ISTINYE UNIVERSITY FACULTY OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE DESCRIPTIONS

1. Semester

Differential and Integral Calculus (2+2), 6
Analytic geometry, functions and limits, derivatives, techniques and applications of differentiation, logarithmic and trigonometric functions. Definite and indefinite integrals, techniques of integration, with applications in sciences and engineering.

Computational Thinking (3+2), 7
Introduction to the central idea of computational thinking as it applies to a wide variety of human endeavors, including natural and physical sciences; computational mathematics with Sage, Matlab, and Mathematica; introduction to programming with Python.

Engineering Physics (3+1), 6
Vectors. Motion in one and two dimensions. Newton's laws and its applications. Work and energy. Conservation of mechanical energy. Momentum and motion of systems. Static equilibrium of rigid bodies. Rotation and angular momentum. Newton's law universal gravitation.

Computing Literacy (2+2), 5
Email and IM usage and etiquette; Computer security basics; Mobile and Cloud computing basics; Google apps and services: Docs, Sheets, Slides, Drive, Calendar, Keep, Scholar; Apple apps and services.

Engineering Design (3+0), 4
Introduction; The Design Process; Creative style; Brainstorming. Effective graphic and verbal communication of design ideas to groups and individuals, Student will learn how to research an engineering problem, where to find information and how to assess its validity, Students will be give an overview of key achievements in the history of engineering. There will also be stories with ethical implications.

Turkish Language I (2+0), 2
To teach the importance of language in human and social life; showing the classification of languages and teaching of Turkish among the world languages; to teach the characteristics of Turkısh in terms of phonology, morphology, syntax; to analyze spelling and writing rules of Turkish.

2. Semester

Linear Algebra with Applications (2+2), 6
Systems of linear equations, matrix algebra, determinants, vector spaces and subspaces, basis and dimension, linear transformations, eigenvalues and eigenvectors, diagonalization, and orthogonality; singular-value decomposition.

Computational Mathematics (3+2), 7
A function approach integrating algebra, trigonometry, and differential calculus; properties and graphs of polynomial, rational, exponential, and logarithmic functions; properties and graphs of trigonometric functions; functions and limits; derivatives; techniques and applications of

differentiation; logarithmic and trigonometric functions; Integral calculus, including definite and indefinite integrals; techniques of integration, with applications in social and life sciences.

Computer Aided Design (2+2), 5
Introduction to computer aided technical drawing. Basic drawing functions and multi-view projection. Sectioning and conventions. General concepts in 3D modelling. Creating parts in 3D design and solid modeling. Transfering 3D parts to drafting detailing. Assembly modelling and assembling parts. Surface modelling.

Electronic Physics and Systems (3+1), 6
In this course the principles of electrical and electronical engineering and basic technology will be introduced. Application examples of the knowledge on engineering will be given. In addition, electric machinery, power electronics, and electrical driving circuits will be introduced according to the mechanical engineering requirements.

Human Body (2+2), 4
The structure and functions of macro molecules and proteins. The structures and functions of cells. Cellular respiration, transport, communication. Energy production, flow, use and photosynthesis. Human genetics and physiology. Biotechnology.

Turkish Language II (2+0), 2
To teach spelling, writing and punctuation rules, to teach basic elements of writing essays, to introduce Turkısh and World literary canons; to teach writing creative texts of literature especially story, poem and essay ; to teach writing scientific paper and texts; To analyse expression and punctuation disorders, to contribute lectures.

3. Semester

Differential Equations (2+2), 6
First and second order differential equations; separation of variables; linear differential equations; systems of first order equations; nonlinear differential equations and stability

Material Science (2+1), 4
Introduction to materials science and classification of atomic structures of the materials. Crystal structures and imperfections. Mechanical and physical properties of the engineering materials. Solid-state diffusion. Phase diagrams and solidification. Ferrous / non-ferrous alloys and heat treatment. Electrical, optical, thermal and magnetic properties associated with electron band structures of the materials. Metallic corrosion and prevention from corrosion. Principle geomaterials, their properties and application areas. Deterioration of geomaterials.

Fundamentals of Mechanical Engineering (2+2), 5
Introduction of the ISU Mechanical Engineering Program and the regulations. Engineering profession and the place of mechanical engineering in it. Development of mechanical engineering. Engineering ethics. Contribution of ME to the solution of societal problems. Principal application areas of ME. Introduction to Scientific and Engineering Calculation, Introduction to Calculation Environment in Matlab, Variables, Operations, Basics of Graph, Algorithms, Logic Operators in Matlab,Flow Control, Errors and Source of Errors and Functions in Matlab, Applications of Linear Algebra, Basic Equation Solutions, Examples of Multiterms, Curve Fitting, Interpolation and Numerical Integration in Matlab.

