University of Sana'a
Faculty of Engineering
Department: Electrical Engineering
Title of the Program: Computer Engineering and Control

Course Specification of Industrial Automation & SCADA Systems

I. Course Identification and General Information:

1.	Course Title:	Industrial Automation & SCADA Systems				
2.	Course Code & Number:	CCE438				
3.	Credit hours:	C.H				Total
		Th.	Tu.	Pr.	Tr.	
		2	-	2	-	3
4.	Study level/ semester at which this course is offered:	Fifth Level / Second Semester				
5.	Pre –requisite (if any):	PLC, Programming II, Control (1)				
6.	Co –requisite (if any):	None.				
7.	Program (s) in which the course is offered:	Computer & Control				
8.	Language of teaching the course:	English				
9.	Location of teaching the course:	Electrical Engineering Department				
10.	Prepared By:	Assoc. Prof. Dr. Farouk AL-Fuhaidy				
11.	Date of Approval	2020				

II. Course Description:

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. It covers the following topics; Concepts, principles, and relationships of automated assembly devices, reviews the different industrial control networks /protocols such as Modbus, CAN, ASI, Profibus and Foundation Fieldbus. Furthermore, the recent technologies in the field of industrial automation will be presented, programmable logic controllers (PLCs), flexible manufacturing systems (FMS), CNC machines, and SCADA systems & typical DCS control systems. The laboratory sessions support the course by providing students with

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

industrial automation experiments for controlling, configuring, and programming industrial systems using PLC and SCADA systems.

III. Course Intended learning outcomes (CILOs) of the course		**Referenced PILOs**
a1	Demonstrate knowledge and understands of various reasons for employing automation in a manufacturing environment and describe concept of CNC machines and distributed control systems (DCS) and their applications.	A2
a2	Describe the fundamentals of typical DCS control systems and SCADA Technologies.	A3
b1	Design an automated control system to meet desired issues and specifications related to industrial environment.	B1, B4
c1	Use a Programmable Logic Controller (PLC) and embedded microcontroller, to perform specified control functions.	C2, C3
c2	Simulate simple industrial automation functions using SCADA system simulation tool.	C4
d1	function effectively while working individually or within project's teams.	D1

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1- Demonstrate knowledge and understands of various reasons for employing automation in a manufacturing environment and describe concept of CNC machines and distributed	▪ Lectures, ▪ Computer Laboratory Sessions, Practical Lab. Work, ▪ Reading Materials & Web-sites searches, ▪ Group Works and Discussions, Projects.	▪ Examinations, ▪ Homework ▪ Presentations, ▪ Individual-Lab. and group project reports

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

	control systems (DCS) and their applications.		
a2-	Describe the fundamentals of typical DCS control systems and SCADA Technologies.	▪ Lectures, ▪ Computer Laboratory Sessions, ▪ Practical Lab. Work, ▪ Reading Materials & Web-sites searches, ▪ Group Works and Discussions, Projects.	▪ Examinations, ▪ Homework ▪ Presentations, ▪ Individual-Lab. and group project reports

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes		Teaching strategies	Assessment Strategies
b1-	Design an automated control system to meet desired issues and specifications related to industrial environment.	▪ Lectures, ▪ Computer Laboratory Sessions, ▪ Practical Laboratory Work, ▪ Group Works, ▪ Projects.	▪ Examinations, ▪ Homework, ▪ Laboratory reports presentations, ▪ Individual-Lab. and group project reports

© Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes		Teaching strategies	Assessment Strategies
c1-	Use a Programmable Logic Controller (PLC) and embedded microcontroller, to perform specified control functions.	▪ Lectures, ▪ Practical Laboratory Work, Group Works, ▪ Projects.	▪ Examinations, ▪ Laboratory reports, ▪ Presentations, ▪ Individual-Lab. and group project reports.

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

c2-	Simulate simple industrial automation functions using SCADA system simulation tool.	▪ Lectures, ▪ Computer Laboratory Work, ▪ Practical Lab. Work, Group Works, Projects.	▪ Examinations, ▪ Laboratory reports, Presentations, ▪ Individual-Lab. and group project reports.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1- function effectively while working individually or within project's teams.	▪ Seminars, ▪ laboratory works, ▪ Group Work, ▪ Projects.	▪ Presentations, ▪ Individual-Lab. and group ▪ Project Reports ▪ Presentation.

