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ENDÜSTRİ MÜHENDİSLİĞİ BÖLÜMÜ
ENDÜSTRİ MÜHENDİSLİĞİ LİSANS PROGRAMI (İNGİLİZCE)

Course Name	**Code**	**Semester**	**Theory (hours/week)**	**Application (hours/week)**	**Laboratory (hours/week)**	**National Credit**	**ECTS**
Computer Networks	**EMÜ412**	Fall/ Spring	3	0	0	3	6
Prerequisites	None						
Course language	English						
Course type	Elective						
Mode of Delivery	Face-to-face						
Learning and Teaching strategies	Lecture, question and answer, problem solving, individual work, team/group work, project design/management, preparing and presenting report.						
Instructor (s)	To be determined by the department						
Course Objective	• The learning objective of this course is to introduce students to the basics of computer networks, the governing protocols, networking and Internet within the perspective of industrial engineering.						
Learning outcomes	Upon completion of this course, the students should be able to • Explain the operation of computer networks. • Realize the advantages of layered architectures • Comprehend the operation of computer protocols and protocols in general • Design an internetwork • Propose improvements for real life protocols within organizations/work environments • Explain classical TCP/IP Applications such as DHCP and Multicasting						
Course Content	• The course covers the topics of computer networks in a top-down approach starting from the basics of the networking, the service oriented approach and continuing with the layered structure from the application layer to the link layer. Contemporary subjects such as wireless and mobile networks, network management and sensor networks that can be found in industrial environments are covered.						
References	• Kurose, J., Koffman, E.B. (2012) Computer Networking: A Top-Down Approach, Pearson, 6th ed. • Tanenbaum, A. (2010) Computer Networks, Prentice Hall, 5th ed.						

Course Outline Weekly

Weeks	Topics
1.	Introduction to Computer Networks & the Internet
2.	Introduction to Computer Networks & the Internet
3.	Application Layer
4.	Application Layer
5.	Transport Layer
6.	Transport Layer
7.	The Network Layer
8.	The Network Layer
9.	Midterm exam
10.	The Link Layer
11.	The Link Layer
12.	Wireless and Sensor Networks
13.	Network Management
14.	Network Security
15.	Study for the Final Exam
16.	Final exam

Assessment Methods

Course activities	**Number**	**Percentage**
Attendance		
Laboratory		
Application		
Field activities		
Specific practical training		
Assignments	5	15%
Presentation		
Project		
Seminar		
Midterms	1	35%
Final exam	1	50%
Total	7	100%
Percentage of semester activities contributing grade success	6	50%
Percentage of final exam contributing grade success	1	50%
Total		100%

Workload and ECTS Calculation

Activities	Number	Duration (hour)	Total Work Load
Course Duration (x14)	14	3	42
Laboratory			
Application			
Specific practical training			
Field activities			
Study Hours Out of Class (Preliminary work, reinforcement, etc.)	13	5	65
Presentation / Seminar Preparation			
Project			
Homework assignment	5	6	30
Midterms (Study duration)	1	18	18
Final Exam (Study duration)	1	25	25
Total Work Load			180

MATRIX OF THE COURSE LEARNING OUTCOMES VERSUS PROGRAM OUTCOMES

Program Outcomes	**Contribution level**				
	1	2	3	4	5
1			X		
2				X	
3					X
4			X		
5		X			
6			X		
7					X
8				X	
9		X			
10			X		

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Course Name	Code	Semester	Theory (hours/week)	Application (hours/week)	Laboratory (hours/week)	National Credit	ECTS
Network Flow Analysis	**EMÜ423**	Fall/ Spring	3	-	-	3	6
Prerequisites	EMÜ221 or EMÜ222						
Course language	English						
Course type	Elective						
Mode of Delivery	Face to Face						
Learning and teaching strategies	Lectures, question-answer, problem solving, personal study						
Instructor (s)	To be determined by the department						
Course objective	• To demonstrate the network flow models in industrial engineering applications • To provide information about fundamental concepts of network flows • To explain the mathematical techniques used to identify and solve network problems • To show the methods to develop approximation algorithms for network problems and to give information about the applications						
Learning outcomes	• Identify network flow problems and explain the concepts about network flows • Express network problems in terms of mathematical models • Use approximate and exact methods to solve shortest path problems and evaluate the results • Solve maximum flow and minimum cost network problems • Implement network simplex method and report the results • Solve distribution and transportation problems using network flow models as an individual or as a team member and report the results						
Course Content	• Place of network flow problems in industrial engineering • Fundamentals of network flows • Shortest path problems, algorithms and mathematical techniques • Maximum flow problems • Minimum cost network problems • Network simplex applications						
References	Ahuja, R. K, Magnanti, T. L., Orlin, J. B. (1993), Network Flows: Theory, Algorithms and Applications, Prentice Hall.						

