University of Turkish Aeronautical Association

Aeronautical Engineering Core and Elective Course Descriptions[1]

Contents

[1] The information provided in this document is subject to change without any notice, and is intended for informational purposes only.

Aeronautical Engineering Principles, AEE 104

In this course, students learn the fundamentals of aeronautical engineering. Main topics of the course are aerospace vehicles, aerodynamics, aircraft structures, aircraft instruments and systems, propulsion, mechanics of flight, air transportation, airports and air navigation. *Fundamentals of Aerospace Engineering* by Manuel Soler is main textbook of the course. At the end of the course, students are expected to

1. Know academic ethics and engineering ethics
2. Know the scope of engineering and in particular aeronautical engineering.
3. Have a general understanding about basic knowledge set of engineering and aeronautical engineering

Academic Presentation Skills, ENG 105

The aim of this course is to enable students to communicate more effectively in seminars, presentations and group work by equipping them with necessary academic speaking skills. Although the course mainly focuses on improvement of speaking skills, improvement on listening, writing and reading skills will also be included to complement communication skills. The course balances language focus and academic input with practice to enhance students' competence and to help them communicate effectively in different academic situations. Learning outcomes of the course are:

1. Develop critical thinking skills through reading, reflection, discussion, oral presentation and writing.
2. Prepare appropriate media for presentations.
3. Demonstrate increased confidence in speaking.
4. Develop skills to learn from other persons' oral presentations.
5. Demonstrate teamwork and group presentation skills as a contributing member of a team.

Engineering Mathematics I, MAT 123

The aim of this course is learning calculus fundamentals with an engineering perspective and applying to real-life problems using tools such as Wolfram Alpha, and MATLAB. Discussions include but not limited to functions, limits and continuity, differentiation, applications of derivatives, integration, applications of definition integrals, and techniques of integration. Applied math part includes numerical assignments to be solved with MATLAB and Wolfram Alpha. The official book used in the course is *Thomas' Calculus: Global Edition, 12/e by George B. Thomas, Jr., Maurice D. Weir, and Joel Hass.* Learning outcomes of the course are:

1. Explain functions, composite functions and their uses in systems with an engineering perspective
2. Explain continuity of functions in connection with limits followed by limit theorems
3. Explain relation between a secant line of a function and its tangent line which is then expanded to derivatives
4. Explain integration and fundamental theorem of calculus built upon antiderivatives

5. Ability to apply derivative and integration to physical problems (such as displacement and optimization) and develop/generate numerical solutions to otherwise hard-to-solve-algebraically math problems using tools such as Wolfram Alpha and MATLAB.

Physics I, PHY 101

Objectives of the course is to have students comprehend well the physics related to mechanics. Course content consists of Measurement and Unit Systems, Vectors and Scalars, Kinematics in One Dimensions, Kinematics in Two and Three Dimensions, Newton's Laws of Motion, Newton's Law of Universal Gravitation, Work and Energy, Conservation of Energy, Linear Momentum, Rotational Motion, Angular Momentum and General Rotation. The official books used in the course are *Physics for Scientist & Engineers with Modern Physics, D. Giancoli, Fourth Edition* and lecture notes. Learning outcomes of the course are:

1. Analyzing the static, kinematic and dynamic processes.
2. Making solution to the problems related to static, kinematic and dynamic processes.
3. Applying these processes to other disciplines in physics.
4. Proposing new models for the static, kinematic and dynamic systems.

Principles of Atatürk and History of the Revolutions I, ATA 103

Course objectives are to make students understand, comment and analyze the basic principles of Atatürk's revolutions. Course contents are modernization activities in the process of disintegration of the Ottoman Empire, of the Ottoman Empire Participate in World War I, The Armistice Agreement, The beginning of the national struggle, Congresses, Opening of TBMM.

Aircraft Performance, AEE 172

Aim of this course is to teach the fundamentals of aircraft and aircraft performance parameters. Course content include Elements of aircraft (A/C), forces and moments acting on an A/C, A/C performance, horizontal flight, climb performance, decent performance, range, endurance, mission profiles. *Aircraft Performance and Design* by John D. Anderson is the official textbook of the course. Learning outcomes are

1. To gain basic knowledge of aircraft performance
2. To learn how to calculate fundamental aircraft performance parameters
3. To define fundamental aeronautical engineering problems

Turkish I, TUR 107

Objective of the course are to make students understand, comment and analyze the basic principles of Turkish language and use the Turkish language in a proper and effective way within the rules of diction. Content of the course can be sorted such as following: Description of Language, Origin of Language, Features of Language, Relationship between Language-Thought-Culture-Society, Turkish Languages and Dialects, Languages on Earth, Text Analysis, Novel Analysis, Written Expression, Forms of Verbal Expression and Practice, Speech Genres, Spelling Rules and Practice, and Sound Features of Turkish.

At the end of this course; students will be able to: Understand the features and rules of Turkish language and give examples, learn the rules of comprehending accurately the texts they read programs they listen to, achieve the habit and skill of showing their emotions, thoughts, plans, impressions, observations, and experiences accurately and efficiently in writing and verbally, achieve the habit of observing the spelling (orthographic) rules and accurate usage of punctuations, achieve the habit of book reading, achieve the skill of scientific, critical, constructive and creative thinking skills.

Computer Aided Engineering Graphics, AEE 123

This course presents technical drafts essentials and use this data to design solid models for manufacturing. Course contents are geometric sketches, orthographic projection fundamentals, drawing techniques for basic manufacturing processes and standard features, 3D drawing techniques, principles of dimensioning, principles of sectioning, principles of auxiliary views, fasteners, tolerances and usage, drawing of mechanical elements, assembly drawings, preparing of letterhead, materials and symbols, creating an industrial product working assembly with animation, modelling a system in the market of aeronautics and astronautics from the point of geometrical structures using SOLIDWORKS and submitting them as a project approach. The book that is used as a resource is *Technical Drawing with Engineering Graphics, by F.E Giesecke, Pearson :International 14th edition.* Learning outcomes are:

1. Understanding the engineering design processes
2. Modelling geometric constructions from the point of technical drawing
3. Applying drawing techniques for basic manufacturing processes and standard features
4. Developing three dimensional drawing techniques
5. Arranging drawings of objects in accordance with dimensioning principles
6. Obtaining sections of objects
7. Using required tolerances and ISO tolerance system
8. Drawing machine elements
9. Drawing assembly drawings

Principles of Atatürk and History of the Revolutions II, ATA 104

Course objectives are to make students understand, comment and analyze the basic principles of Atatürk’s revolutions. Contents of the course include the declaration of the Republic, Lausanne Conference, trials in multi-party system, Atatürk’s foreign policy.

Turkish II, TUR 108

Objectives of the course is to make students understand, interpret and analyze the basic principles of Turkish, and use Turkish language correctly. Course content consists of Written Expression, Verbal Expression, Erroneous Expressions, Text Analysis, Novel Analysis, Template Text, Methods of Thinking, Ways of Improving Thought, Semantics I, Semantics II, and Misuses in Turkish and Practices.

Academic Writing Skills, ENG 106

The aim of this course is to familiarize students with the discoursal and cognitive aspects of writing academic essays, projects and research articles. Starting from the academic writing processes, the course presents an organization from introduction of an overview of the major elements involved in academic writing, differences between academic and personal styles of writing, grammar of academic writing, strategies to produce increasingly more complex texts to creation of whole texts. The course focuses on the creation of bibliographies and the structure of research report and papers. Learning outcomes are:

1. Developing skills for solving problems and generating ideas to compose these ideas into a written text that efficiently convey ideas within academic appropriateness
2. Recognizing academic discourse, academic vocabulary together with processes of academic writing
3. Exploring ways of organizing data
4. Planning how comparisons and contrasts can lead to evaluations
5. Exploring how principles of clarity, honesty, reality and relevance improve texts

Engineering Mathematics II, MAT 124

Students will be able to make analysis by using the various advanced calculus methodologies at the end of the course. Techniques of integration, first order differential equations, infinite sequences and series, polar coordinates, vectors, partial derivatives of functions of several variables, multiple integrals are the subjects of course content. The official book used in the course is *Thomas, G. B., Weir, M. D. and Hass, J. R. (2010) Thomas' Calculus: 12th edition.* Learning outcomes are:

1. Understand and explain concepts of integration and multiple integration,
2. Understand and explain concepts of first order differential equations,
3. Understand and explain concepts of infinite sequences and series,
4. Understand and explain concepts of polar coordinates and vectors,
5. Understand and explain concepts of partial derivatives of functions of several variables.

