34.Course Specification of Manufacturing Processes

I. Course Identification and General Information:

1.	Course Title:	Manufacturing Processes.				
2.	Course Code & Number:	MT207.				
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:	Third Year-Second Semester.				
5.	Pre –requisite (if any):	Engineering Workshop and Engineering Drawing.				
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. Amin Alkhulaidi				
11.	Date of Approval:					

II.Course Description:

This course covers fundamentals of manufacturing processes including interrelationships between the properties of the material and the manufacturing process under the classification of processing operations and the basic parameters involved in these processes. It will focus on the basic machining operations related to drilling, milling, grinding, and lathe and other processes. This course will encompass both theoretical and practical experiences related to the machining of different metals and will develop fundamental skills, practices and safety in working with machine tools, measurement instruments, and related equipment common to manufacturing.

	III.Course Intended learning outcomes (CILOs) of the course	Referenced PILOs
a1.	Define the behavior and properties of materials as they are altered and influenced by processing in manufacturing.	A1
a2.	Describe the different manufacturing processes, concept, capabilities process parameters, process optimization, and the advantages and limitations of various processes.	A2
b1.	Propose the suitable materials according to the application and machining process.	B2

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

b2.	Differentiate between different metal cutting operations and the optimum machining parameters; include feed, speed, cutting forces and the machining time for different cutting processes/materials.	B3
c1.	Conduct practical exposure to different, measuring, and machining with proper cutting parameters and methodologies through lab sessions.	C1
c2.	Perform the required sequence to machine a part and evaluate its size and tolerances to finish an acceptable product	C2
d1.	Assess the manufacturing processes in written technical report and oral seminar.	D1
d2.	Cooperate efficiently within a practical discussion and working as a team.	

(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. Define the behavior and properties of materials as they are altered and influenced by processing in manufacturing.	• Lectures. • Workshop Activities.	• Homework. • Major Exams.
a2. Describe the different manufacturing processes, concept, capabilities process parameters, process optimization, and the advantages and limitations of various processes.		

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
b1. Propose the suitable materials according to the application and machining process.	• Lectures. • Groups Workshop Practical Production Sequence Training.	• Homework. • Theoretical Exam. • Practical Exams. • Product Design. • Finished Product.
b2. Differentiate between different metal cutting operations and the optimum machining parameters; include feed, speed, cutting forces and the machining time for different cutting processes/materials**.**		

© 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. Conduct practical exposure to different, measuring, and machining with proper cutting parameters and methodologies through lab sessions.	• Lectures. • Groups Product Design.	• Product design report assessment.

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c2. Perform the required sequence to machine a part and evaluate its size and tolerances to finish an acceptable product.	• Groups Workshop. • Practical Production. • Sequence Training.	• produced parts assessment. • Theoretical Exams.

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1. Assess the manufacturing processes in written technical report and oral seminar.	Project Report for Design and produce a part.	• Assignment Reports. • Discussion Groups.
d2. Cooperate efficiently within a practical discussion and working as a team.		

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction to Manufacturing.	a1,b2,c2,d2	• Manufacturing a Product: General Considerations • Choosing Methods of Manufacturing • Classification of Manufacturing Processes • Introduction to Deformation Process, Polymer, Casting and Sheet Metal.	1	2
2.	Materials and Manufacturing.	a2,b1,b2,c1,d1,d2	• Introduction to Material Properties • Important Engineering Characteristics of Materials • Material-Process-Geometry Relationships. • Functional Parameters of Mechanical and Thermal Properties affected by Production Processes. • Factors affecting Material Properties during Machining.	1	2

3.	Measurement and Inspection.	a1,b2,c1,d1,d2	• Linear Measurement Metric System (millimeters), Gages, Graduated Measuring Devices. • Shape, Dimensions, Shape and Location Deviations. • Measurement Instruments Inspection Tools and Techniques. • Machined Parts Surface Roughness Measurements, Stylus, Optical Devices SEM. • Introduction to Nondestructive Testing Methods • Common Application/uses of NDT. • Automated Inspection.	1	2
4.	Material Removal Processes.	a1,a2,b1,c1,c2 d1,d2,	• Cutting Tool Materials. • Cutting Tool Geometry. • Cutting Tool Types. • Cutting Tool/Machining Economics. • Machinability Principles. • Cutting Fluids • Basic Chip Formation.	1	2
5.	Machining Processes - Lathe Theory and Geometry.	a2,b1,b2,c1,c2,d 1,d2	• Definition of a Lathe and its Components. • Types of Lathes. • Definition of Cutting Tool Theory. • Types of Work Holding in the Lathe. • Tool Geometry and Design. • Types of Cutting Tools. • Application of Cutting Tools for Turning Process, Threading, Boring, Taper Turning,etc .	3	6

