(It will be applied from 2019-2020 Fall)

İZMİR INSTITUTE OF TECHNOLOGY
GRADUATE SCHOOL OF ENGINEERING AND SCIENCES
DEPARTMENT OF COMPUTER ENGINEERING
MASTER OF SCIENCE PROGRAM IN COMPUTER ENGINEERING

Core Courses	**ECTS**
***CENG 590** Seminar (0-2) Non-credit	7
CENG 500 M.Sc. Thesis (0-1) Non-credit	26
CENG 8XX Special Studies (8-0) Non-credit	4
***CENG 518** Introduction to Research Methodology and Ethics (3-0)NC	9

(*)All M.S. students must register Seminar course untill the beginning of their 4th semester.

Elective Courses	
CENG 501 Introduction to Statistical Data Processing (3-0)3	9
CENG 502 System Modeling and Computer Simulation (3-0)3	9
CENG 503 Computer Applications in Medicine and Biology (3-0)3	9
CENG 504 Optimization Methods (3-0)3	9
CENG 505 Advanced Computer Networks (3-0)3	9
CENG 506 Deep Learning (3-0)3	9
CENG 507 Introduction to Biometric Recognition (3-0)	9
CENG 508 Digital Image Processing (3-0)3	9
CENG 509 Vision Based Tracking and Modeling (3-0)3	9
CENG 511 Advanced Information Theory (3-0)3	9
CENG 512 Advanced Theory of Computation (3-0)3	9
CENG 513 Compiler Design and Construction (3-0)3	9
CENG 514 Computational Number Theory (3-0)3	9
CENG 515 Topics in Computer Science (3-0)3	9
CENG 516 Advanced Programming Languages (3-0)3	9
CENG 517 Classics Works in Computer Science (3-0)3	9
CENG 521 Advanced Operating Systems (3-0)3	9
CENG 522 Advanced Embedded System Design (3-0)3	9
CENG 523 Advanced Topics of Real Time Systems (3-0)3	9
CENG 524 Advanced Computer Architecture (3-0)3	9
CENG 525 Fault Tolerant Computing (3-0)3	9
CENG 531 Advanced Artificial Intelligence (3-0)3	9
CENG 532 Expert Systems and Knowledge Engineering (3-0)3	9
CENG 533 Probabilistic Reasoning (3-0)3	9
CENG 534 Deep Learning for Natural Language Processing (3-0)3	**9**
CENG 541 Advanced Database Management Systems(3-0)3	9
CENG 542 Knowledge Discovery (3-0)3	9
CENG 543 Information Retrieval Systems (3-0)3	9
CENG 551 Advanced Software Engineering (3-0)3	9
CENG 552 Software Testing (3-0)3	9
CENG 555 Analysis and Design of Microservice Based Systems (3-0)3	**9**
CENG 556 Software Management (3-0)3	**9**
CENG 557 Advanced Software Design Patterns (3-0)3	**9**
CENG 561 Advanced Information Security (3-0)3	9
CENG 562 Internet Security (3-0) 3	9
CENG 563 Database and Software Security (3-0)3	9
CENG 564 Information Systems Policy, Management and Organization (3-0)3	9
CENG 565 C4I and Information Warfare (3-0)3	9

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COURSE DESCRIPTIONS

CENG 501 Introduction to Statistical Data Processing (3-0)3 9 ECTS

Organization and application of computers and statistical techniques to data processing. Data handling in terms of coding, preparation, acquisition (with and without computers), screening and reduction; summarization, tabulation and analysis; random variables, statistical estimation and hypothesis testing, enumerated data analysis, linear models (regression, correlation, analysis of variance).

CENG 502 System Modeling and Computer Simulation (3-0)3 9 ECTS

Introduction, System concept, System modeling, Monte Carlo technique, definition and selection of system input variables, generation and examination of random numbers, generation of random variables, Discrete System simulation, Discrete System Simulation Software.

CENG 503 Computer Applications in Medicine and Biology (3-0)3 9 ECTS

The analysis and design of Hospital Information Systems. The mathematical, physical and Physiological basis for algorithms used in medicine, imaging and biological modeling. Topics in computer modeling of organs will be chosen from the brain, heart, nervous system, sense organs etc.

CENG 504 Optimization Methods (3-0)3 9 ECTS

Linear programming, nonlinear programming, iterative methods and dynamic programming are presented, especially as they relate to optimal control problems. Discrete and continuous optimal regulators are derived from dynamic programming approach which also leads to the Hamilton-Jakobi-Bellman Equation and the Minimum Principle. Linear quadratic regulators, linear tracking problems and output regulators are treated. Linear observer and the separation theorem are developed for controller implementation.

CENG 505 Advanced Computer Networks (3-0)3 9 ECTS

Overview of computer networks, wireless networks, OSI, Internet model, TCP-UDP/IP, wireless TCP, mobile IP, IPv6, congestion control, QoS services, multicast routing, supports for real-time communication, network security, future trends in networks.

CENG 506 Deep Learning (3-0)3 9 ECTS

This course covers methods for designing and training deep neural networks. The course content includes the historical evolution of deep neural networks, their fundamental working principles and image classification and object detection and recognition in images using convolutional neural networks.

CENG 507 Introduction to Biometric Recognition (3-0)3 9 ECTS

This course covers biometric recognition and identification methods and systems. The course content includes the historical evolution of biometric recognition, the fundamental principles of biometric recognition systems and basic face and fingerprint recognition algorithms

CENG 508 Digital Image Processing (3-0)3 9 ECTS

This course covers the materials required to process and enhance photographic images, remote sensor multispacial scanner data and others. Topics include transform techniques, records and discriminate function.

(It will be applied from 2019-2020 Fall)

CENG 509 Vision Based Tracking and Modeling (3+0)3 9 ECTS

This course covers the tracking of object and camera positions from images and videos by using computer vision techniques. Course contents include the mathematical theory and the algorithms used in practice necessary for modeling the objects and scene to be tracked.

CENG 511 Advanced Information Theory (3-0)3 9 ECTS

This course will begin by explaining the methods of types. It will then address the rate distortion theory. It will also cover multiple-users channels and channels with random parameters. Finally, correlated source encoding will be provided.

CENG 512 Advanced Theory of Computation (3-0)3 9 ECTS

This course will begin by explaining the different models of computation. It will then address the Church-Turing thesis. The course also will cover the topics of decidability and reducibility. Finally, detailed information is provided about complexity and related concepts.

CENG 513 Compiler Design and Construction (3-0)3 9 ECTS

This course deals with the theory and practice of compiler design. It will address the topics of scanning and parsing. Semantic analysis will also be covered.

CENG 514 Computational Number Theory (3-0)3 9 ECTS

Fundamentals, Algorithms for Congruences, Equations, and Powers, Euler's Φ Function and Coding, Second Degree Congruences, Prime Numbers, Quadratic Residues, Continued Fractions, Algorithms for Primality Testing, Finding Large Primes, Elliptic Curves, Factoring Algorithms, Algorithms for Exponential Methods of Factoring Integers, Subexponential Factoring Algorithms, Computing Discrete Logarithms.

CENG 515 Topics in Computer Science (3-0)3 9 ECTS

Topics from advanced areas will be discussed in a seminar format. Contents may vary.

CENG 516 Advanced Programming Languages (3-0)3 9 ECTS

Design and implement new language features, to precisely understand the rationale for existing features in modern languages, and to understand how design decisions can impact implementations.

CENG 517 Classics Works in Computer Science (3-0)3 9 ECTS

Gödel's undecidability theorem, computability, game theory ideas, information theory basics, graphs, networks, new directions in cryptography, the Antikythera mechanism, declarative programming, relational database model, machines and intelligence, computational complexity.

CENG 518 Introduction to Research Methodology and Ethics (3-0)NC 9 ECTS

Empirical computer science. Basic research methodology. Research and experimental questions. Experimental evaluation. Ethics in research. Study of the larger ethical and social issues of computing, including the role of a digital society in the modern world. Practical and theoretical applications of computer privacy and reliability. Ethical theory and its application to problems in computing.

CENG 521 Advanced Operating Systems (3-0)3 9 ECTS

Operating systems review, process synchronization, distributed system communication, synchronization in distributed systems, distributed algorithms, static and dynamic scheduling in distributed systems, group communication, fault tolerance, distributed real-time systems.