Physics II, PHY 102

Objectives of the course is having students gain the background for electricity and magnetism necessary in the engineering education. Content of the course are Coulomb’s force, the electric field, electric flux, Gauss law, electric potential, capacitors, current and resistivity, direct current circuits, Kirchhoff’s rules, magnetic field, Biot-Savart’s law, Ampere’s law, induction, Faraday’s law, Lenz’s law, inductance, energy in magnetic field, oscillations in the LC circuit, electromagnetic waves. Students can do the following after the course is taken:

1. Analyses the electrical charge and being neutral.
2. Analyses the forces and electric fields produced by charged systems.
3. Determine the technological uses of the capacitors.
4. Makes analysis about the electrical current and conductivity.
5. Understands how magnetic forces and fields are produced.
6. Applies the electromagnetic induction, Faraday and Lenz law to electrical circuits.
7. Analyses the alternating and direct current circuits.

Chemistry, CHEM 101

The aim of this course is to inform students about basic principles of chemistry such as chemical properties, measuring these properties, naming, classifications, and reactions of matter and to gain ability to correlate these information with daily life applications. Course contents consist of Matter properties and classifications, physical measurements, significant numbers; Atoms, Molecules and Ions, Atomic Theory; formulas and naming. Chemical Reaction Equations; Chemical Reaction, Calculation with Chemical Formulas and Equations. Mass and Moles of Substances. Determination of Formulas. Working with Solutions; Gaseous State. Gas Laws; Thermochemistry. Heat of Reaction. Using Heat of Reaction. Quantum Theory of the Atom. Light Waves, Photons and Bohr Theory. Quantum Mechanics and Quantum Numbers; Electronic Configurations and Periodicity; Ionic and Covalent Bonding; Molecular Geometry and Chemical Bonding Theory. Molecular Orbital Theory.

Learning outcomes of the course are:

1. To have knowledge on the atomic and molecular structures
2. To be aware of the bonding patterns of molecules from simple to complex.
3. To have skill of doing calculations in chemistry
4. To be aware of the properties of gases and solutions.
5. To have knowledge on relations between heat and chemical reactions.
6. To know basic principles of quantum chemistry
7. To gain ability to correlate chemistry knowledge with real life applications

Computer Programming for Aviation, CENG 113

This is an introductory course for computer programming using Java. The course covers the fundamentals of algorithmic problem solving for a variety of problems involving the use of basic control and data structures. Other topics include fundamental data types, control structures including conditions and iteration, arrays, input and output. Learning outcomes of the course are:

1. Use an integrated development environment to design and write code in the Java programming language
2. Define and correctly use data types, arrays, conditionals and loops
3. Understand the use of predefined classes
4. Design objects and write new classes
5. Illustrate the principles of object-oriented programming

Summer Practice I, AEE 250

Content of the second year internship is on maintenance and production. For this internship, the internship student must scrutinize the processes of organization and planning of the maintenance and/or production operations for aircraft and/or spacecraft elements and/or subsystems. In addition, the student must take role in one of these processes, if possible.

Statics, AEE 261

Course objective is to teach the fundamentals of vector mechanics of stationary rigid structures. Course contents are Statics of Particles, Rigid Bodies: Equivalent Systems of Forces, Equilibrium of Rigid Bodies, and Distributed Forces: Centroids and Centers of Gravity, Analysis of Structures, Forces in

Beams and Cables, Friction, Distributed Forces: Moments of Inertia. The official book used in the course is *Beer, F. P., Johnston, Jr., E. R., Mazurek, D. F., "Vector Mechanics for Engineers: Statics", 10th Ed. In SI Units, McGraw Hill Inc., 2013.* Learning outcomes are:

1. Developing student's ability to analyze any problem in a simple and logical manner and to apply to its solution a few, well-understood, basic principles.
2. Understanding the fundamentals of vector analysis.
3. Learning the concept of rigid body equilibrium and idea of how to sustain rigid body equilibrium.
4. Learning how to calculate the centroid of a geometry and center of gravity of a rigid, homogeneous body. Understanding the importance of the moment of inertia in vector mechanics.
5. Understanding the basic principles of vector analysis structures such as trusses, frames, etc.
6. Being familiar with the friction phenomena.

Thermodynamics, MEC 225

Objectives of the course are to address the basic principles of thermodynamics, and to give an idea about the use thermodynamics in the engineering applications with real-life examples. System and environment, properties of pure material, property diagrams and tables, phase equation, energy and work fundamentals, energy transfer between the system and environment, thermodynamic process, reversible and irreversible processes, first law of thermodynamics for closed and open systems, heat pumps, coolers, Carnot cycle, second law of thermodynamics and entropy can be listed as the contents of the course. *Thermodynamics: An Engineering Approach 8th Edition by Yunus Cengel, and Michael Boles* is the book that is used for resource. Learning outcomes of this course are:

1. Having knowledge about fundamental thermodynamic concepts such as open, closed and isolated systems, state of a system in equilibrium and extensive and intensive properties of the system in equilibrium.
2. Comprehending properties of pure substances, phase diagrams and phase transitions.
3. Understanding the energy transfer by heat and work.
4. Being acquainted with energy conservation (First Law of Thermodynamics), increased entropy (Second Law of Thermodynamics) and energy conversion.
5. Being familiar with energy conversion devices and machines such as compressors, turbines, boilers, heat exchangers, combustion chambers, etc. and their energy balance analysis.
6. Grasping thermodynamic cycles and conduct their thermodynamic analysis.

Aerospace Materials, AST 261

Objective of the course is to teach the basic concepts of aerospace materials' science and technology, and to help students with this fundamentals, to gain ability to evaluate and make connection between the behaviors of aerospace engineering materials. Content of the course includes Materials and Material Strengthening of Metal Alloys, Phase Diagrams, Phase Transformations, Mechanical and Durability Testing of Aerospace Materials, Polymers for Aerospace Structures, Fibre-Polymer Composites for Aerospace Structures and Engines and so on. The official book used in the course is *Introduction to Aerospace Materials; A.P. Mouritz, 2012, Woodhead Publishing Materials Science and Engineering: An Introduction; W.D. Callister, John Wiley & Sons.* Learning outcomes are:

1. To able to analyze particle kinematics for motion of atoms.

2. To have a solid basic knowledge of the metal’s crystal structures, defects.
3. To able to understand the basics of the phase diagrams and phase transformations.
4. To have a basic knowledge about the manufacturing steps of a metal structure.
5. To have a basic knowledge about the polymer materials used in aerospace industry.
6. To have a basic knowledge about the composite structures manufacturing and concepts.
7. To able to formulate and solve some basic composite mechanics.

Linear Algebra, MAT 221

Aim of this course is to introduce basic concepts of linear algebra including vectors, vector spaces, matrices and determinants, systems of linear equations, eigenvectors and linear transformations. Other than those gains, one experiences following subjects: Systems of Linear Equations, Gaussian Elimination, Matrix Operations and Matrix Types, Applications of Matrices, Determinants, Cramer's Rule, Vector Spaces, Matrix Transformations, and last but not least, *Eigenvalues and Eigenvectors. Elementary Linear Algebra: Applications Version, (10th edition) H. Anton and C. Rorres, Wiley (2010)* and lecture notes are main resources for this course. Learning outcomes can be sorted as following:

1. Solving systems of linear equations.
2. Computing determinants, eigenvalues and eigenvectors.
3. Performing and explaining uses of diagonalization and quadratic forms.
4. Ability to use eigenvalues and eigenvectors on engineering problems.
5. Ability to work cooperatively in groups.

Fundamentals of Electrical and Electronic Circuits, EEE 222

Objective of the course is to introduce the basic concepts in electrical engineering to nonelectrical engineering students. Students will learn the fundamentals of circuit theory, semiconductor devices, and simple electronic circuits like single stage amplifiers. Course contents are Basic electrical quantities and circuit elements, DC and AC analysis of linear circuits, RLC circuits and resonance, semiconductor devices, power supplies and single transistor amplifiers, logic gates, measurement techniques, DC motors. Learning outcomes can be sorted such as following:

1. Learning the basic electrical quantities and basic circuit elements.
2. Learning the basic techniques for the analysis of electrical circuits.
3. Learning the fundamentals of diodes and transistors and simple electronic circuits.

Summer Practice II, AEE 350

Third year internship is on engineering duties/activities/works such as research & development, production development, quality control, project management, logistics management, engineering management, etc. For example, for research & development or production development kind of internship work, the internship student must contribute to the design and production processes in the company by using programming languages (such as FORTRAN, Java, MATLAB, etc.) and/or engineering softwares (such as SOLIDWORKS, CATIA, ANSYS, etc.). In other areas of engineering work, similar duties are expected from the students.

Dynamics, AEE 262

Teaching the fundamentals of vector mechanics of rigid structures in various motion types is the main objective of this course. Kinematics of Particles, Kinetics of Particles: Newton's Second Law, Energy and Momentum Methods, Systems of Particles, Kinematics of Rigid Bodies, Plane Motion of Rigid Bodies, Kinetics of Rigid Bodies in Three Dimensions are the contents of this course. *Beer, F. P., Johnston, Jr., E. R., Cornwell, P. J., "Vector Mechanics for Engineers: Dynamics", 10th Ed. In SI Units, McGraw Hill Inc., 2013* is used as the main resource. Learning outcomes of the course can be sorted as:

1. Develop in the engineering student the ability to analyze any problem in a simple and logical manner and to apply to its solution a few, well-understood, basic principles.
2. Learning the concepts of rigid body motion by means of kinetics and kinematics.
3. Understanding the fundamentals of principles of energy and momentum.
4. To be able to conduct kinetics and kinematics analysis on structures.
5. Applying principles of kinetics and kinematics on three dimensional rigid bodies.

Strength of Materials, MEC 226

In this course students are expected to learn the basics of structural engineering principles such as stress and strain definitions, deflection and displacement of structures, stress-strain transformations. Stress and strain concepts, Axial loading, Statically Indeterminate Axially Loaded Members, Thermal Stress, Torsion, Torsion Angle, Statically Indeterminate Torque Components, Bending, Eccentric Axial Loading, Vertical Shear, Shear Flow in Elements, Combined Loadings, Stress and Strain Transformation, Deflection of Beams and Shafts, Statically Indeterminate Beams and Shafts are the subjects covered in this course. Learning abilities of the course are:

1. Ability to define mechanical properties of a material using a prismatic bar
2. Ability to define the materials obeying the Hooke's law
3. Ability to calculate changes in length of a prismatic bar under non-uniform conditions
4. Ability to define elasticity and plasticity and to calculate the change in length of a prismatic bar under elasto-plastic conditions
5. Ability to solve statically indeterminate problems including temperature effects
6. Ability to calculate normal and shear stresses on inclined sections of prismatic bar.

Differential Equations, MAT 224

Main purpose of this course is to improve mathematical thinking of students and make the students to use this skill in order to solve the problems which are met in mathematics, physic sand mechanical engineering problems. Course content can be listed such that: Definition and Classification of Differential Equations; Examples from Practical Science; 1st Order Differential Equations; Separable into Variables, Homogenized Differential Equations; 1st Order Linear Differential Equations; Exact Differential Equation, Integrating Factors and Solution Methods; High-order Equations; Factorization Method; To Determine Single Solution; Differential Equations with lack of one Variable; High order Linear Differential Equations; Homogeneous and Non-homogeneous Differential Equations; Undefined Coefficients Method; Changing of Parameters (Lagrange) Method; Operator Method; Linear and Non-linear Differential Equations with Variable Coefficients; Cauchy-Euler Equations; Equations with lack of dependent and independent variables; Sarrus Method; Laplace Transform; Calculation of Initial Value Problems by Laplace Transform; 1st order Linear Equation Systems; Elimination and Determinant Methods, Homogeneous Linear Equation Systems with Constant Coefficients; Undefined Coefficients and Changing of Parameters Method.

Introduction to Ordinary Differential Equations, Shepley L. Ross, 4th Edition, Elementary to Differential Equations and Boundary Value Problems, William E. Boyce and Richard C.Di Prima, 5th Edition is the course book. Learning outcomes of the course are:

1. Gaining ability to use differential equations terminology accurately.
2. Solving first order differential equations and use
3. Solving first order differential equations and use them in engineering applications.
4. Learning the all solution methods of differential equations which consist of functions of one variable.

Fluid Mechanics, AEE 241

In this course, basic principles of fluid mechanics, fundamental conservation laws and types of fluid flow are covered. Course contents are Fluid Statics, Fluid Kinematics, Governing Integral Equations of Fluid Flow, Governing Differential Equations of Fluid Flow, and Fluid Flow in Pipes. *Fundamentals of Fluid Mechanics, 7th Edition by Bruce R. Munson, Alric P. Rothmayer, Theodore H. Okiishi, Wade W. Huebsch* is used as the official book. Learning outcomes are:

1. Knowledge of fluid concept and classification of the flow types should be gained
2. Calculating the hydrostatic forces and moments over submerged bodies
3. Understanding the conservation laws of fluid flow
4. Understanding the control volume concept and Reynold’s transport theorem
5. Basic knowledge of moody diagrams and pipes flow equations should be learned.

Computational Methods, AEE 307

One of the objectives of this course is to teach students the mathematical bases of numerical analysis used in the solution of engineering problems. Course content consists of solutions of linear and non-linear systems of equations, Interpolation polynomials, numerical differentiation and integration, Numerical solution of ordinary differential equations. Learning outcomes are:

1. Understanding the approximate solution of mathematical and engineering problems with iterative approach
2. Representing numerical solution techniques in algorithms
3. Computer programming for the solution of mathematical and engineering problems

Applied Elasticity, AEE 361

At the end of the course, the student should be able to design and analyze aerospace engineering components subject to different types of loading. Course content includes Concepts of stress and strain in 3D, Transformations of stress and strain in 3D, Stress-strain and strain-displacement relations in 3D, Generalized Hook’s law, Governing equations of Elasticity, Castigliano’s Theorem, Problems in 2D elasticity: plane strain, plane stress, Polar Coordinates, Torsion of circular bars, Axisymmetrically loaded members: Rotating Disk, thin and thick walled cylinder, Failure Theories, Introduction to advanced topics: Stability, impact fatigue and fracture. *Advanced Strength and Applied Elasticity* by Ugural and Fenster is the official textbook of the course. Learning outcomes are

1. Compute the stress, strain and displacement in a beam subject to normal and shear loads
2. Compute the stresses in shafts due to torsion
3. Use the governing equations for 3-D and 2-D solid mechanics
4. Compute the critical load that a component can withstand using different failure criteria including maximum shear stress criteria, von Mises criteria and buckling criteria
5. Design a component for a specified fatigue life
6. Use computational tools to model and analyze structural components
7. Carry out a design project in a team environment and present the results

Control Systems, AST 303

This is the first course in Control Theory for undergraduate students which will cover basic fundamentals of classical control theory. Course contents are; Continuous-time control systems, including frequency response approach, root-locus approach, and state-space approach to analysis and design of control systems. A gradual development of control theory, solving computational problems with MATLAB, examples and worked problems are featured throughout the course.

The official book used in the course is *Modern Control Engineering 5th Edition, Katsuhiko Ogata.* Learning outcomes of the course are:

1. Understanding the properties of open-loop and closed-loop control architecture.
2. Understanding the importance of performance, robustness and stability in control design.
3. Understanding of the link between the ODE representations, the s-domain representation.
4. Working with block diagram representations of control systems.
5. Designing PID controllers.
6. Understanding Root-Locus method.
7. Computing gain and phase margins.
8. Designing Lead-Lag compensators.
9. Understanding the state-space paradigm and models.

