ELECTRICAL ELECTRONICS ENGINEERING (English)PhD PROGRAMME

First Year						
I. Semester						
Code	Course Title	ECTS	T+P	Credit	C/E	Language
501011901	THE SCIENTIFIC RESEARCH METHODS AND ITS ETHICS	7.5	3+0+0	3	**C**	English
	Elective Course-1	7.5	3+0+0	3	E	English
	Elective Course-2	7.5	3+0+0	3	E	English
	Elective Course-3	7.5	3+0+0	3	E	English
	Total of I. Semester	30		12		
II. Semester						
Code	Course Title	ECTS	T+P	Credit	C/E	Language
	Elective Course-4	7.5	3+0+0	3	E	English
	Elective Course-5	7.5	3+0+0	3	E	English
	Elective Course-6	7.5	3+0+0	3	E	English
505712001	PhD Seminar	7.5	0+1+0	-	**C**	English
	Total of II. Semester	30		9		
	TOTAL OF FIRST YEAR	60		21		

Second Year						
III. Semester						
Code	Course Title	ECTS	T+P	Credit	C/E	Language
505711801	PhD PROFICIENCY	30	0+1+0	-	**C**	English
	Total of III. Semester	30				
IV. Semester						
Code	Course Title	ECTS	T+P	Credit	C/E	Language
501011902	THESIS PROPOSAL	30	0+1+0	-	**C**	Turkish
	Total of IV. Semester	30				
	TOTAL OF SECOND YEAR	60				

Third Year						
V. Semester						
Code	Course Title	ECTS	T+P	Credit	C/E	Language
505711802	PhD THESIS STUDY	25	0+1+0	-	**C**	English
505711803	SPECIALIZATION FIELD COURSE	5	3+0+0	-	**C**	English
	Total of V. Semester	30				
VI. Semester						

Code	Course Title	ECTS	T+P	Credit	C/E	Language
505711802	PhD THESIS STUDY	25	0+1+0	-	C	Turkish
505711803	SPECIALIZATION FIELD COURSE	5	3+0+0	-	C	Turkish
	Total of VI. Semester	30				
	TOTAL OF THIRD YEAR	60				

Fourth Year						
VII. Semester						
Code	Course Title	ECTS	T+P	Credit	C/E	Language
505711802	PhD THESIS STUDY	25	0+1+0	-	C	English
505711803	SPECIALIZATION FIELD COURSE	5	3+0+0	-	C	English
	Total of VII. Semester	30				
VIII. Semester						
Code	Course Title	ECTS	T+P	Credit	C/E	Language
505711802	PhD THESIS STUDY	25	0+1+0	-	C	English
505711803	SPECIALIZATION FIELD COURSE	5	3+0+0	-	C	English
	Total of VIII. Semester	30				
	TOTAL OF FOURTH YEAR	60				

Elective Courses						
Code	Course Title	ECTS	T+P	Credit	C/E	Language
505711501	APPLIED COMPUTER VISION FOR ROBOTICS	7.5	3+0+0	3	E	English
505711502	Introduction to Robotics	7.5	3+0+0	3	E	English
505711503	BIOMEDICAL PATTERN RECOGNITION	7.5	3+0+0	3	E	English
505712601	Robot Path Planning	7.5	3+0+0	3	E	English
505712602	Diffraction Theory	7.5	3+0+0	3	E	English
505712603	Nonlinear Programming for Engineering Sciences	7.5	3+0+0	3	E	English
505712604	Machine learning for computer vision applications	7.5	3+0+0	3	E	English
505712605	Control of Robotic Manipulators	7.5	3+0+0	3	E	English
505712606	Analytical Methods in Electromagnetic Theory	7.5	3+0+0	3	E	English
505712607	BIOMEDICAL SIGNAL PROCESSING AND MODELLING	7.5	3+0+0	3	E	English

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ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	Joint Course for the Institute	**SEMESTER**	Fall-Spring

COURSE			
CODE	501011901	**TITLE**	The Scientific Research Methods and Its Ethics

LEVEL	**HOUR/WEEK**			**Credit**	**ECTS**	**TYPE**		**LANGUAGE**
	Theory	**Practice**	**Laboratory**					
MSc-Ph.D	3	0	0	3+0	7,5	COMPULSORY (X)	ELECTIVE ( )	Turkish

CREDIT DISTRIBUTION		
Basic Science	**Basic Engineering**	**Knowledge in the discipline [if it contains considerable design content, mark with (√)]**
1,5	1,5	

ASSESSMENT CRITERIA			
SEMESTER ACTIVITIES	**Evaluation Type**	**Number**	**Contribution (%)**
	Midterm	1	40
	Quiz		
	Homework		
	Project		
	Report		
	Seminar		
	Other ( )		
	Final Examination		60

PREREQUISITE(S)	None
SHORT COURSE CONTENT	Science, the scientific thought and other fundamental concepts, the scientific research process and its techniques, Methodology: Data Collecting-Analysis-Interpretation, Reporting the scientific research (Preparation of a thesis, oral presentation, article, project), Ethics, Ethics of scientific research and publication.
COURSE OBJECTIVES	The main objectives are: To examine the foundations of scientific research and the scientific research methods, to teach the principles of both the methodology and the ethics, to realize the process on a scientific research and to evaluate the results of research, to teach reporting the results of research (on a thesis, presentation, article).
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	Applying the scientific research methods and the ethical rules in their professional life.
LEARNING OUTCOMES OF THE COURSE	Gaining awareness on ethical principles at basic research methods, becoming skillful at analyzing and reporting the data obtained in scientific researches, being able to have researcher qualification with occupational sense of responsibility, having the scientific and vocational ethics' understanding and being able to defend this understanding in every medium.
TEXTBOOK (Turkish)	Karasar, N. (2015). Bilimsel Araştırma Yöntemi. Nobel Akademi Yayıncılık, Ankara.