Course Outline Weekly

Weeks	Topics
1.	Introduction to network flows and fundamental concepts
2.	Path, tree, cycle concepts, data storage and spanning tree
3.	Minimum spanning tree
4.	Shortest path problems
5.	Shortest path problems
6.	Maximum flow problems
7.	Midterm I
8.	Maximum flow problems
9.	Minimum cost network problems
10.	Minimum cost network problems
11.	Network simplex
12.	Midterm II
13.	Network simplex
14.	Project presentation
15.	Study for the Final Exam
16.	Final Examination

Assessment Methods

Course activities	Number	Percentage
Attendance		
Laboratory		
Application		
Field activities		
Specific practical training		
Assignments		
Presentation	1	%5
Project	2	%30
Seminar		
Midterms	1	%25
Final exam	1	%40
Total	5	%100
Percentage of semester activities contributing grade success	4	%60
Percentage of final exam contributing grade success	1	%40
Total	5	%100

Workload and ECTS Calculation

Activities	Number	Duration (hour)	Total Work Load
Course Duration (x14)	14	3	42
Laboratory			
Application			
Specific practical training			
Field activities			
Study Hours Out of Class (Preliminary work, reinforcement, etc.)	12	5	60
Presentation / Seminar Preparation	1	6	6
Project	2	22	44
Homework assignment			
Midterms (Study duration)	1	10	10
Final Exam (Study duration)	1	12	12
Total Work Load			174

MATRIX OF THE COURSE LEARNING OUTCOMES VERSUS PROGRAM OUTCOMES

Program Outcomes	**Contribution level***				
	1	2	3	4	5
1			X		
2		X			
3				X	
4					X
5			X		
6			X		
7			X		
8	X				
9	X				
10	X				

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Course Name	**Code**	**Semester**	**Theory (hours/week)**	**Application (hours/week)**	**Laboratory (hours/week)**	**National Credit**	**ECTS**
Industry 4.0	**EMÜ440**	Fall/ Spring	3	0	0	3	6
Prerequisites							
Course language	English						
Course type	Elective						
Mode of Delivery	Face-to-face						
Learning and Teaching strategies	Lecture, question and answer, problem solving, project design/management, individual study.						
Instructor (s)	To be determined by the department						
Course Objective	The objective of this course is to introduce the Industry 4.0 – the Industrial Internet – and its applications in manufacturing and to develop skills to overcome the challenges resulting from Internet 4.0.						
Learning outcomes	Upon the completion of this course, the students should be able to • Explain the drivers and enablers of Industry 4.0 • Characterize the basic characteristics of smart factories, products and services • Express the digital systems in a manufacturing plant and their role in Industry 4.0 • Discuss the role of cloud computing in smart manufacturing • Perform the SWOT analysis of Industry 4.0 • Characterize the challenges brought by Industry 4.0 and develop solutions						
Course Content	• Introduction to Industry 4.0 • Roadmap to Industry 4.0 • Smart systems and technologies • Role of data, information, knowledge in Industry 4.0 • Collaboration in future organizations • Applications and case studies						
References	• Lasi, H., Fettke, P., Kemper, H. G., Feld, T., and Hoffmann, M. (2014). Industry 4.0. Business & Information Systems Engineering, 6, 239-242. • Lee, J., Bagheri, B., & Kao, H. A. (2015). A Cyber-physical Systems Architecture for Industry 4.0-based Manufacturing Systems. Manufacturing Letters, 3, 18-23. • Platzer, A. (2010) Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics. Springer Verlag.						

Course Outline Weekly

Weeks	Topics
1.	Introduction to Industry 4.0- Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0
2.	Smart Manufacturing and Cyberphysical Systems
3.	Robotic Automation and Collaborative Robots
4.	Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services
5.	Virtual Manufacturing
6.	Augmented reality
7.	Cloud Computing and Industry 4.0
8.	Midterm exam
9.	Smart Products
10.	Cyber Security- Blockchain technology
11.	Harnessing and sharing knowledge in organizations
12.	Support System for Industry 4.0
13.	Cloud Manufacturing
14.	Future of Works and Skills for Workers in the Industry 4.0 Era
15.	Study for the Final Exam
16.	Final exam