			• Machining Parameters, Speeds and Feeds. Material Removal Rate, Machining Time. • Design a part (at least six operations) showing its sequence to be Machined on the Lathe machine.		
6.	Mid-Term Exam.	a2,b1,b2,c1,c2	• The First 5 Chapters.	1	2
7.	Machining Processes - Shaper and Planner Theory and Geometry.	a2,b1,b2,c1,c2,d1,d2	• Type of Shaper/Planner Machines and their Working Mechanism. • Cutting Tool and Work Holding Fixtures. • Types of Cutting Tools and their Machining Applications. • Machining Parameters, Speeds, Feeds, Material Removal Rate, Machining Time.	1	2
8.	Machining Processes - Milling Machine Theory and Geometry.	a2,b1,b2,c1,c, d1,d2	• Definition of a Milling Machine. • Milling Machines Types (Vertical and Horizontal), Advantages and Disadvantages. • Principle of Milling Process. • Types of Vertical and Horizontal Milling Cutters and their Applications. • Cutting Tools Holding. • Work Holding in Milling. • The Indexing/Dividing Head Types and Applications to Produce Gears, and Regular Shapes. • Type of Manufacturing Operations can be achieved using Vertical and Horizontal Milling Machines.	2	4

			• Machining Parameters, Speeds, Feeds, Material Removal Rate, Machining Time. • Designing and machining a part (using vertical and horizontal milling machines and the Dividing Head) showing the suitable cutting cutters and the required operation sequence		
9.	Machining Processes – Drilling Theory and Geometry.	a2, b1,b2, c1,c2,d1,d2	• Definitions and Types of Drilling Machines. • Types of Drilling Operations. • Cutting Tool and Work Holding Devices. • Cutting Tool Materials. • Cutting Tool Theory. • Types of Cutting Tools and Operations. • Safety Protection during Drilling. • Machining Parameters, Speeds, Feeds, Material Removal Rate, Machining Time.	1	2

10.	Machining Processes - Grinding Theory and Geometry.	a2, b1,b2, c1,c2,d1,d2	• Principle of Abrasive Machining • Types of Abrasive Machining. • Types of Abrasives and Bond Materials. • Manufacturing of Grinding Wheels. • Safety and Care of Abrasive Wheels. • Measuring Residual Stresses and Surface Roughness. • Machining Parameters, Speeds, Feeds, Material Removal Rate, & Machining Time. • Applications using Surface, Cylindrical and Center-less	2	4
11.	Revision.	a1,a2, b1,b2, c1,c2,d1,d2	Final Exam Revision.	1	2
12.	Final Exam	a1,a2, b1,b2, c1,c2	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 Session Devoted to Safety Issues in the Machine-shop.	1	2	a1,b2, c2,d2
2.	Material Test Lab.	1	2	a2, b1, b2 c1, d1, d2
3.	Measurements Tools – Workshop.	1	2	a1, b2, c1, d1, d2
4.	Cutting Tools Types and work holding Fixtures Types – Workshop.	1	2	a1, a2, b1, c1, c2, d1, d2

5.	Lathe Machines Types, Mechanism, Turning Tools, Process and Machining a Part by Lath showing threading, boring and taper operations.	2	4	a2, b1, b2, c1, c2, d1, d2
6.	Shaper and Planner Machines Types, Mechanism, Shaper Tools, Process and Machining a Part by Shaper.	1	2	a2, b1,b2, c1,c2,d1,d2
7.	Milling Machines Types, Mechanism, Vertical and Horizontal Milling Cutters, Process and Machining a Part using Dividing Head (gear or regular shape) by Milling Machines.	2	4	a2, b1,b2, c1,c2,d1,d2
8.	Drill Machines Types, Mechanism, Drilling Tools, Process and Machining a Part by Drill.	1	2	a2, b1,b2, c1,c2,d1,d2
9.	Grinding Machines Types, Mechanism, Abrasive Grinding Wheels Types, Process and Machining a Part by Grinding Machine.	2	4	a2, b1,b2, c1,c2,d1,d2
10.	Practical team work report and machined part submission by lath and milling machines.	2	4	a1,a2, b1,b2, c1,c2,d1,d2
	Number of Weeks /and Units Per Semester	**14**	**28**	

V.Teaching strategies of the course:

- Lectures , Class Activity and Class Attendance.
- Workshop Practical Activities (Single/Groups Practical Activities).
- Reports for Practical Workshop Training and Lab Case Study.