OTHER REFERENCES	**1-**Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., Demirel, F. (2012). Bilimsel Araştırma Yöntemleri. Pegem Akademi Yayınevi, Ankara. **2-**Tanrıöğen, A. (Editör). (2014). Bilimsel Araştırma Yöntemleri. Anı Yayıncılık, Ankara. **3-**Türkiye Bilimler Akademisi Bilim Etiği Komitesi. Bilimsel Araştırmada Etik ve Sorunları, Ankara: TÜBA Yayınları, (2002). **4-**Ekiz, D. (2009). Bilimsel Araştırma Yöntemleri: Yaklaşım, Yöntem ve Teknikler. Anı Yayıncılık, Ankara. **5-**Day, Robert A. (Çeviri: G. Aşkay Altay). (1996). Bilimsel Makale Nasıl Yazılır ve Nasıl Yayımlanır?, TÜBİTAK Yayınları, Ankara. **6-**Özdamar, K. (2003). Modern Bilimsel Araştırma Yöntemleri. Kaan Kitabevi, Eskişehir. **7-**Cebeci, S. (1997). Bilimsel Araştırma ve Yazma Teknikleri. Alfa Basım Yayım Dağıtım, İstanbul. **8-**Wilson, E. B. (1990). An Introduction to Scientific Research. Dover Pub. Inc., New York. **9-**Çömlekçi, N. (2001). Bilimsel Araştırma Yöntemi ve İstatistiksel Anlamlılık Sınamaları. Bilim Teknik Kitabevi, Eskişehir.

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Science, scientific thought and other basic concepts (University, history of university, higher education, science, scientific thought and other related concepts)
2	Science, scientific thought and other basic concepts (University, history of university, higher education, science, scientific thought and other related concepts)
3	The scientific research and its types (Importance of the scientific research, types of science, scientific approach)
4	The scientific research process and its techniques (Access to the scientific knowledge, literature search, determining the research issue, definition of the problem, planning)
5	The scientific research process and its techniques (Access to the scientific knowledge, literature search, determining the research issue, definition of the problem, planning)
6	The scientific research process and its techniques (Access to the scientific knowledge, literature search, determining the research issue, definition of the problem, planning)
7	The method and the approach: Collecting, analysis and interpretation of the data (Data, data types, measurement and measurement tools, collecting data, organizing data, summarizing data, analysis and the interpretation of data)
8	The method and the approach: Collecting, analysis and interpretation of the data (Data, data types, measurement and measurement tools, collecting data, organizing data, summarizing data, analysis and the interpretation of data)
9	Finalizing the scientific research (Reporting, preparing the thesis, oral presentation, preparing an article and a project)
10	Finalizing the scientific research (Reporting, preparing the thesis, oral presentation, preparing an article and a project)
11	Finalizing the scientific research (Reporting, preparing the thesis, oral presentation, preparing an article and a project)
12	Ethics, scientific research and publication ethics (Ethics, rules of ethics, occupational ethics, non-ethical behaviors)
13	Ethics, scientific research and publication ethics (Ethics, rules of ethics, occupational ethics, non-ethical behaviors)
14	Ethics, scientific research and publication ethics (Ethics, rules of ethics, occupational ethics, non-ethical behaviors)
15,16	Mid-term exam, Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE INSTITUTE'S GRADUATE PROGRAMME'S LEARNING OUTCOMES		CONTRIBUTION LEVEL		
NO	**LEARNING OUTCOMES (M.Sc.-Ph.D.)**	**3** High	**2** Mid	**1** Low
LO 1	Having the scientific and vocational ethics' understanding and being able to defend this understanding in every medium.	☒	☐	☐
LO 2	Being able to have researcher qualification with occupational sense of responsibility.	☒	☐	☐
LO 3	Becoming skillful at analyzing and reporting the data obtained in scientific researches.	☒	☐	☐
LO 4	Gaining awareness on ethical principles at basic research methods.	☒	☐	☐

Prepared by : **Date:**

Signature:

T.R.

ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	**ELECTRICAL ELECTRONICS ENGINEERING PhD (English)**	**SEMESTER**	Fall

COURSE			
CODE		**TITLE**	BIOMEDICAL PATTERN RECOGNITION

LEVEL	**HOUR/WEEK**			**Credit**	**ECTS**	**TYPE**		**LANGUAGE**
	Theory	**Practice**	**Laboratory**					
PhD	3	0	0	3	7,5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION		
Basic Science	**Basic Engineering**	**Knowledge in the discipline [if it contains considerable design content, mark with (√)]**
	3	

ASSESSMENT CRITERIA			
SEMESTER ACTIVITIES	**Evaluation Type**	**Number**	**Contribution (%)**
	Midterm	1	30
	Quiz		
	Homework		
	Project	1	30
	Report		
	Seminar		
	Other (……)		
		Final Examination	40

PREREQUISITE(S)	None.
SHORT COURSE CONTENT	Pattern Recognition (PR) techniques are widely used for medical applications for a long time. This course will introduce the most frequently preferred PR techniques in biomedical signal classification studies.
COURSE OBJECTIVES	The objective of this course is first to make student familiar with general approaches such as Bayes Classification, Nearest Neighbor Rule, Principal Component Analysis and later to concentrate on more often used modern classification techniques such as Support Vector Machines and 2D subspace-based classifiers for solving biomedical problems.
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	This course, in particular, will provide a different perspective to the engineers who work in the field of biomedical career.
LEARNING OUTCOMES OF THE COURSE	To introduce the fundamental descriptions and basic concepts of pattern classification, To learn how to use MATLAB software in pattern recognition applications, To understand the basic and advanced 1-D classifiers, To be informed of classical and modern 2-D classifiers, To introduce 1-D biomedical signals (ECG, EMG, etc.) and investigate their characteristics, To introduce 2-D biomedical signals (Digital Mammography, CT images, etc.)

