Sana'a University
Faculty of Engineering
Mechatronics Engineering Department
Mechatronics Engineering Program

Course Specification of Industrial Automation

I. Course Identification and General Information:						
1.	Course Title:	Industrial Automation.				
2.	Course Code & Number:	MT306.				
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):	Manufacturing Process, Analog Control System, and Hydraulic and Pneumatic Systems.				
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:	Ass. Prof. Dr. Khalil Al-Hatab				
11.	Date of Approval:					

II.Course Description:

This course is planned primarily for the design and integration of automated systems for industrial and manufacturing applications. The topics covered are: introduction to automation, overview of

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Ass. Prof. Dr. Khalil Al-Hatab	Ass. Prof. Dr. Abdul-Malik Momin	Ass. Prof. Dr. Mohammad Algorafi	Prof. Dr. Mohammed AL-Bukhaiti	Ass. Prof. Dr. Huda Al-Emad

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manufacturing, NC, CNC, DNC, material handling, group technology, flexible manufacturing systems, process planning and control. In addition, emphasis is on aspects of automation, types of automated manufacturing systems, production planning and procedures, integration of components, process developments and practical methods.

III. Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a.1	Describe basic concepts underlying today's technologies used in the field of automation and their applications in manufacturing systems.	A1
a.2	Depict the fundamental elements of automation including basic structures and hardware and software used in the design of automated manufacturing systems.	A2
a.3	Classify various levels and strategies of automation and control systems that are commonly used in industry.	A7
a.4	Explain basic understanding of the fundamental networking concepts that help in integrating all important components of a manufacturing enterprise.	A8
b.1	Analyze problems related to production flow lines, part features, design of automated assembly systems, and flexible manufacturing systems.	B1
b.2	Investigate the requirement for numerically controlled production system and NC part programming.	B2
b.3	Explore the degrees of automation and type of hardware that might be required in an automated manufacturing plant.	B3
b.4	Differentiate between manufacturing environments where manual labor or automation might be the best solution.	B6

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c.1	Conduct programming and experiments on the use of modern manufacturing equipment such as CNC machine tools.	C1
c.2	Practice various simulation and real-time computer tools on the design and control of automated manufacturing processes and systems.	C2
c.3	Choose suitable automation hardware components for a given manufacturing application.	C3
d.1	Co-operate in work as a team leader or a part of a team coherently and share learned knowledge successfully.	D1
d.2	Assess to self-learning capability on industrial automation and flexible manufacturing systems.	D5
d.3	Examine technical reports, discuss ideas, and justify results creatively during lab sessions and course-project.	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. Describe basic concepts underlying today's technologies used in the field of automation and their applications in manufacturing systems	• Active Lectures. • Independent Learning and Work. • Home-works and Assignments.	• Written Assessment. • Short Essays.
a2. Depict the fundamental elements of automation including basic structures and hardware and	• Active Lectures. • Design Work and Project. • Case Studies.	• Written Assessment • Project Reports. • Case Studies.

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software used in the design of automated manufacturing systems.	• Home-works and Assignments.	
a3. Classify various levels and strategies of automation and control systems that are commonly used in industry.	• Active Lectures. • Design Work and Project. • Case Studies. • Home-works and Assignments.	• Written Assessment • Project Reports. • Case Studies.
a4. Explain basic understanding of the fundamental networking concepts that help in integrating all important components of a manufacturing enterprise.	• Active Lectures. • Design Work and Project. • Case Studies.	• Written Assessment • Project Reports. • Case Studies.

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

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1. Analyze problems related to production flow lines, part features, design of automated assembly systems, and flexible manufacturing systems.	• Active Lectures. • Group Learning and Problem-Based Learning. • Case Studies.	• Written Assessment • Practical Assessment. • Project Reports. • Laboratory Reports. • Case Studies.
b2. Investigate the requirement for numerically controlled production system and NC part programming.	• Active Lectures. • Independent Applications of Engineering Analysis • Independent Learning and Work.	• Written Assessment • Practical Assessment. • Laboratory Reports.

