**TECHNOLOGY FACULTY**

**ENERGY SYSTEMS ENGINEERING LESSON CONTENTS**

**I.SEMESTER**

**MAT183 Mathematics I (4+0) 4**

Matrix transformation of linear equation systems and solution with Cramer's method. Addition and product of vector quantities. Cartesian coordinates and line equations in the plane; line equation, circle equation, parabola, hyperbola and ellipse equations. Functions and graphics; force functions, exponential and logarithmic functions, trigonometric functions, inverse trigonometric functions, implicit functions, hyperbolic functions. Determining the roots of quadratic, cubic and various equations. Complex numbers. Polar coordinate system and drawing of functions given polar equation. Number sequences, series and convergence tests. Bivariate functions; introducing equations of surfaces such as planes, spheres, paraboloids, and plotting. Limit and continuity.

**FIZ183 General Physics I (4+0) 4**

Physics and measurement, Motion in one dimension, Vectors, Motion in two dimensions, Laws of Motion, Circular motion and other applications of Newton's Laws, Work and kinetic energy, Potential energy, and conservation of energy, linear momentum and collisions, Rotation of solid objects around a fixed axis, Rolling motion and angular momentum, Static balance and flexibility, Vibration motion, Universal gravitation law, Fluid mechanics.

**KIM183 General Chemistry (3+0) 3**

Basic concepts in chemistry: Matter, element, compound, mole, mixture and some chemical concepts. Important chemistry laws: Conservation of mass, flat rates, multiple rates, etc. Atom and mole mass. Symbols, formulas, equations and compounds. Simple formula, molecular formula determination. The concept of valence, spelling and naming of compound formulas. Chemical reactions and chemical equations, stoichiometry. Oxidation-reduction reactions (redox). Periodic table and some atomic properties: Electronegativity, ionization energy, electron affinity, quantum numbers and electron orbitals. Gases: Simple gas laws, ideal gas equation, kinetic theory of gases, real gases. Thermochemistry: Heat, reaction heat and calorimetry. Chemical bonds: Basic concepts: Covalent and ionic bond. Liquids, solids and intermolecular forces. Solutions and their physical properties. Chemical balance. Acids, bases and aqueous solution balances. Thermodynamics: Some terms, laws of thermodynamics, Hess law, Gibbs free energy. Electrochemistry: Faraday laws, electrolysis, battery potential, Nernst equation. Organic Chemistry: Classification of organic compounds. Hydrocarbons (alkanes, alkenes and alkynes), alcohols, phenols, ethers, aldehyde and ketones. Carboxylic acids and their derivatives.

**TUR181 Turkish Language I (2+0) 2**

What is language? The place and importance of language in national life as a social institution. Language culture relation. The situation of Turkish Language among world languages and its spreading areas. Sounds in Turkish and their classification. Turkish phonetic features and rules about phonetics. Syllable knowledge, spelling rules and their application, punctuation and application.

**YDL181 Foreign Language I (2+0) 2**

Tenses, verbs; noun phrases: plural expressions in compound adjectives, compound nouns, noun phrases, sentences formed with intermediaries; times used in narration: past simple, past progressive, past perfect simple, past continuous; reflexive justice; irregular verbs; comparison structures; modal structures: probability, imperative, permission, ability, desire modes, future tense, time tense, past tense auxiliary verbs, idioms; synchronous words; structures that reinforce expression, general review: passive roof, times, envelopes

**AIT181 Atatürk’s Principles and History of Revolution I (2+0) 2**

Definition of revolution and Turkish revolution, Concept information, History of Turkish Revolution movement in Turkey, the current appeared to save the Ottoman Empire, World War I, the Treaty of Sevres, the collapse of the Ottoman Empire, the National Struggle Period, congresses, held during the National Struggle wars, relations with Western states and agreements, Lausanne Peace Agreement.

**ESM 101 Fundamental Computer Technology Usage (2+0) 2**

Efficient and efficient use of the computer. Computer literacy. Creating tables, drawing graphics. Presentation and product promotion. Realizing technical drawings and basic drawings related to engineering. Special software (Basic word processing programs, spreadsheet programs, presentation programs, drawing programs required for technical drawings) and their applications at the computer.

**ESM 105 Tecnical Drawing I (2+2) 3**

Technical Drawing Tools and Equipment, standards in technical drawing, papers, folding forms. lines, writings, Drawing Technique, dimensioning and rules, geometric drawings, tangents, arcs, Appearance, perspective pictures, sections, application and assignments.

**ESM103 Introduction to Energy Engineering (2+0) 2**

History of energy engineering, interests and relationships with other engineering disciplines. Trends in the development of new technologies and energy engineering. Skills and training program to be acquired to become an energy engineer. Energy engineering projects and problems. Techniques used in solving engineering problems and their applications to some problems. The importance of written, oral and electronic communication. İmportance of problem solving, lifelong learning and teamwork. Library usage, computer usage, internet and other information sources. The place of the computer in energy engineering. Business areas in which energy engineers work. Professional approach and professional ethics. Technical and legal responsibilities of the energy engineer. Legislation in force. Professional organizations.

**II. SEMESTER**

**MAT186 Mathematics II (4+0) 4**

The concept of integral, definite and indefinite integral, integral of various functions, differential definition, mean theorem, multiple integrals, linear integrals and path independence, surface integrals, arrays, series, power series.

**FIZ186 General Physics II (4+0) 4**

Electric fields, Gauss's law, Electrical Potential, Capacitance and dielectrics, Current and resistance, Direct current circuits, Magnetic fields, Sources of magnetic field, Faraday's law, Inductance, Alternating current circuits, Electromagnetic waves.

**TUR182 Turkish Language II (2+0) 2**

Turkish suffixes and their applications. Rules about composition, plan and application to be used in writing composition. Noun and verb conjugation in Turkish. Forms of expression and its application in composition. Use of adverbs and prepositions in Turkish.

**YDL182 Foreign Language II (2+0) 2**

General repetition: verbs, get + adverb / preposition, transposition sentences, formal and informal language use; conditional sentences: type I, type II; time-reporting sentences; punctuation marks; adjective clauses: defining, non-defining; use of intermediaries; use of intermediate in time phrases; use of intermediate after certain verbs; possessive structures: genitive "s", the "of" structure; language use; stress; language levels; expressing assumptions: hypothetical sentences; request mode: wide time, past time; advanced listening-note-taking skills

**AIT182 Atatürk’s Principles and History of Revolution II (2+0) 2**

Definition of revolution and Turkish revolution, Concept information, after the Lausanne Peace Treaty situation in Turkey, the Turkish Republic, abolition of the Caliphate, multiparty life transition trials, Sheikh Said Rebellion, analysis of Turkish foreign policy, methods of Ataturk's principles and revolutions of Atatürk's principles and reforms of national unity- To teach the importance of togetherness, country integrity and reaching the level of modern civilization

**ESM106 Electric-Electronic Technology(2+2) 3**

Introduction of current, voltage, power concepts and circuit elements (dependent, independent sources). Kirchoff laws used in the analysis of resistant circuits; Node and environmental analysis techniques; Basic op-amp analysis. Linearity, superposition, source transformation, Thevenin and Norton theorem, Maximum power transfer, Sensitivity analysis. Current voltage properties of capacitors and inductors in the circuit

**ESM 110 Computer Aided Drawing (2+2) 3**

Introduction to computer aided drawing. Basic drawing steps and projection techniques. Section view rules. Basic concepts in three-dimensional modeling. Three-dimensional part design and solid modeling. Creating two-dimensional technical drawing from three-dimensional model and detailing. Assembly modeling and assembly of parts. Surface modeling. Computer aided design (CAD) and applications.

**ESM108 Fundamental Manufacturing Processes (2+2) 3**

Safe use, inclination, drilling, tapping, threading, screws, guides and dies for tools and apparatus. Basic information about milling, turning, grinding and grinding machines. Basic information about calipers, micrometers, compensators and other measuring and control instruments and their usage. Hole drilling, drills and sharpening, marking process and marking tools, cutting tools used in turning and milling, cutting speed, safe usage rules of tools and machines, Reaming, Heat treatments, hardness measurement methods, soft and hard soldering and welding processes.

**ESM100 Internship (0+0) 0**

Developing the skills of knowing the workplaces related to the department, learning and applying workplace organizations and interpersonal relations.

**III.SEMESTER**

**MAT283 Differential Equations (3+0) 3**

First order differential equations. Nonlinear equations that can be reduced to linear equations. Equations with constant coefficients. Linear equation systems. Variable coefficient differential equations and series solutions. Partial differential equations. Solution with decomposition of variables. Fourier series and Fourier integrals. Orthogonal functions, application to boundary and initial value problems.

**YDL281 Occupational Foreign Language I (2+0) 2**

Tenses, verbs; noun phrases: plural expressions in compound adjectives, compound nouns, noun phrases, sentences formed with intermediaries; times used in narration: past simple, past progressive, past perfect simple, past continuous; reflexive justice; irregular verbs; comparison structures; modal structures: probability, imperative, permission, ability, desire modes, future tense, time tense, past tense auxiliary verbs, idioms; synchronous words; structures that reinforce expression, general review: passive roof, times, envelopes

**ESM 213 Engineering Mechanics (3+0) 3**

Static of particles. The balance of the material point. Space forces system. Rigid bodies. Equivalent force systems. Balance of rigid bodies. Spread forces. Center of gravity. Carrier systems. Beams and cables. Moments of inertia of fields and masses. Friction. Virtual work. Particle kinematics; road, time, velocity and acceleration concepts and their relations. Two and three dimensional movements of the material point on different axis sets. Relative motion in plane and space. Solid bodies kinematics; translation, rotation and translation-rotational movements of the body. Relative motion approach to objects.

**ESM201 Measurement and Quality Control (2+0) 2**

Basic concepts of measurement. Uncertainty and statistical analysis of experiment data Basic analog electronics. Fourier techniques. Digital electronics Methods and sensors related to size, pressure, flow, temperature, heat, force, strain, vibration and sound measurements. Basic concepts. Uncertainty and statistical analysis of experiment data. Report writing and presentation. Quality standards, national and international quality criteria.

**ESM 215 Materials Science (3+0) 3**

Chemical properties of materials, atomic bonding structures, crystal planes and directions, Bravais and Miller indices, structural defects and their effects on properties of crystalline materials, understanding and measuring mechanical properties of materials, defining the effects of diffusion on chemical composition and mechanical properties of crystalline materials and one dimensional problems, two component phase diagrams, solidification and diffusion principles in alloy systems, structure-property relationship in metal, ceramic, polymer and composite materials, types of corrosion, methods of protection

**ESM203 Installation Systems Technology (2+2) 3**

Standards on the subject. Physical and chemical properties of water, obtaining, transmission and distribution methods, cleaning and softening of water, distribution. Arrangement of clean water installation. Arrangement of wet places and waste water installation, pipe diameter calculation. Arrangement, sizing and calculations of rainwater installation. Arrangement, calculations and design of the fire installation. Calculation, preparation and installation of the domestic hot water needed. Calculations and selection of hydrophore and warehouses.

**Non-Technical Elective Lessons**

**TSD201 Marketing (2+0) 2**

By making a scientific definition of marketing, which is one of the functions of the business, its place and importance in business management is conveyed. Within the scope of this course, marketing concept, marketing mix elements, ways of reaching the consumer and the consumer, marketing planning are given with their basic contents.

**TSD203 Behaviour Sciences (2+0) 2**

System, production system and factory concepts. Selection of the establishment location of the factory; region selection, region and location selection, factors affecting establishment location selection and methods used in selection. Workplace layout and material flow; objectives of workplace layout planning, factory building, workflow types, workplace layout types, arrangement by work, flow arrangement, cellular arrangement, arrangement by invariant positions, material flow systems: AGVS, conveyors, robots, material storage and storage systems: AS / RS, intermediate stocks. Factors and methods used to choose among alternative solutions in factory organization; factors affecting the selection, properties and quantities of products produced in the factory, technological and product strategies implemented in the factory, production systems, cost calculations, machine selection, workplace layout selection, programmed workplace layout algorithms, material flow, stocking and storage system selection.

