41.Course Specification of Embedded Systems and Interfacing

I.Course Identification and General Information:

.1	Course Title:	Embedded Systems and Interfacing.				
.2	Course Code & Number:	MT302.				
.3	Credit hours:	C.H.				TOTALCR. HRS.
		Th.	Seminar	Pr.	Tu.	
		2	-	2	-	3
.4	Study Level/ Semester at which this Course is offered:	Fourth Year- First Semester.				
.5	Pre –Requisite (if any):	Electronics (2), Microcontrollers and Microprocessors, Computer Programming (1) and Logic System Design.				
.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 provides students of mechatronics with the principles and fundamental concepts in embedded and interfacing engineering systems. It offers the desired skills for the student to construct and design a complete embedded and interfacing system for various work environments. The course includes the Formal models and specification languages for acquisition and capturing system's behaviors, techniques for timers/interrupts handling and automation functioning, peripheral interfacing, specification, exploration and refinement, system partitioning and hardware/software co-design in assembly/Micro-C programming. Students also gain the knowledge and understanding on the standard tools used for the design, simulation, validation, and verification of embedded and interfacing systems. Laboratory experiments include the design, implementation, and programming of embedded, measuring, controlling, and interfacing systems. This course is important for mechatronic systems, and robotics courses.

III.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Describe knowledge of the basic theoretical concepts and applications of standard approaches and computer tools used in the design and implementation of embedded and interfacing systems as a part of mechatronics systems.	A1
a2.	Depict the impact of effective embedded and interfacing systems solutions on society, markets, and industries.	A7
b1.	Create innovative embedded and interfacing solutions for monitoring, interfacing, and automating industrial processes.	B3
b2.	Design useful embedded and interfacing systems considering economic, social, and environmental issues.	B6
c1.	Conduct laboratory and environmental experiments safely to verify theoretical concepts related to embedded and interfacing systems.	C1
c2.	Solve engineering problems related to embedded and interfacing systems using appropriate tools and computer software.	C2
d1.	Co-operate in work as a team leader or a part of a team coherently and share learned knowledge successfully.	D1
d2.	Estimate an awareness of ethical principles while designing embedded and interfacing systems to different environmental issues.	D4

(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 the basic theoretical concepts and applications of standard approaches and computer tools used in the design and implementation of embedded and interfacing systems as a part of mechatronics systems.	• Active Lectures. • Tutorials.	• Written Assessment. • Short Essays.
a2. Depict the impact of effective embedded and interfacing systems solutions on society, markets, and industries.	• Group Learning. • Case Studies.	• 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. Create innovative embedded and interfacing solutions for monitoring, interfacing, and automating industrial processes.	• Active Lectures. • Independent Learning and Work.	• Simulations. • Presentations.
b2. Design useful embedded and interfacing systems considering economic, social, and environmental issues.	• Active Lectures. • Group Learning.	• Written Assessment. • Short Essays.

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching Srategies	Assessment Strategies
c1. Conduct laboratory and environmental experiments safely to verify theoretical concepts related to embedded and interfacing systems.	• Hands-on Laboratory Work. • Design Work.	• Practical Assessment. • Laboratory Reports.
c2. Solve engineering problems related to embedded and interfacing systems using appropriate tools and computer software.	• The Use of Communication and Information Technology.	• Simulations.

(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 learned knowledge successfully.	• Group Learning.	• Project Reports.
d2. Estimate an awareness of ethical principles while designing embedded and interfacing systems to different environmental issues.	• Problem-Based Learning. • Case Studies.	• Presentations. • Case Studies.