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b3. Explore the degrees of automation and type of hardware that might be required in an automated manufacturing plant.	• Active Lectures. • Design Work and Project. • Case Studies. • Home-works and Assignments.	• Written Assessment • Practical Assessment. • Laboratory Reports.
b4. Differentiate between manufacturing environments where manual labor or automation might be the best solution.	• Active Lectures. • Case Studies.	• Written Assessment. • Case Studies.

(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. Conduct programming and experiments on the use of modern manufacturing equipment such as CNC machine tools.	• Hands-on Laboratory Work. • Design Work and Project.	• Written Assessment • Practical Assessment. • Simulations. • Presentations.
c2. Practice various simulation and real-time computer tools on the design and control of automated manufacturing processes and systems.	• Hands-on Laboratory Work. • Computer and Web-Based Learning. • Design Work and Project.	• Practical Assessment. • Simulations. • Presentations
c3. Choose suitable automation hardware components for a given manufacturing application.	• Active Lectures. • Hands-on Laboratory Work. • Design Work and Project. • Home-works and Assignments.	• Written Assessment • Practical Assessment • Project Reports.

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(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.	• Hands-on Laboratory Work. • Group Learning. • Design Work and Projects.	• Practical Assessment. • Project Reports. • Presentations
d2. Assess to self-learning capability on industrial automation and flexible manufacturing systems.	• Directed Self-Study. • Independent Learning and Work. • The Use of Communication and Information Technology. • Home-works and Assignments.	• Practical Assessment. • Presentations.
d3. Examine technical reports, discuss ideas, and justify results creatively during lab sessions and course-project.	• Design Work and Projects • Hands-on Laboratory Work.	• Practical Assessment. • Project Reports. • Presentations.

IV. Course Content

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction.	a1,a3, d2	• Course Overview • Production Systems • Automation	1	2

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			• Automation in Production Systems • Automation Principles and Strategies • Elements of an Automated System • Advanced Automation Functions • Levels of Automation		
2.	Automation and Productivity Concepts.	a1,a3, b4, d2	• Automation Justification and Productivity • Production Performance Metrics • Manufacturing Costs • Productivity and the USA Principle	1	2
3.	Introduction to Computer Numerical Control (CNC).	a1, a2, a4, b2, b3, c1, c2, c3, d2, d3	• CNC System Components • Coordinate Systems and Reference Points • Applications of NC • Analysis of Positioning Systems • The Ten Steps of CNC Programming	1	2

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			• Advantages and Disadvantages of CNC Technology • When to Use CNC Technology		
4.	CNC Programming.	a1, b2, c1, c2, d2, d3	• Overview of CNC Programming • Program Code • Cutting Parameters • Program Organization • Programming Process • Turning Programs • Milling Programs	2	4
5.	Material Transport Systems.	a1, a2, a4, b2, b3, c3, d2, d3	• Overview of Material Handling • Material Transport Equipment • Analysis of Material Transport Systems • Automated Storage Systems • Analysis of Storage Systems • Automatic Identification Methods	2	4

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6.	Mid-Term Exam.	a1, a2, a3, a4, b1. b2, b3, b4, c1, c2, c3	• The first 5 chapters.	1	2
7.	Manufacturing Systems: Part 1.	a1, a2, a4, b2, b3, c3, d3, d2	• Components of a Manufacturing System • Types of Manufacturing Systems • Single-Station Manufacturing Cells • Analysis of Single-Station Cells • Analysis of Single-Model Assembly Lines • Line Balancing Algorithms • Workstation Details • Considerations in Assembly Line Design • Alternative Assembly Systems	2	4
8.	Manufacturing Systems: Part 2.	a1, a2, a4, b2, b3, c3, d3, d2	• Automated Production and Assembly Systems: • Fundamentals of Automated Production Lines • Analysis of Transfer Lines	2	4

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			• Fundamentals of Automated Assembly Systems • Analysis of Automated Assembly Systems		
9.	Manufacturing Systems: Part 3.	a1, a2, a4, b2, b3, c3, d3, d2	• Group Technology and Cellular Manufacturing: • Part Families and Machine Groups • Cellular Manufacturing • Applications of Group Technology • Analysis of Cellular Manufacturing	1	2
10.	Manufacturing Systems: Part 4.	a1, a2, a4, b2, b3, c3, d3, d2	• Flexible Manufacturing Cells and Systems: • What Is a Flexible Manufacturing System? • FMC/FMS Components • FMS Application Considerations • Analysis of Flexible Manufacturing Systems • Alternative Approaches to Flexible Manufacturing	1	2