	and investigate their characteristics, To learn the operation of pattern recognition methods used in the biomedical signal classification studies.
TEXTBOOK	Duda, R.O., Hart, P.E., and Stork D.G. (2001). Pattern Classification. John Wiley and Sons, New York, USA.
OTHER REFERENCES	Theodoridis, S. ve Koutroumbas K. (2009). Pattern Recognition, Academic Press, Cambridge, Massachusetts, USA.

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Review: Vectors and Matrices
2	Review: Probability
3	Introduction to Pattern Classification. Statistical Pattern Recognition: Bayes Decision Theory, Bayes Classifier, Minimum Distance Classifier, Naive Bayes Classifier, Special Cases.
4	Basic 1-D Classifiers: k-Nearest Neighbor Classifier (k-NN), Principal Component Analysis (PCA).
5	Basic 1-D Classifiers: Linear Discriminant Analysis (LDA).
6	Advanced 1-D classifiers: Support Vector Machines (SVM), Kernel PCA, Direct-LDA
7	Midterm
8	Classical 2-D classifiers: 2DPCA, 2DLDA
9	Modern 2-D classifiers: 2DSVD (2D Singular Value Decomposition), Common Matrix Approach (CMA), Tensor-based Approaches (using HOSVD)
10	
11	Introduction to 1-D Biomedical Signals (ECG, EMG, etc.). 1-D Biomedical Signal Processing and Classification. A Case Study for Raw ECG Signals
12	Introduction to 2-D Biomedical Signals (Digital Mammography, Fundus Fluorescein Angiography, etc.)
13	2-D Biomedical Signal Processing and Classification. A Case Study for Raw Mammogram Images.
14	Feature Selection Methods: Sequential Wrapper Algoritms: SFS, SBS, LRS, BDS, SFFS.
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD in English PROGRAM LEARNING OUTCOMES		**CONTRIBUTION LEVEL**		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☒	☐	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☒	☐	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works.	☐	☒	☐
LO 4	Ability to present and publish academic studies in any academic environment.	☐	☐	☒
LO 5	Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently and taking responsibility.	☐	☐	☒
LO 6	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☐	☒
LO 7	Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project management.	☐	☐	☒
LO 8	Advanced level of Professional and ethical responsibility.	☐	☐	☒

Prepared by: Assoc. Prof. Dr. Semih ERGİN_ **Date:** 02/02/2022

Signature:

T.R.

ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	**ELECTRICAL ELECTRONICS ENGINEERING PhD (English)**	**SEMESTER**	Spring

COURSE			
CODE		**TITLE**	BIOMEDICAL SIGNAL PROCESSING AND MODELLING

LEVEL	**HOUR/WEEK**			**Credit**	**ECTS**	**TYPE**		**LANGUAGE**
	Theory	**Practice**	**Laboratory**					
PhD	3	0	0	3	7,5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION

Basic Science	**Basic Engineering**	**Knowledge in the discipline [if it contains considerable design content, mark with (√)]**
	3	

ASSESSMENT CRITERIA

	Evaluation Type	**Number**	**Contribution (%)**
SEMESTER ACTIVITIES	Midterm	1	30
	Quiz		
	Homework		
	Project	1	30
	Report		
	Seminar		
	Other (……)		
	Final Examination		40

PREREQUISITE(S)	None.
SHORT COURSE CONTENT	Nowadays, one of the most common research areas is biomedical signals and the accurate analysis of these signals. In this course, various types of biomedical signals will be analyzed and modeled by signal processing techniques.
COURSE OBJECTIVES	The first objective of this course is to introduce the students with two basic concepts of signal processing which are linear systems and probabilistic processes. In the later stages of the course, various filtering and estimation methods will be focused on several biomedical signals.
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	This course, in particular, will provide a different perspective to the engineers who work in the field of biomedical career.
LEARNING OUTCOMES OF THE COURSE	To know the general definitions and basic concepts of signal processing, To be able to comprehend the most basic subjects on linear systems in detail, To be able to analyze random variables, probabilistic processes and their use on biomedical signals, To evaluate the analysis and models of 1-D (ECG, EMG, etc.), 2-D (Digital Mammography, Ultrasonography images, etc.) and 3-D (MRI, Tomography, etc.) biomedical signals,

	To learn how to use MATLAB software in biomedical signal processing and modeling applications.
TEXTBOOK	Eugene N. Bruce, (2001). Biomedical Signal Processing and Signal Modeling, John Wiley and Sons, New York, USA.
OTHER REFERENCES	Steven Kay, (1998). Fundamentals of Statistical Signal Processing, Prentice Hall, New Jersey, USA.

