46.Course Specification of Industrial Networking

I.Course Identification and General Information:						
.1	Course Title:	Industrial Networking.				
.2	Course Code & Number:	MT307.				
.3	Credit Hours:	C.H.				TOTAL CR. HRS.
		Th.	Seminar	Pr.	Tu.	
		2	-	2	-	3
.4	Study Level/ Semester at which this Course is offered:	Fourth Year- Second Semester.				
.5	Pre –Requisite (if any):	Microcontrollers and Microprocessors.				
.6	Co –Requisite (if any):	None.				
7.	Program (s) in which the Course is offered:	Mechatronics Engineering Program.				
.8	Language of Teaching the Course:	English Language.				
.9	Location of Teaching the Course:	Mechatronics Engineering Department.				
.10	Prepared by:	Assoc. Prof. Dr. Farouk AL-Fuhaidy.				
11.	Date of Approval:					

II.Course Description:

This course is intended to provide mechatronics students with the basic concepts and technical aspects on data communications and industrial networking. Topics to be covered include overview of data communication systems, network topologies, layered network architectures for OSI and TCP/IP models, transmission media, switching, internetworking, IP addresses, and standard industrial networks. Students also learn in the laboratory how to design, implement, install, and configure different network types for commercial and industrial environments using standard computer simulation software.

III.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Describe knowledge of basic theoretical concepts related to data communication and networking, standard simulation software, and different devices and machines used for networking applications.	A1

Head of the Department	Quality Assurance Unit	Dean of the Faculty	Academic Development Center & Quality Assurance	Rector of Sana'a University
Assoc. Prof. Dr. Abdul-Malik Momin	Assoc. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Assoc. Prof. Dr. Huda Al-Emad	Prof. Dr. Al-Qassim Mohammed Abbas

a2.	Define the impact of networking solutions on society and industrial environments.	A7
b1.	Categorize problems related to networking using appropriate network simulation tools.	B2
b2.	Design and configure networks for different environments considering economic, social, and industrial issues.	B6
c1.	Solve commercial and industrial networking problems using appropriate computer simulation software and networking devices.	C2
c2.	Perform feasibility studies and prepare budgets while designing networks in different environments.	C4
d1.	Co-operate in work as a team leader or a part of a team coherently and share the knowledge of learned networking concepts successfully.	D1
d2.	Defend acquisition of new technology in data communication and networking as a part of life- long learning strategy.	D5

(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. Describe knowledge of basic theoretical concepts related to communication and data standard networking, simulation software, and different devices and machines used for networking applications.	• Active Lectures. • Tutorials.	• Written Assessments. • Short Essays.
a2. Define the impact of networking solutions on society and industrial environments.	• Group Learning.	• Project Reports. • Presentations.

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

Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1. Categorize problems related to networking using appropriate network simulation tools.	• The use of Communication and Information Technology.	• Practical Assessment. • Project Reports.

	• Case Studies.	
b2. Design and configure networks for different environments considering economic, social, and industrial issues.	• Active Lectures. • Hand-on Laboratory work.	• Written Assessments • Laboratory Reports • Project Reports

(C) 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. Solve commercial and industrial networking problems using computer appropriate software simulation and networking devices.	• Computer-Based Learning • The Use of Communication and Information Technology.	• Practical Assessment. • Simulations such as Computer-Based Learning.
c2. Perform feasibility studies and prepare budgets while designing networks in different environments.	• Active Lectures. • Group Learning. • Design Work and Projects.	• Written Assessments. • Short Essays.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1. Co-operate in work as a team leader or a part of a team coherently and share the knowledge of learned concepts networking successfully.	• Group Learning.	• Practical Assessment. • Project Reports.
d2. Defend acquisition of new technology in data and networking as communication long learning strategy. a part of life-	• Independent Learning.	• Written Assessments. • Presentations.