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1.	Course Orientation and Introduction	a1, a2	▪ Course orientations, ▪ overview on industrial automation, concepts, principles, requirements, goals, equipment and software tools, relationships of automated assembly devices, and applications	1	2
2.	Principles of Industrial Data Communications and Networking:	a1, a2, b1	▪ Copper Cable ▪ Fiber Optics	1.5	3

			▪ RS-232 Overview, RS-485 Overview, Current loop and RS-485 Converters Overview, ▪ TCP/IP Overview ▪ Modbus Overview ▪ Fundamentals of DNP3 ▪ Fundamentals of IEC 60870-5 ▪ Industrial Ethernet Overview ▪ AS-interface (AS-i) Overview, DeviceNet Overview, Profibus PA/DP/FMS Overview, Foundation Fieldbus Overview, Modbus Plus Protocol Overview ▪ Data Highway Plus/DH485 Overview ▪ HART Overview ▪ Wireless Technologies		
3.	Computer Based Control Systems and Fundamentals of Numerical Control (NC) and CNC Machines:	a1, a2, b1	▪ Introduction to computer-based measurement and control systems ▪ Role of computers in measurement and process control. ▪ Basic components of computer-based measurement and control systems ▪ NC Systems, Principles, Types, NC Controllers, and Components of NC Systems,	2.5	5

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

			▪ CNC machine, Principles, Controllers, Programming, and Implementation.		
4.	Trends of industrial automation technologies:	a1, a2, b1, c1	▪ An Overview on Direct Digital Control (DDC), Distributed Control System (DCS), PLC Networking, Field Control System (FCS), and SCADA System.	1	2
5.	Sub-systems in an industrial control system:	a1, a2, b1	▪ Emphasizing on automation point of view considering different modules such as DCS, ESD, F&G, SIS, ... etc.	1	2
6.	An Overview on PLC structures and corresponding languages:	a1, a2, b1, c1	▪ Processors, Power Supply and Programming Devices. ▪ Memory System and I/O Interaction. ▪ Digital Input/ Output Systems. ▪ Analog Input/ Output Systems ▪ Digital Input/ Output Systems ▪ Fundamentals of PLC Programming ▪ High Security PLC Systems ▪ HMI (Human Machine Interface).	1	2
7.	An Overview of Distributed Control Systems (DCS):	a1, a2, b1, c1	▪ Introduction ▪ Basic concepts of Distributed Computing ▪ Evolution of Distributed Computing System ▪ Present market trends in DCS	1.5	3

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

			▪ Basic DCS specification ▪ General description of a commercial DCS ▪ Advantage of DCS systems ▪ DCS selection criteria ▪ DCS architecture ▪ Programming of DCS systems ▪ Alarm system management ▪ Distributed control system (DCS) configuration ▪ Distributed control system applications.		
8.	An overview of SCADA systems:	a1, a2, b1, c1, c2	▪ Introduction ▪ Basics of SCADA system ▪ SCADA key features ▪ Remote terminal units (RTUs) ▪ Typical requirements for an RTU system ▪ PLCs used as RTUs ▪ Consideration and benefits of SCADA system ▪ DCS versus SCADA terminology ▪ SCADA software package ▪ Communications for DCS & SCADA systems	1.5	3
9.	Typical distributed control systems and SCADA systems:	a1, a2, b1, c1, c2	▪ Honeywell PlantScape system ▪ Foxboro I/A series distributed control systems ▪ Delta V system	1.5	3

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

			▪ Citect ▪ Wonderware ▪ Yokogawa ▪ Simatic PCS 7 (Siemens).		
10.	Design of Industrial Automation Functional Specifications for PLCs, DCSs and SCADA Systems:	a1, a2, b1, c1, c2	▪ Functional Design Specifications (FDS) ▪ Standards and Conventions ▪ DCS/PLC/SCADA ▪ Data Communication Requirements ▪ Graphical User Interface (GUI) Requirements ▪ Security Aspects.	1.5	3
Number of Weeks /and Units Per Semester				**14**	**28**

B - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours	Learning Outcomes
1.	Overview on Computer usage: MATLAB, SIMULINK, PLC Networking, LabVIEW (National Instruments), SIMATIC STEP7- Engineering Software (Siemens), SIMATIC WinCC-HMI Software (Siemens) Overview on PLC and Microcontroller Equipment	2	4	a1, a2, c2, d1
2.	Overview of CAD/CAM software (Solidworks and MasterCAM): - Installation, Modeling, Requirements and Application - CAD/CAM data exchange - 2D and 3D Machining (milling & turning) - NC file generation in CAD/CAM	4	8	a1, a2, b1, c1, c2, d1

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

3.	Exercises in Control and Microcontroller Labs. - Water tank system, - Robotic arm, - Filling and packaging system,	2	4	a1, a2, b1, c1, c2, d1
4.	SCADA/HMI system Packages, programming and simulation Typical DCS and SCADA Systems, Honeywell and Foxboro, … etc. Development of Simple SCADA System.	4	6	a1, a2, b1, c1, c2, d1
5.	Project Presentation	1	2	a1, a2, b1, c1, c2, d1
6.	Review	1	2	a1, a2, b1, c1, c2, d1
Number of Weeks /and Units Per Semester		**14**	**28**	

V. Teaching strategies of the course:

- Lectures,
- Assignments,
- Computer-based Laboratory Sessions,
- Practical Lab. Work,
- Reading Materials & Web-sites searches,
- Group Works and Discussions,
- Projects.

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Industrial Networking	a1, a2, b1, c1, d1	3rd	1
2.	NC and CNC Machines	a1, a2, b1, c1, d1	4th to 6th	3

Prepared by
Assoc. Prof. Dr. Farouk AL-Fuhaidy

Head of Department
Asst. Prof. Dr. Adel Ahmed Al-Shakiri

Quality Assurance Unit
Assoc. Prof. Dr. Mohammad Algorafi

Dean of the Faculty
Prof. Dr. Mohammed AL-Bukhaiti

Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

3.	Trends in industrial Automation	a1, a2, b1, c1, d1	7th	1
4.	PLC Structures and Programming	a1, a2, b1, c1, d1	9th	2
5.	DCS	a1, a2, b1, c1, d1	10th & 11th	2
6.	SCADA & Typical DCS Systems	a1, a2, b1, c1, d1	12th & 13th	3
7.	Design of Industrial Automated Systems	a1, a2, b1, c1, d1	14th & 15th	3
	Total			**15**

VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Assignments	3rd to 15th	15	10%	a1, a2, b1, c1, d1
2.	Laboratory and Computer-based Works	3rd to 12th	15	10%	a1, a2, b1, c1, c2, d1
3.	Project Presentation	13th	15	10%	a1, a2, b1, c1, c2, d1
4.	Mid-Term Exam (Theoretical)	8th	15	10%	a1, a2, b1, c1
5.	Final Exam (Practical)	15th	15	10%	a1, a2, b1, c1, c2, d1
6.	Final Exam (Theoretical)	16th	75	50%	a1, a2, b1, c1, c2
	Total		**150**	**100%**	

VIII. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

1- J. Love, 2007, Process Automation Hand Book, Springer.
2- Gordon Clarke, 2004, Practical Modern SCADA Protocols.
3- Groover, M. P. (2008) Automation, Production Systems, and Computer-Integrated Manufacturing, 3rd Ed. Pearson Education. ISBN 0-13-239321-2.
4- IDC Technologies, Practical Distributed Control Systems (DCS), Western Australia.

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

	5- IDC Technology, (2012)- Design of Industrial Automation Functional Specifications for PLCs, DCSs and SCADA Systems- 1st Edition- West Perth, Western Australia- ISBN: 978-1-922062-01-7
2- Essential References.	
	1- John Park, 2003, Practical Data Acquisition for Instrumentation and Control Systems. **2-** Steve Mackay, 2004, Practical Industrial Data Networks. **3-** L. A. Bryan, E. A. Bryan, Programmable Controllers - Selected Applications. **4-** Stuart A. Boyer, ISA, SCADA: Supervisory Control and Data Acquisition. **5-** Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, John Wiley & Sons, Process Dynamics and Control.
3- Electronic Materials and Web Sites *etc*.	
	1- www.control.com **2-** www.plcs.net **3-** www.pacontrol.com **4-** www.triplc.com **5-** www.seimens.com **6-** http://plc-training-rslogix-simulator.soft32.com/free-download/ **7-** www.plcsimulator.net/ **8-** http://scada.winsite.com **9-** http://sourceforge.net/projects/scadabr/files/latest/download?source=directory **10-** Lecture Prepared by the Lecturer

IX. Course Policies:

1.	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic
2.	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class he will be considered as absent.