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Properties of biological signals: Non-stationary, non-linear, non-Gaussian. Linear shift invariant systems.
2	Finite and infinite impulse responses. Moving average filters.
3	Discrete Fourier transform. Magnitude and phase responses. Poles and zeros. Stability and Causality.
4	Convolution theorem. Linear versus circular convolution.
5	Discrete versus continuous time signals. Sampling theorem. Pre-filtering: Up and Down-sampling.
6	Probability distribution and density functions of 1D random variables. Conditional distribution. Normal distribution and the central limit theorem.
7	Midterm
8	Moments and Cumulants. Characteristic functions. Gaussian and Poison distributions.
9	Multivariate distributions. Multivariate Gaussian functions.
10	Statistical independence and factorization. Bayes theory and prior/posterior probabilities. Probabilistic prediction. Auto-Correlation. Shifts in biomedical signal frequencies and variance.
11	Linear discriminants.
12	Harmonic analysis: Estimation of heart rates from ECG signals.
13	Linear Prediction analysis: Estimation of the spectrum for 'thoughts' from EEG signals.
14	Filtering: X-ray filtering. Independent components analysis. Wavelets.
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD in English PROGRAM LEARNING OUTCOMES		**CONTRIBUTION LEVEL**		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☒	☐	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☒	☐	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works.	☐	☒	☐
LO 4	Ability to present and publish academic studies in any academic environment.	☐	☐	☒
LO 5	Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently and taking responsibility.	☐	☐	☒
LO 6	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☐	☒
LO 7	Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project management.	☐	☐	☒
LO 8	Advanced level of Professional and ethical responsibility.	☐	☐	☒

Prepared by: Assoc. Prof. Dr. Semih ERGİN_ **Date:** 02/02/2022

Signature:

T.R.

ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	ELECTRICAL ELECTRONICS ENGINEERING PhD (English)	SEMESTER	Spring

COURSE			
CODE		TITLE	Control of Robotic Manipulators

LEVEL	HOUR/WEEK			Credit	ECTS	TYPE		LANGUAGE
	Theory	Practice	Laboratory					
PhD	3	0	0	3	7,5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION

Basic Science	Basic Engineering	Knowledge in the discipline [if it contains considerable design content, mark with (√)]

ASSESSMENT CRITERIA

	Evaluation Type	Number	Contribution (%)
SEMESTER ACTIVITIES	Midterm	1	35
	Quiz		
	Homework	5	20
	Project		
	Report		
	Seminar		
	Other (……)		
	Final Examination		45

PREREQUISITE(S)	-
SHORT COURSE CONTENT	Introduction and definitions. Stability theory. Structure and properties of robot dynamic equation. Cartesian and other dynamics, actuator dynamics Computed-torque control. Adaptive control of robotic manipulators. Robust Control of robotic manipulators Force control.
COURSE OBJECTIVES	The aim of this course is to teach control techniques of robotic manipulators.
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	Students will be able to develop control methods for industrial robots.
LEARNING OUTCOMES OF THE COURSE	Learning how to control a complex system.

TEXTBOOK	Lewis F.L., C. T. Abdallah, and D. M. Dawson, Control of Robot manipulators, Macmillan, New York, 1993.
OTHER REFERENCES	Sciavicco, L., and Siciliano, B. Modeling and Control of Robot Manipulators, Mc Graw Hill, 1996.

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Introduction and definitions.
2	Stability theory.
3	Structure and properties of robot dynamic equation.
4	Cartesian and other dynamics,
5	actuator dynamics
6	Computed-torque control
7	Computed-torque like control
8	Midterm Exam
9	Adaptive control of robotic manipulators
10	Adaptive control of robotic manipulators
11	Robust control of robotic manipulators
12	Robust control of robotic manipulators
13	Force Control
14	Force Control
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD in English PROGRAM LEARNING OUTCOMES		**CONTRIBUTION LEVEL**		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☒	☐	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☐	☒	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works.	☐	☐	☐
LO 4	Ability to present and publish academic studies in any academic environment.	☐	☒	☐
LO 5	Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently and taking responsibility.	☐	☐	☐
LO 6	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☐	☐
LO 7	Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project management.	☐	☐	☐
LO 8	Advanced level of Professional and ethical responsibility.	☐	☐	☐

Prepared by: Prof. Dr. Osman Parlaktuna **Date:** 16.01.2022

Signature:

T.R.

ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	**ELECTRICAL ELECTRONICS ENGINEERING PhD (English)**	**SEMESTER**	Fall

COURSE			
CODE		**TITLE**	Introduction to Robotics

LEVEL	**HOUR/WEEK**			**Credit**	**ECTS**	**TYPE**		**LANGUAGE**
	Theory	**Practice**	**Laboratory**					
PhD	3	0	0	3	7,5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION		
Basic Science	**Basic Engineering**	**Knowledge in the discipline [if it contains considerable design content, mark with (√)]**

ASSESSMENT CRITERIA

	Evaluation Type	**Number**	**Contribution (%)**
SEMESTER ACTIVITIES	Midterm	1	35
	Quiz		
	Homework	5	20
	Project		
	Report		
	Seminar		
	Other (……)		
	Final Examination		45

PREREQUISITE(S)	-
SHORT COURSE CONTENT	Introduction and definitions. Spatial relations: position, rotation, homogeneous transformation matrix, Euler angles. Kinematics. Relations between joints and links of a robot manipulator. Inverse kinematics. Velocities, Jacobian matrix, static forces. Dynamics: Newton-Euler and Lagrangian methods. Trajectory generation
COURSE OBJECTIVES	1)Teaching the spatial relations between objects. 2) Deriving kinematics of robotic manipulators 3) Solving inverse kinematics of robotic manipulators 4) Deriving dynamics equations of robotic manipulators
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	Students can derive the equations of industrial robots.
LEARNING OUTCOMES OF THE COURSE	Students will learn how to model an industrial robot.
TEXTBOOK	Craig J. J., Introduction to Robotics: Mechanics and Control, 3rd Ed. Addison Wesley, Reading Mass., 2004.
OTHER REFERENCES	Sciavicco, L., and Siciliano, B. Modeling and Control of Robot Manipulators, Mc Graw Hill, 1996.