VI.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Design a part showing the manufacturing sequence (using lath and milling machines).	a1,a2, b1,b2, c1,c2,d1,d2	6	5
2.	Machining the designed part.	a1,a2, b1,b2, c1,c2,d1,d2	11	5
Total				**10**

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes

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

1.	Practical Projects assessments Designing and machining a part using turning and milling machines,	10 th	15	10%	a1,a2, b1,b2, c1,c2,d1,d2
2.	Mid-Term Written Exam,	8th	45	30%	a1,a2, b1,b2, c1,c2,d1,d2
3.	Final Exam.	16 th	90	60%	a1,a2, b1,b2, c1,c2,d1,d2
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. John A. Schey (2000), Introduction to Manufacturing Processes, 3rd, Edition, McGraw Hill.
2. G. Boothroyd and W.A. Knight (2006), Fundamentals of Machining and Machine Tools, 3rd edition, CRC Taylor and Francis.

2- Essential References.

1. Serope Kalpakjian and Steven R. Schmid, (2001) "Manufacturing Engineering and Technology", 4th Edition, Prentice-Hall, Inc.,
2. DeGarmo, (1997) "Materials and Processes in Manufacturing", 2nd Edition, Prentice Hall,.
3. George Tlusty, (2000) Manufacturing Processes and Equipment, Prentice-Hall, Inc.,.

3- Electronic Materials and Web Sites *etc*.

Internet engine Search – Manufacturing Process Topics.
Video Cassettes / CDS .
Learning Materials Transparencies

IX.Course Policies:

1. **Class Attendance:**
The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and considered as an exam failure. If the student is absent due to illness, he/she should bring the approved statement from university Clinic.

2. **Tardy:**
For late in attending the class, the student will be initially notified. If he comes late in attending class again, he will consider as absent.

3. **Exam Attendance/Punctuality:**
The student should attend the exam on time. He is Permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in exam.

4. **Assignments & Projects:**

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

	In general, one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment.
5.	**Cheating**: For cheating in exam, the student considered as failure. Case the cheating repeated three times during study the student will disengage from the Faculty
6.	**Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other student. If the examination committee proved 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 Affair Council of the university.
7.	**Other Policies:** - The mobile phone is not allowed to be used during class lecture. It must be closed, otherwise the student will ask to leave the lecture room - The mobile phone is not allowed to be taken with in class during the examination. - Lecture notes and assignments may be 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. Head of Mechatronics Engineering Department: Assoc. Prof. Dr. Abdul-Malik Momin.
	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

Template for Course Plan of Manufacturing Processes

I. - Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Assoc. Prof. Dr. Amin Alkhulaidi	Office Hours					
Location& Telephone No.	712000446	SAT	SUN	MON	TUE	WED	THU
E-mail	Amin2001@y.net.ye						

II. Course Identification and General Information:

1.	Course Title:	Manufacturing Processes.				
2.	Course Code & Number:	MT207.				
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:	Third Year-Second Semester.				
5.	Pre –requisite (if any):	Engineering Workshop and Engineering Drawing.				
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 Workshop.				
11.	Location of teaching the course:					

III.Course Description:

This course covers fundamentals of manufacturing processes including interrelationships between the properties of the material and the manufacturing process under the classification of processing operations and the basic parameters involved in these processes. It will focus on the basic machining operations related to drilling, milling, grinding, and lathe and other processes. This course will encompass both theoretical and practical experiences related to the machining of different metals and will develop fundamental skills, practices and safety in working with machine tools, measurement instruments, and related equipment common to manufacturing.