Statics (2+1), 4
Principles of statics, force vector, equilibrium of particle, moment of a couple, equilibrium of rigid body, planar forces, center of gravity, Theorem of Pappus-Guldinus, distributed loads and hydrostatics forces, supports and support reactions, Gerber beam, frames, simple machines, trusses, cables, friction, virtual work.

General English I (2+0), 2
The English of the terms and concepts encountered in various branches of engineering are examined in depth, and for the proper use of these terms, Turkish-English bilingual translations are explained. English language training for students starts from simple forms and intended to develop over time.

Ataturk's Principles and History of Revolution I (2+0), 2
The Collapse of the Ottoman Empire, Tanzimat and Reform Edict, I. and II. Constitutional Era, Tripoli and Balkan Wars, Worl War I, Mudros Armistice, War of Independence; Amasya Circular, National Congresses, Establishment of Turkish Grand National Assembly, Declaration of Republic

Manifest of Istinye I (0+1), 1

4. Semester

Dynamics (2+1), 4
Kinematics of particles; velocity and acceleration in rectangular, cylindrical, spherical and normal and tangential coordinates. Rectilinear motion. Relative motion. Kinetics of particles; Newton's law of motion. Equation of motion. Work. Impulse. Momentum. Principle of work and energy, principle of impulse and momentum. Angular momentum, angular impulse and momentum principle. Kinetics of systems of particles. Planar kinematics of rigid bodies, instantaneous center of rotation. Planar kinetics of rigid bodies. Three dimensional kinematics of rigid bodies. Three dimensional kinetics of rigid bodies.

Vector Calculus (2+2), 6
Calculus of functions of several variables; vector-valued functions; scalar and vector fields; integration along paths, double and triple integrals; integration over surfaces and applications of integrals; integral theorems of vector calculus; infinite series; Fourier series; integrals and transforms; partial differential equations

Manufacturing Processes (3+1), 4
Principles and classifications of processes in manufacturing; advantages, limitations and comparisons of material processing. Design and manufacturing; selection of process. Casting, welding, forming, machining, and powder metallurgy. Manufacturing of polymer and composites parts. Rapid prototyping and ceramic part manufacturing.

Measurement and Instrumentation (1+1), 2
Introduction to Measurement Techniques and Definitions, Metrology and Calibration, Introduce to Turkish Standards Related with Measurement Techniques; Other Foreign Standards, Norms and Rules, Analyzing Experimental Results, Measuring of Macro and Micro Geometry, Measuring of Dimension, Angle and Area, Measuring of Pressure, Measuring of Temperature, Measuring of Flow Rate, Measuring of Level, Measuring of Thermo physical Characteristics, Measuring of Force, Moment and Power of Shaft, Sensors and Basic Physical Characteristics of Sensors, Electrical Measurements in Mechanical Engineering, Sampling and Measuring of Air Pollution

Strength of Materials (2+2), 5
Basic Concepts of Solid Mechanics, Mechanical Properties of Materials, Axial Loading, Shear Stresses and Shear Loading, Bending, Deflection of Beams, Torsion, Buckling of Columns, States of stress, State of strain, Criteria for Failure, Combined Loading, Fatigue.

Industrial Training I (0+0), 0

General English II (2+0), 2
The English terms and concepts encountered are examined in depth and Turkish-English bilingual translations are used in order to use the concepts correctly. To be able to master professional English language, the students are informed about grammatical structures of sentences, spelling and pronunciation.

Ataturk's Principles and History of Revolution II (2+0), 2
Revolutions in Turkish politics, political parties and multi-party system attempts, revolutions in law, reorganization of public life, reforms in economics, Turkish foreign policy 1923-1938, Turkish domestic and international politics in post-Atatürk era.

Manifest of Istinye II (0+1), 1

5. Semester

Thermodynamics I (2+2), 4
Properties of pure substances. Ideal and real gases. Energy, heat, work. Conservation of energy. Application on closed systems and control volumes. Heat engine. Second law of thermodynamics. Carnot principles. Clausius inequality. Entropy. Principle of the increase of entropy. Exergy, second law analysis.