**TSD205 Public Relationships (2+0) 2**

The Introduction to Public Relations course is designed to provide students with an initial knowledge of public relations science and practices. With this course, students will understand the concept of public relations, comprehend the public relations process, and have theoretical knowledge to perceive and criticize public relations practices. In this course, the concept of public relations and other related concepts, public relations process, media relations, public relations practices will be included.

**TSD207 Critical Analytical Thinking Techniques (2+0) 2**

Concepts and definitions, Brain as a thinking organ, Grouping of thinking, Involuntary thinking and its features, Thinking voluntarily, Properties of voluntary thinking, Methods of voluntary thinking, Critical and analytical thinking, Critical-analytical thinking, basic features and criteria, Critical-analytical thinking steps, Critical- Factors affecting analytical thinking, The scope of critical-analytical thinking, How should critical-analytical thinking be done?

**TSD209 Entrepreneurship I ( 2+0 ) 2**

Concept of Entrepreneurship and its emergence, types of entrepreneurship, entrepreneurial features, benefits of entrepreneurship, obstacles in front of entrepreneurship, entrepreneurship culture, business establishment stages, basic functions of businesses, necessary documents for business organization and places of application for receiving.

**Technical Elective Lessons**

**ESM207 Steam Boilers Technology (2+2) 3**

Steam boiler types and technical values. Selection of steam boilers. Thermal losses and thermal efficiency. Grate furnaces, powder coal, liquid and gas fuel furnaces, determination of furnace dimensions. Finding the cooker temperature. Calculation of heating surfaces; calculation of superheater, economizer and recuperator surfaces. Calculation of load losses, chimney calculation. Information about the material used in steam boilers, calculation of wall thickness of cylindrical containers exposed to internal pressure. Calculation of the wall thicknesses of flame pipes exposed to external and internal pressure. Tension, strut pipe, Antruaz calculations.

**ESM209 Three Dimensional Design (2+2) 3**

Wireframe models, Surface modeling. Solid modeling. Complex surfaces, Coordinate systems, paper space and printout techniques.

**ESM211 Electromechanical Energy Conversion (2+2) 3**

Basic laws about electromagnetics, developments and analysis of magnetic circuits with coils and permanent magnets, giving the concept of force and moment in an electromechanical system, the concept of coenergy, power and current transformers, electrical machines

**IV.SEMESTER**

**YDL282 Occupational Foreign Language II (2+0) 2**

Various Science (mathematics, physics, chemistry) and engineering related concepts; tools, engines, measuring instruments used in industry; examination of sample subjects related to materials, mechanics, thermodynamics, static, manufacturing which are basic engineering subjects

**ESM222 Strength of Materials (3+0) 3**

Support types and support forces, Calculation of internal forces and cutting method; Introduction to Strength; Stress: Normal stresses, shear stresses and bearing stresses; Strain: Hooke's Law and modulus of elasticity, elongation in axially loaded bars, poisson ratio, strain measurement and strain badges; Stress transformations: Mohr circle, prime stresses and prime stress planes; Flow and fracture criteria; Stresses in thin walled pressure vessels; Moments of fields: First (static) moment and second (inertia) moment; Torsion; Simple bending; Transverse loading: shear force, normal force and bending moment in beam sections; Shear force and bending moment diagrams; Stresses in beams; Displacement and elastic curve (deflection) in beams: Integration method, superposition method, moment field method; Hyperstatic problems.

**ESM202 Thermodynamics-I (3+0) 3**

Basic definitions of thermodynamics. Properties of pure substances. First law of thermodynamics (closed systems). First law of thermodynamics (control volumes). The second law of thermodynamics. Entropy. Power and cooling cycle. Constant heat conduction. Transient heat conduction. Forced convection. Natural convection. Radiation heat transfer. Heat exchangers.

**ESM214 Alternative Energy Sources (2+0) 2**

General information about the available energies and the possibilities of using solar, geothermal, wind and nuclear energies offered as alternative energies in relation to this energy environment. Energy sources are inexhaustible fossils and inexhaustible natural energy sources. Solar energy and its main applications, production and use of biogas, natural gas, geothermal energy, wind energy, tidal energy, wave energy (Wave Energy) Biomass fuels, biodiesel fuels

**ESM218 Natural Gas Systems Technology (2+2) 3**

Types of gases, their classification and combustion properties, transport, storage and distribution of gas, types of gas firing devices and chimneys and their intended use, information on architectural, structural elements and location of buildings. Industrial and industrial gases and related applications. Storage tanks and safety rules. They Regulator. Automatic converters. OPSO-UPSO (tank and burner) Regulators. Gas circuit fittings and standards. Fire precautions and procedures. Bulk gas supply systems. Natural gas conversion plants. Pressure test.

**ESM208 Numerical Analysis (2+0) 2**

Purpose of Numerical Analysis and Numbers Accuracy, Calculus Analysis and Taylor Series, Numerical Derivative, Numerical Integral, Root Finding, Matrix Algebra, Linear Equation Systems, Linear Equation Systems, Nonlinear Equations Regression and Polynomial Regression (Least Squares Method), Interpolation, Lagrange Interpolation, Numerical Solutions of Ordinary Differential Equations

**ESM250 Workplace Education I (0+2) 1**

It knows the workplaces related to undergraduate programs closely. Students reinforce their knowledge and experience gained during their study period, learn by practicing their hierarchical responsibilities, relationships, organizational structure, work discipline in their workplaces, and closely monitor the functions of sector employees, and increase their knowledge and experience regarding diploma programs. Workplace training works in harmony with the staff of the institution they work with and communicates well with other people (customers or other institutions) with whom the business is concerned.