IV.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	Define the behavior and properties of materials as they are altered and influenced by processing in manufacturing.	A1
a2.	Describe the different manufacturing processes, concept, capabilities process parameters, process optimization, and the advantages and limitations of various processes.	A2
b1.	Propose the suitable materials according to the application and machining process.	B2
b2.	Differentiate between different metal cutting operations and the optimum machining parameters; include feed, speed, cutting forces and the machining time for different cutting processes/materials.	B3
c1.	Conduct practical exposure to different, measuring, and machining with proper cutting parameters and methodologies through lab sessions.	C1
c2.	Perform the required sequence to machine a part and evaluate its size and tolerances to finish an acceptable product	C2
d1.	Assess the manufacturing processes in written technical report and oral seminar.	D1
d2.	Cooperate efficiently within a practical discussion and working as a team.	

V.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction to Manufacturing.	• Manufacturing a Product: General Considerations • Choosing Methods of Manufacturing • Classification of Manufacturing Processes • Introduction to Deformation Process, Polymer, Casting and Sheet Metal.	1	2
2.	Materials and Manufacturing.	• Introduction to Material Properties • Important Engineering Characteristics of Materials • Material-Process-Geometry Relationships.	2	2

		• Functional Parameters of Mechanical and Thermal Properties affected by Production Processes. • Factors affecting Material Properties during Machining.		
3.	Measurement and Inspection.	• Linear Measurement Metric System (millimeters), Gages , Graduated Measuring Devices. • Shape , Dimensions, Shape and Location Deviations. • Measurement Instruments Inspection Tools and Techniques. • Machined Parts Surface Roughness Measurements, Stylus, Optical Devices SEM. • Introduction to Nondestructive Testing Methods. • Common Application/uses of NDT. • Automated Inspection.	3	2
4.	Material Removal Processes.	• Cutting Tool Materials. • Cutting Tool Geometry. • Cutting Tool Types. • Cutting Tool/Machining Economics. • Machinability Principles. • Cutting Fluids. • Basic Chip Formation.	4	2

5.	Machining Processes - Lathe Theory and Geometry.	• Definition of a Lathe and its Components. • Types of Lathes. • Definition of Cutting Tool Theory. • Types of Work Holding in the Lathe. • Tool Geometry and Design. • Types of Cutting Tools. • Application of Cutting Tools for Turning Process, Threading, Boring, Taper Turning,.etc . • Machining Parameters, Speeds and Feeds. Material Removal Rate, Machining Time. • Design a Part (at least six operations) showing its Sequence to be Machined on the Lathe Machine.	5,6,7	6
6.	Mid-Term Exam.	• The First 5 Chapters.	8	2
7.	Machining Processes - Shaper and Planner Theory and Geometry.	• Type of Shaper/Planner Machines and their Working Mechanism. • Cutting Tool and Work Holding Fixtures. • Types of Cutting Tools and their Machining Applications. • Machining Parameters, Speeds, Feeds, Material Removal Rate, Machining Time.	9	2
8.	Machining Processes - Milling Machine Theory and Geometry.	• Definition of a Milling Machine. • Milling Machines Types (Vertical and Horizontal), Advantages and Disadvantages. • Principle of Milling Process. • Types of Vertical and Horizontal Milling Cutters and their Applications. • Cutting Tools Holding. • Work Holding in Milling. • The Indexing/Dividing Head Types and Applications to Produce Gears, and Regular Shapes.	10,11	

		• Type of Manufacturing Operations can be achieved using Vertical and Horizontal Milling Machines. • Machining Parameters, Speeds, Feeds, Material Removal Rate, Machining Time. • Designing and Machining a Part (using Vertical and Horizontal Milling Machines and the Dividing Head) showing the Suitable Cutting Cutters and the required Operation Sequence.		4
9.	Machining Processes –Drilling Theory and Geometry.	• Definitions and Types of Drilling Machines. • Types of Drilling Operations. • Cutting Tool and Work Holding Devices. • Cutting Tool Materials. • Cutting Tool Theory. • Types of Cutting Tools and Operations. • Safety Protection during Drilling. • Machining Parameters, Speeds, Feeds, Material Removal Rate, Machining Time.	12	2
10.	Machining Processes -Grinding Theory and Geometry.	• Principle of Abrasive Machining • Types of Abrasive Machining. • Types of Abrasives and Bond Materials. • Manufacturing of Grinding Wheels. • Safety and Care of Abrasive Wheels. • Measuring Residual Stresses and Surface Roughness. • Machining Parameters, Speeds, Feeds, Material Removal Rate, & Machining Time. • Applications using Surface, Cylindrical and Center-less	13,14	4