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11.	Manufacturing Support Systems.	a1, a2, a4, b2, b3, c3, d3, d2	• Product Design and CAD/CAM • Process Planning and Concurrent Engineering • Production Planning and Control Systems • Just-In-Time and Lean Production	1	2
12.	Final Exam.	a1, a2, a3, a4, b1. b2, b3, b4, c1, c2, c3	• 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.	Safety Considerations.	1	2	c1, c2, c3, d1, d2, d3
2.	CNC Simulation.	2	4	b2, c1, c2, c3, d1, d2, d3
3.	Getting to Know Boxford Software.	1	2	b2, c1, c2, c3, d1, d2, d3
4.	CNC Components.	1	2	b2, c1, c2, c3, d1, d2, d3
5.	CNC Operating Manual.	1	2	b2, c1, c2, c3, d1, d2, d3
6.	Milling Project 1.	1	2	b2, c1, c2, c3, d1, d2, d3

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7.	Milling Project 2.	1	2	b2, c1, c2, c3, d1, d2, d3
8.	Milling Project 3.	1	2	b2, c1, c2, c3, d1, d2, d3
9.	Automated Assembly Line.	1	2	a4, b1, b2, c1, c2, c3, d1,d2,d3
10.	Group Technology.	2	4	a4, b1, b2, c1, c2, c3, d1,d2,d3
11.	CAPPC.	1	2	a4, b1, b2, c1, c2, c3, d1,d2,d3
12.	Final Practical Exam.	1	2	a4, b1, b2, c1, c2, c3, d1,d2,d3
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.
- Hands-on Laboratory Work.
- Independent Learning and Work.
- Group Learning and Problem-Based Learning.
- Independent Applications of Engineering Analysis.
- The Use of Communication and Information Technology.
- Computer and Web-Based Learning.
- Case Studies.
- Design Work and Projects.
- Directed Self-Study.
- Home-Works and Assignments.

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VI. Assessment Methods of the Course:

The assessment methods of the course are as follows:

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

VII. Assignments:

Order	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1.	Automation Justification and Productivity Concepts.	a1, a3, b4, d2, d3	3rd	1.5
2.	Introduction to Computer Numerical Control (CNC).	a1, a2, a4, b2, b3, d2, d3	4th	3
3.	CNC Programming.	a1, b2, c1, c2, d1, d2, d3	5th	1.5
4.	Material Transport Systems.	a1, a2, a4, b2, b3, c3, d3	8h	1.5
5.	Manufacturing Systems: Part 1.	a1, a2, a4, b2, b3, c3, d3	10th	1.5
6.	Manufacturing Systems: Part 2.	a1, a2, a4, b2, b3, c3, d3	11th	1.5
7.	Manufacturing Systems: Part 3.	a1, a2, a4, b2, b3, c3, d3	12th	1.5
8.	Manufacturing Systems: Part 4.	a1, a2, a4, b2, b3, c3, d3	13th	1.5

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9.	Manufacturing Support Systems.	a1, a2, a4, b2, b3, c3, d3	14th	1.5
Total				**15**

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

Order	Assessment Method	Week Due	Marks	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Home Assignments.	3rd to 14th	15	10%	a1, a2, a4, b2, b3, c3, d2, d3
2.	Practical Reports.	4th to 12th	10.5	7%	b2, c1, c2, c3, d1,d2,d3
3.	Quizzes.	4th, 10th	4.5	3%	a1, a2, a4, b2, b3, c3, d2, d3
4.	Final Practical Exam.	15th	10.5	7%	a4, b1, b2, c1, c2, c3, d1,d2,d3
5.	Mid-Term Exam.	8th	15	10%	a1, a2, a4, b2, b3, c1, c2, c3, d2, d3
6.	Projects.	8th – 14th	4.5	3%	a4, b1, b2, c1, c2, c3, d1,d2,d3
7.	Final Exam.	16th	90	60%	a1, a2, a4, b2, b3, c3, d2, d3
Total			**150**	**100%**	