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Introduction and definitions.
2	Spatial relations: position, rotation
3	Homogeneous transformation matrix, Euler angles.
4	Kinematics.
5	Kinematics.
6	Relations between joints and links of a robot manipulator.
7	Inverse kinematics.
8	Midterm Exam
9	Inverse kinematics.
10	Velocities, Jacobian matrix, static forces.
11	Dynamics
12	Newton-Euler Method
13	Lagrangian method
14	Trajectory generation
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD in English PROGRAM LEARNING OUTCOMES		**CONTRIBUTION LEVEL**		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☒	☐	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☐	☐	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works.	☐	☐	☐
LO 4	Ability to present and publish academic studies in any academic environment.	☐	☐	☐
LO 5	Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently and taking responsibility.	☐	☐	☐
LO 6	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☐	☐
LO 7	Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project management.	☐	☐	☐
LO 8	Advanced level of Professional and ethical responsibility.	☐	☐	☐

Prepared by: Prof. Dr. Osman Parlaktuna **Date:** 16.01.2022

Signature:

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ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	**ELECTRICAL ELECTRONICS ENGINEERING PhD (English)**	**SEMESTER**	Fall

COURSE			
CODE		**TITLE**	APPLIED COMPUTER VISION FOR ROBOTICS

LEVEL	**HOUR/WEEK**			**Credit**	**ECTS**	**TYPE**		**LANGUAGE**
	Theory	**Practice**	**Laboratory**					
PhD	3	0	0	3	7,5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION		
Basic Science	**Basic Engineering**	**Knowledge in the discipline [if it contains considerable design content, mark with (√)]**
	3	

ASSESSMENT CRITERIA			
SEMESTER ACTIVITIES	**Evaluation Type**	**Number**	**Contribution (%)**
	Midterm	1	20
	Quiz		
	Homework	4	30
	Project	1	20
	Report		
	Seminar		
	Other (……)		
	Final Examination		30

PREREQUISITE(S)	Introduction to Image Processing
SHORT COURSE CONTENT	Feature Detectors and Descriptors, 3D reconstruction, Stereo reconstruction, Visual odometry, Localization, Mapping, SLAM
COURSE OBJECTIVES	(1) understand and apply fundamental mathematical and computational techniques in computer vision (2) implement computer vision techniques to be used in robotic tasks
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	Students will be able to use computer vision techniques for specific robotic applications and integrate them to robotic systems.
LEARNING OUTCOMES OF THE COURSE	Learning advanced topics of Computer Vision for robotic applications. Ability to design vision-based components of pipelines for robotic tasks.
TEXTBOOK	Computer Vision: Algorithms and Applications, by R. Szeliski, Springer, 2011.
OTHER REFERENCES	Robot Vision,B. Horn, MIT Press 1986. Computer Vision: A Modern Approach, Forsyth and Ponce, Prentice Hall 2002. Probabilistic Robotics by Sebastian Thrun, Wolfram Burgard and Dieter Fox, MIT Press, 2005.

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Edge detection, Thresholding, Morphological Image Processing, Connected Components, Contour Extraction
2	Image segmentation, Region based methods, Edge based methods, K-means, Watershed Algorithm
3	Feature Detectors and Descriptors, Feature Matching and Tracking
4	RGBD Sensors, 3D Reconstruction, Depth Sensor Technologies
5	Stereo vision: Camera calibration, epi-polar geometry, fundamental matrix, pixel and feature-based approaches for stereo matching.
6	Visual odometry: Image features, RANSAC, Optical flow analysis
7	Ego-motion estimation : Visual servoing, model matching
8	Navigation : Exploration algorithms, obstacle avoidance, landmark based navigation.
9	Localization: Kalman filters
10	Localization: Monte-Carlo methods, particle fields, distance filters.
11	Mapping: occupancy grids, topological maps
12	Simultaneous localization and mapping (SLAM)
13	Project presentations
14	Project presentations
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD in English PROGRAM LEARNING OUTCOMES		**CONTRIBUTION LEVEL**		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☒	☐	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☐	☒	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works.	☐	☐	☒
LO 4	Ability to present and publish academic studies in any academic environment.	☐	☐	☒
LO 5	Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently and taking responsibility.	☐	☐	☒
LO 6	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☐	☒
LO 7	Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project management.	☐	☐	☒
LO 8	Advanced level of Professional and ethical responsibility.	☐	☐	☒

Prepared by: Helin Dutağacı **Date:**

Signature:

T.R.

ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	ELECTRICAL ELECTRONICS ENGINEERING PhD (English)	SEMESTER	Spring

COURSE			
CODE		TITLE	Robot Path Planning

LEVEL	HOUR/WEEK			Credit	ECTS	TYPE		LANGUAGE
	Theory	Practice	Laboratory					
PhD	3	0	0	3	7,5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION

Basic Science	Basic Engineering	Knowledge in the discipline [if it contains considerable design content, mark with (√)]
	0	

ASSESSMENT CRITERIA

	Evaluation Type	Number	Contribution (%)
SEMESTER ACTIVITIES	Midterm		
	Quiz		
	Homework	3	60
	Project	1	40
	Report		
	Seminar		
	Other (……)		
	Final Examination		

PREREQUISITE(S)	-
SHORT COURSE CONTENT	Bug Algorithms, Potential functions and collision avoidance behavior, roadmaps, path planning for coverage problem, graph theory and graph-based shortest path planning algorithms, search-based shortest path planning algorithms
COURSE OBJECTIVES	To know behavior-based path planning algorithms such as Bug algorithms for mobile robots. To introduce collision avoidance algorithms. To be able to learn roadmap concept. To know path planning algorithms for coverage problem. To be able to use graph and grid based shortest path algorithms.
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	In this course, students will be familiar to produce global and local path plans for mobile robots. They will also learn to develop behaviors for collision avoidance. They will learn to implement programs for robots that perform the produced paths. Then, they will learn to choose approporiate algorithms in terms of time and memory complexity for producing path plans.
LEARNING OUTCOMES OF THE COURSE	1) Students will learn behavior-based path planning algorithms such as Bug algorithms. 2) Students will learn approaches for collision avoidance.