11.	Revision.	Final Exam Revision.	15	2
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 Session Devoted to Safety Issues in the Machine-shop.	1	2	a1,b2, c2,d2
2.	Material Test Lab.	2	2	a2, b1, b2 c1, d1, d2
3.	Measurements Tools – Workshop.	3	2	a1, b2, c1, d1, d2
4.	Cutting Tools Types and work holding Fixtures Types – Workshop.	4	2	a1, a2, b1, c1, c2, d1, d2
5.	Lathe Machines Types, Mechanism, Turning Tools, Process and Machining a Part by Lathe showing threading, boring and taper operations.	5,6	4	a2, b1, b2, c1, c2, d1, d2
6.	Shaper and Planner Machines Types, Mechanism, Shaper Tools, Process and Machining a Part by Shaper.	7	2	a2, b1,b2, c1,c2,d1,d2
7.	Milling Machines Types, Mechanism, Vertical and Horizontal Milling Cutters, Process and Machining a Part using Dividing Head (gear or regular shape) by Milling Machines.	8,9	4	a2, b1,b2, c1,c2,d1,d2
8.	Drill Machines Types, Mechanism, Drilling Tools, Process and Machining a Part by Drill.	10	2	a2, b1,b2, c1,c2,d1,d2
9.	Grinding Machines Types, Mechanism, Abrasive Grinding Wheels Types, Process and Machining a Part by Grinding Machine.	11,12	4	a2, b1,b2, c1,c2,d1,d2
10.	Practical Team Work Report and Machined Part Submission by Lathe and Milling Machines.	13,14	4	a1,a2, b1,b2, c1,c2,d1,d2
Number of Weeks /and Units Per Semester		**14**	**28**	

VI.Teaching strategies of the course:

- Lectures, Class Activity and Class Attendance.
- Workshop Practical Activities (Single/Groups Practical Activities).

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

- Reports for Practical Workshop Training & Lab. Case Study.

VII.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1.	Design a Part showing the Manufacturing Sequence (using lathe and milling machines).	a1,a2, b1,b2, c1,c2,d1,d2	6	5
2.	Machining the Designed Part.	a1,a2, b1,b2, c1,c2,d1,d2	11	5
Total				**10**

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Practical Projects Assessments Designing and Machining a Part using Turning and milling Machines,	10 th	15	10%	a1,a2, b1,b2, c1,c2,d1,d2
2.	Mid-Term Written Exam.	8th	45	30%	a1,a2, b1,b2, c1,c2,d1,d2
3.	Final Exam.	16 th	90	60%	a1,a2, b1,b2, c1,c2,d1,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. John A. Schey (2000), Introduction to Manufacturing Processes, 3rd, Edition, McGraw Hill.
2. G. Boothroyd and W.A. Knight (2006), Fundamentals of Machining and Machine Tools, 3rd edition, CRC Taylor and Francis.

2- Essential References.

1. Serope Kalpakjian and Steven R. Schmid, (2001) "Manufacturing Engineering and Technology", 4th Edition, Prentice-Hall, Inc.,
2. DeGarmo, (1997) "Materials and Processes in Manufacturing", 2nd Edition, Prentice Hall,.
3. George Tlusty, (2000) Manufacturing Processes and Equipment, Prentice-Hall, Inc.,.

3- Electronic Materials and Web Sites *etc*.	
	Internet engine Search – Manufacturing Process Topics. Video Cassettes / CDS. Learning Materials Transparencies.

X.Course Policies:	
1.	**Class Attendance:** The student should be attending not less than 75% of total contact hours of the subject, otherwise he will not able to take exam and considered as an exam failure. If the student is absent due to illness, he/she should bring the approved statement from university Clinic.
2.	**Tardy:** For late in attending the class, the student will be initially notified. If he comes late in attending class again, he will consider as absent.
3.	**Exam Attendance/Punctuality:** The student should attend the exam on time. He is Permitted to attend the exam half one hour from exam beginning, after that he/she will not be permitted to take exam and he/she is considered absent in exam.
4.	**Assignments & Projects:** In general, one assignment is given after each chapter of a course. The student should submit the assignment on time, mostly one week after giving the assignment.
5.	**Cheating**: For cheating in exam, the student considered as failure. Case the cheating repeated three times during study the student will disengage from the Faculty
6.	**Plagiarism**: Plagiarism is the attending of the student the exam of a course instead of other student. If the examination committee proved 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 Affair Council of the university.
7.	**Other Policies:** - The mobile phone is not allowed to be used during class lecture. It must be closed, otherwise the student will ask to leave the lecture room - The mobile phone is not allowed to be taken with in class during the examination. - Lecture notes and assignments may be given directly to students using soft or hard copy.