Heat Transfer, MEC 321

Main objective of this course is to teach basics of heat transfer and heat transfer mechanisms. Content of the course include mechanisms of heat transfer, steady one-dimensional heat conduction, thermal resistance, heat transfer systems, analytical and numerical solution of two-dimensional systems, unsteady heat conduction, forced and natural convection heat transfer and radiation heat transfer. The official books used in the course are *Fundamentals of Heat and Mass Transfer* by T.L. Bergman, Adrienne S.Lavine, Frank P.Incopera, David P. DeWitt and *Heat Transfer* by J.P. Holman. At the end of the course, students are expected to

1. Learn the mechanisms of heat transfer
2. Know steady one-dimensional heat conduction, thermal resistance, heat transfer systems, analytical and numerical solution of two dimensional systems
3. Know unsteady heat conduction, forced and natural convection heat transfer, radiation heat transfer.

Probability and Statistics, MAT 301

Objectives of this course is to introduce the basic probability concepts such as probability, random variables, and their distribution functions and to teach basic statistical techniques used in parameter estimation. Course content consists of Random Variables, Discrete and Continuous Probability Distributions, Sampling Distributions, Sample Statistics, Hypothesis Testing and p-value. At the end of the course, student

1. Comprehends the basic concepts of probability such as conditionality, independence of events, expected value and randomness.
2. Decides in which situations to apply discrete and continuous distributions.
3. Computes measures of central tendency (mean, median) and deviation (range, standard deviation) of a given sample and population
4. Formulates an appropriate one two sided hypotheses test, performs the test and clearly states the result of the test in the problem context
5. Comprehends the meaning of P- value and decides on whether to reject the null hypothesis based on P-value

Impact Dynamics and Spacecraft Protection, AST 483

This course presents an introduction to spacecraft which operate in densely populated altitude regimes and which are experiencing a steady debris and meteoroid particle flux which strongly increases with decreasing particle sizes. The consequences of resulting impacts can range from small surface pits for µm-size impactors, via clear hole penetrations for mm-size objects, to partial or complete destruction via shockwaves for projectiles larger than a few centimeters. The most probable impact velocities are in the range from 0 to 15 km/s for space debris, and between 5 km/s and 30 km/s for meteoroids (denoted as hypervelocity impacts or HVI). At such speeds, the impact of an aluminum sphere of 1 cm diameter deploys the same energy as an exploding hand-grenade, with equally devastating consequences, unless special protection measures are applied. Learning outcomes can be sorted as follows:

1. Understanding the space MMOD environment
2. Understanding the collision models
3. Understanding the high-speed collision physics
4. Understanding the damage mechanism
5. Design of protection techniques
6. Collision avoidance maneuvers

Propulsion Systems, AEE 331

Aim of this course is to teach the students the fundamentals of propulsion and calculation of performance parameters of propulsion systems. Content of course include Definitions, ideal ramjet and turbojet engines, turbofan engines, turboprop engines, after burners, Non-ideal cycle analysis, efficiency and non-ideal turbojets, nozzle and diffuser, combustion and combustion chambers, compressors, turbines, engine performance. Learning outcomes of the course can eb listed as

1. Learning the fundamentals of propulsion
2. Calculating the performance parameters of propulsion systems

3. Calculating the characteristics of flow ahead, inside and after the propulsion systems
4. Learning experimental techniques about propulsion systems

Aerodynamics I, AEE 341

The fundamentals of subsonic flow are investigated within the scope of this course. Course content consists of Potential Flow (Inviscid, Incompressible), Complex Variables, Lifting Line Theory, and Finite Wing Theory. *Fundamentals of Aerodynamics* of John D. Anderson is the official course textbook. At the end of the course,

1. The governing equations for Inviscid incompressible flow are learned
2. The application of conservation laws within a control volume is learned
3. Finding the potential and stream functions of a flow field around bodies and calculation of the pressure distribution are learned
4. Computation of the lift and moment coefficients via thin airfoil theory is learned
5. Computation of the lift and drag coefficients via finite wing theory is learned

Aerodynamics II, AEE 342

In this course the fundamentals of compressible aerodynamics and boundary layer theory will be taught. Content of the course include Inviscid, compressible flow; Steady 1D compressible flow; Subsonic compressible flow over airfoils; Linear supersonic flow; Viscous, incompressible flow; Boundary layer equations; Introduction to turbulent flow; Introduction to turbulent boundary layers; Lift and drag on airfoils (viscous and inviscid). *Fundamentals of Aerodynamics* of J.D. Anderson is the official textbook of the course. At the end of the course students learn

1. Applying basic principles of thermodynamics to flow problems
2. Obtaining flow properties in one dimensional inviscid flows
3. Understanding the normal shock concept and calculation of the physical state around them
4. Understanding the deflection phenomena of shock waves and calculating the flow properties
5. Compressible internal flow phenomena should be understood
6. Calculating subsonic and supersonic compressible flow properties around airfoils
7. Understanding laminar and turbulent boundary layers and calculating the physical properties within them

Aircraft Structures, AEE 362

This course presents the basic structural analysis principles of aerospace structures with special emphasis on aircraft structures. Content of course are an introduction, Energy Methods in Structural Analysis, Structural Analysis for Thin Walled Open Section Beams, and Structural Analysis for Thin Walled Closed Section Beams, Bending of Unsymmetrical Sections, Structural Analysis of Aircraft Sub-Structures and Elastic Stability. *Aircraft Structures for Engineering Students* of T.H.G. Megson is the official textbook of the course. Learning outcomes are

1. Gaining a basic understanding on the aerospace structures
2. Understanding about the basic analysis principals on the aerospace structures

3. Applying analysis principals to thin walled members which form the components of sub-structures of aerospace structures
4. Applying analysis principals to main building blocks of the aerospace structures
5. Ability to apply numerical solution of complex built-up aerospace structures

Flight Mechanics, AEE 372

This course introduces the fundamental concepts of aircraft performance characteristics and equations of motion at all stages of flight to the students. Content of the course include necessary definitions, Coordinate Systems, Euler Angles and Transformation, Aircraft Dynamics, Small Gain Theory, Stability of Steady Flight, Longitudinal Aerodynamic Characteristics, Lateral Aerodynamic Characteristic, Dynamics of Rotorcraft and Spacecraft. *Mechanics of Flight* of Warren F. Phillips is the official textbook of the course. At the end of the course, students

1. Gain the ability of literature review and group study and projecting the knowledge on studies done
2. Using aerodynamics and propulsion systems knowledge on aircraft performance calculations.
3. Gain the ability to write computer codes for the solution of flight mechanics equations of motion
4. Perform aircraft static and dynamic stability analyses
5. Determine the importance of air traffic control in aviation

Aircraft Design, AEE 451

Students who take this course can understand the philosophy beneath aircraft design and become capable of designing an aircraft with desired characteristics. Content of the course are conceptual design of fixed wing aircraft, Aircraft sizing, Airfoil and geometry selection, Thrust to weight ratio and wing loading, Configuration layout, Propulsion and fuel system integration, Landing gear and subsystems, Weights and balance, Stability, control and handling quality, Performance and flight mechanics and Cost. Learning outcomes of the course are

1. Learning all aspects of conceptual aircraft design
2. Being able to work within a multidisciplinary engineering group task
3. Combining the necessary tools in order to reach a reliable, feasible and successful design
4. Understanding the basics of aviation laws in designer point of view
5. Understanding the importance of report preparation in engineering study
6. Details of certification and reliability are learned

System Dynamics, AEE 313

Aim of this course is to educate students who have a grasp of modeling a physical system, system units and system equations. Content of the course include modeling of physical systems, energy gates, one and two-port systems, mechanical, electrical, fluid and thermal system units, linear graphics, dynamic equations, modeling of impure elements, linearization, condition variables, presence of A-matrix form of system equations, physically, canonical and phase variables, time and frequency responses of systems. Latest edition of *System Dynamics: Modeling and Simulation of Mechatronic Systems* by DC.