	3) Students will learn roadmap concept and they will learn approaches frequently used for producing roadmaps. 4) Students will learn path planning aproaches for coverage problem. 5) Students will learn graph theory and graph-based shortest path algorithms. 6) Students will learn search-based shortest path algorithms.
TEXTBOOK	Howie Choset, Kevin M. Lynch, Seth Hutchinson, George A. Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, Principles of Robot Motion Theory, Algorithms, and Implementations, MIT Press, 2005.
OTHER REFERENCES	Ahuja, Ravindra; Magnanti, Thomas; Orlin, James, Network Flows: Theory, Algorithms, and Applications, Pearson, 2015. Web cites

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Introduction to path planning problem
2	Bug Algorithms 1
3	Bug Algorithms 2
4	ROS and GAZEBO, Robot Programming
5	Potential Functions 1
6	Potential Functions 2
7	State-of-the-art collision avoidance approaches
8	Roadmaps 1
9	Roadmaps 2
10	Path Planning for Coverage Problem 1
11	Path Planning for Coverage Problem 2
12	Graph Theory
13	Graph-Based Shortest Path Algorithms
14	Search-Based Shortest Path Algorithms
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD in English PROGRAM LEARNING OUTCOMES		**CONTRIBUTION LEVEL**		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☐	☒	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☐	☒	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works.	☐	☐	☒
LO 4	Ability to present and publish academic studies in any academic environment.	☐	☒	☐
LO 5	Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently and taking responsibility.	☐	☐	☒
LO 6	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☒	☐
LO 7	Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project management.	☐	☐	☒
LO 8	Advanced level of Professional and ethical responsibility.	☐	☐	☒

Prepared by: Asist. Prof. Burak Kaleci **Date:** 24/01/2022

Signature:

T.R.

ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	**ELECTRICAL ELECTRONICS ENGINEERING PhD (English)**	**SEMESTER**	Spring

COURSE			
CODE		**TITLE**	Machine learning for computer vision applications

LEVEL	**HOUR/WEEK**			**Credit**	**ECTS**	**TYPE**		**LANGUAGE**
	Theory	**Practice**	**Laboratory**					
PhD	3	0	0	3	7,5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION		
Basic Science	**Basic Engineering**	**Knowledge in the discipline [if it contains considerable design content, mark with (√)]**
		3

ASSESSMENT CRITERIA			
SEMESTER ACTIVITIES	**Evaluation Type**	**Number**	**Contribution (%)**
	Midterm		
	Quiz		
	Homework	1	30
	Project	1	30
	Report		
	Seminar		
	Other (……)		
	Final Examination		40

PREREQUISITE(S)	An "Introduction to Image Processing" or a similar lecture is recommended as a preliminary
SHORT COURSE CONTENT	Machine learning fundamentals, image descriptors, classification, artificial neural networks, convolutional neural networks for visual computing.
COURSE OBJECTIVES	To introduce the basic concepts of machine learning and basic concepts of deep learning architecture that have recently achieved great achievements in computer vision applications using visual images.
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	Students who take this course can make various object recognition applications by using some pretrained models or they can create their own models by training a basic visual classifier.
LEARNING OUTCOMES OF THE COURSE	-Understanding some image description definitions, -Image classification -Regression based learning, -To analyze various artificial neural network models, -To design an image recognition application by using pre-trained models.
TEXTBOOK	-Ragav Venkatesan and Baoxin Li, "Convolutional Neural Networks in Visual Computing", ISBN: 978-1-4987-7039-2, Taylor & Francis, 2018.

OTHER REFERENCES	-Steven W. Knox, "Machine Learning: a Concise Introduction", ISBN: 978-1-1194-3907-3, Wiley, 2018. -Simon Rogers, Mark Girolami, "A First Course in Machine Learning", ISBN: 978-1-4987-3856-9, Crc Press, 2018. -Sandro Skansi, "Introduction to deep Learning From Logical Calculus to Artificial Intelligence", ISBN: 978-3-319-73003-5, Springer, 2018.

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Background: Machine Learning, Computer Vision
2	Fundamental concepts on digital image processing
3	Image features: Transform spaces, LBP, LTP, Gradients
4	Image descriptors: Histogram of Gradients (HOG)
5	Image descriptors: Scale invariant features (SIFT), Speeded-up robust features (SURF)
6	Machine learning fundamentals: probabilistic modelling, clustering.
7	Supervised Learning and Inference, Unsupervised Learning: Clustering
8	Midterm presentations
9	Subspace based classification
10	Support Vector Machine (SVM) Classification
11	Artificial Neural Networks: perceptron, backpropagation, feed forward neural networks
12	Convolutional Neural Networks: regularization, stochastic gradient descent, on-line learning
13	CNN architectures: LeNet, AlexNet
14	CNN architectures: GoogleNet, VGG-19
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD in English PROGRAM LEARNING OUTCOMES		**CONTRIBUTION LEVEL**		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☐	☒	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☒	☐	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works.	☐	☒	☐
LO 4	Ability to present and publish academic studies in any academic environment.	☐	☒	☐
LO 5	Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently and taking responsibility.	☐	☐	☒
LO 6	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☐	☐
LO 7	Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project management.	☐	☐	☐
LO 8	Advanced level of Professional and ethical responsibility.	☐	☐	☐

Prepared by: Dr. Öğr. Üyesi Hasan Serhan Yavuz **Date:** 25.03.2022

Signature:

T.R.

ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	ELECTRICAL ELECTRONICS ENGINEERING PhD (English)	SEMESTER	Spring

COURSE			
CODE		TITLE	Nonlinear Programming for Engineering Sciences

LEVEL	HOUR/WEEK			Credit	ECTS	TYPE		LANGUAGE
	Theory	Practice	Laboratory					
PhD	3	0	0	3	7,5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION

Basic Science	Basic Engineering	Knowledge in the discipline [if it contains considerable design content, mark with (√)]

ASSESSMENT CRITERIA

	Evaluation Type	Number	Contribution (%)
SEMESTER ACTIVITIES	Midterm	1	20
	Quiz		
	Homework	1	20
	Project	1	20
	Report		
	Seminar		
	Other (……)		
	Final Examination		40

PREREQUISITE(S)	-
SHORT COURSE CONTENT	Convexity; Fundamentals of Unconstrained Optimization; Trust-Region Methods; Conjugate Gradient Methods; Newton's method; Fundamentals of Algorithms for Nonlinear Constrained Optimization.
COURSE OBJECTIVES	Aim of this course is to teach the major topics of nonlinear programming methods with the basic mathematical tools needed for the subject.
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	Ability to choose and apply the necessary tools and methods to solve the problems in engineering applications related to the nonlinear programming.
LEARNING OUTCOMES OF THE COURSE	1) Students learn basic topics of nonlinear programming. 2) Students learn how to implement different techniques of nonlinear optimization. 3) Students can develop algorithms for nonlinear optimization methods. 4) Students learn how the nonlinear programming techniques can be applied to solve some real-world problems.
TEXTBOOK	E. K. P. Chong and S. H. Zak, An introduction to Optimization, Wiley & Sons, 2nd edition, 2001.

OTHER REFERENCES	M. S. Bazaraa, H. D. Sherali, and C. M. Shetty, Nonlinear Programming: Theory and Algorithms, Wiley & Sons, 3rd edition, 2006. S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, 2004.

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Convexity
2	Fundamentals of Unconstrained Optimization
3	Fundamentals of Unconstrained Optimization
4	Line Search Methods
5	Trust-Region Methods
6	Conjugate Gradient Methods
7	Practical Newton Methods
8	Practical Newton Methods
9	Midterm Examination 1
10	Quasi-Newton Methods
11	Fundamentals of Algorithms for Nonlinear Constrained Optimization
12	Fundamentals of Algorithms for Nonlinear Constrained Optimization
13	Presentations of student projects
14	
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD in English PROGRAM LEARNING OUTCOMES		**CONTRIBUTION LEVEL**		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☐	☒	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☐	☒	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works.	☐	☒	☐
LO 4	Ability to present and publish academic studies in any academic environment.	☐	☐	☒
LO 5	Ability to work effectively in interdisciplinary and multidisciplinary teams, making leadership of these kind of teams. Ability to work independently and taking responsibility.	☐	☐	☒
LO 6	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☐	☒
LO 7	Awareness of social, environmental, health, safety, and legal issues of engineering applications and Project management.	☐	☐	☒
LO 8	Advanced level of Professional and ethical responsibility.	☐	☐	☒

Prepared by: Prof. Dr. Hakan Çevikalp **Date:** 24/3/2022

Signature:

T.R.

ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	ELECTRICAL ELECTRONICS ENGINEERING (PhD)	SEMESTER	Spring

COURSE			
CODE		TITLE	Analytical Methods in Electromagnetic Theory

LEVEL	HOUR/WEEK			Credit	ECTS	TYPE		LANGUAGE
	Theory	Practice	Laboratory					
PhD	3	0	0	3	7.5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION

Basic Science	Basic Engineering	Knowledge in the discipline [if it contains considerable design content, mark with (√)]
	3	

ASSESSMENT CRITERIA

	Evaluation Type	Number	Contribution (%)
SEMESTER ACTIVITIES	Midterm	1	30
	Quiz		
	Homework	2	40
	Project		
	Report		
	Other ( )		
	Final Examination		30

PREREQUISITE(S)	
SHORT COURSE CONTENT	Partial differential equations and Fourier analysis, boundary-value problems, Strum-Liouville problems, modal analysis in electromagnetic waveguides, mode-matching technique, analysis of some step discontinuities with mode-matching technique, generalized scattering matrix method
COURSE OBJECTIVES	Provide the ability to analyze electromagnetic problems with mathematical analysis
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	Provide ability to analyze fundamental problems of RF engineering.
LEARNING OUTCOMES OF THE COURSE	1-Understand Fourier analysis and Strum-Liouville problems 2- Analyze waveguides with modal analysis 3- Apply mode-matching technique to waveguide problems 4- Apply generalized scattering matrix method to waveguide problems
TEXTBOOK	R. Mittra ve S. W. Lee, Analytical Techniques in the Theory of Guided Waves, The MacMillan Company, New York, 1971.
OTHER REFERENCES	Mithat İdemen, Lineer Sınır Değer Problemleri ve Özel Fonksiyonlar, İTÜ Vakfı Yayınları, İstanbul, 2015.