35.Course Specification of Industrial Instrumentation and Measurements

I.Course Identification and General Information:						
.1	Course Title:	Industrial Instrumentation & Measurements.				
.2	Course Code & Number:	MT208.				
.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:	Third Year-Second Semester.				
.5	Pre –requisite (if any):	Mathematics (1), Analog and Digital Signals and Electronics (2).				
.6	Co –requisite (if any):	Microcontrollers and Microprocessors.				
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:	Eng. Mahran Alabsie.				
11.	Date of Approval:					

II.Course Description:

This course is intended to broaden understanding of the fundamentals of measurements and instrumentation which is of great importance in Mechatronics Engineering as essential tools for giving insight into physical quantities. The course provides, the Basics of Measurement systems, Types of instruments, Methods of measuring, Static & Dynamic Characteristics of Instruments, Quantification of Systematic Errors, Random Errors Statistical Analysis, Principles of Calibration, Computer-Based Data Acquisition with Lab VIEW, Signal Processing with Lab VIEW, Analog and Digital Devices recording instruments, Sensor, and Transducers, Measurements of electrical and non-electrical parameters including : Current, Voltage , Power, Resistance, Capacitance, Inductance, Temperature, Pressure, Flow rate, Translational motion, Vibration, Mass, Force, Torque etc.

III.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs)
a1.	List out the necessary information data about the measurement such as: quantities ,precision; accuracy; reliability, uncertainty calculation and be aware of the various known sources of errors and methods how to avoid them in mechatronics system.	A1,A2,A3,A4
a2.	Characterize the principal elements of measurement systems and devices, different techniques, their function, performance characteristics, operation conditions and limits.	A1,A2,A3,A4
b1.	Analyze the theory of operation and response characteristics of the static and dynamic measurement system and calibration.	B1,B2,B3,B4,B5
b2.	Differentiate between the various methods for measuring: temperature, fluid parameters…. etc.	B1,B2,B3,B4,B5
c1.	Perform the lab. experiments within proper technical safety and use the proper measuring tools , sensors, data reductions for mechatronics system.	C1,C2,C3,C4
c2.	Implement measuring real system using Labview, microcontroller or any controller with industrial environment.	C1,C2,C3,C4
d1.	Review problem solving and design skills of computer applications and internet.	D1,D5,D6
d2.	Co-operate in a teamwork, presentation and communication skills.	D1,D5,D6

(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. List out the necessary information data about the measurement such as: quantities ,precision; accuracy; reliability, uncertainty calculation and be aware of the various known sources of errors and methods how to avoid them in mechatronics system.	Lectures, tutorials, experiments, class discussion.	Assignments, presentation, projects, test, written exam.
a2. Characterize the principal elements of measurement systems and devices, different techniques, their function, performance characteristics, operation conditions and limits.	Lectures, tutorials, experiments, class discussion.	Assignments, presentation, projects, test ,written exam.

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

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

b1. Analyze the theory of operation and response characteristics of the static and dynamic measurement system and calibration.	Lectures, tutorials, experiments, class discussion.	Assignments, presentation, projects, test ,written exam.
b2. Differentiate between the various methods for measuring: temperature, fluid parameters. etc.	Lectures, tutorials, experiments, class discussion.	Assignments, presentation, projects, test ,written exam.

© **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. Perform the lab. experiments within proper technical safety and use measuring tools. the proper sensors, data reductions for mechatronics system.	Lectures, tutorials,experments, class discussion.	Assignments, presentation, projects, test ,written exam.
c2. Implement measuring real system using Labview, microcontroller or any controller with industrial environment..	Lectures, tutorials, experiments, class discussion.	Assignments, presentation, projects, test ,written exam.

