

IZMIR INSTITUTE OF TECHNOLOGY
FACULTY OF ENGINEERING
DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING
UNDERGRADUATE PROGRAM

COURSE CONTENTS

CHEM 101 General Chemistry I (4-0)4 5 Ects

Matter, its properties and measurement. Introduction to atomic theory, stoichiometry. The structural and chemical properties of matter. Gases, liquids and solids. Intermolecular forces. Atomic and molecular structure. Compounds, molecules and molecular formulas. Ions and ionic compounds. Atomic and electronic configurations and periodicity. Basic concepts of chemical bonding, ionic, covalent and metallic bonding.

CHEM 131 General Chemistry Lab I (0-4)2 2 Ects

Experiments complementary to the course material related to the topics discussed in CHEM 101 General Chemistry I lectures will be carried out in this laboratory section.

PHYS 101 General Physics I (2-2)3 6 Ects

Basic concepts of mechanics using vectors and calculus; Newton's laws of motion; conservation of energy and momentum. Kinematics and dynamics of particle and rigid bodies undergoing rectilinear, rotational, and oscillatory motion. Gravitation.

PHYS 111 General Physics Lab I (0-2)1 2 Ects

Experiments complementary to the course material related to the topics discussed in PHYS 101 General Physics I will be carried out.

MATH 141 Calculus I**(3-2)4****5 Ects**

Functions; preliminaries. Limits and continuity. Differentiation. Applications of Derivatives; Extreme values of functions, the mean value theorem, monotonic functions and the 1st derivative test, concavity and curve sketching, optimization problems, indeterminate forms and L'Hopital's rule, antiderivatives. Integration; estimating with finite sums, the definite integral, the fundamental theorem of calculus, the substitution rule. Applications of Definite Integrals. Transcendental functions. Techniques of Integration. Conic sections and polar coordinates.

MSE 100 Introduction to Materials Science and Engineering**(1-0) 1 2 Ects**

Orientation about the department. Explanation of the current studies worked in the department. The importance and definition of materials science and engineering. The reasons for using different materials and the definition of these materials. Definition of the concepts of materials science.

MSE 113 Computer Aided Engineering Graphics**(2-2)3****5 Ects**

This course contains (covers) the basic knowledge of preparation and the application of instrumental and CAD engineering drawing. This basic knowledge has the following titles: basic drawing techniques, lettering and dimensioning, orthographic projections, auxiliary views, sectional views, isometric and oblique projections, CAD modeling and assembly drawing.

ENG 101 Development of Reading and Writing Skills I**(3-0)3****3 Ects**

The overall aim of this course is to develop freshman students' English academic reading and writing skills. The course also aims at equipping students with basic study skills they will need throughout their academic life. Students are encouraged to write and present what they read; therefore, speaking skills are introduced and make the students use them while presenting a topic.

gradient vectors, extreme values and saddle points, Lagrange multipliers. Multiple integrals; double integrals, double integrals in polar form, triple integrals in rectangular, cylindrical and spherical coordinates, substitutions in multiple integrals. Integration in vector fields; line integrals, vector fields, path independence, Green's theorem, surface area and surface integrals, Stokes' theorem, the Divergence theorem.

MSE 120 Introduction to Computer Programming (2-2)3 5 Ects

Introduction to programming; vectors and arrays; execution control; 2- and 3-dimensional plots; matrices; numerical methods.

ENG 102 Development of Reading and Writing Skills II (3-0)3 3 Ects

The overall aim of this course is to develop freshman students' English academic writing skills, evaluating original articles and to make them able to write an original article about their own opinions on that topic. Students are encouraged to present what they have written.

MSE 201 Materials Science I (4-0)4 7 Ects

Introduction to engineering materials such as metals, ceramics and glasses, polymers, and composites; crystalline structure and defects; elastic and plastic deformations of materials; basics of mechanical properties. Types and use of steel and cast iron. Heat treatment of metals and alloys. Non-ferrous metals and alloys and their use in engineering applications.

MSE 205 Materials Thermodynamics (3-0)3 6 Ects

Concepts and definition of thermodynamics in materials science. Laws of thermodynamics; internal energy, heat and work, heat capacity, enthalpy and entropy. Helmholtz and Gibbs free energies, coefficient of thermodynamic variables and Maxwell relations. Equilibrium criterion and conditions for thermodynamic systems. Unary and multicomponent heterogeneous systems, multicomponent homogeneous nonreacting systems.