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction.	a1	• Course Oientation.	1	2

			• Defining Embedded and data Acquisition Systems and their Applications. • Essential Attributes of Embedded Systems. • Embedded Systems Historical Aspects. • New Trends in Embedded Systems.		
2.	Minimum System Requirements and Programming Concepts for the Embedded Systems.	a1, b1, c2	• PIC16-µCs family, internal features and external interfacing applications. • PIC16F84-µC on-board features, internal organization, and external Pins interfacing. • PIC16F84-µC internal memories organization, use, and manipulation. • PIC16F84-µC programming, description and working with its 34-assembly instructions, Subroutines and Macros, assembly instruction format, program layout, writing a simple PIC16F84-µC Assembly program, building software Look-up and delay subroutines in assembly. • Using PIC16F84-µC for interfacing LEDs, different types of Switches, and Buzzer using Assembly programming.	4	8

3.	Timing and Interrupts Handling.	a1, a2, b1	• Basic concepts of Timing and Interrupts (H/W and S/W), applications, auto-functioning and working with Timers and Interrupts. • PIC16F84-µC Timer0 block diagram description, configuration (Control) registers, and its relation to WatchDog Timer based on pre-scalar assignment. • PIC16F84-µC Interrupts, explanation using logic diagram different PIC16F84-µC's interrupts, work and configuration, implementing interrupts using assembly programs with one or more than one active interrupts. • Designing and building simple embedded and interfacing system with external interfacing devices like, switches, sensors, and LEDs employing the use of timers and interrupts.	2	4
4.	Mid-Term Exam.	a1, a2, b1, c2	• The First 3 Chapters.	1	2
5.	Data Acquisition Concepts and PIC16F877-µC ADC Module.	a1, a2, b1, b2	• Introduction to Data Acquisition System, basic Data Acquisition System block diagram, elements of Data Acquisition System and their characteristics.	3	6

			• Sensors and Transducers, various types of sensors and their applications, transducers principles of operations (motion, force, • Pressure, flow, and Temperature) and characteristics (Accuracy, Sensitivity, Repeatability, Range) • Signal Conditioning, analog/Discrete signals characteristics, Amplification, Isolation, Filtering, linearization, Signal Bouncing, Plug-in board signal conditioning, Direct connect modular – two-wire transmitters, Distributed I/O – digital transmitters, Noise and interference, and Noise Reduction • Introduction to ADC/DAC process, signal sampling, Quantization concepts, ADC/DAC parameters and characteristics, • PIC16F877-µC ADC module, different Analog input channels for PIC16F877-µC, Multiplexing, Reference voltages, ADC related Control/Data registers and their configuration,		

			• Building Data Acquisition and Interfacing System Example employing PIC16F877-µC's ADC module, External real world analog input device, assembly programming and interrupt concept.		
6.	Accessing On-Chip and Interfacing to Out-Chip(physical and Human) Peripherals.	a1, a2, b1, b2, c2	• PIC16F877-µC interfacing to Keypad, Seven Segment Display, LCD, Relay, and Opto-Isolator applying external hardware interrupts handling. • PIC16F877-µC Timers 1&2 explanation and applications. • PIC16F877-µC CCP Module, describe how to configure and function the CCP module to work either in Capturing, Comparing, and/or PWM modes and their applications • Waveform Generation and DAC Implementation using PIC16F877-µC On-Chip CCP module in PWM mode of operation for Motors/Actuators driving. • Pseudo-Random Number Generation through PIC.	2	4
7.	Serial Communication and Interfacing to PIC16F877.	a2, b1, b2, c2	• Serial/parallel communication concepts, Synchronous/Asynchronous, Master/Slave, and advantages and Drawbacks.	1	2

			• Serial Communication to PIC16F877 using USART, modes of operation (Synchronous/Asynchronous, Master/Salve, and Full-Duplex), control registers Configuration, and Assembly program example. • PIC Interfaced to I^2C Compatible Devices, Details and description of I^2C operation and Interface, I^2C Based Real Time Clock.		
8.	Smart Systems and IOT.	a2, b1, b2, c2, d2	• Introduction to IOT and its relation to Embedded Systems as a recently technology trends and their application in smart rooms, building, and cities • Introduction to Smart Systems like PIC18 and PIC32 Microcontrollers, Raspberry-Pi, and Python Programming.	1	2
9.	Final Exam.	a1, a2, b1, b2, c2, d2	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.	• Pre-laboratory hardware/lab-view software orientations, embedded and interfacing system's standard simulation software,	1	2	a1, c2