(D) **Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:**		
Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1. Review problem solving and design skills of computer applications and internet.	Lectures, tutorials,experments, class discussion.	Assignments, presentation, projects, test ,written exam.
d2. Co-operate in a teamwork, presentation and communication skills.	Lectures, tutorials, experiments, class discussion.	Assignments, presentation, projects, test ,written exam.

IV.Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Fundamentals of Measurement Systems.	a1, a2, b1, b2, c1, c2, d1, d2.	• Measurement Units. • Introduction to Measurement System. Applications	2	4

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			• Types of Measuring Instrument. • Static and Dynamic Characteristics of Measuring Instruments. • Calibration of Measuring Sensors and Instruments.		
2.	Uncertainty Analysis.	a1, a2, b1, b2, c1, c2, d1, d2.	• Sources of Systematic Error • Reduction of Systematic Errors • Quantification of Systematic Errors Random Errors • Statistical Analysis • Aggregation of Measurement Errors	2	4
3.	Analog Electrical Devices and Data Acquisition Measurements.	a1, a2, b1, b2, c1, c2, d1, d2.	• Analogue Meters (Deflection instruments). • Bridges as null method measurement. • Amplifiers and filter.	1	2
4.	Sensor Technologies.	a1, a2, b1, b2, c1, c2, d1, d2.	• Resistive sensing elements • Capacitive sensing elements • Inductive sensing elements • Piezoelectric sensing elements • Hall effect sensing elements. • Thermoelectric sensing element	2	4

			• Optical sensing elements		
5.	Mid-Term Exam.	a1, a2, b1, b2, c1, c2.	• The first four chapters.	1	2
6.	Measurement of Basic Parameters.	a1, a2, b1, b2, c1, c2, d1, d2	• Level & Displacement measurement. • Velocity and acceleration. measurement. • Temperature measurement • Force, torque measurement. • Pressure measurement • Flow measurement	6	12
7.	Data Acquisition with LabVIEW.	a1, a2, b1, b2, c1, c2, d1, d2	• Programming in LabVIEW.	1	2
8.	Final Exam.	a1, a2, b1, b2, c1, c2.	• 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.	**Lab1**: Introduction. Overview on Measurement Laboratory: Working Rules, Safety, and Dimensional Analysis.	1	2	a1, a2, b1, b2, c1, c2, d1, d2
2.	**Lab. 2:** Measurement Analysis, Calibration and Uncertainty analysis.	2	4	a1, a2, b1, b2, c1, c2, d1, d2.

3.	**Lab. 3:** Labview • Labview Programming Installation. • Software Tools for Laboratory Data Acquisition: Introduction to LabView. • LabVIEW Function Generation. • Logic Operations in LabVIEW. • Loops in LabVIEW. • Read/Write Data from Files.	3	6	a1, a2, b1, b2, c1, c2, d1, d2.
4.	**Lab: 4 and 5:** Practical Measurement • Voltage and Resistance Measurement. • Pot Position Measurement.	2	4	a1, a2, b1, b2, c1, c2, d1, d2.
5.	**Lab: 6,7,8,9,10 and 11:** Industrial Measurement and Data Acquisition. • Level Measurement. • Temperature Measurement. • Strain Gauge measurement. • Speed Measurements. • Force &Torque Measurements. • Flow Rate Measurements.	6	12	a1, a2, b1, b2, c1, c2, d1, d2
Number of Weeks /and Units Per Semester		**14**	**28**	

V.Teaching strategies of the course:

- Lectures.
- Tutorials.
- Experiments.
- Group Discussion.

VI.Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark

1.	Homework.	a1, a2, b1, b2, c1, c2, d1, d2.	1-14	30
2.	Presentation.			
3.	Mini Projects.			
Total				**30**

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.	1-14	45	30%	a1, a2, b1, b2, c1, c2.
2.	Mid-Term Exam.	8	15	10%	
3.	Final Exam.	16	90	60%	
Total			**150**	**100%**	

VIII.Learning Resources:

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

- David G. Alciatore, Michael B. Histand, 2012, Introduction to Mechatronics and Measure Systems, 4 th edition, Colorido State University.
- Christopher T. Kilian, 2005, Modern Control and Technology : Control and System 3 rd ed

2- Essential References.