Karnopp, DL. Margolis and RC. Rosenberg is the official textbook of the course. At the end of this course, students will be able to

1. Model physical system
2. Learn system units
3. Write system equations in A-matrix form
4. Have knowledge about time and frequency response of systems

Heat Transfer, AEE 311

Aim of this course is to teach the basics of Heat Transfer mechanisms. Content of the course include Mechanisms of heat transfer, steady one-dimensional heat conduction, thermal resistance, heat transfer systems, analytical and numerical solution of two-dimensional, unsteady heat conduction, forced and natural convection heat transfer, radiation heat transfer. *Heat Transfer* by J.P. Holman is the main textbook of the course. Learning outcomes are

1. To learn the mechanisms of heat transfer
2. To know steady one-dimensional heat conduction, thermal resistance, heat transfer systems, analytical and numerical solution of two-dimensional
3. To know unsteady heat conduction, forced and natural convection heat transfer, radiation heat transfer

Airborne Systems Engineering, AEE 305

The aim of this course is to teach the students fundamentals of systems engineering in the aviation point of view. Course starts with a review of evolution of systems engineering discipline. Content of the course include an Introduction to the concepts of system life cycle and life cycle cost, System design development and qualification through systems engineering process, system modeling methods, development of functional, physical and operational architectures, system integration and interface management. *Spacecraft Systems Engineering* of Peter Fortescue, Graham Swinerd and John Stark is the main textbook of the course. Learning outcomes are

1. Understanding the basics of systems engineering discipline
2. Understanding the philosophy behind system life cycle and life cycle cost
3. Understanding the importance of system qualification
4. Understanding the system design, integration and interface management concepts

Theory of Elasticity, AEE 301

At the end of the course, student should be able to design and analyze aerospace engineering components subject to different types of loading. Content of the course are concepts of stress and strain in 3D, Transformations of stress and strain in 3D, Stress-strain and strain-displacement relations in 3D, Generalized Hook’s law, Governing equations of Elasticity, Castigliano’s Theorem, Problems in 2D elasticity: plane strain, plane stress, Polar Coordinates, Torsion of circular bars, Axisymmetrically loaded members: Rotating Disk, thin and thick walled cylinder, Failure Theories, Introduction to advanced topics: Stability, impact fatigue and fracture. At the end of the course, students can

1. Apply mathematical tools to solve mechanics problems

2. Compute the stress, strain and displacement in a beam subject to normal and shear loads
3. Compute the stresses in shafts due to torsion
4. Use the governing equations for 3-D and 2-D solid mechanics
5. Compute the critical load that a component can withstand using different failure criteria including maximum shear stress criteria, von Mises criteria and buckling criteria
6. Design a component for a specified fatigue life
7. Use computational tools to model and analyze structural components
8. Carry out a design project in a team environment

Strength of Materials, AEE 206

The subject of the course is to investigate the mechanical behavior of deformable bodies in equilibrium. Content of the course are Stress and strain concepts, Axial loading, statically indeterminate axially loaded members, thermal stress, Torsion, torsion angle, statically indeterminate torque components, Bending, eccentric axial loading, Vertical shear, shear flow in elements, Combined loadings, Stress and strain transformation, Deflection of beams and shafts, statically indeterminate beams and shafts. *Strength of Materials* of Beer, Johnston & Dewolf is the main textbook of the course. Students who take this course have

1. Ability to define mechanical properties of a material using a prismatic bar
2. Ability to define the materials obeying the Hooke's law
3. Ability to calculate changes in length of a prismatic bar under non-uniform conditions
4. Ability to define elasticity and plasticity and to calculate the change in length of a prismatic bar under elasto-plastic conditions
5. Ability to solve statically indeterminate problems including temperature effects
6. Ability to calculate normal and shear stresses on inclined sections of prismatic bar

Mechanics II: Dynamics, AEE 202

Aim of this course is to teach the fundamentals of vector mechanics of rigid structures, related with aeronautical engineering, in various motion types. Content of the course are Kinematics of Particles, Kinetics of Particles: Newton's Second Law, Energy and Momentum Methods, Systems of Particles, Kinematics of Rigid Bodies, Plane Motion of Rigid Bodies: Forces and Accelerations, Energy and Momentum Methods, Kinetics of Rigid Bodies in Three Dimensions. *Engineering Mechanics: Dynamics* by Russell C. Hibbeler is the main textbook of the course. Learning outcomes are

1. Develop in the engineering student the ability to analyze any problem in a simple and logical manner and to apply to its solution a few, well-understood, basic principles.
2. Learning the concept of rigid body motion and idea concepts of kinetics and kinematics.
3. Understanding the fundamentals of principles of energy and momentum.
4. To be able to conduct kinetics and kinematics analysis on aeronautical structures.
5. Applying principles of kinetics and kinematics on three dimensional rigid bodies.

Mechanics I: Statics, AEE 201

Aim of this course is to teach the fundamentals of vector mechanics of stationary rigid structures related with the aeronautical engineering. Course content include an introduction, Statics of Particles, Rigid Bodies: Equivalent Systems of Forces, Equilibrium of Rigid Bodies, Distributed Forces: Centroids and Centers of Gravity, Analysis of Structures, Forces in Beams and Cables, Friction, Distributed Forces: Moments of Inertia, Method of Virtual Work. Latest edition of *Vector Mechanics for Engineers: Statics* of Beer, F. P., Johnston, Jr., E. R., Mazurek, D. F. is the main textbook of the course. Learning outcomes are

1. Develop in the engineering student the ability to analyze any problem in a simple and logical manner and to apply to its solution a few, well-understood, basic principles.
2. Understanding the fundamentals of vector analysis.
3. Learning the concept of rigid body equilibrium and idea of how to sustain rigid body equilibrium.
4. Learning how to calculate the centroid of a geometry and center of gravity of a rigid, homogeneous body. Understanding the importance of the moment of inertia in vector mechanics.
5. Understanding the basic principles of vector analysis of aeronautical structures such as trusses, frames, etc.
6. Being familiar with the friction phenomena.
7. Being familiar with the principle of virtual work in structural analysis.

Aircraft Maintenance Engineering, AEE 411

The objective of the course is to teach the fundamentals of maintenance, repair and inspection of aircraft and aircraft components. The content of the course include: an introduction of general information regarding descriptive data, abbreviations. Information pertaining to light maintenance and periodic inspection lists for aircrafts. Hazardous materials and safety practices for maintenance. Principal aircraft structures are basically defined. Engine components and aircraft instruments are also covered with their duties. Inspection, repair and test methods such as welding, visual inspection. How an engineer manages the maintenance and uses overhaul books are clearly explained. Learning outcomes are

1. Learning the fundamentals of terminologies
2. Learning light maintenance, periodic inspection lists of the aircraft
3. Learning hazardous materials and safety practices

Advanced Thermodynamics, AEE 431

Students in this course develop a mathematical and physical understanding of the fundamental concepts and principles of engineering thermodynamics including properties, state determination, work and heat transfer, entropy and exergy analysis. Students also learn procedures for first and second law analysis with applications to both energy conversion components and cycles. Course content include properties of pure substances, first and second laws of thermodynamics, entropy and exergy analysis with applications to energy conversion devices and thermodynamic cycles, single- and multi-phase systems, irreversibility in thermodynamics. *Vectors Tensors and the basic equations of fluid mechanics* of Aris R is the main textbook of the course. Learning outcomes are

1. Understanding the basic thermodynamic definitions and concepts
2. Evaluating the thermodynamic state and properties for pure substances and ideal gases
3. Evaluating the work and heat transfer of processes

4. Applying the principles of conservation of mass and the 1st Law of Thermodynamics to open and closed systems
5. Applying the 2nd Law of Thermodynamics to determine ultimate cycle performance and efficiency limitations.