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Partial differential equations
2	Fourier analysis
3	Fourier analysis applications to Laplace equation
4	Boundary-value problems
5	Applications of boundary-value problems
6	Applications of Strum-Liouville problems
7	Midterm Exam
8	Modal analysis in electromagnetic waveguides
9	Analysis of sudden area expansion with mode-matching technique
10	Analysis of sudden area contraction with mode-matching technique
11	Analysis of single-axis discontinuity in rectangular waveguides with mode-matching technique
12	Analysis of double-axis discontinuity in rectangular waveguides with mode-matching technique
13	Generalized scattering matrix method applied on sudden are expansion and contraction
14	Generalized scattering matrix method applied on complex discontinuities
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES		**CONTRIBUTION LEVEL**		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☒	☐	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☒	☐	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works	☐	☐	☐
LO 4	Ability to present and publish academic studies in any academic environment	☐	☐	☐
LO 5	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☒	☐
LO 6	Ability to make critical analysis, synthesis and evaluation of ideas and developments in the area of work.	☐	☐	☐
LO 7	Advanced level of Professional and ethical responsibility.	☐	☐	☐

Prepared by : Assoc. Prof. Dr. Özge YANAZ ÇINAR **Date:** 28.03.2022

Signature:

T.R.

ESKISEHIR OSMANGAZI UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

COURSE INFORMATION FORM

DEPARTMENT	ELECTRICAL ELECTRONICS ENGINEERING (PhD)	SEMESTER	Spring

COURSE			
CODE		TITLE	Diffraction Theory

LEVEL	HOUR/WEEK			Credit	ECTS	TYPE		LANGUAGE
	Theory	Practice	Laboratory					
PhD	3	0	0	3	7.5	COMPULSORY ( )	ELECTIVE (X)	English

CREDIT DISTRIBUTION		
Basic Science	Basic Engineering	Knowledge in the discipline [if it contains considerable design content, mark with (√)]

ASSESSMENT CRITERIA			
SEMESTER ACTIVITIES	Evaluation Type	Number	Contribution (%)
	Midterm	1	30
	Quiz		
	Homework	2	40
	Project		
	Report		
	Other ( )		
	Final Examination		30

PREREQUISITE(S)	
SHORT COURSE CONTENT	Review on electromagnetic theory, Fourier transform and Wiener-Hopf technique, half-plane problem, modified Wiener-Hopf geometries, several scattering problems along waveguides.
COURSE OBJECTIVES	Teaching Wiener-Hopf technique for application on electromagnetic and acoustic wave diffraction
COURSE CONTRIBUTION TO THE PROFESSIONAL EDUCATION	Providing the ability of mathematical analysis for some applications related to wave scattering
LEARNING OUTCOMES OF THE COURSE	1. Apply Wiener-Hopf technique on diffraction of electromagnetic and acoustic waves. 2. Solve problems related to modified Wiener-Hopf geometries. 3. Apply spectral iteration technique. 4. Analyze scattering in waveguides.
TEXTBOOK	Ben Noble, Methods Based on the Wiener-Hopf Technique, Pergamon Press, 1958
OTHER REFERENCES	Alinur Büyükaksoy, Gökhan Uzgören, Ali Alkumru, Dalga Kırınımında Analitik Yöntemler Cilt I – II, İTÜ Vakfı Yayınları, 2011

COURSE SCHEDULE (Weekly)	
WEEK	**TOPICS**
1	Maxwell equations, electromagnetic boundary conditions, edge and radiation conditions, Fourier transform, Wiener-Hopf technique
2	Diffraction by a half-plane (Dirichlet problem)
3	Diffraction by a half-plane (Neumann problem)
4	Modified Wiener-Hopf geometry of the first kind: Diffraction by a strip
5	Modified Wiener-Hopf geometry of the first kind: Diffraction by a strip
6	Modified Wiener-Hopf geometry of the second kind: Diffraction by a step discontinuity
7	Modified Wiener-Hopf geometry of the second kind: Diffraction by a step discontinuity
8	Midterm Exam
9	Diffraction by a step discontinuity on a parallel-plate waveguide
10	Diffraction by a step discontinuity on a parallel-plate waveguide
11	Diffraction by a step discontinuity on a waveguide with circular cross-section
12	Diffraction by a step discontinuity on a waveguide with circular cross-section
13	Analysis of successive step discontinuities with Generalized Scattering Matrices
14	Analysis of successive step discontinuities with Generalized Scattering Matrices
15,16	Final Examination

CONTRIBUTION OF THE COURSE LEARNING OUTCOMES TO THE ELECTRICAL ELECTRONICS ENGINEERING PhD PROGRAM LEARNING OUTCOMES		CONTRIBUTION LEVEL		
NO	**LEARNING OUTCOMES (PhD)**	**3** High	**2** Mid	**1** Low
LO 1	Ability to apply knowledge of mathematics, basic sciences and engineering in expertise level in Electrical-Electronics Engineering and other related areas.	☒	☐	☐
LO 2	Developing new and original ideas and methods; ability to develop innovative/alternative solutions in system, component or process design.	☒	☐	☐
LO 3	Ability to design, plan, manage, finalize, and implement innovative multi-disciplinary works	☐	☒	☐
LO 4	Ability to present and publish academic studies in any academic environment	☐	☐	☒
LO 5	Ability to use a foreign language at an advanced level, ability to communicate in oral and written forms.	☐	☐	☒
LO 6	Ability to make critical analysis, synthesis and evaluation of ideas and developments in the area of work.	☐	☐	☒
LO 7	Advanced level of Professional and ethical responsibility.	☐	☐	☒

Prepared by : Prof. Dr. Gökhan ÇINAR **Date:** 28.03.2022

Signature: