

**NECMETTIN ERBAKAN UNIVERSITY**  
**FACULTY OF ENGINEERING**  
**DEPARTMENT OF METALLURGY AND MATERIAL ENGINEERING (ENGLISH)**  
**UNDERGRADUATE PROGRAM COURSE CONTENTS**

**1. YEAR/I. SEMESTER**

**MME101 Physics-1 (2+2)**

Physical Quantities, Vectors, Motion in One Dimension, Motion in Two Dimensions, Newton's Laws of Motion, Circular Motion; Business and Energy; Potential Energy and Conservation of Energy; Impulse and Momentum; Rotation Kinematics; Rotation Dynamics; Static Balance; Oscillating Movement

**MME102 Mathematics-1 (2+2)**

The aim of this course is to introduce to students the fundamental concepts of mathematics, functions, limits, continuity, and derivatives of functions.

Functions; Limits; Continuity; Derivatives

**MME103 General Chemistry-1 (2+2)**

Introduction to Chemistry, Matter and Energy, Atoms and Elements, Molecules and compounds, Chemical composition, Chemical reactions, Atoms and periodic table, Chemical bonding, Gasses, Intermolecular forces, Solutions

**AİT101 Atatürk's Principles & Revolution History-1 (2+0)**

The Purpose and Subject of the History of the Republic of Turkey, from the Establishment of the Ottoman State to the Armistice of Mudros, The Establishment and Fall of the Ottoman State, the Eastern Question, Reform Movements After the Tanzimat, Streams of Thought Towards the Saving the Ottoman State, the activities of minorities in the Ottoman history especially the emergence of the Armenian issue and its reflections to this day, Secret Treaties and Wilson's Principles, From the Armistice of Mudros to the Turkish War of Independence, the Turkish War of Independence, the Life of Mustafa Kemal, Military and Political Activities, the National Pact and the Opening of the Turkish Grand National Assembly, from the Turkish Independence Movement Treaty of Lausanne, Establishment of Regular Army and East, West and Southern Fronts, Armistice of Mudanya, Abolition of Sultanate, Treaty of Lausanne and Its Results.

### **AYD101 Academic Writing (2+0)**

The aim of this course is to provide the key principles and application of effective and efficient academic writing.

This course includes Writing skills and strategies (research, planning, organizing, plagiarism, referencing), Components of writing, Writing vocabulary and language, The structure of scientific papers

### **TDL101 Turkish Literature-1 (2+0)**

To gain the ability to use Turkish correctly and beautifully as a means of written and oral expression. To make the unifying language dominant in teaching and to raise individuals with mother tongue consciousness. Concept of language, ways of success in essay writing, word, sentence and paragraph; verbal expression exercises; general information about composition, spelling rules and punctuation marks. Historical development of Turkish, its current situation and spreading areas. Phonetics, syllables, words, sentences and semantics of Turkish.

### **MME108 Introduction to Computer & Information Systems (1+2)**

Basic overview of computer systems, Development of computers, computer networks, information processing, CPU, memory, computer input/output and storage devices, software, operating systems, Microsoft Word, Microsoft Excel, and Microsoft Power Point

### **MME107 Technical English (2+0)**

The purpose of this course is to prepare students to develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts for undergraduate level students. Their ability to write effective reports and speaking skills to make technical presentations, participate in group discussions will be improved. Students will strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

### **YBD101 Foreign Language-1 (2+0)**

This course focuses on developing students' basic skills in Foreign Language Education, namely Reading, Writing, Speaking, Grammar and Vocabulary. In order to achieve this goal, students' critical and analytical thinking skills are developed. By working on reading passages arranged according to their topics, students are able to evaluate, synthesize and respond to the ideas presented in the pieces.

### **AKT101 Occupational Turkish-1 (2+0)**

Course description, characteristics and evaluation process, Text reading studies, Academic text reading studies, Oral reports, Text writing studies, Using sources in text writing, Understanding a statement by using other words, Quoting studies, Writing a concise, informative or persuasive text with integrity of meaning

## **1.YEAR/2. SEMESTER**

### **MME121 Physics-2 (2+2)**

Charges and objects, Electric field and Gauss's law, Electric potential, Capacitors and dielectrics, Current and resistance, Electromotive force and electric circuits, Magnetic field and Ampere's law, Faraday's law, Inductance and L-C-R circuits, Magnetic properties of solids, Electromagnetic waves, Geometric optics ; reflection and refraction; Lenses; optics and

interference phenomenon in optics; Newton's rings; Interferometer; polarization in optics; photometer; atomic models; modern quantum mechanics; Schrodinger wave equation; nuclear physics etc.

### **MME122 Mathematics-2 (2+2)**

The aim of this course is to introduce to students the fundamental concepts of derivatives and integrations.

Derivatives, Integrals and their applications

### **MME123 General Chemistry-2 (2+2)**

Acids and bases, kinetics and equilibria of chemical reactions, properties of gases and solutions, electrochemistry, and nuclear chemistry.

### **TDL102 Turkish Literature-2 (2+0)**

To gain the ability to use Turkish correctly and beautifully as a means of written and oral expression. To make the unifying language dominant in teaching and to raise individuals with mother tongue consciousness.