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Course Orientation and Overview.	a1, a2	Course subjects orientations, demonstration on different types of networking and technologies, new trends in networking, impact effect of networking on economic, social, commercial, and industrial environments.	1	2
2.	Introduction to Data Communication and Networking.	a1, a2	Introduction, Data communications system, elements, protocols, and standards, Network Topologies (Star, Bus, Mesh, Ring), Network types (LANs, MANs, and WANs), switching, The Internet, Accessing the Internet.	1	2
3.	Network Models.	a1, a2	Protocol Layering, The OSI Model, Layers in the OSI Model, the TCP/IP protocol suite, Layers in the TCP/IP protocol suite, Description of each layer, Encapsulation and encapsulation, addressing, Multiplexing and demultiplexing, The OSI versus the TCP/IP Model.	1	2
4.	Transmission Media and Multiplexing and DeMultiplexing.	a1, a2, b2	Guided media (Twisted pair cable, Coaxial cable, Fiber optic cable) Unguided media, Wireless channels, Multiplexing, TDM, FDM, and WDM.	1	2

5.	Network Layer Protocols.	a1, b1, b2, c1	IPv4 (Datagram, Fragmentation), IPv4 ADDRESSES (Classful Addressing, Classless Addressing, Network Address Translation, Subnet address), ICMP (Types of messages),IPv6 (IPv6 addresses, Categories of addresses, IPv6 packet format, Fragmentation, ICMPv6, Transition from IPv4 to IPv6), Interconnecting Devices, HUP, Switch, Bridge, Routers, and Gateways, Introduction to routing protocols like OSPF routing protocol.	2	4
6.	The Standard Ethernet Networks	a1, a2, b2, c1	Ethernet networks, explanation of 10Mb (Standard) Ethernet, Fast (100Mb) Ethernet, 1G (High-speed) Ethernet, and 10Gb Ethernet, Collisions and collision domain for different Ethernet networks.	1	2
7.	Mid-Term Exam.	a1, a2, b1, b2, c1	The First 6 Chapters.	1	2
8.	Wide Area Network Switching.	a1, a2, b2, c1	Defining the meaning of switching in networking, Three different techniques of switching, Switching and TCP/IP layers, Circuit switched network (three phases, efficiency, delay), Packet switching (datagram networks, virtual circuit networks), Switches devices.	2	4

9.	Transport Layer Protocols.	a1, b1, b2, c1	TCP, UDP, and STCP protocols, Introduction to Client-Server Protocols.	1	2
10.	Industrial Networks (Introduction).	a1, a2, b2	Introduction to industrial networks classes, topologies, physical medium and application layer protocols,Comparison of industrial network structure with OSI model and TCP/IP suite.	1	2
11.	Industrial Networks Types.	a1, a2, b1, b2, c1	Modbus and ASCII messages, Profibus-DP and the ISO model, Physical layer, Link layer, Application layer, Profiles, Strengths –weaknesses, Interbus and the ISO model, Physical layer, Link layer, Application layer, Profiles, Strengths –weaknesses. Modbus and the ISO model, Physical layer, Link layer, Application layer, Profiles, Strengths –weaknesses, Ethernet with TCP/IP in industrial, Architecture, different layers explanation.	3	6
12.	Final Exam.	a1, a2, b1, b2, c1	All the chapters.	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

B - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	Lab orientation, network's standard simulations software, Packet Tracer Simulator Installation and work environment.	**1**	**2**	**a1, c1**

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

2.	Survey on network's devices, switches, routers, and physical media Cabling and RG45 connection.	**1**	**2**	**a1, c1**
3.	**IPv4 addressing, classful and classless addressing, subnetting Design and implementation using simulation of LAN Networks Design and implementation using simulation of MAN/WAN Networks**	**3**	**6**	**c1, c2, d1**
4.	Configuration of router using router commands, Configuration of switches.	**1**	**2**	**c1, d1**
5.	Configuration of WiredLAN with static IP addressing and DHCP with MAC security and filters, Configuration of ARP, RARP, ICMP.	**1**	**2**	**c1, d1**
6.	Configuration of VLAN, Dynamic trunk protocol and spanning tree protocol OSPF – Explore Neighbor-ship Condition and Requirement, Neighbor-ship states, OSPF Metric Cost Calculation.	**1**	**2**	**c1, c2, d1, d2**
7.	Client-Server Network Programming using UDP and TCP.	**1**	**2**	**c1, d1, d2**
8.	Use a suitable industrial network Simulation tool to build and configure some different industrial networks types- based on devices and machine controlling.	**2**	**4**	**c1, c2, d1, d2**
9.	**Students work in groups completing term project on the design, configuring, and implementing using simulation different commercial/industrial networks with feasibility study report preparation Project Presentation.**	**2**	**4**	**c1, c2, d1, d2**
10.	**Final Exam.**	**1**	**2**	**a1, c1, c2, d1, d2**
	Number of Weeks /and Units Per Semester	**14**	**28**	