IX. Learning Resources:

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

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1- Required Textbook(s) (maximum two).	
	1- Groover P., 2015, Automation, Production Systems, and Computer Integrated Manufacturing, 4th Edition, NJ-USA, Prentice Hall, Inc.
2- Essential References.	
	1- John W. Webb and Ronald A. Reiss, 2002, Programmable Logic Controllers - Principle and Applications, 5th edition, N.J., USA, Prentice Hall. 2- P. Radhakrishnan, S. Subramanyam and V. Raju, 2008, CAD/CAM/CIM, 3 rd Edition, New Delhi, New Age International. 3- Miltiadis A. Boboulos, 2010, CAD-CAM & Rapid Prototyping Application Evaluation, Ventus Publishing ApS. 4- Beno Benhabib, 2003, Manufacturing Design, Production, Automation, and Integration, NY-USA, Marcel Dekker Publisher. 5- Mikell P. Groover, 2002, Fundamentals of Modern Manufacturing: Materials, Processes, And Systems, 2nd Edition, NY-USA, John Wiley & Sons, Inc. 6- Lee Kunwoo, 1999, Principles of CAD/CAM/CAE Systems, NY-USA, Addison-Wesley-Longman Inc. 7- Frank D. Petruzella, 2011, Programmable Logic Controllers, 4 th edition, NY-USA, McGraw-Hill.
3- Electronic Materials and Web Sites *etc*.	
	1- Website: CAD/CAM

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	https://www.onlineresourcesinc.com/category/CAD-CAM 2- Website: Solid-Professor https://www.solidprofessor.com/ 3- Website: Automatic CNC Programs Generation https://www.pycam.sourceforge.net

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 has to face the examination committee for enquires.

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6.	**Plagiarism**: The student will be terminated from the Faculty, if one student attend 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.

Reviewed By	Vice Dean for Academic Affairs and Post Graduate Studies: Dr. Tarek A. Barakat President of Quality Assurance Unit: Ass. Prof. Dr. Mohammed Algorafi Head of Mechatronics Engineering Department: Ass. Prof. Dr. Abdul-Malik Momin Dr. Hatem Al-Dois
	Deputy Rector for Academic Affairs Dr. Ibrahim AlMutaa Ass. Prof. Dr. Ahmed Mujahed Dr. Munaser Alsubri

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Course Plan of Industrial Automation

I. Information about Faculty Member Responsible for the Course:

Name of Faculty Member	Ass. Prof. Dr. Khalil Al-Hatab	**Office Hours**					
Location& Telephone No.	Department of Mechanical Engineering 771157027	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	alhatab22@yahoo.com						

II. Course Identification and General Information:

1.	Course Title:	Industrial Automation.				
2.	Course Code & Number:	MT306.				
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):	Manufacturing Process, Analog Control System, and Hydraulic and Pneumatic Systems.				
6.	Co –Requisite (if any):	None.				
7.	Program (s) in which the Course is offered:	Mechatronics Engineering Program.				

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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 planned primarily for the design and integration of automated systems for industrial and manufacturing applications. The topics covered are: introduction to automation, overview of manufacturing, NC, CNC, DNC, material handling, group technology, flexible manufacturing systems, process planning and control. In addition, emphasis is on aspects of automation, types of automated manufacturing systems, production planning and procedures, integration of components, process developments and practical methods.

IV. Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a.1	Describe basic concepts underlying today's technologies used in the field of automation and their applications in manufacturing systems.	A1
a.2	Depict the fundamental elements of automation including basic structures and hardware and software used in the design of automated manufacturing systems.	A2

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a.3	Classify various levels and strategies of automation and control systems that are commonly used in industry.	A7
a.4	Explain basic understanding of the fundamental networking concepts that help in integrating all important components of a manufacturing enterprise.	A8
b.1	Analyze problems related to production flow lines, part features, design of automated assembly systems, and flexible manufacturing systems.	B1
b.2	Investigate the requirement for numerically controlled production system and NC part programming.	B2
b.3	Explore the degrees of automation and type of hardware that might be required in an automated manufacturing plant.	B3
b.4	Differentiate between manufacturing environments where manual labor or automation might be the best solution.	B6
c.1	Conduct programming and experiments on the use of modern manufacturing equipment such as CNC machine tools.	C1
c.2	Practice various simulation and real-time computer tools on the design and control of automated manufacturing processes and systems.	C2
c.3	Choose suitable automation hardware components for a given manufacturing application.	C3
d.1	Co-operate in work as a team leader or a part of a team coherently and share learned knowledge successfully.	D1
d.2	Assess to self-learning capability on industrial automation and flexible manufacturing systems.	D5
d.3	Examine technical reports, discuss ideas, and justify results creatively during lab sessions and course-project.	D6

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V. Course Content:

- Distribution of Semester Weekly Plan Of course Topics/Items and Activities.