Structure knowledge (inflectional suffixes), word types, word groups, gerunds-adjectives, verb frame, elements of sentence, syntax, expression disorders, types of oral expression, types of written expression.

### **MME127 Technical Drawing (1+2)**

Technical Drawing in Engineering, Meanings of Line Types, Principles of Projection, Isometric Perspectives, Dimensioning, Section Views

### **AİT102 Atatürk's Principles & Revolution History -2(2+0)**

Kuva-yi Milliye. Projects of Allied Powers to Share Turkey. I. İnönü War. II. Battle of Inonu. Battle of Sakarya. Major assault. Armistice of Mudanya. The Lausanne Peace Treaty. Strategy of the Turkish Revolution. Revolutions made in the political field: proclamation of the republic, abolition of the caliphate. Progressive Republican Party and the Period of Appreciation. Revolutions in the field of law. Revolutions in the field of education and culture. Revolutions in the economic field. Constitutional Movements. Political Parties after the National Struggle. Transition to the Multi-Party Era. Reactions to the Regime. Revolution in Law. Revolution in Education. Revolutions Made in the Social Field. Atatürk's Principles and Revolutions. Atatürk Era Foreign Policy.

### **KRP102 Career Planning (1+0)**

This course aims to plan the career paths of the students in the Department of Metallurgical and Materials Engineering, to provide knowledge about professional life in industry and academic fields and the requirements.

This course includes Communication skills, Soft skills, CV preparation, Network, Presentations by industry professionals

### **MME128 Introduction to Metallurgical and Materials Engineering (2+0)**

The purpose of this course is to provide a general background of the field of materials science and engineering for undergraduate level students. Fundamental topics such as chemical bonding in materials, crystal structure and defects, diffusion, and phase diagrams will be introduced. Then the mechanical, electrical and optical properties of materials will be covered and information of types of materials and their applications will be provided.

### **YBD102 Foreign Language-2 (2+0)**

This course focuses on developing students' basic skills in Foreign Language Education, namely Reading, Writing, Speaking, Grammar and Vocabulary. In order to achieve this goal, students' critical and analytical thinking skills are developed. By working on reading passages arranged according to their topics, students are able to evaluate, synthesize and respond to the ideas presented in the pieces.

## **2.YEAR/1. SEMESTER**

### **MME201 Materials Science-1 (3+0)**

The students will attain basic understanding about materials science and engineering, in particular the relations between the structure, properties and processing of materials. The level of understanding should be such that the students should be able to participate in discussions regarding materials selection and choices of processing methods for materials. The course will cover four major topics including: fundamental concepts, microstructure development and phase equilibria, material properties, fabrication methods, and applications. The atomic structure, atomic bonding, crystal structures, defects, and diffusion in materials will be covered. The phase transformations and phase equilibria and how they impact the microstructure development will be provided. The electrical, magnetic, optical, thermal, and mechanical properties of materials will also be reviewed. Materials encountered in the course are metals, ceramics, polymeric, and composite materials, primarily for engineering purposes..

### **MME202 Extractive Metallurgy (3+0)**

It is aimed to teach the basic concepts and processes of extractive metallurgy, usage and recycling of raw material resources and the transformation of advanced technology into products.

This course includes Introduction and basic concepts, Mineral processing: crushing, grinding, dressing, Metallurgical pretreatments: drying, calcination, agglomeration, roasting, Pyrometallurgical processes: fuels, reduction, furnaces, smelting, converter process, slags, refining, distillation, Hydrometallurgical processes: leaching and dissolution mechanisms,

thermodynamics and kinetics of dissolution, metal recovery from solution, Electrometallurgy: electrolytic cells, electrolytic precipitation and electrolytic purification, Recycling and recovery

### **MME204 Thermodynamics of Materials-1 (2+2)**

Basic concepts and definitions of thermodynamics, 1st law of thermodynamics, 2nd law of thermodynamics, heat capacity, enthalpy and mountain calculations and 3rd law of thermodynamics, auxiliary functions, balance between phases in systems with one component

### **MME205 Differential Equations (3+0)**

Definition and Classification of Differential Equations, Order and Degree of Differential Equation, Solutions of Differential Equations: Integral Curve, Closed-Open Solution, Special Solution, General Solution, Singular Solution, Initial Value Problem. Derivation of Differential Equations. First Order Differential Equations: Separable Differential Equations, Differential Equations That Can Be Converted to Separable Differential Equations. Homogeneous Functions, Homogeneous Differential Equations, Differential Equations That Can Be Converted to Homogeneous, Linear Equations, Method of Integration Factors, Method of Variation of Parameters, Bernoulli Differential Equations, Exact Differential Equations and Integration Factors, Higher Degrees of Integration Factors, Higher Order Differentials from Single Variables, Include Mercables Clairaut and Lagrange Equations from Differential Equations. Higher Order Linear Differential Equations: Homogeneous Differential Equations with Constant Coefficients, Characteristic Equations, General Solutions of Linear Homogeneous Equations, Linear Independence and Wronskian Determinant. Complex Roots of Characteristic Equations, Real Value Solutions, Repeating Roots, Inhomogeneous Equations. Uncertain Coefficients Method, Variation of Parameters (Change of Constant-Lagrange) Method. Euler Differential Equation with Variable Coefficients. Some Special Second Order Differential Equations: Differential Equations Without Dependent Variable, Differential Equations Without Independent Variable. Series Solutions of Second Order Linear Differential Equations: Brief Review of Power Series, Solution with Series Around an Ordinary Point. Laplace Transform, Definition of Laplace Transform, Inverse Laplace Transform, Definition of Inverse Laplace Transform, Solution of Initial Value Problems with the Help of

Laplace Transform. Systems of first order linear differential equations: Elimination and Determinant method.