V.Teaching Strategies of the Course:

The teaching strategies of the course as follow:

- Active Lectures.
- Tutorials.
- Group Learning.
- Case Studies.
- The use of Communication and Information Technology.
- Hand-on Laboratory Work.
- Computer-Based Learning.
- Design Work and Projects.
- Independent Learning.

VI.Assessment Methods of the Course:

The assessment methods of the course are as follows:

- Written Assessments.
- Short Essays.
- Project Reports.
- Presentations.
- Practical Assessment.
- Laboratory Reports.
- Simulations such as Computer-Based Learning.

VII.Assignments:

Order	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	IPv4 Addressing and Network Design.	a1, a2, b1, b2, c2, d1	5 & 6	1.5
2.	Switching.	a1, a2, b1, b2, d1, d2	8 & 9	2
3.	UDP and TCP.	a1, a2, b1, b2, d1	10	2
4.	Industrial Networking.	a1, a2, b1, b2, c2, d1	11 & 15	2
Total				**7.5**

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

Order	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Assignments.	5-15	7.5	5%	a1, a2, b1, b2, c2, d1
2.	Lab-Works and Reports.	3-14	7.5	5%	**a1, c1, c2, d1, d2**
3.	Mid-Term Exam (Theoretically).	8	15	10%	a1, a2, b1, b2, c1
4.	Project Presentation.	13	15	10%	**c1, c2, d1, d2**
5.	Final Exam (Practically).	14	15	10%	**c1, c2, d1, d2**
6.	Final Exam (Theoretically).	16	90	60%	a1, a2, b1, b2, c1
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- Behrouz A. Forouzan, 2013, Data Communications and Networking, 5th edition, NY-USA, McGraw-Hill..
2- Steve Mackay, Edwin Wright, John Park, Deon Reynders, 2004, Practical Industrial Data Networks: Design, Installation and Troubleshooting, 1st edition, UK, Newnes.
3- Sunit Kumar Sen, 2014, Fieldbus and Networking in Process Automation, 1st edition, NY, CRC Press.

2- Essential References.

1- Douglas Comer, 2008, Computer Networks and Internets, 5th edition, NJ-USA, Prentice Hall.
2- R. Perlman, 2002, Interconnections, Bridges, Routers, Switches, and Internetworking Protocols, 2nd edition, NY, Addison Wesley.

3- Electronic Materials and Web Sites *etc*.

1- The Network Simulator - ns-2, http://www.isi.edu/nsnam/ns/
2- http://ocw.mit.edu/courses.
3- http://nptel.ac.in

X.Course Policies:

1.	**Class Attendance:** The students should have more than 75 % of attendance according to rules and regulations of the Faculty.
2.	Tardy:

Head of the Department Assoc. Prof. Dr. Abdul-Malik Momin	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

	The students should respect the timing of attending the lectures. They should attend within 10 minutes from starting of the lecture.
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6.	**Plagiarism**: The student will be terminated from the Faculty, if one student attends the exam on another university. behalf according to the policy, rules and regulations of the
7.	**Other Policies:** • All the teaching materials should be kept out the examination hall. • The mobile phone is not allowed. • There should be a respect between the student and his teacher.