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction.	• Course Overview • Production Systems • Automation • Automation in Production Systems • Automation Principles and Strategies • Elements of an Automated System • Advanced Automation Functions • Levels of Automation	1	2
2.	Automation and Productivity Concepts.	• Automation Justification and Productivity • Production Performance Metrics • Manufacturing Costs • Productivity and the USA Principle	2	2
3.	Introduction to Computer Numerical Control (CNC).	• CNC System Components • Coordinate Systems and Reference Points • Applications of NC • Analysis of Positioning Systems • The Ten Steps of CNC Programming • Advantages and Disadvantages of CNC Technology	3	2

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		• When to Use CNC Technology		
4.	CNC Programming.	• Overview of CNC Programming • Program Code • Cutting Parameters • Program Organization • Programming Process • Turning Programs • Milling Programs	4,5	4
5.	Material Transport Systems.	• Overview of Material Handling • Material Transport Equipment • Analysis of Material Transport Systems • Automated Storage Systems • Analysis of Storage Systems • Automatic Identification Methods	6,7	4
6.	Mid-Term Exam.	The first 5 chapters.	8	2
7.	Manufacturing Systems: Part 1.	• Components of a Manufacturing System • Types of Manufacturing Systems • Single-Station Manufacturing Cells • Analysis of Single-Station Cells • Analysis of Single-Model Assembly Lines • Line Balancing Algorithms • Workstation Details • Considerations in Assembly Line Design • Alternative Assembly Systems	9,10	4

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8.	Manufacturing Systems: Part 2.	**Automated Production and Assembly Systems:** • Fundamentals of Automated Production Lines • Analysis of Transfer Lines • Fundamentals of Automated Assembly Systems • Analysis of Automated Assembly Systems	11,12	4
9.	Manufacturing Systems: Part 3.	**Group Technology and Cellular Manufacturing:** • Part Families and Machine Groups • Cellular Manufacturing • Applications of Group Technology • Analysis of Cellular Manufacturing	13	2
10.	Manufacturing Systems: Part 4.	**Flexible Manufacturing Cells and Systems:** • What Is a Flexible Manufacturing System? • FMC/FMS Components • FMS Application Considerations • Analysis of Flexible Manufacturing Systems • Alternative Approaches to Flexible Manufacturing	14	2
11.	Manufacturing Support Systems.	• Product Design and CAD/CAM • Process Planning and Concurrent Engineering • Production Planning and Control Systems • Just-In-Time and Lean Production	15	2

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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.	Safety Considerations.	1	2	c1, c2, c3, d1, d2, d3
2.	CNC Simulation.	2,3	4	b2, c1, c2, c3, d1, d2, d3
3.	Getting to Know Boxford Software.	4	2	b2, c1, c2, c3, d1, d2, d3
4.	CNC Components.	5	2	b2, c1, c2, c3, d1, d2, d3
5.	CNC Operating Manual.	6	2	b2, c1, c2, c3, d1, d2, d3
6.	Milling Project 1.	7	2	b2, c1, c2, c3, d1, d2, d3
7.	Milling Project 2.	8	2	b2, c1, c2, c3, d1, d2, d3
8.	Milling Project 3.	9	2	b2, c1, c2, c3, d1, d2, d3
9.	Automated Assembly Line.	10	2	a4, b1, b2, c1, c2, c3, d1,d2,d3
10.	Group Technology.	11,12	4	a4, b1, b2, c1, c2, c3, d1,d2,d3
11.	CAPPC.	13	2	a4, b1, b2, c1, c2, c3, d1,d2,d3
12.	Final Practical Exam.	14	2	a4, b1, b2, c1, c2, c3, d1,d2,d3
Number of Weeks /and Units Per Semester		**14**	**28**	

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VI. Teaching Strategies of the Course:

The teaching strategies of the course are as follows:

- Active Lectures.
- Hands-on Laboratory Work.
- Independent Learning and Work.
- Group Learning and Problem-Based Learning.
- Independent Applications of Engineering Analysis.
- The Use of Communication and Information Technology.
- Computer and Web-Based Learning.
- Case Studies.
- Design Work and Projects
- Directed Self-Study.
- Home-Works and Assignments.