### **MME226 Phase Equilibria (3+0)**

Basic concepts, Gibbs Phase Rule, One-component systems, Free energy-equilibrium diagram curves, Two-component systems (such as Pb-Sn, Cu-Zn, Al Si, Fe-N), Isomorphic, eutectic, peritectic, eutectoid, constant such as peritectoid temperature reactions, cooling curves and microstructure formations. Solid solutions and intermediate phases. Fe-C equilibrium diagrams and microstructure formations in this system. Three component systems.

### **BTF201 Scientific History and Philosophy (2+0)**

The course of development of science in history, the meaning and scope of science, the structure of scientific method and philosophical approach to science.

### **Technical Elective (1 Course)**

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### **MME208 Mineral Processing (3+0)**

Structure of minerals, Basic concepts in ore preparation, mineral properties: Physical properties, chemical properties, mineralogical properties, separation, Sizing, Size reduction: Crushing, crushers, grinding, grinders, Enrichment: Classification by size and enrichment by sorting, enrichment by gravity, Magnetic enrichment by separation, enrichment by electrostatic separation, chemical enrichment, flotation. Raw Materials (Metallic Raw Materials, Ceramic Raw Materials, Other Raw Materials), Pre-treatment and Inter-treatment of Raw Materials, Basic Operations, Sampling and Grain Size Analysis, Surface Augmentation Processes, Classification and raw material enrichment processes

### **MME229 Photovoltaic Technologies (3+0)**

Fundamentals of photoelectric conversion: charge excitation, conduction, separation, and collection. Lectures cover commercial and emerging photovoltaic technologies and cross-cutting themes, including conversion efficiencies, loss mechanisms, characterization, manufacturing, systems, reliability, life-cycle analysis, risk analysis, and technology evolution in the context of markets, policies, society, and environment. Identify and critically evaluate current developments and emerging trends within the field of photovoltaic technologies. Professionally apply systematic engineering methods to appraise and design photovoltaic systems.

### **Pedagogical Formation Education Elective 1**

### **PFE3101 Instructional Principles and Methods (3+0)**

Basic concepts related to teaching principles and methods; teaching-learning principles, models, strategies, methods and techniques; setting goals and objectives in teaching; teaching and content selection and organization in learning; instructional materials; planning and teaching plans; theories and approaches related to teaching; teaching, learning and success in learning; assessment of classroom learning.

### **PFE3102 Introduction to Education (3+0)**

Basic concepts of education, the relationship and functions of education with other sciences (philosophical, social, legal, psychological, economic, political foundations), historical development of educational science, Trends in 21st century educational science, research methods in educational science, Turkish The structure and characteristics of the National Education System, the role of the teacher in the education system, characteristics of the teaching profession, practices in the field of teacher training and Developments.

## **2. YEAR/2. SEMESTER**

### **MME223 Mechanical Metallurgy (3+0)**

Atomic Bonding and Crystal Structure; Elastic Behavior in Crystal Structures; Tensors; Fundamentals of Fracture Mechanics; Fracture Strength of Materials; Mechanical Behaviors; Measurements; Test Methods; Resistance; Elastic Modulus; Satiety; Fracture Energy; Business Energy; Hardness; Plastic Deformation in Crystal Structures; Viscosity and Viscoelasticity; Creep Deformation; Fatigue; Increasing Strength and Toughness of Materials; Thermal Shock Parameters of Materials; Thermal Behavior of Materials; Analysis of Mechanical Decay; Strength and Engineering Design.

### **MME224 Materials Science-2 (3+0)**

The students will attain basic understanding about materials science and engineering, in particular the relations between the structure, properties and processing of materials. The level of understanding should be such that the students should be able to participate in discussions regarding materials selection and choices of processing methods for materials. The course will cover four major topics including: fundamental concepts, microstructure development and phase equilibria, material properties, fabrication methods, and applications. The atomic structure, atomic bonding, crystal structures, defects, and diffusion in materials will be covered. The phase transformations and phase equilibria and how they impact the microstructure development will be provided. The electrical, magnetic, optical, thermal, and mechanical properties of materials will also be reviewed. Materials encountered in the course are metals, ceramics, polymeric, and composite materials, primarily for engineering purposes.