Template for Course Plan of Industrial Networking

I. Information about Faculty Member Responsible for the Course:

		Office Hours					
Name of Faculty Member	Assoc. Prof. Dr. Farouk AL-Fuhaidy.						
Location& Telephone No.	777909815.	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	farouqakh@gmail.com.nn b,,m,m						

II. Course Identification and General Information:

1.	Course Title:	Industrial Networking**.**

2.	Course Code & Number:	MT307.				
3.	Credit Hours:	C.H.				TOTAL Cr. Hrs.
		Th.	Seminar	Pr.	Tu.	
		2	-	2	-	3
4.	Study Level/ Semester at which this Course is offered:	Fourth Year- Second Semester.				
5.	Pre –Requisite (if any):	Microcontrollers and Microprocessors.				
6.	Co –Requisite (if any):	None.				
7.	Program (s) in which the Course is offered:	Mechatronics Engineering Program.				
8.	Language of Teaching the Course:	English Language.				
9.	System of Study:	Semesters.				
10.	Mode of Delivery:	Lectures and Labs.				
11.	Location of Teaching the Course:	Mechatronics Engineering Department.				

III. Course Description:

This course is intended to provide mechatronics students with the basic concepts and technical aspects on data communications and industrial networking. Topics to be covered include overview of data communication systems, network topologies, layered network architectures for OSI and TCP/IP models, transmission media, switching, internetworking, IP addresses, and standard industrial networks. Students also learn in the laboratory how to design, implement, install, and configure different network types for commercial and industrial environments using standard computer simulation software.

IV.	Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
a1.	Describe knowledge of basic theoretical concepts related to data communication and networking, standard simulation software, and different devices and machines used for networking applications.	A1
a2.	Define the impact of networking solutions on society and industrial environments.	A7
b1.	Categorize problems related to networking using appropriate network simulation tools.	B2
b2.	Design and configure networks for different environments considering economic, social, and industrial issues.	B6
c1.	Solve commercial and industrial networking problems using appropriate computer simulation software and networking devices.	C2

c2.	Perform feasibility studies and prepare budgets while designing networks in different environments.	C4
d1.	Co-operate in work as a team leader or a part of a team coherently and share the knowledge of learned networking concepts successfully.	D1
d2.	Defend acquisition of new technology in data communication and networking as a part of life- long learning strategy.	D5

V. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Course Orientation and Overview.	Course subjects orientations, demonstration on different types of networking and technologies, new trends in networking, impact effect of networking on economic, social, commercial, and industrial environments.	1	2
2.	Introduction to Data Communication and Networking.	Introduction, Data communications system, elements, protocols, and standards Network Topologies (Star, Bus, Mesh, Ring), Network types (LANs, MANs, and WANs), switching, The Internet, Accessing the Internet.	2	2
3.	Network Models.	Protocol Layering, The OSI Model, Layers in the OSI Model, the TCP/IP protocol suite, Layers in the TCP/IP protocol suite, Description of each layer, Encapsulation and encapsulation, addressing, Multiplexing and demultiplexing, The OSI versus the TCP/IP Model.	3	2
4.	Transmission Media and Multiplexing and DeMultiplexing.	Guided media (Twisted pair cable, Coaxial cable, Fiber optic cable) Unguided media, Wireless channels Multiplexing, TDM, FDM, and WDM.	4	2