Fluid Mechanics I (2+2), 4
Basic concepts, Hydro-Aerostatics, Conservation equations in integral analysis, Bernoulli and Energy equations, Differential conservation equations and boundary conditions, Similitude and dimensional analysis, Viscous flow in pipes , Introduction to open channel flow, Introduction to turbomachinery.

Numerical Methods (2+2), 4
Description of Numerical Methods and application of them particularly in engineering. Error analyses in numerical methods, analitical solutions, numerical methods for the solution of systems (lineer and non linear), approximation methods, interpolation, linear regression, numerical integration.

Machine Design I (2+2), 5
Mechanical engineering design activity and importance of machine elements knowledge in this activity. Fundamentals of design and applications of machine elements. Welded, soldered, adhesive bonded, riveted joints. Shaft-hub connections. Bolted joints and power screw mechanisms. Pins, knuckles, springs, shafts and axles, coupling and clutches, lubricants and lubrication theory, sliding and rolling bearings.

6. Semester

Heat Transfer (2+2), 4
Mechanisms of heat transfer. Steady and transient heat conduction in solids, solution methods. Laminar and turbulent forced convection, natural convection. Phase change heat transfer. Heat exchangers. Radiation heat transfer

Fluid Mechanics II (2+2), 4
Viscous Flow in pipes and ducts. Laminar and turbulent boundary layers. Major and minor losses in pipes. Flow over immersed bodies. Boundary layer equations, Potential Flow, Introduction to CFD, Compressible flow. Fluid Machinery. Water hammer.

Theory of Machines (2+2), 6
Mechanisms, kinematic diagrams, kinematic chains and mobility. Some basic mechanisms. Kinematic analysis and synthesis of mechanisms. Review of some fundamental principles of mechanics. Static balance of machinery. Machine equation of motion and its implementation. Speed fluctuations and flywheel calculation. Force analysis in machinery. Shaking forces and mass balance. Balancing of rigid rotors.

Industrial Training II (0+0), 0

Machine Design II (2+2), 5
Fundamentals of speed reduction mechanisms, kinematics and geometry of gears, spur, helical, bevel, spiral and worm gear mechanisms, belt drive and chain mechanisms.

Thermodynamics II (2+2), 4
Gas power cycles. Vapor and combined power cycles. Cogeneration. Refrigeration cycles. Gas mixtures. Gas-vapor mixtures and air-conditioning. Chemical reactions. Chemical and phase equilibrium.

7. Semester

Capstone Project I (3+2), 7
This no-lecture course includes an appropriate design project with all the design phases starting from project selection to completion and presentation, and which leads the students use the knowledge they gained during their tenure in the department and gain complete design experience. In this course, design of a machine, system or process is conducted in the framework of an open-ended engineering problem and a team of students develops the solution.

Finite Element Methods (3+1), 5
Introduction to fundamentals of Finite Element Method (FEM), Direct Approach, Springs and Truss Elements, Beam Elements, FE Formulation for General Continuum, , Plane Stress and Plane Strain Elements, Finite Elements and Interpolation Functions, Element Formulation in Natural Co-ordinates, Numerical Integration, Applications.

System Dynamics and Control (2+2), 4
Introduction to system dynamics and control, Transfer function of linear systems. Linearization, Transient response analysis, Stability analysis, Basic control algorithms and structures, PID tuning methods, Frequency response analysis, Basic controller design methods and examples.

Manifest of Istinye III (0+1), 1

8. Semester

Capstone Project II (3+2), 7
This no-lecture course includes an appropriate design project with all the design phases starting from project selection to completion and presentation, and which leads the students use the knowledge they gained during their tenure in the department and gain complete design experience. In this

course, design of a machine, system or process is conducted in the framework of an open-ended engineering problem and a team of students develops the solution.

Mechanical Engineering Student Laboratory I (1+2), 6
System experiments on basic fields of mechanical engineering. Realizing experiments in groups, concerning thermal systems, hydraulic systems, automotive systems, mechanical vibrations and acoustics, controls, manufacturing, and strength of materials, analysis of experimental data and presentation of results in written reports.

Manifest of Istinye IV (0+1), 1

DEPARTMENT ELECTIVE COURSE DESCRIPTIONS

Directed Research (2+2), 5
The students are involved in projects that are going on research centers. They are required to attend meetings, develop code, help to build devices, and give presentations as needed. The lecturer covers basic research techniques, search, writing papers in LaTeX, and working with data.

Engineering Ethics (2+2), 5
The origins of ethical thought; ethical principles and basic theories; personal, academic and professional ethics for engineers; environmental ethics; ethical implications of technology, computer ethics; ethics in research and experimentation.