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

3.	**Exam Attendance/Punctuality:** A student should attend the exam on time. He is Permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam-
4.	**Assignments & Projects:** The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time-
5.	**Cheating:** For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty-
6.	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university.
7.	**Other policies:** - Mobile phones are not allowed to use during a class lecture. It must be closed, otherwise the student will be asked to leave the lecture room - Mobile phones are not allowed in class during the examination. Lecture notes and assignments my given directly to students using soft or hard copy

Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies: Asst. Prof. Dr. Tarek A. Barakat** **President of Quality Assurance Unit: Assoc. Prof. Dr. Mohammed Algorafi** **Name of Reviewer from the Department: Asst. Prof. Dr. Adel Ahmed Al-Shakiri**
	Deputy Rector for Academic Affairs Asst. Prof. Dr. Ibrahim AlMutaa **Assoc. Prof. Dr. Ahmed Mujahed** **Asst. Prof. Dr. Munasar Alsubri**

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

University of Sana'a
Faculty of Engineering
Department: Electrical Engineering
Title of the Program: Computer Engineering and Control

Template for Course Plan of Industrial Automation & SCADA Systems

I. Information about Faculty Member Responsible for the Course:								
Name of Faculty Member	Assoc. Prof. Dr. Farouk AL-Fuhaidy	**Office Hours**						
Location& Telephone No.	777909815	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**	
E-mail	farouqakh@gmail.com							

II. Course Identification and General Information:						
1-	Course Title:	Industrial Automation & SCADA Systems				
2-	Course Number & Code:	CCE438				
3-	Credit hours:	C.H				Total
		Th.	Tu.	Pr.	Tr.	
		2	-	2	-	3
4-	Study level/year at which this course is offered:	Fifth Year/ Second Semester				
5-	Pre –requisite (if any):	PLC, Programming II, Control (1)				
6-	Co –requisite (if any):	None.				
7-	Program (s) in which the course is offered	Computer & Control				
8-	Language of teaching the course:	English				
9-	System of Study:	Regular				
10-	Mode of delivery:	Face-to-face with Lab. Work				
11-	Location of teaching the course:	Electrical Engineering Department				

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

III. Course Description:

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. It covers the following topics; Concepts, principles, and relationships of automated assembly devices, reviews the different industrial control networks /protocols such as Modbus, CAN, ASI, Profibus and Foundation Fieldbus. Furthermore, the recent technologies in the field of industrial automation will be presented, programmable logic controllers (PLCs), flexible manufacturing systems (FMS), CNC machines, and SCADA systems & typical DCS control systems. The laboratory sessions support the course by providing students with industrial automation experiments for controlling, configuring, and programming industrial systems using PLC and SCADA systems.

IV. Intended learning outcomes (ILOs) of the course:

- Brief summary of the knowledge or skill the course is intended to develop**:**

1- Demonstrate knowledge and understands of various reasons for employing automation in a manufacturing environment and describe concept of CNC machines and distributed control systems (DCS) and their applications.
2- Describe the fundamentals of typical DCS control systems and SCADA Technologies.
3- Design an automated control system to meet desired issues and specifications related to industrial environment.
4- Use a Programmable Logic Controller (PLC) and embedded microcontroller, to perform specified control functions.
5- Simulate simple industrial automation functions using SCADA system simulation tool.
6- function effectively while working individually or within project's teams.