	• Exploring features and applications of PIC16F84 and PIC16F877 in embedded and interfacing systems.			
2.	• PIC16F84 and PIC16F877 assembly and micro-C programming and interfacing to simple I/O devices, like switches and leds ...etc. • Generating delay time using software program and on-chip hardware configuration.	3	6	c1, c2, d1
3.	• Exploring interrupt and timing work and function them using PIC16-Mcs to build automated/control embedded and interfacing systems to monitor some phenomena like motion and self-react to it.	2	4	c1, c2, d1
4.	• On-Off temperature controller using on-chip ADC.	1	2	c1, c2, d1
5.	• Implementing a PID temperature controller using PIC16F877.	1	2	c1, c2, d1, d2
6.	• Controlling motors/actuators using ADC/DAC, timers, interrupts and CCP module to build a simple toy derbot/CAR.	2	4	c1, c2, d1, d2
7.	• Serial communication experiments to interface external modules/ICs like memory or another microcontrollers using USART and MSSP on-chip PIC16 modules.	1	2	c1, c2, d1, d2
8.	• Students work in groups to complete their term projects, present and discuss their suggested embedded and interfacing projects.	**2**	**4**	a1, a2, b1, b2, c1, c2, d1, d2
9.	Final Practical Exam.	**1**	**2**	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 are as follows:

- Active Lectures.
- Independent Learning and Work.
- Group Learning.
- Hands-on Laboratory Work.
- Design Work.

- The Use of Communication and Information Technology.
- Problem-Based Learning.
- Case Studies.

VI.Assessment Methods of the Course:

The assessment methods of the course are as follows:

- Written Assessment.
- Short Essays.
- Project Reports.
- Presentations.
- Simulations.
- Practical Assessment.
- Laboratory Reports.
- Case Studies.

VII.Assignments:

Order	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1.	PIC16-Mc assembly programming.	a1, c2	2nd to 4th	1.5
2.	Timing and interrupts handling and programming.	a1, a2, b1, c2	5th to 8th	3
3.	Data acquisition and interfacing systems and ADC/DAC.	a1, a2, b1, b2, c2	9th to 11th	3
4.	Human interfacing and on-chip modules.	a1, a2, b1, b2, c2	12th to 14th	3
5.	Serial communication and serial/parallel port.	a1, a2, b1, b2, c2	15th	1.5
Total				**12**

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 & Home Works.	2nd to 15th	12	8%	a1, a2, b1, b2, c2

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

2.	Lab. Work and Experiments Reports.	3rd to 14th	10	6.67%	c1, c2, d1, d2
3.	Practical Term-Project and Presentation.	3rd to 14th	18	12%	a1, a2, b1, b2, c1, c2, d1, d2
4.	Mid-Term Exam (Theoretically).	8th	10	6.67%	a1, a2, b1
5.	Final Exam (Practically).	14th	10	6.67%	c1, c2, d1, d2
6.	Final Exam (Theoretically).	16th	90	60%	a1, a2, b1, b2, c2, d2
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. Tim Wilmshurst, 2010, Designing Embedded Systems with PIC Microcontrollers Principles and applications, 2nd edition, USA, Elsevier Ltd.
2. Park & Mackay, 2003, Practical Data Acquisition for Instrumentation and Control Systems, UK, Newnes.
3. Kevin James, 2000, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, UK, Newnes.

2- Essential References.

