Programmable Logic Controllers (PLCs) for Automation and Process Control, IDC, 2007. [4] - Technologies, Practical Distributed Control Systems (DCS) for Engineers and Technicians, IDC, 2008.
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		