Engineering Economics (2+2), 5
Foundations of Engineering Economy, Engineering Economy Principles,Simple and Compound Interest Calculations, Uniform Series Present Worth Factor,Capital Recovery Factor, Sinking Fund Factor, Uniform Series Compound Amount Factor, Arithmatic and Geometric Gradient Series Factor, Present Worth Analysis, Future Worth Analysis, Rate of Return Analysis, Benefit-Cost Analysis, Payback Analysis, Cost Estimation, Sensitivity Analysis, Using Computer in Engineering Economics

Introduction to Robotics (2+2), 5
Components of robot systems; coordinate frames, homogeneous transformations, kinematics for manipulator, inverse kinematics; manipulator dynamics, Jacobians: velocities and static forces, control of manipulator and robotic programming.

Signal Processing and Data Acquisition (2+2), 5
Introduction to data acquisition and signal processing. Types of signals. Components in the measurement chain. Sampling theorem. Resolution and accuracy. Time Domain Processing: Statistical analysis, correlation, convolution and digital filtering. Frequency Domain Processing: Fourier series, frequency resolution and windowing, Discrete Fourier analysis, aliasing, auto spectrum, cross spectrum, Frequency Response (Transfer) Function, Coherence, Envelope and Cepstrum Analyses, Digital filtering and design of filters.

Probability Theory and Stochastic Processes (2+2), 5
Concepts of probability; random variables; combinatorial probability; discrete and continuous distributions; joint distributions, expected values; moment generating functions; law of large numbers and central limit theorems; Distribution of sample mean and sample variance; summarizing data by statistics and graphs; estimation theory for single samples; hypothesis testing: likelihood ratio test; confidence intervals.

Biomechanics (2+2), 5
Fundamentals of bone mechanics; Hard and soft tissue biomechanics, structure, types and mechanical properties; Mechanically mediated bone adaptation, osseointegration, micro-motion, stress shielding and bone resorption; Materials for implants and prothesis, properties and their forms; Aspects of Biocompatibility and its importance in implant and prosthesis design; Interface of Tissue and Biomaterial, interface geometires and load transfer between tissue and biomaterial

Computation Fluid Dynamids (CFD) (2+2), 5
Basic aspects of computational fluid dynamics, Governing equations of fluid dynamics, Initial and boundary value problems, classification of partial differential equations, Finite difference formulations, stability analysis, Parabolic equations explicit and implicit methods, ADI method, Elliptic equations: Jacobi, Gauss-Seidel and SOR iteration; Hyperbolic equation: Lax-Wendroff, MacCormack's method, Euler equations, Grid generation.

Heating Ventilation and Air Conditioning (HVAC) (2+2), 5
Duct design, Air conditioning System Components, Air Distribution, Air Conditioning Systems.

Gas Dynamics (2+2), 5
Fundamentals of fluid mechanics and thermodynamics. Introduction to compressible flows. Isentropic flow. Normal shock waves; moving and reflected shock waves. Flow in constant area ducts with friction; Fanno line, choking due to friction. Flow in constant area ducts with heat transfer; Rayleigh line, choking due to heat transfer. Isothermal frictional flow in uninsulated ducts, Steady two-dimensional supersonic flows; oblique shock waves, Prandtl-Meyer flow.

Gas Turbines (2+2), 5
Brayton cycle, turbo shafts. Flow in nozzles, Rayleigh and Fanno lines. Aircraft gas turbine engines: Thrust, parametric analysis, pressure distribution in inlets and the diffusers, component efficiency. Turbomachinery: design of turbine and compressor blades. Combustion systems.

Turbomachinery (2+2), 5
One-dimensional flow of compressible fluids. Subsonic and supersonic flows. Nozzles, Convergent and convergent-divergent nozzles, sizing of nozzles, Underexpansion and overexpansion in nozzles, diffusers, Euler turbomachinery equations, Steam turbines, Impulse turbines, reaction turbines,Velocity compounded turbines, velocity triangles, losses in turbines, pressure and velocity diagrams. Fans and compressors.

Internal Combustion Engines (ICEs) (2+2), 5
Principles of SI and CI engine operation, 4-stroke and 2-stroke engines, ideal cycles, thermal efficiency, fuels and combustion, induction, compression, combustion and expansion-exhaust processes, mixture preparation in SI and CI engines, fuel systems, engine characteristics.