1- Steve Heath, 2002, Embedded Systems Design, 2nd edition , UK, Newnes.
2- Programming Embedded Systems in C and C++, Michael Barr, O'Reilly Media,
3- John Essick, 2008, Hands On Introduction to LabVIEW for Scientist and Engineers, 1st edition, Oxford University Press, Oxford.
4- Travis and Kring, 2006, LabVIEW for Everyone, 1st edition, NJ-USA, Prentice Hall.
5- Muhamad Ali Mazidi, 2012, Embedded Systems Design Using PIC18", 1st , NJ-USA, , Prentice Hall.

3- Electronic Materials and Web Sites *etc*.

1- http://www.ocw.mit.edu/courses.
2- Lecture notes prepared by the Lecturer.

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: **The students should respect the timing of attending the lectures. They should attend within 10 minutes from starting of the lecture.**
3.	**Exam Attendance/Punctuality:**

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 student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final 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**: If any cheating occurred during the examination, the student is not allowed to continue and the examination committee for enquiries. he has to face
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.

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. Head of Mechatronics Engineering Department: Assoc. Prof. Dr. Abdul-Malik Momin. Asst. Prof. Dr. Hatem Al-Dois.
	Deputy Rector for Academic Affairs Assoc. Prof. Dr. Ibrahim AlMutaa. Assoc. Prof. Dr. Ahmed Mujahed. Asst. Prof. Dr. Munaser Alsubari.

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

Course Plan of Embedded Systems and Interfacing

I.Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Assoc. Prof. Dr Farouk AL-Fuahidy	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:	Embedded Systems and Interfacing.				
.2	Course Code & Number:	MT302.				
.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- First Semester.				
.5	Pre –Requisite (if any):	Electronics (2), Microcontrollers and Microprocessors, Computer Programming (1) and Logic System Design.				
.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 provides students of mechatronics with the principles and fundamental concepts in embedded and interfacing engineering systems. It offers the desired skills for the student to construct and design a complete embedded and interfacing system for various work environments. The course includes the Formal models and specification languages for acquisition and capturing

system's behaviors, techniques for timers/interrupts handling and automation functioning, peripheral interfacing, specification, exploration and refinement, system partitioning and hardware/software co-design in assembly/Micro-C programming. Students also gain the knowledge and understanding on the standard tools used for the design, simulation, validation, and verification of embedded and interfacing systems. Laboratory experiments include the design, implementation, and programming of embedded, measuring, controlling, and interfacing systems. This course is important for mechatronic systems, and robotics courses.

IV.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Describe knowledge of the basic theoretical concepts and applications of standard approaches and computer tools used in the design and implementation of embedded and interfacing systems as a part of mechatronics systems.	A1
a2.	Depict the impact of effective embedded and interfacing systems solutions on society, markets, and industries.	A7
b1.	Create innovative embedded and interfacing solutions for monitoring, interfacing, and automating industrial processes.	B3
b2.	Design useful embedded and interfacing systems considering economic, social, and environmental issues.	B6
c1.	Conduct laboratory and environmental experiments safely to verify theoretical concepts related to embedded and interfacing systems.	C1
c2.	Solve engineering problems related to embedded and interfacing systems using appropriate tools and computer software.	C2
d1.	Co-operate in work as a team leader or a part of a team coherently and share learned knowledge successfully.	D1
d2.	Estimate an awareness of ethical principles while designing embedded and interfacing systems to different environmental issues.	D4

V.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction.	• Course Orientation. • Defining Embedded and data Acquisition Systems and their Applications.	1	2