Assessment Methods

Course activities	Number	Percentage
Attendance		
Laboratory		
Application		
Field activities		
Specific practical training		
Assignments	3	15%
Presentation		
Project	1	15%
Seminar		
Midterms	1	30%
Final exam	1	40%
Total	6	100%
Percentage of semester activities contributing grade success	5	60%
Percentage of final exam contributing grade success	1	40%
Total		100%

Workload and ECTS Calculation

Activities	Number	Duration (hour)	Total Work Load
Course Duration (x14)	14	3	42
Laboratory			
Application			
Specific practical training			
Field activities			
Study Hours Out of Class (Preliminary work, reinforcement, etc.)	13	3	39
Presentation / Seminar Preparation			
Project	1	30	30
Homework assignment	3	10	30
Midterms (Study duration)	1	15	15
Final Exam (Study duration)	1	24	24
Total Work Load			180

MATRIX OF THE COURSE LEARNING OUTCOMES VERSUS PROGRAM OUTCOMES

Program Outcomes	**Contribution level**				
	1	2	3	4	5
1			X		
2					X
3		X			
4			X		
5				X	
6			X		
7			X		
8			X		
9		X			
10					X

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Course Name	**Code**	**Semester**	**Theory (hours/week)**	**Application (hours/week)**	**Laboratory (hours/week)**	**National Credit**	**ECTS**
Distribution Logistics	**EMÜ447**	Fall/ Spring	3	0	0	3	6
Prerequisites	EMÜ221 or EMÜ222						
Course language	English						
Course type	Elective						
Mode of Delivery	Distance Education						
Learning and Teaching strategies	Lecture, question and answer, problem solving, homeworks, project, individual study.						
Instructor (s)	To be determined by the department						
Course Objective	The objective of this course is to introduce the concept of distribution logistics; to develop students' skills to model distribution logistic networks and implement the solution methodologies of these models.						
Learning outcomes	Upon completion of this course, the students should be able to • Model and solve location problems • Develop mathematical models to optimize the flow on a network • Solve vehicle routing problems • Design a distribution logistics network						
Course Content	• Introduction to logistics • Location problems • Network design problems • Vehicle routing problems						
References	• Ghiani G., Laporte G. and Musmanno R. (2013) Introduction to Logistics Systems Management, Wiley, 2nd ed.						

Weekly Course Outline

Weeks	Topics
1.	Introduction to Logistics
2.	Qualitative Methods in Location Problems; Single-Commodity Single-Echelon Location Problems
3.	Single-Commodity Single-Echelon Location Problems
4.	Single-Commodity Single-Echelon Location Problems
5.	Single-Commodity and Multi-Commodity Two-Echelon Location Problems
6.	Location Covering Problems; Freight Traffic Assignment Problems
7.	Freight Traffic Assignment Problems
8.	Service Network Design Problems
9.	Midterm Exam
10.	Service Network Design Problems; Vehicle Allocation Problems
11.	Vehicle Routing Problems; Traveling Salesman Problem
12.	Traveling Salesman Problem; The Node Routing Problem with Capacity and Length Constraints
13.	The Node Routing and Scheduling Problem with Time Windows; Arc Routing Problems
14.	Project Presentations
15.	Study for the Final Exam
16.	Final Exam

Assessment Methods

Course activities	Number	Percentage
Attendance		
Laboratory		
Application		
Field activities		
Specific practical training		
Assignments	4	10%
Presentation	1	5%
Project	1	10%
Seminar		
Midterms	1	25%
Final exam	1	40%
Total	8	100%
Percentage of semester activities contributing grade success	7	60%
Percentage of final exam contributing grade success	1	40%
Total		100%

Workload and ECTS Calculation

Activities	Number	Duration (hour)	Total Work Load
Course Duration (x14)	14	3	42
Laboratory			
Application			
Specific practical training			
Field activities			
Study Hours Out of Class (Preliminary work, reinforcement, etc.)	12	3	36
Presentation / Seminar Preparation	1	7	7
Project	1	20	20
Homework assignment	4	7	28
Midterms (Study duration)	1	15	15
Final Exam (Study duration)	1	20	20
Total Work Load			168

MATRIX OF THE COURSE LEARNING OUTCOMES VERSUS PROGRAM OUTCOMES

Program Outcomes	**Contribution level**				
	1	2	3	4	5
1			X		
2					X
3			X		
4					X
5				X	
6			X		
7			X		
8		X			
9			X		
10	X				