Alternative Fuels (2+2), 5
This course aims to draw on existing information and review the various alternative fuels that exist for road vehicles. For each alternative considered, benefits and disadvantages are discussed with respect to exhaust emissions, energy consumption, fuel production and distribution implications and vehicular modifications that may be necessary.

Fuel economy (2+2), 5
General aspects of automotive fuel economy, Fuel consumption of a road vehicle, Mathematical modeling of fuel consumption, Fuel economy in internal combustion engines, Affecting parameters, Power-Train matching and fuel economy, Affecting criterion, Aerodynamics of road vehicles, Rolling resistance and fuel economy, Effect of driving cycle on fuel economy, Fuel economy and exhaust

emissions, Engine control, Alternative light materials and new production methods, Simulation models for fuel economy and their validity.

Electrical and Hybrid Vehicles (2+2), 5
The course deals with the fundamentals, theory, and design of electric vehicles (EVs), hybrid electric vehicles (HEVs), and fuel cell vehicles (FCVs). It presents vehicle configurations, control strategy, design methodology, performance, modeling, and simulation for different conventional and modern vehicles. The course includes design methodologies and examples as well as simulation models for alternative propulsion vehicle systems of ground vehicles. It covers important sub-topics like electric machines, energy storage systems and regenerative braking.

Vehicle Technology (2+2), 5
The primary objective of the course is to learn the fundamental relationships between vehicle design parameters and vehicle response, including performance, handling and ride. With this understanding, the student should be able to model the behavior of a vehicle to determine appropriate values of the design parameters to enhance response.

Renewable and Sustainable Energy (2+2), 5
Sustainable energy and utilization of energy sources. Geothermal energy utilization: Thermodynamic cycles, heat pumps. Wind energy utilization: Aerodynamics, statistics. Biomass Conversion: Anerobic digestion, power generation. Fuel Cells: Thermodynamics. Solar Energy: Use in industrial processes. Passive systems. Thermal power. Photovoltaic Systems: Semi-conductors, solar modules.

Acoustics and Vibration (2+2), 5
Fundamentals of acoustics and vibration. Acoustic noise and vibration measurement methods. Outdoor sound propagation. Sound in small enclosures. Noise in rooms. Sound absorbing materials and sound absorbers. Interaction of sound waves with solid structures. Criteria for noise and vibration in human bodies. Machinery noise and vibrations.

Computer Aided Manufacturing (CAM) (2+2), 5
Introduction to CAD, CAM and Computer Graphical Systems, Geometrical Modeling and Databases, Curves, Wire Frame Modeling, Surface and Solid Modeling, Group technology and process planning, Numerical Control Systems and machine tools, Manual part programming: ISO Language, Computerized part programming: APT language and CAM systems, CAD-CAM-CNC Systems Integration, Reverse Engineering, Rapid Prototyping.

Hydraulic and Pneumatic (2+2), 5
Basic theory of Hydraulic Turbo machinery and their principles of work. Type definition quantities. Performance curves. Construction types. Cavitation. Main common design principles. Fundamentals of operational concerns.

MEMS Design (2+2), 5
MEMS (Microsystem) design principles. Introduction to surface and bulk micromachining. Principles on electrostatic design. Sensing by piezoresistive elements and design in micro-scale. Sensing by magnetic forces. Lumped and energy methods in design. Case studies: Piezoresistive pressure sensor, microfudic system and mechanical structure for bio-sensing.

Nano Materials (2+2), 5
Nanomaterials past, present and future, Materials characterisation at the nanoscale , Top down and bottom up manufacture of nanomaterials, Carbon Nanotubes, graphene and other species, Nanometallics, Nanoceramics, Waterborne Polymer Nanoparticles & Composite Particles, Applications & Properties of Nanocomposite Films & Nanoparticles, Dispersion of Nanoparticlulates

in Polymers, Mechanical Properties of Nanoreinforced Polymers, Nanolayers at Polymer/Metal Interfaces, Nano-assisted manufacturing, Nanostructured Coatings for Wear Resistant applications, Applications of nanomaterials, Nano-sensors.

Composite Materials (2+2), 5

History and types of composite materials. Composition-property relations. Particle-reinforced composites. Brittle fiber-ductile matrix composites. Properties of matrix and fiber materials, Weibull analysis. Stiffness and strength relations for FRC with continuous fibers. FRC under discontinuous fibers. Effect of fiber orientation on mechanical properties. FRC under compressive stresses. Mix optimization. Ductile fiber-brittle matrix composites. Stress-strain relations for laminated composites, orthotropic composites, experimental determination of stiffness and strength. Biaxial strength theories. Classical lamination theory.