VII. Assignments:

Order	Assignments	Aligned CILOs (symbols)	Week Due	Mark
1.	Automation Justification and Productivity Concepts.	a1, a3, b4, d2, d3	3rd	1.5
2.	Introduction to Computer Numerical Control (CNC).	a1, a2, a4, b2, b3, d2, d3	4th	3
3.	CNC Programming.	a1, b2, c1, c2, d1, d2, d3	5th	1.5
4.	Material Transport Systems.	a1, a2, a4, b2, b3, c3, d3	8h	1.5
5.	Manufacturing Systems: Part 1.	a1, a2, a4, b2, b3, c3, d3	10th	1.5
6.	Manufacturing Systems: Part 2.	a1, a2, a4, b2, b3, c3, d3	11th	1.5

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7.	Manufacturing Systems: Part 3.	a1, a2, a4, b2, b3, c3, d3	12th	1.5
8.	Manufacturing Systems: Part 4.	a1, a2, a4, b2, b3, c3, d3	13th	1.5
9.	Manufacturing Support Systems.	a1, a2, a4, b2, b3, c3, d3	14th	1.5
Total				**15**

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

Order	Assessment Method	Week Due	Marks	Proportion of Final Assessment	Aligned Course Learning Outcomes
1.	Home Assignments.	3rd to 14th	15	10%	a1, a2, a4, b2, b3, c3, d2, d3
2.	Practical Reports.	4th to 12th	10.5	7%	b2, c1, c2, c3, d1,d2,d3
3.	Quizzes.	4th, 10th	4.5	3%	a1, a2, a4, b2, b3, c3, d2, d3
4.	Final Practical Exam.	15th	10.5	7%	a4, b1, b2, c1, c2, c3, d1,d2,d3
5.	Mid-Term Exam.	8th	15	10%	a1, a2, a4, b2, b3, c1, c2, c3, d2, d3
6.	Projects.	8th – 14th	4.5	3%	a4, b1, b2, c1, c2, c3, d1,d2,d3
7.	Final Exam.	16th	90	60%	a1, a2, a4, b2, b3, c3, d2, d3
Total			**150**	**100%**	

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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- Groover P., 2015, Automation, Production Systems, and Computer Integrated Manufacturing, 4th Edition, NJ-USA, Prentice Hall, Inc.

2- Essential References.

1- John W. Webb and Ronald A. Reiss, 2002, Programmable Logic Controllers - Principle and Applications, 5 th edition, N.J., USA, Prentice Hall.

2- P. Radhakrishnan, S. Subramanyam and V. Raju, 2008, CAD/CAM/CIM, 3 rd Edition, New Delhi, New Age International.

3- Miltiadis A. Boboulos, 2010, CAD-CAM & Rapid Prototyping Application Evaluation, Ventus Publishing ApS.

4- Beno Benhabib, 2003, Manufacturing Design, Production, Automation, and Integration, NY-USA, Marcel Dekker Publisher.

5- Mikell P. Groover, 2002, Fundamentals of Modern Manufacturing: Materials, Processes, And Systems, 2 nd Edition, NY-USA, John Wiley & Sons, Inc.

6- Lee Kunwoo, 1999, Principles of CAD/CAM/CAE Systems, NY-USA, Addison-Wesley-Longman Inc.

7- Frank D. Petruzella, 2011, Programmable Logic Controllers, 4 th edition, NY-USA, McGraw-Hill.

3- Electronic Materials and Web Sites *etc*.

1- Website: CAD/CAM
https://www.onlineresourcesinc.com/category/CAD-CAM

2- Website: Solid-Professor
https://www.solidprofessor.com/

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	3- Website: Automatic CNC Programs Generation https://www.pycam.sourceforge.net

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 has to face the examination committee for enquires.

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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.

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