**Non-Technical Elective Lessons**

**TSD202 Philosophy of Science (2+0) 2**

What is the nature of science in the course? based on the question focuses on the difference between science and non-science. Also in the context of this question, logical empiricism, historicalism, etc. Different approaches developed for understanding the nature of science are discussed.

**TSD204 Factory Organization (2+0) 2**

Factory analysis and planning techniques. Process and process analysis; Method and time study; Productivity. Determination of production standards; Workplace organization; Facility renovation and maintenance problems. Wage and job evaluation methods; Quantitative planning and control techniques. Some modern mathematical and statistical models; Organization of the transaction structure and management; Cost, budgeting, personnel, sales, procurement and planning techniques.

**TSD206 Standardization (2+0) 2**

Standardization Policy, standardization in Turkey, International Trade Relations in standardization, mandatory standards to be applied in Turkey

**TSD208 Project Methods (2+0) 2**

Introduction to project management, project life cycle, project management processes, organization types, project start, project needs and requirements, project plan, work distribution tree, risk management, cost estimation, calendaring, resource allocation, project execution, team structure, human size, project control, change management, shape management, progress measurement and control, earned value, evaluation, project closure.

**TSD210 Entrepreneurship II ( 2+0 ) 2**

What is the project, project idea, Business Plan Concept, Project stages and institutions and organizations to be given the project, to determine the features that should be considered in project preparation and project writing. To provide project based work while doing a job.

**Technical Elective Lessons**

**ESM210 Energy Systems Environmental Effects (2+0) 2**

Introduction, Energy Resources, Petroleum, Electric Power, Turkey's Energy Policy and Natural Gas, Environmental Awareness, 21st century Environmental Issues, Waste, Pollution Trade, Energy and Alternative for 10-50 years now, Global Warming, Global Security and Radioactivity

**ESM216 Economic Analysis Methods (2+0) 2**

Basic concepts of the economy; Basics of macroeconomics and microeconomics; Economic analysis of energy projects; Financing of energy projects; Financial analysis of energy investments; Energy investment planning, tariffing and pricing; Energy cost analysis; Energy trade; Energy derivative markets; Global energy potential, supply and demand; Energy balance; Global energy markets; Regional views for the next 30 years: prevailing trends and forecasts; Energy indicators; Analysis and modeling of energy policy; Energy and economic growth; Regulations, liberalization and competition in energy markets; Energy and sustainable growth. Energy policies.

**ESM220 Electrical Energy Conduction and Distribution (2+0) 2**

Basic terms, general line parameters, parameters related to other elements of power systems, superficial studies to design the distribution part of the power system, General method of solution of state spaces in a distribution system, Design of network cross-sectional area on voltage drop and power losses, protection against dangerous contact voltage, Distribution special cases of system process, serial and parallel power factor correction in distribution networks.

**V.SEMESTER**

**ESM323 Machine Elements I (3+0) 3**

General concepts, stress analysis, compound stress, fracture theory, fatigue, safety coefficient, reliability, notch, size, surface and other factors. Material selection, riveted, welded, soldered joints, force and moment load. Connection and power screws, shafts, two-dimensional analysis, wedges, springs. Oils and lubrication theory, plain and rolling bearings. Design of gear wheels; straight, helical and bevel gears, spiral and worm screw mechanisms. Design of couplings, clutches and brakes. Design of belt- pulley mechanisms, design of chain- gear mechanisms. Friction wheels. Term project.

**ESM301 Thermodynamics II (3+0) 3**

Basic relations for simple compressible systems. Generalized diagrams. Mixtures that do not react chemically. Steam machine cycles; Carnot cycle, Ericson cycle, Brayton cycle. Closed and open circuit gas turbines. Cycle of internal combustion piston machines. Refrigeration machines and heat pump cycles.

**ESM303 Heat Transfer (3+0) 3**

Flat plate in fixed and time-dependent regimes; in cylindrical and spherical bodies; heat conduction in one and two dimensions. Cases with heat source in it; Heat transfer in multi-storey objects. Using numerical methods in heat conduction problems; The vanes. Heat radiation; Heat radiation between black and gray surfaces; Shape factors; Radiation shield; Gas radiation. Hydrodynamic and thermal boundary layers. Natural and forced heat convection. Dimensionless numbers; Reynolds similarity. Flow in pipes and bundles. Evaporation and condensation. Heat exchangers; Effectiveness method. Mass transition and laws. Similarities between heat and mass transfer. Mass transfer by convection and diffusion routes. Hydrodynamic and thermal boundary layers. Natural and forced heat convection. Dimensionless numbers; Reynold's resemblance. Flow in pipes and bundles. Evaporation and condensation. Heat exchangers; Effectiveness method. Mass transition and laws. Similarities between heat and mass transfer. Mass transfer by convection and diffusion routes.

**ESM305 Fluid Mechanics I (3+0) 3**

General descriptions, fluid mechanics and hydraulics, units, viscosity, hydrostatic force acting on plane surfaces, fluid flow, permanent and uniform flow, flow charts, continuity program writing, introduction of operation, input-output statements, control statements, preset functions, filing processes and commands, program examples. Momentum equation, size analysis and similitude, viscous flows in pipes and channels, boundary-layer theory, potential flow theory, compressible flow, flow measurement techniques.

**ESM307 Fuels and Combustion (2+2) 3**

Fuels and their properties; Combustion; Chimneys; Torches; Combustion control. Definition of combustion. Combustion types and flame types. Combustion and thermochemistry; thermodynamic laws, reactants and product mixtures, adiabatic flame temperatures, chemical equilibrium. Introduction to mass transfer; fundamentals of mass transfer, some applications of mass transfer. Chemical kinetics; basic reaction rates, reaction rates for multi-step mechanisms. Laminar premixed flames; physical definition, analysis, factors affecting flame speed and thickness, extinction, flammability and ignition, flame stability. Laminar diffusion flames; Unreacted Fixed-Density Laminar jet, physical definition of jet flame, theoretical definitions, counter-flow flames.