TURK 201 Turkish Language I**(2-0)0****2 Ects**

The course is organized in such a way that the students develop a consciousness of and an interest in Turkish language, which is the native language for most of the students.

MSE 202 Materials Science II**(4-0)4****7 Ects**

Introduction to properties of materials. Mechanical behavior of solids: Elasticity , theoretical strength, plastic deformation, fracture, creep, fatigue. Thermal properties of materials: Thermal conductivity, thermal expansion. Electronic properties, optical properties, magnetic properties.

Prerequisite(s): MSE 201

MSE 204 Materials Chemistry**(3-0)3****6 Ects**

Periodic table, chemical and physical bondings, thermal, optical and magnetic properties of materials, coordination chemistry, synthesis of organic and inorganic materials, solid state chemistry, electrochemical behaviours of materials.

MSE 212 Materials Lab I**(2-2)3****5 Ects**

Mechanical testing; tensile testing, impact testing and hardness. Heat treatment and microstructures; annealing, quenching and tempering of steel. Crystallography and X-ray diffraction; phase identification. Metallographic sample preparation. Observation of microstructures of ferrous alloys with an optical microscope.

Prerequisite(s): MSE 201

MSE 222 Applied Mathematics for MSE**(4-0)4****6 Ects**

Vector analysis, matrices, determinants, systems of linear equations, linear transformations, complex numbers and variables, fundamental theorems of integral calculus.

HIST 202 Principles of Ataturk II (2-0)0 2 Ects

Discusses major events that have taken place from 1923 to 1950, the structuring of the Republic of Turkey and the political, social, economic, and cultural revolutions introduced by Mustafa Kemal Atatürk.

TURK 202 Turkish Language II (2-0)0 2 Ects

Grammatical and linguistic knowledge, poems, stories, novels and essays written by the Turkish writers who use the language most skillfully. Besides, some panels and conferences are held, related to the books selected.

MSE300 Summer Practice I (0-0)0 7 Ects

An internship of at least 21 working days preferably carried out in a plant that will involve processing of materials in an integrated manner. The report prepared at the end of summer practice should reflect both the practical experience and the knowledge gained in the second year courses.

MSE 305 Transport Phenomena (3+0)3 5 Ects

Introduction and basic concepts, dimensions and units. General overview of transport phenomena including various applications. The concept of viscosity & kinematic viscosity, Momentum transfer, Newtonian and non-Newtonian fluids, Steady-state unidirectional flow, The differential equations of flow, Applications of differential equations of flow, Fluid flow and Reynolds number. Basic concepts in heat transfer, Heat transfer mechanisms, Fourier's law of heat conduction, Thermal conductivity, Convective & radiative heat transfer. Fick's Law and Diffusivity of Materials, Diffusion in Solids

MSE 307 Physical Metallurgy**(3+0)3****5 Ects**

Vacancy formation in crystalline materials. Nucleation and solidification mechanisms. Morphologies that form during phase transformations (nucleation, growth, solidification). Fe-C equilibrium phase diagram. TTT diagram for steels. Diffusionless transformation. Martensitic transformations and shape memory alloys.

Prerequisite(s): MSE 201

MSE 309 Mechanical Behavior of Materials**(3+0)3****5 Ects**

Micromechanics of deformation. Strengthening mechanisms: solid solution strengthening, particle strengthening, grain size strengthening, fiber strengthening. work hardening. Micromechanics of fracture. Fatigue. Creep. Mechanical behavior of materials at high temperatures. Mechanical behavior of composites and nanomaterials.

Prerequisite(s): MSE 202

MSE 313 Introduction to Solid State Physics**(3+0)3****5 Ects**

Basics of quantum mechanics; crystal structures; bonding in solids; periodicity and the reciprocal space; reciprocal lattice and crystal diffraction; lattice vibrations; phonon heat capacity; free and non-interacting electrons; electrons in a periodic potential; energy bands of a solid; semiconductors.

MSE 310 Materials Characterization**(3+0)3****5 Ects**

Materials characterization techniques. Basics of X-ray physics and its diffraction principles. Crystal structure determination using X-ray radiations. Light and electron microscopes for materials characterizations.