(It will be applied from 2019-2020 Fall)

CENG 522 Advanced Embedded System Design (3-0)3 9 ECTS

Nature of embedded systems, their role in computer engineering; special and general purpose microprocessor design, embedded microcontrollers, embedded software; real time systems, problems of timing and scheduling; testing and performance issues, reliability; design methodologies, software tool support for development of such systems; problems of maintenance and upgrade; introduction to Application Specific Integrated Circuit (ASIC) Design, VHDL.

CENG 523 Advanced Topics of Real Time Systems (3-0)3 9 ECTS

Real-Time software design issues, real-time operating systems, real-time scheduling algorithms, formal methods in software specification, modeling and verification using timed-automata, software design, programming languages, testing, performance analysis and optimization, documentation, software re-use, fault-tolerance

CENG 524 Advanced Computer Architecture (3-0)3 9 ECTS

Basic principles of processor design, instruction set architecture, pipelining, design of advanced memory hierarchies, multithreading, task-level and instruction-level parallelism, inter-processor communication models, multiprocessors, future trends.

CENG 525 Fault Tolerant Computing (3-0)3 9 ECTS

Fault modeling, testing and redundancy techniques to achieve fault tolerance in computer systems, error detection, failure recovery, error coverage, current research in the field.

CENG 531 Advanced Artificial Intelligence (3-0)3 9 ECTS

Approaches to AI; higherorder logic; planning; expert systems; environment of AI systems; soft computing in AI systems; nonsymbolic learning; natural language processing; intelligent agent; multiagent
system; semantic web; robotics.

CENG 532 Expert Systems and Knowledge Engineering (3-0)3 9 ECTS

Introduction to the various techniques used in building an expert systems. Topics covered include: knowledge representation methods, production systems, inference procedures, uncertainty and evidence combination, expert systems architectures and control, knowledge acquisition, programming languages for expert systems, and various case studies.

CENG 533 Probabilistic Reasoning (3-0)3 9 ECTS

Graphical Probability Models. Bayesian Reasoning. Bayesian Networks. Learning in Bayesian Networks. Knowledge Engineering. Temporal Models. Inference in Dynamic Bayesian Networks. Markov Decision Processes.

CENG 534 Deep Learning for Natural Language Processing (3-0)3 9 ECTS

Natural language processing (NLP) is one of the most important technologies of the information age. In traditional NLP, task-specific feature engineering and language-specific solutions were common. Recently, deep learning approaches have obtained very high performance across many different NLP tasks and multilingual solutions have been introduced. This course covers cutting-edge research in deep learning applied to NLP. Topics include word vector representations, window-based neural networks, recurrent neural networks, longshort-term-memory models, recursive neural networks, convolutional neural networks as well as some very novel models involving a memory component. A term project to implement, train, test, and visualize a custom neural network solution to a large scale NLP problem will be given.

(It will be applied from 2019-2020 Fall)

CENG 541 Advanced Database Management (3-0)3 9 ECTS

Relational theory and extensions, such as relational calculus, relational algebra, higher order normal forms; advanced DBMS concepts, such as integrity, recovery, concurrency, security, query optimisation; object-oriented databases; distributed databases, related techniques and protocols, such as data replication, data fragmentation, synchronisation, load balancing; parallel databases; deductive databases; federated databases and homogeneity/heterogeneity.

CENG 542 Knowledge Discovery (3-0)3 9 ECTS

Knowledge discovery and data mining, data warehousing, data preparation and data mining primitives, concept description, mining association rules in large databases, classification and prediction, cluster analysis, web mining, applications in data mining.

CENG543 Information Retrieval Systems (3-0)3 9 ECTS

This course covers the components of information retrieval systems that are used to search within document collections that contain unstructured data. Information retrieval from text documents as well as documents containing rich media (such as images and video) is included in the course contents.

CENG 551 Advanced Software Engineering (3-0)3 9 ECTS

This course will begin by explaining the concept of software engineering. Afterwards, the software development process is described. The course will then cover software requirements, software specification, software analysis, and formal analysis. Finally, quality management, product metrics, process metrics, COTS, and software psychology are addressed.

CENG 552 Software Testing (3-0)3 9 ECTS

Fundamentals of software testing; software test process and continuous quality improvement; Test generation using finite state models; Test adequacy assessment using black box and white box criteria; applications of model based testing.