**Technical Elective Lessons**

**ESM309 Solar Energy Systems (2+0) 2**

Relationship with solar energy and other renewable energy sources. Movement of the sun, solar geometry and sun angles and similar basic information. Radiation types, calculations related to total solar radiation coming to flat and inclined surfaces on earth. Types of air and liquid solar collectors, working systems (direct and indirect systems, natural and forced systems, vacuum tube and heat pipe systems), properties, connection types (parallel and serial connection) and efficiency. Associating solar systems with existing systems. Various solar energy applications (solar chimney, solar pool, solar cells, solar swimming pool systems, solar heating etc.). Designs for solar collector area, pipe diameter and pump capacity required for heating and hot water preparation systems and designs related to solar energy systems.

**ESM311 Psychometric Analysis (2+0) 2**

Description of ventilation, air conditioning and cooling. Creation and use of psychrometric diagram. Definition of concepts such as wet thermometer, dry thermometer, specific humidity, relative humidity, dew point temperature, enthalpy and their presence from the psychrometric diagram. Psychrometric explanation of air heating, cooling, humidification and dehumidification processes. Solution of summer and winter air conditioning applications from psychrometric diagram. Psychrometric explanation of the requirement of preheater and bypass air in an air handling unit.

**ESM313 Energy Generation and Storage Systems (2+0) 2**

Energy production systems, Sankey Diagrams of System Elements, Optimization of Energy Systems, System design and development methods, System Design in terms of Energy Efficiency, System design in terms of energy cost, Recovery of losses in energy production systems, Efficiency enhancement methods, Design of equipment used in Energy Production Systems in terms of efficiency. Determination of System Diagram, Efficiency Analysis Based on Thermal Diagram, Measures to Increase Total System Efficiency, Designs Depending on the Relationship Between Energy Production and Cost, Designing Systems Depending on Needs and Energy Source Opportunities, Codes Used for Design and Overview of These Codes.

**ESM315 Fuel Cells (2+0) 2**

Definitions Historical Development. Emissions; Fuel Cell Systems Overview; Alkaline Fuel Cell. Operating Conditions and Principles of Molten Carbonate Fuel Cell, Solid Oxide Fuel Cell and Solid Polymer Fuel Cell, Typical Cell Materials, Cell Configurations, Applications and Economies; Principles of Fuel Cell Electrochemistry, Heat in Fuel Cells. Adiabatic flame temperature. Chemical equilibrium criteria, Equilibrium constants. Chemical kinetics: reaction rates, Arrhenius equation. Activation energy. One-step, sequential and chain reactions. Droplet and spray burn. Combustion systems, Fuel atomization, group combustion numbers. Combustion in fluidized bed. Coal burn. Emission of pollutants from the environment as a result of ignition and burning.

**ESM317 Pumps (2+0) 2**

Location and importance of pumps in installation systems, Pump types and principles of operation, Structure and properties of circulating pump and centrifugal pumps, Determining pump characteristic curves, Determination of working conditions related to pipe equipment and viscosity, Catalog reading and selection of suitable pumps, Electric control of pump motors, Installation rules of pumps Breakdown and maintenance rules.

**ESM319 Heat Pump (2+0) 2**

Basic information, heat pump types; vapor compression; cooled; thermoelectric and others, heat pump systems, heat pump design, system analysis, design and control. Building applications, hot water supply, heating, cooling and dehumidification processes. Industrial heat pump applications.

**ESM321 Work Safety**

Triple Responsibility. Ergonomics. Security Policies, Laws and Rules. Security of Energy Systems. Pressure Vessels Safety. Protection and Response Methods Against Fire and Explosions. Hazardous Chemicals. Environmental Protection: Emissions and wastewater vapors. Personal Protective Material Selection. First Aid Measures. Occupational Accidents. Accidents at work. Effects of Security Measures on Human Psychology. Occupational Health and Safety Legal Method

**Non-Technical Elective Lessons**

**TSD301 Work Law (2+0) 2**

Individual Labor Law: The Place of Labor Law in the Discrimination of the Branches of Law / The Subject of Labor Law / The Parts of Labor Law / The Sources of Labor Law / Basic Principles of Labor Law / Basic Concepts of Labor Law: The Concept of Employee, Employer, Employer Attorney, Apprentice, Workplace / Business / Employment Contract and Types / Employment Contract / Employee and Employer's Obligations Arising From the Employment Contract / The Concept and Types of Wages / Wages Guarantee / The Concept of Minimum Wages / Working and Rest Periods / Termination of Employment Contract / Results of Termination of Employment Contract. Collective Labor Law: Unions and Executive Bodies / Unionism Basics in Turkey / Unions Organization / Unions Organs / Union Membership of nature Rights and Obligations / Unions of Income Sources / Unions of Legal Personality of Termination / Collective Bargaining Defining / Bulk in Turkey Features of Business Contract / Peaceful Remedies: Mediation and Arbitration / strike: Concept and Definition / legal strike Conditions in Turkey / strike Rating / Strikes Delay / Lockout: Concept and Definition / Legal Lockout Conditions in Turkey.

**TSD303 Patent and Industrial Design (2+0) 2**

Stages of product design, classification of design theories and methodical approaches, creation of ideas, examination of ideas, initial design development and testing Market analysis, final product development, presentation of the product to the market, product development studies, design processes, design and design strategy with teamwork, designer's action and approaches that externalize the process, organizational design process, design stages, finding and creating new ideas, decision making and features.

**TSD305 Scientific Research Techniques and Effective Presentation Methods (2+0) 2**

Techniques of research article, compilation, poster preparation and oral presentation, specifying points to be considered in writing the summary, introduction, material-method, statistics and conclusion sections in the research article, points to be considered in the preparation of graphics and tables in written and oral presentations

**VI.SEMESTER**

**ESM302 Fluid Mechanics II (3+0) 3**

Dimensional analysis and Similarity, General equations, Bernoulli equation and applications in relative motion and non-continuous flows. Flow and cavitation problem in siphon. Piping Systems (networks and networks). Moody Diagram and Continuous head losses. Local (local) losses. Water impulses. Measurement of speed, flow, pressure and viscosity with venturimeter, orifice meter, pitot tube. Pumps and turbines, cavitation.

**ESM304 Heat Exchangers (3+0) 3**

Definition, importance, intended use and places of heat exchangers. Classification of heat exchangers (by type of fluid, number, type of production, flow patterns, etc.). Thermal calculations in heat exchangers. Properties, usage areas and design of body-pipe type heat exchangers. Features, applications and design of plate heat exchangers. Features, applications and design of tubular heat exchangers. Temperature and pressure drop in heat exchangers. Efficiency of heat exchangers. Pollution that occur in heat exchangers and its effects.

**ESM-306 Heating, Ventilation and Climatization (3+2) 4**

Basics of individual and central heating. Introducing the heating elements. Hot water and source water heating circuits. Low pressure steam heating circuits. Determination of heat load and dimensions of the elements used. Calculation of pipes and diameters. Ventilation and air heating. Channel and culvert calculations. Projecting of heating and ventilation systems.

**ESM308 Simulation in Energy Systems (2+0) 2**

Introduction, Basic concepts, Energy systems, basic equations in the solution of heat-flow problems and numerical solution methods of these equations. Geometry and model creation in ANSYS Fluent software, creating mesh in the model structure, determining the element types and boundary conditions and numerical analysis of the problem. Laminar and turbulent pipe flow, flow between two plates, forced convection on the plate, flow on the cylinder, flow on the airplane wing, etc. numerical solution of problems.

**ESM350 Workplace Education II (0+1) 1**

Knows the technological developments in the sector, to consolidate the theoretical knowledge they acquired at school, to improve their skills and experience in laboratory studies, to help them know their workplace organizations, production processes and new technologies, to prepare students for their professional life, to guide them in determining their career goals and to work in their field**.**

**Technical Elective Lessons**

**ESM310 Insulation Technologies (3+0) 3**

The importance of heat and sound insulation. Necessity of insulation. Related laws and regulations. Application places and methods. New building applications. Old building applications. Thermal insulation materials. Sound Insulation materials. Cost calculations. Software used in insulation calculations.

**ESM312 Energy Systems Automatic Control (3+0) 3**

Basics of automatic control. Control systems terminology. Basic automatic control elements. HVAC / R applications. Digital control system applications. Automatic control system design. Control circuit diagrams and application examples.

**ESM314 Thermic Turbo Machines (3+0) 3**

One-dimensional flow of compressible fluid. Supersonic, subsonic, sonic streaming. Nozzles, flow and sizing in nozzles. Emitters. General equation of turbo machines, speed triangles, pressure and speed diagrams, power. Steam Turbines: Efficiency and losses, Effect of condensation, Classification, Turbine selection. Centrifugal and axial fans: Yield, characteristic curves, fan laws. Axial and centrifugal compressors: Velocity triangles, sizing, wing design, characteristic curve, efficiency.

**ESM318 Welding Technologies (3+0) 3**

Definition, concept and basic information about the source. Welding types, welding techniques and methods. Welding equipment. Applications with different welding methods (electric arc, oxy-acetylene, TIG, MIG etc.). Post-welding control, cleaning procedures and materials. Heating circuit elements, tools and devices used in heating. Examination of the working principles of heating elements (boiler, boiler, stove, radiator, valve etc.) and circuit assembly. Automatic control elements.

**ESM320 Gas Techniques (3+0) 3**

Types of gases, their classification and combustion properties, transport, storage and distribution of gas, types of gas firing devices and chimneys and their intended use, information on architectural, structural elements and location of buildings. Industrial and industrial gases and related applications. Storage tanks and safety rules. They Regulator. Automatic converters. OPSO-UPSO (tank and burner) Regulators. Gas circuit fittings and standards. Fire precautions and procedures. Bulk gas supply systems. Natural gas conversion plants. Pressure test.

**ESM322 Heating Systems Technology (3+0) 3**

It is a course that supports the application education given to students about Heating Systems with its theoretical knowledge infrastructure. It covers the concept of heat, the importance of heating in terms of life and technique, obtaining heat, conduction and different evaluation methods, used heating technologies, project design principles, related equipment, control and safety equipment, the importance and basic techniques of alternative heating systems.

**ESM-324 Power Electronics (3+0) 3**

Login; Power semiconductors; Power loss and calculations in semiconductors; Cooling of power semiconductors; Fundamentals of Fourier analysis; RLC circuits; One and three phase controlled / uncontrolled rectifiers; Not ideal commutative effect in rectifiers, harmonics, input power factor, utility factor, rate of use of transformers; Rectifier's four-quarter operation; AA voltage regulators; Design and analysis of DA-DA power converters (buck, boost, buck-boost, cuk, sepic).

**Non-Technical Elective Lessons**

**TSD302 International Communication (2+0) 2**

Definition of International Communication, Aims and functions of international communication, Brief History of International Communication, Relationship between basic institutions such as economy, culture, politics, international communication, Global communication process and the relationship between international communication process, technology, Raw materials, Organization, Law and transfers in the context of , International News Agencies, International Advertising Agencies, International Computer Networks, International communication in the context of international treaties, Imbalance in international communication and its reasons, International trade, Export and Import in Engineering.

**TSD304 Human Resources (2+0) 2**

Definition, Organization and Environment of Human Resources Management, Human Resources Planning, Finding, Selecting and Directing Human Resources, Training and Development of Human Resources, Valuation and Pricing of Human Resources (Success valuation and pricing methods.), Business Relations, (Establishing effective business relations and need to continue.)

**TSD306 Organization Systems (2+0) 2**

Regarding Management and Organization; basic concepts, concept of manager, establishment and functioning of organizations, forms of organization, management functions and the development of management in the historical process

**VII.SEMESTER**

**ESM401 Hydraulic Machines (2+0) 2**

Hydraulic machine definition and Euler's theory. Basic concepts. Similarity theory and applications. Cavitation phenomenon. Pumps (classification, construction and calculation forms, operating characteristics, parallel and mixed connections). Water turbines; (Pelton, Francis, Kaplan turbines and Uskur wheels), construction and calculations.