Aircraft Engine Design, AEE 431

Aim of this course is to teach the philosophy behind aircraft engine design and introducing the theory underneath it. Course content include performance characteristics of aircraft engines, Inlet, compressor, combustor, turbine and nozzle design; component matching, discussion of various engine types including turbojet, turbofan and turboprops; future design, liquid, solid and hybrid propellants, optimization and losses. Latest edition of *Aircraft Engine Design* by Jack D. Mattingly, William H. Heiser and David T. Pratt is the official textbook of the course. At the end of the course,

1. fundamentals of aircraft engine design should be learned
2. identification of the engine requirements should be understood
3. principles of engine – aircraft matching should be understood
4. engine component design should be learned
5. ways of handling engineering design tasks as a group should be learned

Principles of Combustion, AEE 433

One of the main aims of this course is to teach fundamentals of combustion. Content of the course include combustion and thermochemistry, chemical kinetics and mechanisms, chemical and thermal coupled analysis, laminar and turbulent flames. Main textbook of the course is T. Poinsot, D. Veynante, "*Theoretical and Numerical Combustion*", Edwards, 2nd Edition, 2005. At the end of the course, students

1. Gain basic knowledge of combustion
2. Learn basic chemical dynamics during combustion
3. Define fundamental laminar and turbulent combustion problems

Internal Combustion Engines, AEE 434

This course aims to improve understanding of the engines and their operation and to use them to experience how materials on fluid mechanics, thermodynamics, and heat transfer studied in previous years integrates into a total engineering concept. Course content include Thermodynamic cycle analysis solution of gas change, compression, expansion and combustion processes; Combustion mechanism; Fuel and additive; Real cycles; Performance characteristics; Short analysis of fuel metering and ignition systems; Exhaust emissions and control systems; Heat transfer; Friction and lubrication systems. *Internal Combustion Engine Fundamentals* of John Heywood is the main textbook of the course. Learning outcomes are

1. Identifying advantages and disadvantages of the operation and efficiency of internal combustion engines of all type
2. Describing the key pollutants associated with combustion in engines and understanding their significance with respect to health and the environment
3. Describing basics of the combustion and pollutant processes

4. Performing basic calculations relating to the performance and emissions of internal combustion engines

Aerodynamic Design of Aircrafts, AEE 441

During the course, fundamental methods and applications of CFD in aircraft design are discussed. Content of the course include Cartesian grids, 3-D panel method, laminar and turbulent flow modeling, and wing production methods for a model aircraft. *Low-Speed Aerodynamics* of J. Katz is the official textbook of the course. At the end of the course,

1. The governing equations for Inviscid incompressible flow are learned
2. The Cartesian grid methods in order to model the aircraft are learned
3. Finding the potential and stream functions of a flow field around bodies and calculation of the pressure distribution are learned
4. Boundary layers models and coupling them with panel method are learned
5. Computation of lift and drag forces and moment according to the mission of aircraft is learned
6. Wing production for a model aircraft is learned.

Experimental Aerodynamics, AEE 442

In this course, students focus on planning, conducting, and processing data from flow measurements. An increased understanding of basic physical phenomena and their influence on the performance of aircraft should be developed by the student. Comparisons between experimental and computational results are used to gain experience concerning what type of investigations are most suitable for an experimental approach. Content of the course include experiments in fluid mechanics, aerodynamics and propulsion with emphasis on data acquisition and analysis, e.g., measurement techniques, laboratory instrumentation, errors and noise in measurements, and digital sampling. *Fluid Mechanics Measurements* by R.J. Goldstein (Ed.) and Taylor Francis is the main textbook of the course. At the end of the course, students

1. Observe main aerodynamic phenomena that have been introduced.
2. Plan, conduct and process data from experiments.
3. Decide the type of flight conditions for modeling.
4. Compare and explain computational and experimental data.
5. Develop an understanding of basic phenomena and their influence on the performance of the aircraft.

Computational Aerodynamics, AEE 443

In this course, fundamentals of methods and applications of CFD for 2-D subsonic and transonic flows are discussed. Course content includes 2-D panel method, laminar and turbulent flow modeling. *Low-Speed Aerodynamics* of J. Katz is the official textbook of the course.

1. The governing equations for Inviscid incompressible flow are learned
2. Finding the potential and stream functions of a flow field around bodies and calculation of the pressure distribution are learned
3. Boundary layers models and coupling them with panel method are learned

4. Computation of lift and drag forces are learned

Aerodynamic Shape Optimization, AEE 444

In this course, fundamentals of aerodynamic solvers, gradient based optimization techniques are discussed. Course content includes 2-D panel method, laminar and turbulent flow modeling, optimization techniques. Low-Speed Aerodynamics of J. Katz is the official textbook of the course. At the end of the course,

1. The governing equations for Inviscid incompressible flow are learned
2. Finding the potential and stream functions of a flow field around bodies and calculation of the pressure distribution are learned
3. Boundary layers models and coupling them with panel method are learned
4. Computation of lift and drag forces are learned
5. Gradient based optimization techniques for unconstraint and constraint optimization problems

Boundary Layer Flow, AEE 445

In this course fundamentals of boundary layer models and laminar transition are discussed. Course content includes boundary layer models and transition prediction. *An Introduction to Theoretical and Computational Aerodynamics* of J. Moran is the official textbook of the course. At the end of the course

1. Approximate solution to integral form of laminar boundary layer is learned.
2. Derivation of Orr-Sommerfeld equations for transition is learned.
3. Solutions to Integral Form of Momentum Equation for turbulent boundary layer is learned.

Computational Fluid Dynamics, AEE 446

The aim of this course is to teach numerical solutions of the fluid flow equations. Course content includes simplification of the Navier-Stokes equations for steady, attached flows, integral formulation of inviscid, irrotational flow equations for subsonic flows, panel methods, Design optimization of an airfoil with a panel method, Inverse airfoil design based on a panel method, Characteristic lines, Discretization of the Transonic Small Disturbance equation on Cartesian grids using Finite Difference methods, upwind differencing in supersonic regions, numerical solution of transonic flows over airfoil profiles, numerical solution of unsteady Full Potential Flow equation in curvilinear coordinate systems. Latest edition of Low-*Speed Aerodynamics* by Joseph Katz and Allen Plotkin is the main textbook of the course. At the end of the course,

1. The use of panel method in computational aerodynamics should be understood
2. The concept of design optimization in aerodynamics point of view should be learned
3. The numerical solution methods of the transonic small disturbance equation should be examined
4. The general numerical solution of the full potential flow equation should be took for granted.

Turbulent Flows, AEE 422

In this course, we introduce the turbulence phenomena and the solution of the governing equations of turbulent flow to the students. Content of the course are The Nature of Turbulent Flows, motion equations, the statistical description of turbulent flows, scales of turbulent motion and spectral representation, İntroduction to modeling, Direct Numerical Simulations (DNS), Eddy-viscosity models, Reynolds stress and Related Models, and Large Eddy Simulations (LES). *Turbulent Flows* by Stephen B. Pope is the main textbook of the course. Learning outcomes are

1. Learning the nature of the turbulent flows.
2. Understanding the philosophy of turbulent modeling
3. Understanding the spectral representation phenomena
4. Being able to apply eddy simulations.

Helicopter Aerodynamics, AEE 448

In this course, students learn the fundamentals of helicopter aerodynamics and performance. Latest editions of *Basic Helicopter Aerodynamics* of Seddon, J., and *Helicopter Performance, Stability and Control* of Prouty, R. are the main textbooks of the course. At the end of the course, student

1. Understands the rotor aerodynamics in vertical flight
2. Understands the rotor aerodynamics in forward flight
3. Learns performance calculations for hover and vertical flight
4. Learns performance calculations for forward flight

Design of Unmanned Aerial Systems, AEE 452

Different design aspects of unmanned aerial system are taught. Course content include Preliminary design, aerodynamic and airframe configurations, design standards, development and tests of unmanned aerial systems, certification process. *Unmanned Aircraft Systems UAVs Design, Development and Deployment* of R. Austin is the main textbook of the course. In this course,

1. Competitor study for preliminary design is learned
2. Selection of aerodynamic and structural configuration is learned
3. Design standards and regulations for different countries are learned
4. Details of ground and in-flight tests are learned

Design of Aircraft Structures, AEE 461

The objective of the course is to equip the senior year aeronautical engineering students with the relevant infrastructure to carry out the design of aircraft sub-structures like wings, fuselages, empennages, landing gears etc. Content of the course include an introduction of design philosophies like damage tolerance, safe life, failsafe; Establishment of relations between the design requirements and airworthiness regulations; an introduction of the aircraft data requirements and description of the critical air loads used in the design and analysis of aircraft structures; an introduction of the aeroelastic stability design constraint; an overview of the role and lay-out of main structural members used in aircraft structures; Initial sizing calculations based on design constraints such as deflection, local Buckling; general design considerations used in the structural joints and fittings; fatigue failure consideration and its relation with design philosophies, fatigue loads in aircraft operations and fatigue life analysis methods. Latest edition of *Airframe Structural Design* by M.Niu is the main textbook of the course. Learning outcomes are