CENG 555 Analysis and Design of Microservice Based Systems (3-0)3 9 ECTS

Service Orientation Web Services Microservice Based Architectures Event Oriented Analysis Designing Microservice Based Systems Reactive Systems.

CENG 556 Software Management (3-0)3 9 ECTS

This course focuses on two advanced aspects of software management; organizational cha nge and software measurement. Primary topics include software process improvement frameworks, agile maturity models, software process modeling languages, software measurement and social aspects of organizational change. Students participate in a modelling and organizational assessment project to as well as gain hands on experience on measurement and pre diction for software projects.

CENG 557 Advanced Software Design Patterns (3-0)3 9 ECTS

This course focuses on advanced software design patterns. Primary topics include advanced object-oriented programming principles, object-oriented design patterns, patterns of enterprise application architecture, enterprise integration patterns, and patterns related to domain-driven design. Students will learn concepts of modern software development with design patterns and participate in development of a mid-size programming project working in teams.

(It will be applied from 2019-2020 Fall)

CENG 561 Advanced Information Security (3-0)3

Concepts and applications of system and data security. Topics include risks and vulnerabilities, policy formation, controls and protection methods, database security, encryption, authentication technologies, host-based and network-based security issues, personnel and physical security issues, issues of law and privacy. Areas of particular focus include secure network design, implementation and transition issues, and techniques for responding to security breaches.

CENG 562 Internet Security (3-0)3 9 ECTS

Internet security overview; Basic encryption techniques; TCP/IP security; Authentication protocols; Electronic mail security; Web security; Network management security; Firewalls; Intrusion detection systems, Internet security management tools.

CENG 563 Database and Software Security (3-0)3 9 ECTS

Developments, issues, and challenges in secure databases and secure software applications. Security models, fundamentals and practices for databases and software.

CENG 564 Information Systems Policy, Management and Organization (3-0)3 9 ECTS

Strategy, Security, National/International Crypto Strategy and Policy, Export/Import Restrictions on Cryptographic Equipments, Information Management and Policy, Information Systems Strategy/Security Standards and Policies, Computer Emergency Response Teams (CERTs), Continuity Planning, Disaster Recovery Standards and Policies, Organizations, NGOs and Think Tanks, Informations Systems Open Source Intelligence, Strategy/Policy Making Software and Simulators, Electronic Commerce, Certification Authorities, Electronic Notery, Electronic Money.

CENG 565 C4I and Information Warfare (3-0)3 9 ECTS

Concepts, Terminology, Command-Control-Communications-Computers and Intelligence (C^4I) Structure, Aims and Threats, Attacks and Defenses in Cyber Space, Economic – Psychological and Intelligence Warfare, Information Warfare Strategy, Intelligence and Counterintelligence in Cyber Space, Cyber Terrorism.

CENG 590 Seminar Non-Credit (0-2) 7 ECTS

This seminar course must be taken by all MSc students working towards their MSc thesis. The students taking the course are required to make presentations on their thesis studies and prepare progress reports and final reports.

CENG 500 MSc Thesis Non-Credit (0-1) 26 ECTS

Program of research leading to MSc degree, arranged between a student and the faculty member. Students register to this course in all semesters starting from the beginning of their second semester while the research program or write-up of the thesis is in progress.

CENG 8XX Special Studies Non-Credit (8-0) 4ECTS

Graduate students supervised by the same faculty member study advanced topics under the guidance of their advisor.

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Course Codes

Coding structure

Department Code	1st	2nd	3rd
CENG	X	X	X

1st digit: indicates the year

2nd digit: indicates the course area

0 ⇒ General Engineering
1 ⇒ Theory
2 ⇒ Systems
3 ⇒ Artificial Intelligence
4 ⇒ Information Management
5 ⇒ Software Engineering
6 ⇒ Information Assurance
7-8 ⇒ Reserved
9 ⇒ Non-credit courses

3rd digit: indicates the number of the course from within that specific area

Example:

1. CENG 513 : 5th year, Area of Theory, Modeling, 3rd course of that area.
2. CENG 542 : 5th year, Area of Information Management,2nd course of that area.

*** All M.S. students must register Seminar course untill the beginning of their 4th semester.**