**ESM403 Cooling Technology (2+2) 3**

Cooling with open and closed exchange ways. Cold weather machines. Mechanical compressor cooling systems, absorption cooling system, injector cooling system. Equipment and calculations used in cooling systems; compressor, evaporator, condenser, expansion valve, capillary tube, safety and regulating elements. Projecting of cold stores. Information on air and water vapor mixture. Psychrometric definitions of air conditioning and psychrometric equations. Psychrometric diagram and its explanation. The study of the change of air and its representation on the psychrometric diagram. Display of the air sent to the air-conditioned volume. Psychrometric processes, heating, cooling, spraying of moist air, adiabatic mixture with water or steam, cooling and dehumidification, heating and humidification. General information about the air handling unit.

**ESM405 Engineering Ethics (2+0) 2**

Introduction to the concepts of ethics. Professionalism and professional ethics codes. Ethics in design. Rights and responsibilities in business life. Solution techniques of ethical problems. Risk, safety and accident. Responsibility in scientific research. Responsibility in experimental work. Powers and responsibilities in the printing and publication of research results.

**Technical Elective Lessons**

**ESM407 Alternative Heating and Cooling Methods (3+0) 3**

The importance of alternative fuel heating systems and alternative heating methods-general principles. Status of alternative energy sources and their application to heating systems. Heat pump heating systems structure, properties of heat conduction and design. Radiant (by radiation) heating. Solar energy heating systems structure, properties, heat conduction and design. Structure, properties of heat transfer and design of geothermal energy heating systems. Biogas production and biogas energy can be used in heating systems. Biodiesel production and usability of biodiesel energy in heating systems. Operating principles of absorption cooling system, properties and application areas of fluid pairs used in the system, methods to determine the efficiency of the system. Working principles of adsorption cooling system, properties and application areas of solid and fluid pairs used in the system, methods of determining the efficiency of the system. Vortex tube, thermomoelectric cooling system, Alternative cooling systems, methods of operating with alternative energy sources. Basic thermal calculations of alternative cooling systems and vapor compression cooling systems and methods of comparison in terms of efficiency and cost.

**ESM409 Energy Law (3+0) 3**

Energy law history, energy market, laws and regulations, effective use of energy, security of supply, promotion and provisions of renewable energy use, taxation in the field of energy, international cooperation, the concept of competition, energy agreements, independent authorities in the field of energy.

**ESM411 Heat Storage Technique (3+0) 3**

Thermal Energy, Heat Storage Methods Hidden Heat Storage Thermochemical Method Comparing Heat Storage Heat Storage Methods Design of Heat Storage Systems Energy and Consequences Analysis Efficiency of Heat Storage Systems Economic Analysis of Heat Storage Systems Heat Pump, Heat Storage in Greenhouse Greenhouses

**ESM413 Biofuel and Energy Biotechnologies (3+0) 3**

Biomass Energy Principles, Areas of Biomass and Biomass Energy Sources, Biomass Potential in the World and in Turkey, Energy Flow Between the Plant and the Environment: Photosynthesis, C3 and C4 Metabolism in Plants, Differences Between C3 and C4 Plants (Energy Plants) ., Physical and Chemical Properties of Materials Used in Biomass Energy Conversion Systems, Methods of Obtaining Energy from Biomass: Thermochemical Methods (Direct Burning, Gasification, Pyrolysis, Liquefaction), Biochemical Methods (Alcohol Fermentation, Anaerobic Fermentation, Biofotolysis), Agrochemical Methods (Fuel Extraction) , Biomass Energy Usage Areas: Classical Biomass Usage, Modern Biomass Usage, Advantages and Disadvantages of Biomass Energy

**ESM415 Numerical Heat Transfer (3+0) 3**

Dimensions, units, conservation of energy, Control volume, introduction to heat transfer, regulation of the problem, heat conduction in continuous regime, heat conduction in transient regime, temperature dependent thermal properties, Boundary conditions, phase change, connection between nodes, introduction to finite difference method, Matrices and linear equation systems, numerical analysis methods of nonlinear equation systems, finite difference method and analysis in continuous regime, matrix inversion method, gauss seidel iteresion method, finite difference method in time-dependent heat equations, open approach, implicit approach, graphical plotting of results, engineering applications.

**ESM417 Exergy Applications (3+0) 3**

Definition of Exergy and Energy, Exergy Balance and Exergy Losses, Exergy Efficiency of Thermal Systems, Basic Thermodynamic Applications of Exergy Analysis, Exergy Calculation, Exergy Calculation in Open Systems, Calculation of Physical Exergy, Calculation of Chemical Exergy, Calculation of Exergy of Thermal Radiation, Exergy Analysis of Typical Thermal Systems, Heat Exergy Analysis of Heat Exchangers, Exergy Analysis of Flow Machines, Exergy Analysis of Combustion Processes, Exergy Analysis of Steam Generators and Heating Furnaces. Exergy Analysis of Steam Power Systems, Vapor Compression Cooling Systems and Exergy Analysis of Heat Pumps, Exergy Analysis of Heat Exchangers, Exergy Analysis of Combined Processes, Exergy Analysis of Solar Collectors.

**ESM419 Radiative Heat Transfer (3+0) 3**

Statistical thermodynamic and electromagnetic wave bases of radiation heat transfer mechanism. Radiation properties of real surfaces. Shape factors. Radiative heat transfer on even-dispersing gray surfaces. Radiation, Gas radiation, Complete and approximate solution methods between mirror-like surfaces. Compound heat transfer.

**ESM423 Advanced Nuclear Technologies (3+0) 3**

Fundamentals of atom and nuclear physics, matter reactions and radiation, nuclear reactions, neutron diffusion and moderator, nuclear rector theory, time-dependent reactions, heat transfer and heat intake in nuclear reactors, radiation protection, radiation armoring, reactor licensing, safety and environment.