- **S**.P. Venkateshan, 2015, MECHANICAL MEASUREMENTS (2nd Edition)
- Richard S. Figliola, Donald E. Beasley, 2011, Theory and Design for Mechanical Measurements.

3- Electronic Materials and Web Sites *etc*.

- https://nptel.ac.in/

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.
	Deputy Rector for Academic Affairs Assoc. Prof. Dr. Ibrahim AlMutaa. Assoc. Prof. Dr. Ahmed Mujahed. Asst. Prof.Dr. Munaser Alsubari.

	IX.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 midterm exam and final exam.
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.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 behalf according to the policy, rules and regulations of the university.
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 Instrumentation and Measurements.

I.Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Eng. Mahran Alabsie.	**Office Hours**					
Location& Telephone No.	772764549.	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	Mhran.150@gmail.com.						

II.Course Identification and General Information:						
1.	Course Title:	Industrial Instrumentation and Measurements.				
2.	Course Number & Code:	MT208.				
3.	Credit hours:	C.H				Total Credit Hours
		Th.	Seminar	Pr.	Tu.	
		2		2	-	3
4.	Study level/year at which this course is offered:	Third Year-Second Semester.				
5.	Pre –requisite (if any):	Mathematics (1), Analog and Digital Signals and Electronics (2).				
6.	Co –requisite (if any):	Microprocessors and Microcontrollers.				
7.	Program (s) in which the course is offered	Engineering Program.				
8.	Language of teaching the course:	English Language.				
9.	System of Study:	Semesters.				
10.	Mode of delivery:	Lectures and Lab. Work.				
11.	Location of teaching the course:	Mechatronics Engineering Department.				

III.Course Description:

This course is intended to broaden understanding of the fundamentals of measurements and instrumentation which is of great importance in Mechatronics Engineering as essential tools for giving insight into physical quantities. The course provides, the Basics of Measurement systems, Types of instruments, Methods of measuring, Static & Dynamic Characteristics of Instruments, Quantification of Systematic Errors, Random Errors Statistical Analysis, Principles of Calibration, Computer-Based Data Acquisition with Lab VIEW, Signal Processing with Lab VIEW, Analog and Digital Devices recording instruments, Sensor, and Transducers, Measurements of electrical and non-electrical parameters including : Current, Voltage , Power, Resistance, Capacitance, Inductance, Temperature, Pressure, Flow rate, Translational motion, Vibration, Mass, Force, Torque etc.

IV.Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a1.	List out the necessary information data about the measurement such as: quantities ,precision; accuracy; reliability, uncertainty calculation and be aware of the various known sources of errors and methods how to avoid them in mechatronics system.	A1,A2,A3,A4
a2.	Characterize the principal elements of measurement systems and devices, different techniques, their function, performance characteristics, operation conditions and limits.	A1,A2,A3,A4
b1.	Analyze the theory of operation and response characteristics of the static and dynamic measurement system and calibration.	B1,B2,B3,B4,B5
b2.	Differentiate between the various methods for measuring: temperature, fluid parameters…..etc.	B1,B2,B3,B4,B5
c1.	Perform the lab. experiments within proper technical safety and use the proper measuring tools , sensors, data reductions for mechatronics system.	C1,C2,C3,C4
c2.	Implement measuring real system using Labview, microcontroller or any controller with industrial environment.	C1,C2,C3,C4
d1.	Review problem solving and design skills of computer applications and internet.	D1,D5,D6
d2.	Co-operate in a teamwork, presentation and communication skills.	D1,D5,D6

V.Course Content:

A – Theoretical Aspect:

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5.	Mid-Term Exam.	• The first four chapters.	8	2
6.	Measurement of Basic Parameters.	• Level & Displacement measurement. • Velocity and acceleration. measurement. • Temperature measurement • Force , torque measurement. • Pressure measurement • Flow measurement	9,10,11,12 ,13,14	12
7.	Data Acquisition with LabVIEW.	• Programming in LabVIEW	15	2
8.	Final Exam.	• All the chapters.	16	2
Number of Weeks /and Units Per Semester			16	32

B - Practical Aspect:

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	• Read/Write Data from Files.			
4.	**Lab: 4 and 5:** Practical Measurement • Voltage and Resistance Measurement. • Pot Position Measurement.	7,8	4	a1, a2, b1, b2, c1, c2, d1, d2.
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Number of Weeks /and Units Per Semester		**14**	**28**	

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