5.	Network Layer Protocols.	IPv4 (Datagram, Fragmentation) IPv4 ADDRESSES (Classful Addressing, Classless Addressing, Network Address Translation, Subnet address) ICMP (Types of messages), IPv6 (IPv6 addresses, Categories of addresses, IPv6 packet format, Fragmentation, ICMPv6, Transition from IPv4 to IPv6), Interconnecting Devices, HUP, Switch, Bridge, Routers, and Gateways, Introduction to routing protocols like OSPF routing protocol.	5,6	4
6.	The Standard Ethernet Networks.	Ethernet networks, explanation of 10Mb (Standard) Ethernet, Fast (100Mb) Ethernet, 1G (High-speed) Ethernet, and 10Gb Ethernet, Collisions and collision domain for different Ethernet networks.	7	2
7.	Mid-Term Exam.	The First 6 Chapters.	8	2
8.	Wide Area Network Switching.	Defining the meaning of switching in networking, Three different techniques of switching, Switching and TCP/IP layers, Circuit switched network (three phases, efficiency, delay), Packet switching (datagram networks, virtual circuit networks), Switches devices.	9,10	4
9.	Transport Layer Protocols.	TCP, UDP, and STCP protocols, Introduction to Client-Server Protocols.	11	2
10.	Industrial Networks (Introduction).	Introduction to industrial networks classes, topologies, physical medium and application layer protocols, Comparison of industrial network structure with OSI model and TCP/IP suite.	12	2
11.	Industrial Networks Types.	Modbus and ASCII messages, Profibus-DP and the ISO model, Physical layer, Link layer, Application layer, Profiles, Strengths –weaknesses, Interbus and the ISO model, Physical	13,14,15	6

		layer, Link layer, Application layer, Profiles, Strengths –weaknesses, Modbus and the ISO model, Physical layer, Link layer, Application layer, Profiles, Strengths – weaknesses,Ethernet with TCP/IP in industrial, Architecture, different layers explanation.		
12.	Final Exam.	All the Chapters.	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B - Practical Aspect:

Order	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes
1.	Lab. orientation, network's standard simulations software, Packet Tracer Simulator Installation and work environment.	1	2	a1, c1
2.	Survey on network's devices, switches, routers, and physical media Cabling and RG45 connection.	2	2	a1, c1
3.	IPv4 addressing, classful and classless addressing, subnetting. Design and implementation using simulation of LAN Networks. Design and implementation using simulation of MAN/WAN Networks.	3,4,5	6	c1, c2, d1
4.	Configuration of router using router commands, Configuration of switches.	6	2	c1, d1
5.	Configuration of WiredLAN with static IP addressing and DHCP with MAC security and filters, Configuration of ARP, RARP, ICMP.	7	2	c1, d1
6.	Configuration of VLAN, Dynamic trunk protocol and spanning tree protocol OSPF – Explore Neighbor-ship Condition and Requirement, Neighbor-ship states, OSPF Metric Cost Calculation.	8	2	c1, c2, d1, d2

7.	Client-Server Network Programming using UDP and TCP.	9	2	c1, d1, d2
8.	Use a suitable industrial network Simulation tool to build and configure some different industrial networks types-based on devices and machine controlling.	10,11	4	c1, c2, d1, d2
9.	Students work in groups completing term project on the design, configuring, and implementing using simulation different commercial/industrial networks with feasibility study report preparation Project Presentation.	12,13	4	c1, c2, d1, d2
10.	Final Exam.	14	2	a1, c1, c2, d1, d2
Number of Weeks /and Units Per Semester		**14**	**28**	

VI. Teaching strategies of the course:

The teaching strategies of the course as follow:

- Active Lectures.
- Tutorials**.**
- Group Learning.
- Case Studies**.**
- The use of Communication and Information Technology.
- Hand-on Laboratory Work.
- Computer-Based Learning.
- Design Work and Projects**.**
- Independent Learning.

VII. Assignments:

Order	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	IPv4 Addressing and Network Design.	a1, a2, b1, b2, c2, d1	5 & 6	1.5
2.	Switching.	a1, a2, b1, b2, d1, d2	8 & 9	2
3.	UDP and TCP.	a1, a2, b1, b2, d1	10	2
4.	Industrial Networking.	a1, a2, b1, b2, c2, d1	11 & 15	2
Total				**7.5**

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

Order	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Assignments.	5-15	7.5	5%	a1, a2, b1, b2, c2, d1
2.	Lab-Works and Reports.	3-14	7.5	5%	a1, c1, c2, d1, d2
3.	Mid-Term Exam (Theoretically).	8	15	10%	a1, a2, b1, b2, c1
4.	Project Presentation.	13	15	10%	c1, c2, d1, d2
5.	Final Exam (Practically).	14	15	10%	c1, c2, d1, d2
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