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Dersin Adı	**Code**	**Semester**	**Theory (hours/week)**	**Application (hours/week)**	**Laboratory (hours/week)**	**National Credit**	**ECTS**
Lean Production Systems	**EMÜ448**	Fall/ Spring	3	-	-	3	6
Prerequisites							
Course language	English						
Course type	Elective						
Mode of Delivery	Face to face						
Learning and teaching strategies	Lectures, problem solving, discussions, project design/management, individual and group studies						
Instructor (s)	To be determined by the department						
Course objective	The objective of this course is to introduce the basic concepts of lean thinking philosophy and the tools of lean production systems for identifying and reducing wastes in production and service systems and developing the students' skills to implement lean tools						
Learning outcomes	Upon the completion of this course, students should be able to: • Specify the importance of lean thinking concepts • Define basic concepts related to lean production • Implement various lean tools such as value stream mapping, operation standardization, waste identification and elimination, performance measurement • Propose improving suggestions for production and service systems						
Course Content	• Basic concepts of lean production systems. • Lean production tools and strategies • Performance measurement of equipment and systems • Identification and reduction of waste • Lean production system planning						
References	• Askin, R. G., & Goldberg, J. B. (2002) Design and analysis of lean production systems. John Wiley & Sons. • Hopp, W. J., & Spearman, M. L. (2011) Factory physics. Waveland Press. • Womack, J.P., Jones, D.T. & Roos, D. (1991) The machine that changed the world: the story of lean production Harper Collins.						

Course Outline Weekly

Weeks	Topics
1.	History of lean thinking and lean production and introduction to lean production
2.	Basic concepts of lean production (Value, Types of waste, Kaizen, Takt time)
3.	Basic concepts of lean production (pull-push systems, bottleneck analysis, waste-walking)
4.	Problem solving and continuous improvement frameworks (6-sigma, A3, DMAIC and PDCA cycles)
5.	Value Stream Mapping
6.	Information flows in lean systems
7.	Just in Time production
8.	Midterm
9.	Lean production tools-I (5s, 5 Whys, Poka Yoke)
10.	Lean production tools-II (SOP, Performance management and metrics)
11.	Lean production tools-III (Kanban, Heijunka, Milk-run)
12.	Lean approach in service systems
13.	Information systems in lean production and Lean production technologies
14.	Current trends in lean production systems (Digital transformation and Industrial revolutions)
15.	Lean production applications
16.	Final exam

Assessment Methods

Course activities	Number	Percentage
Attendance		
Laboratory		
Application		
Field activities		
Specific practical training		
Assignments		
Presentation	1	10%
Project	1	20%
Seminar		
Midterms	1	30%
Final exam	1	40%
Total		100%
Percentage of semester activities contributing grade success	3	60%
Percentage of final exam contributing grade success	1	40%
Total		100%

Workload and ECTS Calculation

Activities	Number	Duration (hour)	Total Work Load
Course Duration (x14)	14	3	42
Laboratory			
Application			
Specific practical training			
Field activities			
Study Hours Out of Class (Preliminary work, reinforcement, etc.)	12	4	48
Presentation / Seminar Preparation	1	10	10
Project	1	20	20
Homework assignment			
Midterms (Study duration)	1	30	30
Final Exam (Study duration)	1	30	30
Total Work Load			180

MATRIX OF THE COURSE LEARNING OUTCOMES VERSUS PROGRAM OUTCOMES

Program Outcomes	Contribution level				
	1	2	3	4	5
1			x		
2			x		
3					x
4			x		
5				x	
6			x		
7					x
8		x			
9			x		
10			x		

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Course Name	Code	Semester	Theory (hours/week)	Application (hours/week)	Laboratory (hours/week)	National Credit	ECTS
Maintenance Engineering	**EMÜ454**	Fall/ Spring	3	-	-	3	6
Prerequisites							
Course language	English						
Course type	Elective						
Mode of Delivery	Distance education						
Learning and teaching strategies	Lectures, problem solving, discussions, project design/management, individual and group studies						
Instructor (s)	To be determined by the department						
Course objective	The objective of this course is to develop skills to implement modern maintenance methods to improve processes and performance of systems and equipment.						
Learning outcomes	Upon the completion of this course, students should be able to: • Specify the significance of maintenance engineering. • Define the concepts of maintenance engineering. • Implement various maintenance methodologies • Develop maintenance plans and provide recommendations						
Course Content	• Concepts of maintenance in industrial and service systems • Maintenance planning and performance measurement • Data analysis for the improvement of maintenance systems • Maintenance policies, strategies, and operations • Methodologies and analyses in the fields of maintenance engineering and maintenance management						
References	• Ben-Daya, M., Kumar, U. and Murthy, DNP. (2016) Introduction to Maintenance Engineering: Modelling, Optimization and Management. John Wiley & Sons. • Seiichi, N. (1988) Introduction to TPM: Total Productive Maintenance. Productivity Press Inc.						