		• Essential Attributes of Embedded Systems. • Embedded Systems Historical Aspects. • New Trends in Embedded Systems.		
2.	Minimum System Requirements and Programming Concepts for the Embedded Systems.	• PIC16-µCs family, internal features and external interfacing applications. • PIC16F84-µC on-board features, internal organization, and external Pins interfacing. • PIC16F84-µC internal memories organization, use, and manipulation. • PIC16F84-µC programming, description and working with its 34-assembly instructions, Subroutines and Macros, assembly instruction format, program layout, writing a simple PIC16F84-µC Assembly program, building software Look-up and delay subroutines in assembly. • Using PIC16F84-µC for interfacing LEDs, different types of Switches, and Buzzer using Assembly programming.	2,3,4,5	8
3.	Timing and Interrupts Handling.	• Basic concepts of Timing and Interrupts (H/W and S/W), applications, auto-functioning and working with Timers and Interrupts. • PIC16F84-µC Timer0 block diagram description, configuration (Control) registers, and its relation to WatchDog Timer based on pre-scalar assignment. • PIC16F84-µC Interrupts, explanation using logic diagram different PIC16F84-µC's interrupts, work and configuration, implementing interrupts using assembly programs with one or more than one active interrupts.	6,7	4

		• Designing and building simple embedded and interfacing system with external interfacing devices like, switches, sensors, and LEDs employing the use of timers and interrupts.		
4.	Mid-Term Exam.	• The first 3 chapters.	8	2
5.	Data Acquisition Concepts and PIC16F877-µC ADC Module.	• Introduction to Data Acquisition System, basic Data Acquisition System block diagram, elements of Data Acquisition System and their characteristics. • Sensors and Transducers, various types of sensors and their applications, transducers principles of operations (motion, force, • Pressure, flow, and Temperature) and characteristics (Accuracy, Sensitivity, Repeatability, Range) • Signal Conditioning, analog/Discrete signals characteristics, Amplification, Isolation, Filtering, linearization, Signal Bouncing, Plug-in board signal conditioning, Direct connect modular – two-wire transmitters, Distributed I/O – digital transmitters, Noise and interference, and Noise Reduction • Introduction to ADC/DAC process, signal sampling, Quantization concepts, ADC/DAC parameters and characteristics, • PIC16F877-µC ADC module, different Analog input channels for PIC16F877-µC, Multiplexing, Reference voltages, ADC related Control/Data registers and their configuration,	9,10,11	6

		• Building Data Acquisition and Interfacing System Example employing PIC16F877-µC's ADC module, External real world analog input device, assembly programming and interrupt concept.		
6.	Accessing On-Chip and Interfacing to Out-Chip(physical and Human) Peripherals.	• PIC16F877-µC interfacing to Keypad, Seven Segment Display, LCD, Relay, and Opto-Isolator applying external hardware interrupts handling. • PIC16F877-µC Timers 1&2 explanation and applications. • PIC16F877-µC CCP Module, describe how to configure and function the CCP module to work either in Capturing, Comparing, and/or PWM modes and their applications • Waveform Generation and DAC Implementation using PIC16F877-µC On-Chip CCP module in PWM mode of operation for Motors/Actuators driving. • Pseudo-Random Number Generation through PIC.	12,13	4
7.	Serial Communication and Interfacing to PIC16F877.	• Serial/parallel communication concepts, Synchronous/Asynchronous, Master/Slave, and advantages and Drawbacks. • Serial Communication to PIC16F877 using USART, modes of operation (Synchronous/Asynchronous, Master/Salve, and Full-Duplex), control registers Configuration, and Assembly program example. • PIC Interfaced to I^2C Compatible Devices, Details and description of I^2C operation and Interface, I^2C Based Real Time Clock.	14	2

8.	Smart Systems and IOT.	• Introduction to IOT and its relation to Embedded Systems as a recently technology trends and their application in smart rooms, building, and cities. • Introduction to Smart Systems like PIC18 and PIC32 Microcontrollers, Raspberry-Pi, and Python Programming.	15	2
9.	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.	• Pre-laboratory hardware/lab-view software orientations, embedded and interfacing system's standard simulation software, • Exploring features and applications of PIC16F84 and PIC16F877 in embedded and interfacing systems.	1	2	a1, c2
2.	• PIC16F84 and PIC16F877 assembly and micro-C programming and interfacing to simple I/O devices, like switches and leds ...etc. • Generating delay time using software program and on-chip hardware configuration.	2,3,4	6	c1, c2, d1
3.	• Exploring interrupt and timing work and function them using PIC16-Mcs to build automated/control embedded and interfacing systems to monitor some phenomena like motion and self-react to it.	5,6	4	c1, c2, d1
4.	• On-Off temperature controller using on-chip ADC.	7	2	c1, c2, d1
5.	• Implementing a PID temperature controller using PIC16F877.	8	2	c1, c2, d1, d2