### **MME225 Fundamentals of Manufacturing Technologies (3+0)**

General classification, comparisons, applications of forming technologies. Plastic forming, Casting, Forging techniques, rolling, hot and cold rolling, extrusion, cutting, bending, bending, spinning, deep drawing, Wire drawing, Machining techniques, Turning, milling, CNC machines, Grinding, Welding metallurgy, Powder Metallurgy

### **MME230 Iron and Steelmaking (3+0)**

Iron and steel industry in the world and in Turkey, current production situation and production

flow chart. Industrial applications of iron and steel products and their importance in economy. Raw materials and pre-treatments used in raw iron production: Ore preparation, Sintering and Pelletizing. Production of metallurgical coke: Properties and effects of parameters on properties. Liquid raw iron production in blast furnace: Blast furnace and its facilities, principles of liquid raw iron production and chemical reactions. Thermodynamics of raw iron production in blast furnace, kinetics of reduction of iron oxides. Blast furnace charge calculations. Factors affecting the composition of the peak in the blast furnace. The dispersion properties of elements in liquid raw iron and slag in the blast furnace. Efficiency increasing measures in blast furnace. Steel production: Basic principles and technology of steel production. Thermodynamics of steel production. Steel production with basic oxygen converter. Principles of steel production with electric arc furnace, technological developments in electric arc furnaces. Secondary steelmaking: Deoxidation of steels, alloy additions, principles and applications. Alternative methods and new technologies in iron and steel production.

### **MME 221 Thermodynamics of Material -2 (2+2)**

Equilibrium (Gibbs energy, Helmholtz energy, chemical potential, Gibbs-Helmholtz equation) Solutions thermodynamics (ideal solutions, non-ideal solutions, activities, reference states, Henry's law, Sieverts law, multicomponent solutions, solution models) Phase equilibria (Clapeyron and Clausius-Clapeyron equations, Gibbs phase rule, phase diagrams)

### **Technical Elective (1 Course)**

#### **MME227 X-Ray Diffraction Technique (3+0)**

Short and long-range order, symmetry, group theory, point groups, space groups, reciprocal lattice, tensor representation of crystals and their properties, the definition of X-ray and its properties, X-ray diffraction, phase identification, structure determination, crystallite, and microstrain measurement, Rietveld refinement, precise lattice parameter.

#### **MME232 Surface Treatments (3+0)**

Surface Engineering, Transformation Hardening, Surface Melting, Thermochemical processes, ion implantation, Surface coating.



## **Pedagogical Formation Education Elective 2**

### **PFE4101 Educational Psychology (3+0)**

Basic concepts and principles of learning, factors affecting learning, learning theories, effective learning methods and techniques.

### **PFE4102 Instructional Technologies (2+0)**

Information technologies in education; teaching process and classification of instructional technologies; theoretical approaches to instructional technologies; new approaches to learning trends; current literacies; instructional technologies as tools and materials; instructional design of materials; designing thematic teaching materials; domain-specific object warehouse creation, teaching material evaluation criteria.

## **3. YEAR/1. SEMESTER**

### **MME302 Materials Characterization (2+2)**

Importance of characterization, Classification of characterization techniques, Properties and generation of X-rays, Bragg's law and diffraction, Characterization of materials using X-rays, Analysis of patterns obtained by using X-rays, Thermal Analysis Techniques; Dilatometry, thermogravimetric analysis, differential thermal analysis, differential scanning calorimetry, Optical microscopes and optical microscope techniques, Comparison of light and electrons, Sample-electron interactions, Scanning electron microscopes and techniques, Chemical analysis techniques used in electron microscopes, Parameters to be known for obtaining good images and reliable analysis in electron microscopy, Transmission electron microscopes and techniques, Other characterization techniques and Comparison of characterization techniques

### **MME304 Metallic Materials and Metallography (2+2)**

Microscopes Sample Preparation Melting Solidification Grain Formation and Grain Size Measurement Macroscopic Analysis SEM, X-Rays Iron-carbon phase diagram and steel microstructures, Cast iron microstructures, Heat treated steel and cast iron microstructures Investigation of microstructures of non-ferrous alloys

### **MME305 Materials Processing Lab (0+4)**

Metallographic Sample Preparation, Metallography of Non-Ferrous and Ferrous Metals, Treated Materials, Analysis of Factors Affecting X-Ray Diffraction Pattern, Qualitative Phase Analysis by X-Ray Diffraction, Liquid Penetrant, Magnetic Powder Method, Ultrasonic and Radiographic Methods, Powder Blends and Mixtures Preparation, Pre-forming Processes Applied to Ceramic-Based Mixtures, Sintering, Sample Analysis with Electron Microscope

### **MME306 Polymer Materials (3+0)**

Introduction to Polymers: Nomenclature, Concepts, Production and Development, Thermal Properties of Polymers, Crystal Structures of Polymers, Solubility of Polymers, Fractions and Molecular Mass Types, Molecular Mass Determination Methods of Polymers, Stepped Polymerization, Radical Addition Polymerization, Ionic Polymerization, Coordination and Ziegler-, Group Transfer and Olefin Metathesis Polymerizations, Ring Opening and Atom Transfer Polymerizations, Copolymerization, Conductive Polymers, Inputs Used in the Production of Polymers

### **MME330 Heat Treatment (3+0)**

General information of steel materials and productions. Mechanical properties and application areas of metallic materials, general heat treatments and special heat treatments. Steel materials and definitions. TTT and CCT diagrams. Hardening, normalizing, and stress relieving heat treatments. Re-crystallization and tempering heat treatment. Martempering and austempering. Surface hardening treatments and cementation. Nitriding, boriding, flame hardening.