1. Learning the fundamentals of design philosophies
2. Establishing the relations between design requirements and airworthiness regulations
3. Being able to identify the design constraints depending on the mission of the aircraft
4. Understanding the effect and role of each member in an aircraft structure
5. Perform design procedure considering the failure possibilities of aircraft structures

Thin Walled Structures, AEE 462

The basic objective of this course is to understand analysis of thin-walled structures. Course content includes a review of mechanics of materials, stresses in stiffened shell beams, deformation analysis by energy methods, multi-cell beams, an introduction to the matrix stiffness method including truss and beam elements. *"Aircraft Structures for Engineering Students, 3rd Edition" by T. H. G. Megson* is the main textbook of the course. Learning outcomes of the course can be listed as

1. The concept of uniform stress state versus non-uniform stress state in 2- and 3-D is understood.
2. Being able to draw the beam shear force and bending moment diagrams for complex loads using common discrete representation of the applied loads. Given the bending moment distribution, to calculate the bending stresses and deflections for beams with symmetric and non-symmetric cross-sectional areas.
3. Torsion of thin-walled open and closed-section tubes is examined. The concept of shear center, center of twist, and elastic axis are understood. The location of the shear center of an open section and effective torsional stiffness are determined.
4. The shear stresses in a thin-walled section due to shear force is determined.

Finite Element Theory, AEE 464

One of the aims of this course is to teach fundamentals of finite element method, and giving students the ability to encode their finite element method based on finite element method. A commercial software will be introduced to students within the scope of the course. Content of course includes an introduction to finite element analysis, one dimensional elements, 1D finite element method based computer programming, finite element form of Rayleigh Ritz Method, general derivation of the element stiffness matrix, interpolation and shape functions, FE software applications of aerospace structures. Latest edition of *Concepts and Applications of Finite Element Analysis* by Robert D. Cook, David S. Malkus, Michael E. Plesha is the main textbook of the course. Learning outcomes are

1. Understanding the fundamentals of finite element method (FEM)
2. Solving 1D and 2D structural problems with FEM
3. Solving real life problems with FEM
4. Effectively use a commercial FE software
5. Reading the results of FEA
6. Strengthen structural modeling, problem solving and report preparation abilities

Acoustics and Noise Control Engineering, AEE 465

The aim of this course is to introduce the students the fundamentals of acoustics and noise control engineering. Content of the course includes wave motion, wave equation and its solutions, acoustic plane waves, spherical waves, the energy relations, sound transmission and the transmission loss, the mechanism of hearing, sound perception, noise limits and legislation, room acoustics, echo, `Sabine equation, Wave theory, transmission path from the source and receiver noise control, Noise limit design principles. Latest edition of *Engineering Noise Control: Theory and Practice* of David Bies is the main textbook of the course. Learning outcomes of the course are

1. Learning the fundamentals of noise
2. Learning wave types and wave propagation
3. Being able to recognize the acoustic and noise measurement devices and the measurement standards
4. Understanding the effect of noise in human life
5. Learning the techniques of noise isolation and reduction

Design of Control Systems, AEE 481

Control theory is a mathematical optimization method with important applications in the aerospace industry. Following the historical introduction are five chapters dealing with theory and five dealing with primarily aerospace applications. The theoretical section follows the calculus of variations approach, while also covering topics such as gradient methods, adjoint analysis, hodograph perspectives, and singular control. Important examples such as Zermelo's navigation problem are addressed throughout the theoretical chapters. The applications section contains case studies in areas such as atmospheric flight, rocket performance, and missile guidance. The cases chosen are those that demonstrate some new computational aspects, are historically important. To keep the mathematical level at that of undergraduate students in engineering, rigorous proofs of many important results are not given, while the interested reader is referred to more mathematical sources. *Optimal Control Theory with Aerospace Applications* by Joseph Z. Ben-Asher is the official textbook of the course. Learning outcomes of this course are

1. Fundamentals of control theory should be understood.
2. Mathematical tools of the control systems should be understood
3. Control system applications in the aeronautical engineering should be understood
4. Numerical methods in control systems should be learned
5. Ways of handling control system design tasks as a group should be learned

Composite Materials, AEE 491

The purpose of the course is to introduce composite materials. Matrix materials, reinforcement materials, polymer matrix composites, metal matrix composites, ceramic matrix composites and carbon-carbon composites will be introduced. Course content consists of Composites, matrix and reinforcement materials, polymer, metal and ceramic matrixes. Students learn

1. Composites
2. Matrix materials
3. Reinforcement materials
4. Polymer, metal and ceramic matrixes
5. Application of composite materials in aerospace industry

Engineering with Polymers, AEE 492

The purpose of the course is to introduce polymer science to engineers. Structure of polymers, properties and applications of polymers, processing of polymers and designing with polymers will be introduced. Physical properties of the polymers will be discussed in detail. Course content consists of structure of polymers, properties and application of polymers and physical properties of polymers. At the end of the semester students know

1. Polymer structures
2. Polymer structure-property relationships
3. Processing of polymers
4. Polymer composites
5. Application of polymers in aerospace industry

Introduction to Nanoscience and Nanotechnology, AEE 493

The purpose of the course is to introduce the nanoscale science and technology. Nanomaterials synthesis, characterization, application of them in a variety of field will be introduced. Electrical, optical, magnetic, and mechanical properties of the nanomaterials will be discussed in detail. Course content consists of Nanoscience and nanotechnology, nanomaterials, physical properties of nanomaterials. At the end of the course student should know

1. The difference between Nano and Macro Scales.
2. Nanomaterials
3. Synthesis of nanomaterials
4. Characterization of nanomaterials
5. Physical properties of nanomaterials

Nanophotonics, AEE 494

The purpose of the course is to introduce nanophotonic. Light, the wave nature of light, lasers, photonics, plasmonics, metal and semıconductor quantum dots, nanocomposites, nanofabrication and application of nanophotonics will be introduced. . Course content consists of Nanophotonics, plasmonics, lasers, quantum dots and fabrication of nanomaterials. At the end of the course student should know

1. The wave nature of light
2. Lasers
3. Quantum dots
4. Plasmonics
5. Application of nanophotonics

Manufacturing Methods in Aeronautical Engineering, AEE 496

The objective of the course is to introduce the manufacturing techniques and methods used in the aerospace industry, including manufacturing tools and devices, non-destructive investigations. Course contents include an introduction to aerospace manufacturing methods, Processing, milling and forming of metallic alloys for aerospace applications, Introduction to manufacturing of composite materials for aerospace applications, Smart materials used in Aerospace and overview of Nano materials which can be utilized in Aerospace Industry, Processing of high temperature durable and high strength materials for aerospace applications, Introduction to manufacturing tool and machines used in Aerospace and showcase of existing manufacturing methods in Industry zones in Turkey and Non-destructive investigation methods. *Manufacturing technology for aerospace structural materials* by Flake C Campell Jr is the main textbook of the course. At the end of the course, students are expected to

1. Learn standardized literature of manufacturing and technical drawings for different types of manufacturing methods.
2. Learn the metals and metal forming methods used for aerospace applications
3. Learn subtractive manufacturing method of metals used for Aerospace applications
4. Learn the composites and composite production methods used for the aerospace applications
5. Understand the additive methods and 3D printing
6. Gain knowledge of advanced materials such as smart materials, nano materials, high temperature alloys used for aerospace applications
7. Learn non-destructive evaluation of aerospace materials for post-manufacturing
8. Understand the effects of design on manufacturing

Advanced Aircraft Control Systems, AEE 451

In this course concepts and techniques of linear and nonlinear control system analysis and synthesis will be studied in the modern control (state space) framework. It will have preferential bias towards aerospace applications, especially towards guidance and control of aircrafts and missiles. Content of the course include an introduction and Review, State-Space Controller Design Approach, Lyapunov stability analysis, Introduction to Optimal Control, Linear Quadratic Regulator (LQR) Design. Learning outcomes are

1. Learning the advanced aspects of modern control engineering
2. Being able to design a state-space controller
3. Understanding control optimization
4. Designing linear quadratic regulators