6.	• Controlling motors/actuators using ADC/DAC, timers, interrupts and CCP module to build a simple toy derbot/CAR.	9,10	4	c1, c2, d1, d2
7.	• Serial communication experiments to interface external modules/ICs like memory or another microcontrollers using USART and MSSP on-chip PIC16 modules.	11	2	c1, c2, d1, d2
8.	• Students work in groups to complete their term projects, present and discuss their suggested embedded and interfacing projects.	**12,13**	**4**	a1, a2, b1, b2, c1, c2, d1, d2
9.	Final Practical Exam.	**14**	**2**	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 are as follows:

- Active Lectures.
- Independent Learning and Work.
- Group Learning.
- Hands-on Laboratory Work.
- Design Work.
- The Use of Communication and Information Technology.
- Problem-Based Learning.
- Case Studies.

VII.Assignments:

Order	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1.	PIC16-Mc assembly programming.	a1, c2	2nd to 4th	1.5
2.	Timing and interrupts handling and programming.	a1, a2, b1, c2	5th to 8th	3
3.	Data acquisition and interfacing systems and ADC/DAC.	a1, a2, b1, b2, c2	9th to 11th	3
4.	Human interfacing and on-chip modules.	a1, a2, b1, b2, c2	12th to 14th	3
5.	Serial communication and serial/parallel port.	a1, a2, b1, b2, c2	15th	1.5

Total	12

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 & Home Works.	2nd to 15th	12	8%	a1, a2, b1, b2, c2
2.	Lab. Work and Experiments Reports.	3rd to 14th	10	6.67%	c1, c2, d1, d2
3.	Practical Term-Project and Presentation.	3rd to 14th	18	12%	a1, a2, b1, b2, c1, c2, d1, d2
4.	Mid-Term Exam (Theoretically).	8th	10	6.67%	a1, a2, b1
5.	Final-Term Exam (Practically).	14th	10	6.67%	c1, c2, d1, d2
6.	Final-Term Exam (Theoretically).	16th	90	60%	a1, a2, b1, b2, c2, d2
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- Tim Wilmshurst, 2010, Designing Embedded Systems with PIC Microcontrollers Principles and applications, 2nd edition, USA, Elsevier Ltd.
2- Park & Mackay, 2003, Practical Data Acquisition for Instrumentation and Control Systems, UK, Newnes.
3- Kevin James, 2000, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, UK, Newnes.

2- Essential References.

1- Steve Heath, 2002, Embedded Systems Design, 2nd edition , UK, Newnes.
2- Programming Embedded Systems in C and C++, Michael Barr, O'Reilly Media,
3- John Essick, 2008, Hands On Introduction to LabVIEW for Scientist and Engineers, 1st edition, Oxford University Press, Oxford.
4- Travis and Kring, 2006, LabVIEW for Everyone, 1st edition, NJ-USA, Prentice Hall.
5- Muhamad Ali Mazidi, 2012, Embedded Systems Design Using PIC18", 1st , NJ-USA, , Prentice Hall.

3- Electronic Materials and Web Sites *etc*.

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

	1- http://www.ocw.mit.edu/courses. 2- Lecture notes prepared by the Lecturer.

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: **The students should respect the timing of attending the lectures. They should attend within 10 minutes from starting of the lecture.**
3.	**Exam Attendance/Punctuality:** The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for mid-term exam and final 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**: If any cheating occurred during the examination, the student is not allowed to continue and he the examination committee for enquiries. has to face
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.