### **MME307 Summer Practice-1 (0+2)**

In this internship, students will do internship in industrial organizations. It includes the practical training that students will receive in the field of engineering in order to familiarize them with basic production methods, machinery and equipment in workplaces whose criteria are determined by the department. The presentation and function of the workshop covers topics such as shaping, welding, casting, and they should also be informed about occupational safety.

### **İSGGÜV1 Occupational Health and Safety-1 (1+0)**

Hazards and protection methods, Occupational health and safety management, OHS management systems, Management's leadership and commitment, OHS in planning and organization, Risk management and analysis, Investigation and recording of accidents, Informing and training of employees, OHS audits.

### **Technical Elective (1 Course)**

#### **MME308 Opto-electronic Materials (3+0)**

Electrical conductivity, semiconductivity, electrical conductivity in ionic ceramics and polymers, dielectric behavior, refraction, reflection, absorption, optical properties of metals, optical properties of non-metals.

#### **MME309 Hydrometallurgy (3+0)**

It is aimed to teach the basics of hydrometallurgical processes and their usage in metal production.

This course includes Introduction to the basics hydrometallurgy, Acid, alkali and pressure leaching, Thermodynamic and kinetics of leaching, Purification of leaching fluids by ion exchange, Solvent extraction, Adsorption using activated carbon, Selective precipitation processes and solid-liquid separation.

### **Pedagogical Formation Education Elective 3**

#### **PFE 501 Classroom Management (2+0)**

Basic concepts of classroom management; physical, social and psychological dimensions of the classroom; classroom rules and discipline in the classroom; models related to classroom discipline and management; classroom management of student behavior, 11 communication and interaction process in the classroom; students in the classroom motivation; time management in the classroom; the teacher as an instructional leader in the classroom; managing teacher-parent conferences; creating a positive classroom and learning climate; case studies related to classroom management according to school levels.

## **3. YEAR/2. SEMESTER**

#### **MME322 Ceramic Materials (3+0)**

Definition and Comparison of Traditional and High Technology Ceramic Materials, Engineering Ceramics, Bonds and Crystal Structures in Ceramic Materials. Properties of ceramic materials, Ceramic phase diagrams. Ceramic Raw Materials: Test methods applied to ceramic raw materials. Forming methods of ceramic materials: Drying and sintering methods of ceramic materials. Tests applied to ceramic materials. Classification of ceramic glazes.

#### **MME323 Metallurgical Processing Lab (0+4)**

Cupellation, Sulfurized Copper Concentrate. Copper Production by Sulphating Roasting, Copper Refining and Reduction Electrolysis, Cementation Hydroxide Precipitation-Analysis Methods, Zinc Reduction Electrolysis, Carbothermic Reducing Smelting, Metalothermic Reducing Smelting, Pelletizing Iron Ore Powders, Reduction of Ferrous Raw Materials

#### **MME324 Kinetics (3+0)**

Kinetic concepts and definitions. Determination of reaction rate, Kinetics of homogeneous reactions, The concept of reaction degree. Determination of reaction degrees. Effect of temperature on reaction rate. Transfers and reaction kinetics in heterogeneous systems.

Parameters affecting kinetics. Reactions with solids and investigation of these reactions depending on the interface geometry and the nature of the solid reaction product. Kinetics of heterogeneous reactions, effects of concentration and reaction temperature on reaction rate.

### **MME325 Casting and Solidification (3+0)**

Introduction to casting technology and industry, History of foundry, Turkish and World Casting industry, Classification of casting methods, development from past to present, application areas and diversity, Casting with Traditional Sand Molding, casting models, model making, Cores, types, properties, core making technologies, Melting process and melting furnaces, Foundry equipment, Liquid metal properties, preparation of liquid metal for casting process, Pouring liquid metal into the mold, Solidification principles (solidification of pure metals, solidification of alloys, solidification of real casting, exiter - feeder applications, etc.), Shell Mold Casting, Plaster Mold Casting, Ceramic Metal mold casting methods, Pressure mold casting methods, Continuous casting methods, Centrifugal casting methods, Other casting methods, Various special casting applications, Newly developed methods, Design in metal casting, casting processes, Quality control methods, Casting errors, Repair method miles.

### **MME326 Physical Metallurgy (3+0)**

Mass transfer-atomic diffusion-diffusion in solids. Diffusion mechanisms, interstitial and local diffusion. Fick's first law-steady-state diffusion. Effect of temperature on diffusion rate Arrhenius equation. Fick's second law-unstable-state diffusion. Interfaces and their energies. Crystal errors, one, two and three dimensional errors. Dislocations and their types. Interactions between dislocations and dislocation energy. Stacking errors, stacking error energy, the place of stacking errors in deformation. Low angle boundaries-particle boundaries, polygonization, grain boundary energies. High-angle boundaries-grain boundaries, grain boundary energy. Normal grain growth, curvature and impurity effect on coarsening. Cold working, recovery and recrystallization. Effects of old grain size-impurity on temperature recrystallization rate. Particle reinforcement theory in material. Aging in Al-Cu system. Aging and overaging stages-mechanisms-thermodynamic approach. Interference of second phase particles, precipitates with dislocations and strength changes in the material. Particle-precipitate coarsening, Ostwald ripening.