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

V. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact hours
1.	Course Orientation and Introduction	▪ Course orientations, ▪ overview on industrial automation, concepts, principles, requirements, goals, equipment and software tools, relationships of automated assembly devices, and applications	1st	2
2.	Principles of Industrial Data Communications and Networking:	▪ Copper Cable ▪ Fiber Optics ▪ RS-232 Overview, RS-485 Overview, Current loop and RS-485 Converters Overview, ▪ TCP/IP Overview ▪ Modbus Overview ▪ Fundamentals of DNP3 ▪ Fundamentals of IEC 60870-5 ▪ Industrial Ethernet Overview ▪ AS-interface (AS-i) Overview, DeviceNet Overview, Profibus PA/DP/FMS Overview, Foundation Fieldbus Overview, Modbus Plus Protocol Overview ▪ Data Highway Plus/DH485 Overview ▪ HART Overview ▪ Wireless Technologies	2nd ,3rd	3
3.	Computer Based Control Systems and Fundamentals	▪ Introduction to computer-based measurement and control systems	3rd , 4th ,5th	5

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

	of Numerical Control (NC) and CNC Machines:	▪ Role of computers in measurement and process control. ▪ Basic components of computer-based measurement and control systems ▪ NC Systems, Principles, Types, NC Controllers, and Components of NC Systems, ▪ CNC machine, Principles, Controllers, Programming, and Implementation.		
4.	Trends of industrial automation technologies:	▪ An Overview on Direct Digital Control (DDC), Distributed Control System (DCS), PLC Networking, Field Control System (FCS), and SCADA System.	6th	2
5.	Sub-systems in an industrial control system:	▪ Emphasizing on automation point of view considering different modules such as DCS, ESD, F&G, SIS, ... etc.	7th	2
6.	Mid-Term Exam	▪ All Previous Topics	8th	2
7.	An Overview on PLC structures and corresponding languages:	▪ Processors, Power Supply and Programming Devices. ▪ Memory System and I/O Interaction. ▪ Digital Input/ Output Systems. ▪ Analog Input/ Output Systems ▪ Digital Input/ Output Systems ▪ Fundamentals of PLC Programming ▪ High Security PLC Systems ▪ HMI (Human Machine Interface).	9th	2
8.	An Overview of Distributed Control Systems (DCS):	▪ Introduction ▪ Basic concepts of Distributed Computing ▪ Evolution of Distributed Computing System ▪ Present market trends in DCS	10th ,11th	3

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

		▪ Basic DCS specification ▪ General description of a commercial DCS ▪ Advantage of DCS systems ▪ DCS selection criteria ▪ DCS architecture ▪ Programming of DCS systems ▪ Alarm system management ▪ Distributed control system (DCS) configuration ▪ Distributed control system applications.		
9.	An overview of SCADA systems:	▪ Introduction ▪ Basics of SCADA system ▪ SCADA key features ▪ Remote terminal units (RTUs) ▪ Typical requirements for an RTU system ▪ PLCs used as RTUs ▪ Consideration and benefits of SCADA system ▪ DCS versus SCADA terminology ▪ SCADA software package ▪ Communications for DCS & SCADA systems	11^{th} ,12^{th}	3
10.	Typical distributed control systems and SCADA systems:	▪ Honeywell PlantScape system ▪ Foxboro I/A series distributed control systems ▪ Delta V system ▪ Citect ▪ Wonderware ▪ Yokogawa ▪ Simatic PCS 7 (Siemens).	13^{th} ,14^{th}	3

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

11.	Design of Industrial Automation Functional Specifications for PLCs, DCSs and SCADA Systems:	▪ Functional Design Specifications (FDS) ▪ Standards and Conventions ▪ DCS/PLC/SCADA ▪ Data Communication Requirements ▪ Graphical User Interface (GUI) Requirements ▪ Security Aspects.	14th ,15th	3
12.	Final Exam	▪ ALL Topics	16th	2
Number of Weeks /and Units Per Semester			**16**	**28**

B - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact hours
1.	Overview on Computer usage: MATLAB, SIMULINK, PLC Networking, LabVIEW (National Instruments), SIMATIC STEP7- Engineering Software (Siemens), SIMATIC WinCC-HMI Software (Siemens) Overview on PLC and Microcontroller Equipment	1st ,2nd	4
2.	Overview of CAD/CAM software (Solidworks and MasterCAM): - Installation, Modeling, Requirements and Application - CAD/CAM data exchange - 2D and 3D Machining (milling & turning) - NC file generation in CAD/CAM	3rd ,4th ,5th ,6th	8
3.	Exercises in Control and Microcontroller Labs. - Water tank system, - Robotic arm, - Filling and packaging system,	7th ,8th	4
4.	SCADA/HMI system Packages, programming and simulation	9th ,10th ,11th ,12th	6