Prerequisite(s): MSE 202

MSE 312 Introduction to Modeling and Simulation in MSE (2+2)3 5 Ects

Fundamentals of molecular dynamics; modelling chemical interactions; property calculation using molecular dynamics; quantum mechanical modeling; density functional theory (DFT); applications of DFT.

MSE 314 Introduction to Nanoscience and Nanotechnology (3+0)3 5 Ects

Introduction to nanoscience and importance of nanoscience. Obtaining nanomaterials. Properties of nanomaterials. Characterization of nanomaterials. Applications of nanomaterials.

ENG 302 Technical Writing and Communication (3+0) 3 3 Ects

This course has been designed to improve students' communication skills in business life and in other courses. During the course, students will work on different genres of technical writing and will deliver oral presentations about some specific subjects related to their fields. Students will produce and analyze a number of technical writing genres ranging from technical reports, business letters/e-mail, letters of intent, technical definitions, to CVs and proposals. In addition to technical writing, students are expected to deliver oral presentations about a specific subject from their fields.

MSE 316 Materials Lab II (2+2) 3 5 Ects

Microstructure characterization and chemical composition determination using Scanning Electron Microscope. Surface Characterization using an Atomic Force Microscope. Thermal Analysis of materials using DTA /TGA/DSC. Optical characterization of materials using Raman and UV/VIS Spectroscopy.

MSE 400 Summer Practice II**(0-0)0****7 Ects**

An internship of at least 21 working days preferably carried out in a plant that will involve processing of materials in an integrated manner. The report prepared at the end of summer practice should reflect both the practical experience and the knowledge gained in the second year courses.

MSE 451 Materials Design**(3+0) 3****8 Ects**

Design process. Steps of design. Design tools. Materials selection in design. Process selection in design. Case studies in materials and process selection. Economic decision making in design. Design project.

MSE 479 Ceramic and Glass Materials**(3+0) 3****5 Ects**

Classification of ceramic products with respect to their functions. Classical and modern Ceramics. Methods of ceramic production: Natural and synthetic raw materials, shaping methods, drying and firing of ceramic articles.

MSE 448 Introduction to Polymer Science**(3+0) 3****5 Ects**

It covers polymer chemistry and physics. The polymer chemistry part covers polymerization and copolymerization methods that involve different mechanisms, and industrial polymerization processes. In polymer physics part, the concept of average molecular weights and polydispersity will be briefly revisited, and the principles and techniques used to measure molecular weights are introduced. Factors affecting polymer properties are being taught that include polymer chain structures, the importance of thermal transitions in polymers, relationship between polymer microstructures and mechanical properties.

MSE 476 Electroceramic Materials and Electrochemical Devices (3+0)3 5 Ects

Basic ceramic structures relevant to electroceramics such as perovskite, fluorite, spinel. Defects and non-stoichiometry in ceramics, Kröger-Vink notation. Electrical conductivity. Ionic conduction. Solid oxide fuel cells. Li-ion batteries. Charge displacement and electrical polarization. Insulators, dielectrics, ferroelectrics and piezoelectrics. Pyroelectric effect and its applications. Fundamentals of magnetic materials. Applications of magnetic ceramics. Multiferroic materials.

MSE 477 IRON AND STEEL MAKING

(3+0)3

5 Ects

Introduction to iron and steel making processes. Raw materials and metallurgical pretreatments. Production of metallurgical coke. Iron ore and characterization. Sintering and pelletizing of iron ore. Production of molten (pig) iron. Blast furnace and auxiliaries Principles of pig iron production at the blast furnace. Reduction of iron oxides. Bosh and heart reactions. Slag formation. Techniques for increasing blast furnace productivity. Basic principles of steel production and history processes. Steel production in basic oxygen converter. Steel production in electric arc furnaces. Deoxidation, gas purging and other ladle treatments. Principles and technologies of ingot and continuous casting methods. Technologies principles of long and flat products production. Production of sponge iron. Smelting reduction processes. Iron and steel industry in the world and Turkey.

MSE 481 Smart Materials and Structures

(3+0)3

5 Ects

To introduce the student to some basic principles of smart materials. Investigation of smart materials in nature, manufacturing and properties of bio-geo-mimetic smart materials and systems