### **İSGGÜV2 Occupational Health and Safety-2(1+0)**

OHS in the Design, Manufacturing and Use of Work Equipment, OHS in Welding, OHS Measures in Electrical Work, OHS in Machinery Pressure Vessels, OHS in Mining Workplaces, Fire and Fire Protection Methods, Occupational Accidents and OHS in Work Machines, First Aid, OHS in Indoor Working, OHS in Food Businesses , Ethics, Environment and Occupational Health.

### **ELD302 Critical Thinking (2+0)**

Ways of thinking, elements of critical and ordinary thinking, reasoning charts, standards for thinking, solving a scientific problem

### **Technical Elective (1 Course)**

#### **MME327 Energy Materials (3+0)**

This course is a materials science approach to the challenge of energy-efficient technology. It first focuses on materials energy content (production, processing, use and recycling), with students developing a short case study in this area. It then describes how advanced materials make possible efficient energy harvesting (e.g., organic and inorganic solar cells, nuclear materials, polymer composites for wind energy, bismuth telluride for thermoelectrics), energy transformation (e.g., polymer and solid oxide fuel cells, light emitting diodes, engines and turbines) and energy storage (e.g., batteries, hydrogen storage, phase change materials). Finally, materials enabling energy-efficient transportation and housing are discussed. One or two guest lecturers may be invited to describe their own area of specialization.

#### **MME328 Powder Metallurgy (3+0)**

Definition and importance of powder metallurgy (P/M), metal powder production techniques: Atomization, electrolytic and grinding techniques. Testing of metal powders and chemical determination of their properties. Compression of metal powders: briquetting, sintering, forging, hot and cold isostatic pressing. Full densification, theory of plasticity for porous materials. Mechanical properties of materials produced by powder metallurgy method. Powder systems and applications.

#### **MME330 Glass and Glaze (3+0)**

Glass definition and oxides, Raw materials used, Glass bulk calculation, Glass types, Glass production process, Physical, chemical and optical properties of glass, Glaze definition, Oxide and raw materials used in glaze, Frit and its production, Glaze production processes, Glaze application, Seger calculations, Glaze errors and corrections.

Textbooks: 1-Pincus, A. G. and Davies, D. H., Raw Materials in the Glass Industry, Part I-II, Ashlee Publishing Co, Inc., 1983. 2-Paul, A., Chemistry of Glasses, Chapman and Hall, 1982.

3-Karasu, B. and Ay, N., Glass Technology, Ministry of National Education Publications, No 3525, National Education Press, Ankara 2000.

4-Shelby, J. E. (1997) To Glass Science and Technology Introduction, Royal Society of Chemistry, UK.

### **Pedagogical Formation Education Elective 4**

#### **PFE 6101 Measurement and Assessment (3+0)**

The place and importance of measurement and evaluation in education; measurement and evaluation basic concepts, psychometric (validity, reliability, usefulness) of measurement tools characteristics; developing and administering achievement tests, interpretation of test results and feedback reporting; analysis of test and item scores, evaluation and grading.

#### **4. YEAR/1. SEMESTER**

##### **MME401 Principles of Corrosion and Corrosion Protection (2+0)**

Definition of corrosion, its importance in the country's economy, cost of corrosion. Grouping corrosion according to different properties. Thermodynamic principles of corrosion. Potential-pH diagrams. Passivation events. Corrosion kinetics. corrosion rate. Types of corrosion. High temperature corrosion phenomena. Corrosion protection methods,

##### **MME402 Non-ferrous Metal Metallurgy (3+0)**

Introduction, basics of extractive metallurgy, non-ferrous metals and their economy, production, enrichment, properties (mechanical, corrosive, thermal etc.) of copper, aluminum, nickel, lead, magnesium, zinc, aluminum, boron, tin, silver, gold and its alloys, and its uses in industry.

##### **MME404 Materials Engineering Design-1 (2+0)**

Implementation of different projects (theoretical and practical) on Metallurgical and Materials Engineering in a laboratory environment. Project work can be done individually or as a group, provided that it is under the supervision of a faculty member.

##### **MME405 Summer Practice-2 (0+2)**

In this internship, students include the field of factory organization in addition to production. It is aimed for the student to get to know the factory and to gain practical information on the issues related to the production of the enterprise: it covers the management of the factory, business inputs, the layout of the equipment, the production process and quality control stages and occupational safety.

##### **Technical Elective (2 Courses)**

##### **MME406 Electrometallurgy (3+0)**

It is aimed to teach the chemical principles and applications of electrometallurgy and other electrochemical processes used in metals manufacturing.