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

	Typical DCS and SCADA Systems, Honeywell and Foxboro, … etc. Development of Simple SCADA System.		
5.	Project Presentation	13th	2
6.	Review	14th	2
7.	Final Exam	15th	2
Number of Weeks /and Units Per Semester		**15**	**30**

VI. Teaching strategies of the course:

- Lectures,
- Assignments,
- Computer-based Laboratory Sessions,
- Practical Lab. Work,
- Reading Materials & Web-sites searches,
- Group Works and Discussions,
- Projects.

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Industrial Networking	a1, a2, b1, c1, d1	3rd	1
2.	NC and CNC Machines	a1, a2, b1, c1, d1	4th to 6th	3
3.	Trends in industrial Automation	a1, a2, b1, c1, d1	7th	1
4.	PLC Structures and Programming	a1, a2, b1, c1, d1	9th	2
5.	DCS	a1, a2, b1, c1, d1	10th & 11th	2
6.	SCADA & Typical DCS Systems	a1, a2, b1, c1, d1	12th & 13th	3
7.	Design of Industrial Automated Systems	a1, a2, b1, c1, d1	14th & 15th	3
	Total			**15**

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1.	Assignments	3rd to 15th	15	10%
2.	Laboratory and Computer-based Works	3rd to 12th	15	10%
3.	Project Presentation	13th	15	10%
4.	Mid-Term Exam (Theoretical)	8th	15	10%
5.	Final Exam (Practical)	15th	15	10%
6.	Final Exam (Theoretical)	16th	75	50%
	Total		**150**	**100%**

IX. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

1. J. Love, 2007, Process Automation Hand Book, Springer.
2. Gordon Clarke, 2004, Practical Modern SCADA Protocols.
3. Groover, M. P. (2008) Automation, Production Systems, and Computer-Integrated Manufacturing, 3rd Ed. Pearson Education. ISBN 0-13-239321-2.
4. IDC Technologies, Practical Distributed Control Systems (DCS), Western Australia.
5. IDC Technology, (2012)- Design of Industrial Automation Functional Specifications for PLCs, DCSs and SCADA Systems- 1st Edition- West Perth, Western Australia- ISBN: 978-1-922062-01-7

2- Essential References.

1. John Park, 2003, Practical Data Acquisition for Instrumentation and Control Systems.
2. Steve Mackay, 2004, Practical Industrial Data Networks.
3. L. A. Bryan, E. A. Bryan, Programmable Controllers - Selected Applications.
4. Stuart A. Boyer, ISA, SCADA: Supervisory Control and Data Acquisition.

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

	5. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, John Wiley & Sons, Process Dynamics and Control.
3- Electronic Materials and Web Sites *etc*.	
	1. www.control.com **2.** www.plcs.net **3.** www.pacontrol.com **4.** www.triplc.com **5.** www.seimens.com **6.** http://plc-training-rslogix-simulator.soft32.com/free-download/ **7.** www.plcsimulator.net/ **8.** http://scada.winsite.com **9.** http://sourceforge.net/projects/scadabr/files/latest/download?source=directory **10.** Lecture Prepared by the Lecturer

X. Course Policies:

1.	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic
2.	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class he will be considered as absent.
3.	**Exam Attendance/Punctuality:** A student should attend the exam on time. He is Permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam-
4.	**Assignments & Projects:** The assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time-

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas

5.	**Cheating:** For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty-
6.	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university.
7.	**Other policies:** - Mobile phones are not allowed to use during a class lecture. It must be closed, otherwise the student will be asked to leave the lecture room - Mobile phones are not allowed in class during the examination. Lecture notes and assignments my given directly to students using soft or hard copy

Prepared by	Head of Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance
Assoc. Prof. Dr. Farouk AL-Fuhaidy	Asst. Prof. Dr. Adel Ahmed Al-Shakiri	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad

Rector of Sana'a University
Prof. Dr. Al-Qassim Mohammed Abbas