**ESM425 Wind Energy Systems (3+0) 3**

General concepts about wind energy. Calculation of wind energy potential, wind speed and energy potential measurement systems. Power density function, power curve in wind turbine. Modern wind turbines, wind turbine system performance, wind turbines aerodynamic behavior. Horizontal axis wind turbine applications in different sizes and research topics. Theoretical models for wind field calculations, applications. Wind Statistics. Technological trends and economies in wind energy conversion systems

**ESM427 Hydrogen Energy Systems (3+0) 3**

Hydrogen can be obtained as a clean energy source with solar cells or it can be obtained by using dams in idle times. Hydrogen production, storage and usage technologies.

**VIII.SEMESTER**

**ESM430 Graduation Project (0+2) 1**

Comprehensive, scientific researches and investigations that can be made theoretically or practically for selected subjects that are of interest to Energy Engineering, and presenting and defending the study in a technical report prepared in accordance with the principles of graduation homework.

**ESM404 Engineering Economy and Energy Efficiency (3+0) 3**

Giving information about basic economic concepts, cost overhead, price, BBN (break-even point) review, budget, depreciation, balance sheet information, investment project preparation and evaluation methods.

**ESM406 Laboratory in Engineering (2+2) 3**

Cooling machines, heat pumps, heating systems (boilers, boilers, condensing boilers ... etc), solar energy systems (solar collectors, solar cells, solar ovens, solar pools).

**Technical Elective Lessons**

**ESM408 Hygienic (Hospital) Air Conditioners (3+0) 3**

Technical features and working principles of hospital air conditioners. Air quality. Elements to be considered in the design of hospital air conditioners. Presentation of equipment used in clean rooms and capacity calculations of equipment. Filter types. Related standards and project rules. Design and project of hospital air conditioners.

**ESM410 Clean Room Applications (3+0) 3**

Presentation of clean room systems. Technique features and working principles of clean rooms. Clean room heating, ventilation, air conditioning and the elements to be considered in designing the cooling system. Clean room application areas (hospitals, design, development and production laboratories of electrical-electronic and chemical products, etc.). Presentation of equipment used in clean rooms and capacity calculations of equipment. Design and project of clean room systems.

**ESM412 Industrial Heating, Ventilation, Climatization and Cooling Systems (3+0) 3**

The importance and need of industrial heating, ventilation, air conditioning and cooling (IHİS). Industrial IHİS application areas. Cold rooms, cold stores. Cascade systems. Refrigerated transport vehicles. Auto air conditioners. Heat pump applications. Skating rink. Discrete coolers. Building cooling systems etc. Industrial IHİS design. Electric circuits and automatic control in industrial IHIS. Failure and maintenance.

**ESM414 Boron Technologies (3+0) 3**

General information about inorganic boron compounds, production technologies from boron ore inorganic boron compounds: sodium borate, sodium 1-2 borates, dehydration, and drying the borax, borax production: borax production from Tincal Turkey, anhydrous borax production, use and characteristics of boric acid production methods, production of sulfate acid and boric acid from colemanite, boron compounds and biological properties of boron, environmental pollution of boron, use of boron in energy field.

**ESM416 Energy Architecture (3+0) 3**

History and development of energy architecture, Energy use in lighting, heating, cooling and ventilation, effects on buildings and environment, importance of renewable energies in sustainable energy production and consumption, design and technologies, design and economy of solar energy systems, design and economy of wind energy systems.

**ESM418 Technical Report Writing and Operating (3+0) 3**

Scientific research method, research types and data collection methods, resource compilation, citation, preparing research report and oral presentation, information about writing reports and other correspondence that may be required in school, daily, business and academic life, effective language use in scientific report, language in writing concept of effectiveness, spelling rules, computer writing and desktop publishing, displaying data with graphics and charts, formal structure of research, writing report text, preparing text for computer presentation and presentation techniques

**ESM420 Energy Management in Industry (3+0) 3**

Introduction, World's and Turkey's general energy outlook, alternative energy sources, the introduction of energy management program of principles and industrial energy management program, industrial energy audit process, monitoring in terms of energy management of industrial plants and the stages of creation targets for possible savings potentials Determination of energy consumption standard in industrial plants, energy production, transportation and usage methods in industrial plants. Cogeneration applications in industrial plants, evaluation of waste energies in industrial plants. Evaluation criteria of investment of energy-saving projects, determination of the effects of energies used in industrial facilities on the environment.

**ESM422 Sustainable Energy Techniques (3+0) 3**

Sustainable Energy Policies, Energy Use and Environment Relationship, Factors Affecting the Environment, Energy and Sustainable Development, Sustainable Development, Parameters Affecting Sustainable Development, Environment and Sustainable Development, Energy- Environment and Sustainable Development, Relations between Renewable Resources and Renewable Resources, Energy Use, Environmental impact, Sustainability transformation.

**ESM424 İnternal Combustion Engines (3+0) 3**

Introduction to internal combustion engines. Basic definitions such as performance, volumetric, thermal and mechanical efficiencies, average effective pressures, specific fuel consumption. Combustion, cyclical differences, knock and octane number in gasoline engines. Basic computer model for calculating combustion in gasoline engines. Diesel engines, Cetane number and diesel combustion chamber types. Ideal engine cycles and efficiencies. Calculation of heat transfer from stoichiometry, dissociation and burnt products to the cylinder wall. Emissions and emission control methods.

**ESM426 Hydraulic Energy Systems (3+0) 3**

Introduction and basic concepts, Classification of hydraulic machines, Pumps, Speed triangles Simulation rates, Number of Definitions, Selection and projecting of centrifugal pump, Classification, selection and projecting of water turbines in hydraulic power plants.

**ESM428 Geothermal Energy Systems (3+0) 3**

Formation of geothermal energy and types of geothermal systems. Exploration of geothermal energy: geothermal well drilling, drilling fluids and completion. Measurements in geothermal production wells Geothermal reservoir engineering. Effects of geothermal energy to the environment. Mineral precipitation in geothermal waters. Use of geothermal energy, direct and indirect use. Electric energy cycles from geothermal energy. Marketing and economy of geothermal energy