This course includes Ions and electrolytic conductivity, Electrodes and electrode potentials, Conductivity in molten salts, Electrode potentials-comparison of electrochemical series, Electrolytes, Nernst equation, Calculation of cell potential, Application of redox series, Electrolysis, Faraday's laws, Current density, Theoretical cell voltage, Electrical reduction (electroreduction) and purification (electrorefining) of metals from aqueous solutions.

##### **MME407 Non-Destructive Testing of Materials (3+0)**

Introduction to non-destructive testing, comparison of destructive and non-destructive testing, principles and applications of liquid impregnation, magnetic, radiographic, ultrasonic and other non-destructive testing methods, tests and applications

##### **MME413 Advanced Characterization Techniques (3+0)**

Compositional and Structural Characterization, Advanced Microscopy Techniques for Nanomaterials, Spectroscopic Techniques, Nanomaterials Electrical and Magnetic Characterization Techniques, Physical and Optical Characterizations of Nanostructured Materials, Thermal and Electrochemical Characterization.

### **MME409 Composite Materials (3+0)**

Classification of composites, properties of matrix and reinforcement phases in composite materials and desired conditions; Effects of thermal expansion differences in composite materials; fracture strength of composites; Mechanical properties of composites; Fracture mechanism of composites; Toughness mechanisms; Interface properties and thermal stresses; Thermal shock parameters; Load-strain behavior of ceramics with the addition of reinforcement phase

### **MME411 Refractories (3+0)**

Introduction to Refractory Materials, Classification of Refractory, Acidic Refractory, Basic Refractory, Neutral Refractory, Shaped and Amorphous Refractory, Production of Refractory, Characterization of Refractory Properties, Refractory Used in Iron-Steel Production, Refractory Used in Non-Ferrous Metal Production, Damage Analysis in Refractory, Refractory Industry in the World and Turkey.

Textbooks:

- 1- Refractories F.H. Norton, McGraw-Hill, 1968
- 2-Fundamentals of Refractory Technology, J.P. Bennett, J.D. Smith, 2012
- 3-Refractory Materials and Their Properties, A.G. Dider-Werke, 198

### **Non-Technical Elective (1 Course)**

#### **MME411 Philosophy of Science (1+2)**

Definitions of science and philosophy are made, the importance of science, the characteristics of science, logical inference techniques, scientific method stages, different philosophical views on scientific method, experiment, observation and measurement processes in scientific method, some philosophy of science thinkers.

#### **MME412 Business Law (1+2)**

Basic Information about Labor Law, Application Area of Labor Law, Employment Contract, Obligations arising from the Employment Contract, Termination of the Employment Contract, Severance Pay, Arrangement of the Work in Terms of Time, Organization of the Work in Terms of Persons

#### **GNLÇLŞ Volunteer Studies (1+2)**

Volunteering, Ethics, Ethics, Philanthropy, Importance of Volunteering, Individual Social Volunteering Studies, Institutional Volunteering, Institutional Identity, Institutional Image, Economic, Organizational and Social Issues in Corporate Volunteering, Volunteering Issues and Analysis of Successful Volunteering Studies

### **BİL101 Informatics Technologic (1+2)**

Research and reporting techniques, referencing techniques, effective presentation techniques, use of Word, Excel and Power Point programs in presentations.

1- Daley, 2009, Computers are your future, PrenticeHall.

### **MME206 Scientific Writing Skills (1+2)**

The course Introduction to Academic Writing focuses on the academic skills and basic elements of academic writing. The aim of this course is to increase students' agency as writers by acquiring both the theoretical knowledge and practical skills necessary to produce texts for the interdisciplinary academic discourses. More specifically, students will have an opportunity to practice critical reading and writing through summarizing, analyzing, evaluating and synthesizing ideas. Students will also learn how to engage with scholarly sources effectively and incorporate them into their own texts. The main focus will be the argumentative essay as the building block of most genres of academic writing.

### **EVL401 Marriage and Family Education (1+0)**

Aile ve önemi, Evlilik ve evliliğe sağlıklı başlangıç, Toplumsal cinsiyet eşitliği, Aile içi iletişim, Sağlığa genel bakış, Sağlıklı yaşamın korunması, Sağlıklı yaşama yönelik tehditler(bağımlılık), Temel ilk yardım,

### **Pedagogical Formation Education Elective 5**

### **PFE 701 Guidance and Special Education (3+0)**

Basic concepts and principles of RPD, history, field and branches of RPD; used research and evaluation methods, school counseling models (traditional and developmental), school counseling approaches (crisis-oriented, remedial preventive and developmental), the purpose and principles of the traditional school counseling model, traditional roles and functions of the school counselor, developmental school counseling model purpose, principles and program (Comprehensive Developmental Guidance Program), basic services/interventions and the role and functions of the developmental school counselor; in RPD purpose and principles of developmental and preventive approach, life in developmental approach importance of skills training, positive youth development approaches and preventive approach levels of prevention (basic, second and third level).



#### **4. YEAR/2. SEMESTER**

##### **MME421 Graduation Thesis (2+0)**

Realization of various projects (theoretical and practical) on Metallurgical and Materials Engineering in a laboratory environment. Project work can be done individually or as a group under the supervision of a faculty member.