Course Outline Weekly

Weeks	Topics
1.	History and evolution of maintenance concepts
2.	Philosophies and fundamentals of maintenance engineering
3.	Reliability, availability and maintainability
4.	Maintenance policies, strategies, operations
5.	Failure analysis & prevention
6.	Preventative and corrective maintenance
7.	Preventative and corrective maintenance
8.	Midterm exam
9.	Predictive and condition based maintenance
10.	Predictive and condition based maintenance
11.	Total productive maintenance (TPM)
12.	Collection and analysis of maintenance data
13.	Computer aided maintenance management
14.	Technologies for maintenance and maintenance management
15.	Preparation for the final exam
16.	Final Exam

Assessment Methods

Course activities	Number	Percentage
Attendance		
Laboratory		
Application		
Field activities		
Specific practical training		
Assignments	1	10%
Presentation		
Project	1	20%
Seminar		
Midterms	1	30%
Final exam	1	40%
Total		100%
Percentage of semester activities contributing grade success	3	60%
Percentage of final exam contributing grade success	1	40%
Total		100%

Workload and ECTS Calculation

Activities	Number	Duration (hour)	Total Work Load
Course Duration (x14)	14	3	42
Laboratory			
Application			
Specific practical training			
Field activities			
Study Hours Out of Class (Preliminary work, reinforcement, etc.)	12	4	48
Presentation / Seminar Preparation			
Project	1	35	35
Homework assignment	1	18	18
Midterms (Study duration)	1	16	16
Final Exam (Study duration)	1	20	20
Total Work Load			179

MATRIX OF THE COURSE LEARNING OUTCOMES VERSUS PROGRAM OUTCOMES

Program Outcomes	**Contribution level**				
	1	2	3	4	5
1			X		
2				X	
3			X		
4					X
5			X		
6		X			
7				X	
8			X		
9		X			
10		X			

Hacettepe University
Department of Industrial Engineering

Syllabus

EMÜ 491 – Information Communication Technology in Production
Fall 2021-2022

INSTRUCTORS: Assoc.Prof.Dr. Reza Vatankhah
Email: reza.vatankhah@hacettepe.edu,tr
Office: 319
Office hrs: Monday 14^{00}-15^{00} (other times by Appointment)

COURSE CONTENTS:
To introduce the concepts of information systems and technology in manufacturing system and production

- To introduce production related information communication systems
- To enlighten students about the IE roles in building IT and ICT system in enterprise

RECOMMENDED TEXTBOOK:

Laudon K.C. Laudon, J.P.	Management Information Systems: Managing the Digital Firm, 16th Edition	Pearson	2020	978-1-292-29656-2

COURSE PREREQUISITES: N/A
COURSE WEBPAGE:
HTTPS://EVDEKAL.HACETTEPE.EDU.TR/LOGIN/INDEX.PHP

Grading Breakdown

Hws, Case Study and project presentation	20%
Mid Term Exam	40%
Final Exam	40%

Special instructions are given below.
At week 4, students should form their groups and inform the course instructor through course website. Groups should include **three students**. Those who do not/cannot form a group will be grouped by the instructor. These groups will be valid for both the case study and the project.
At week 10, groups should submit their completed Case Study by uploading the soft-copy to the course website.
At week 14, groups should submit the complete the project by uploading a project report to the course website.
There will be homework assignments in the Pearson's MyLab online course platform. Students are expected to complete the assignments **individually**.
The necessary information about the deliverables will be provided at the course webpage. Students are required to follow the course website and the announcements. The deadlines are strict and will be dictated by Moodle and MyLab platform (e.g., Moodle and MyLab platform will not accept any submissions after the deadline).

COURSE OUTLINE

Week	Topic	Associated Chapter
1	Information Systems	Ch 1
2	Hardware and Software Basics	Ch 2
3	Designing Databases: Flowcharts	Ch 3
4	Decisions and Processes	Ch 5
5	Business Process Redesign	Ch 6, Handout
6	E-business	Ch 7
7	Enterprise Applications	Ch 8
8	Infrastructures	Ch 9
9	ERP software	Ch 10, Handout
10	Ethics and Information Security: ISO Standards	Ch 4, Ch 11
11	Networks and Telecommunications	Ch 12
12	Networks: Mobile Business	Ch 13
13	Business Intelligence	Ch 14
14	Systems and IT Project Management	Ch 15