##### **MME423 Materials Engineering Design-2 (2+0)**

Implementation of different projects (theoretical and practical) on Metallurgical and Materials Engineering in a laboratory environment. Project work can be done individually or as a group, provided that it is under the supervision of a faculty member.

##### **Technical Elective (4 Courses)**

##### **MME425 Welding Metallurgy (3+0)**

Welding arc formation and weldability, Welding thermal cycle, metallurgical effects on base metal, Welding preparation practices and Welding seam symbols, Classification of welding methods, Electric arc skid and equipment, Oxy-Acetylene welding and equipment, MIG, MAG welding and equipment, TIG, WIG welding and equipment, Submerged arc welding and equipment, Special welding methods, Welding controls.

##### **MME426 Nanomaterials (3+0)**

Definition of nanomaterials. Today, the importance of nanomaterials and the properties and production of nanostructures. Application areas of nanomaterials: Applications in the field of health, applications in the field of aviation and space, applications in the field of environment and energy, applications in the field of agriculture, applications in the field of food. Effects of nanomaterials on life and future importance of nanomaterials.

### **MME427 Advanced Ceramics (3+0)**

Advanced technology ceramic raw materials, powder production, Oxide Ceramics, Non-Oxide Ceramics, Usage Areas

### **MME428 Biomaterials (3+0)**

Introductory lecture, Metals I, Metals II, Ceramics I, Ceramics II, Polymers I, Polymers II, Hard Tissues I, Hard Tissues II, Orthopedic Soft Tissues I, Orthopedic Soft Tissues II, Other Soft Tissues, Inflammatory Response/Foreign Body Response, Surface Chemistry, Surface, Characterization I, Surface Characterization II, FDA and Patent Law, Current Topics in Biomaterials Research

### **MME429 Thin Films Fabrication and Characterization (3+0)**

Thin films and thin film devices, Epitaxial growth and deposition, Cleanroom micro and nano device processing; Characterization of thin films, thin film coatings, electronic, optical and magnetic thin film devices.

### **MME432 Materials Selection and Design (3+0)**

Introduction: a) The place of design in our lives and materials science and engineering, b) Determination of designs, c) Determination of design projects, Design process: a) Definition, b) Design process c) Types of design d) Function, material, shape and process relationship, e) Design examples, Shapeless Material Selection: a) Material-Function interaction, b) Material selection strategy, c) Primary limiters, d) Performance indicators, Shaped Material Selection: a) Shape factors, b) Shape, stiffness, and strength, c) Performance indicators considering shape, d) Shaped material selection process, e) Use of software for material selection, f) Examples of shaped material selection, h) Selection of shaped material by calculation, i) Transfer of shape factors to material property graphs.

### **MME434 Organic Chemistry (3+0)**

Basics, Families of Carbon Compounds, Organic Reactions and Their Mechanisms, Nomenclature and Conformations of Alkanes and Cycloalkanes, Stereochemistry, Ionic Reactions, Alkenes and Alkynes.

### **Non-Technical Elective (1 Course)**

#### **MME430 Business Life and Quality Control (2+0)**

Definitions and concepts of workers and employers, Basic information on occupational health and safety, Occupational diseases and occupational accidents, Duties to be done on occupational safety and worker health, Laws and regulations, Expression of the concept of quality, explanation of the trio of quality, cost and delivery, explaining the concept of gemba, gemba Explaining kaizen, explaining upstream management, Quality Costs, Quality Assurance System and ISO 9001, TSE, CE, Total Quality Management, Environmental standards, Total Productive Maintenance (TPM), Total Productive Maintenance (TPM), Process competence Machine competence, Zero quality control "Eliminating the problem at its source, Poka Yoke system", 5S:Organization of working life in 5 steps, Problem solving techniques

#### **MME431 Introduction to Research (2+0)**

Course Objective, Content, Sources and Introduction of Process, Science, Scientific Research and Scientific Method Access to Scientific Information, Reading, Understanding and Summarizing Scientific Texts, Research Approach-Pattern and Research Problem and Determination, Data Collection Tools, Sampling in Research, Data Analysis, Scientific Validity and Reliability in Research Academic Writing, Scientific Ethics and Research Ethics, Research Proposals and General Evaluation of the Course

### **TKNBAG Technology Addiction (2+0)**

Basic concepts, positive and negative aspects of technology, addiction; internet, game, smartphone and social network addiction, what is cyberbullying, its types, prevalence, research, awareness and coping strategies for students, families and teachers

### **Pedagogical Formation Education Elective 6**

#### **PFE8101 Teaching Methods (3+0)**

Information technologies in education; teaching process and classification of instructional technologies; theoretical approaches to instructional technologies; new approaches to learning trends; current literacies; instructional technologies as tools and materials; instructional design of materials; designing thematic teaching materials; domain-specific object warehouse creation, teaching material evaluation criteria.

#### **PFE8102 Teaching Practice (1+8)**

Examination of educational, vocational and personal/social RPD activities in pre-school, primary, middle and high schools; application and interpretation of test and non-test techniques; development and implementation of group guidance programs on various subjects.