Wind Energy, AEE 431

Aim of this course is to teach the students the basics of wind energy and how to design machines that converts it to consumable power. Content of the course include Origins of Wind Energy, Wind Resource and Characteristics, Wind turbine aerodynamics and performance, Wind turbine loading and dynamic response, Conceptual design of wind turbines, Wind Turbine Control, Wind Turbine Siting and Wind Farms, Electrical Systems, Wind Energy System Economics, Environmental Aspects and Impacts. *Wind Energy*, Walker, J. F., 1997 is the main textbook of the course. Learning outcomes are

1. Understanding the advantages of using alternative energy sources
2. Learning the basics of the wind energy
3. Understanding the importance of designing pollution free machines
4. Learning how to convert wind energy into electrical energy
5. Learning how to design the most efficient and economical wind turbine

Fundamentals of Vibrations, AEE 463

One of the aims of this course is to prepare the students about vibration problems by teaching the general principles of mechanical vibrations, isolation and calculation of vibrations. Content of the course includes forced and free vibrations of single degree of freedom linear undamped systems, types of damping, properties of damping and effects on the response characteristics, two degree of freedom systems, coordinate transformations, coupling, response to harmonic excitation, multi degree of freedom systems, eigenvalue problems, eigenvectors and orthogonality, vibration of continuous systems, transverse vibration of beams, effects of boundary conditions on response characteristics, vibration measurement and isolation. Latest edition of *Fundamentals of Vibrations* by L. Meirovitch is main textbook of the course. Learning outcomes of the course are

1. Learning the fundamentals of mechanical vibrations
2. Learning the concept and calculation of free and forced vibrations
3. Understanding the importance of mechanical vibrations in aircraft design
4. Gaining information about vibration isolation and damping
5. Understanding the techniques beneath the vibration measurements and FFT analysis

Numerical Methods for Partial Differential Equations, AST 405

This course provides an insight to student reader how to formulate a partial differential equation from the physical problem (constructing the mathematical model) and how to solve the equation (along with initial and boundary conditions). Content of the course consist of an introduction to partial differential equations, heat equation, separation of variables, boundary conditions, integral transform, Fourier and Laplace transforms and Duhamel's principle. At the end of the course, students are able to

1. Identify an partial differential equation and its order
2. Classify partial differential equations into linear and nonlinear equations
3. Find solutions of separable partial differential equations
4. Solve simple eigenvalue problems of Sturm-Liouville type
5. Find the Fourier series of periodic functions
6. Find the Fourier sine and cosine series for functions
7. Identify parabolic, hyperbolic and elliptic PDEs

Gas Dynamics, AST 441

One of the main objectives of this course is to develop theoretical framework for describing compressible flows and to discuss the basic principles behind compressible flow applications. Content of the course consists of review of fluid mechanics and thermodynamics, one-dimensional gas dynamics, shock waves, steady and two-dimensional supersonic flows. H. W. Liepmann and A. Roshko, *Elements of Gas Dynamics*, Dover Publications, 2001 is the official book used in the course. Learning outcomes are

1. To understand compressible flow phenomena
2. To understand one-dimensional gas dynamics
3. To gain an understanding on two-dimensional compressible flows

Introduction to Plasma Physics and Engineering, AST 442

This course's aim is giving the general insight into the plasma physics, applications of plasma physics and different models of plasma. The course emphasizes relations between microscopic and macroscopic description of plasma. This course introduces the basic principles of plasma physics underlying a wide variety of phenomena mainly for undergraduates, with applications to energy generation by controlled thermonuclear fusion, space physics, satellite communications, aerosphere physics, and astrophysics. It covers basic plasma properties and collective behavior, motion of charged particles in magnetic fields, fluid models, wave propagation, Coulomb collisions and transport processes, simple equilibrium and stability theory. "Introduction to Plasma Physics", by R J Goldston, P H Rutherford, IoP, 1995 is the main book of the course.

Learning outcomes are:

1. Understanding and use the basic mathematical formalism needed for describing the dynamics of continuous media
2. Distinguishing the dynamics of plasmas and neutral fluid media
3. Formulating and modify the basic dynamic fluid equations to account for the dynamics of plasma media
4. Describing the propagation of waves in plasmas, and derive the dispersion relation for these waves
5. Making a simplified model for the Earth's magnetosphere, and obtain analytical expressions for some characteristic quantities

Viscous Flow, AST 443

Main objective of this course is to develop theoretical framework for describing viscous flows, in particular boundary layer theory. Content of the course consists of Navier-Stokes equations, boundary layer theory, laminar boundary layers for compressible flow and turbulent flows. F. White, *Viscous Fluid Flow*, 3rd Edition, McGraw-Hill, 2005 is the official book used in the course. Learning outcomes include

1. To understand the viscous flow phenomena.
2. To understand boundary layer concept, laminar-turbulent transition, basics of turbulence.
3. To study exact solutions for Navies-Stokes and boundary layer equations for simple flows.

Hypersonic Flow, AST 444

This course develops an understanding of inviscid hypersonic flows, viscous hypersonic flows and high temperature effects as they apply to hypersonic aerodynamics. Content of the course includes general characterization of hypersonic flows, Ideal hypersonic flow and high temperature effects. "Hypersonic Flow" by Maurice Rasmussen and M. L. Rasmussen is the official book used in the course. At the end of the semester, students are expected to develop

1. An ability to solve problems involving inviscid hypersonic flows

2. An ability to solve problems involving viscous hypersonic flows
3. An understanding of high temperature effects in hypersonic aerodynamics
4. An understanding of the design issues for hypersonic wings
5. An ability to use computational tools to evaluate hypersonic flows
6. A knowledge of recent developments in hypersonic aerodynamics with application to astronautical systems

Guided Missile Design, AST 451

Main objectives of this course include designing a tactical missile system using detection, computation, launching and damaging mechanisms together. Content of course include an introduction to tactical missile units, develop a scenario, guidance laws, radar design, warhead design and propulsion requirements. *Tactical Missile Design* of Prof.Gerald H. Lindsey, Lt. Dan. R. Redmon is the main resource of the course. Learning outcomes are

1. Learning different defense scenarios
2. Learning historical progress in guided missiles
3. Learning aerodynamic aspects
4. Learning warheads
5. Learning navigation laws
6. Learning propulsion unit

Spacecraft Thermal Control, AST 471

This course addresses how to control the operating temperature environment of spacecraft systems. Content of the course include a presentation of the basic and specific concepts of a space mission, its development phases, the environment it must withstand, the orbits and trajectories needed to accomplish the mission, and the subsystems that help to achieve this. *Spacecraft Thermal Control* of J. Meseguer, I. Pérez-Grande and A. Sanz-Andrés is the main resource of the course. Learning outcomes are

1. Understanding of conductive heat transfer fundamentals
2. Understanding of radiative heat transfer fundamentals
3. Thermal analysis of spacecraft
4. Understanding the working principles of the thermal control sub-systems
5. An ability to use computational tools to evaluate heat transfer problems
6. Design an spacecraft thermal control system

High Power Lasers, AST 472

This course gives a comprehensive details on the latest advances in high-power laser development and applications. Content of the course includes performance parameters for each major class of lasers, high-power gas, chemical, and free-electron lasers and then discusses semiconductor diode lasers, along with the associated technologies of packaging, reliability, and beam shaping and delivery. Current research and development in solid-state lasers as well as scaling approaches for high CW powers, high pulse energies, and high peak powers are also discussed. *High Power Laser Handbook* of Hagop Injeyan, Gregory D. Goodno is the official book used in the course. At the end of the course, students

1. develop an understanding the Laser physics
2. develop understanding the gain medium and cavity
3. develop understanding continuous and pulsed modes of operation
4. develop understanding propagation medium
5. learn high power laser beam focusing
6. learn Power Supplies of high power lasers

Radar Systems, AST 481

This course includes a comprehensive introduction to modern radar systems. Course covers a range of new topics in the field of radar technology. Moving Target Indicator (MTI), phased-array radar, detection in the clutter, synthetic aperture radar (SAR), HF over-the-horizon radar, height-finding radar, 3D radar, millimeter wave radars, tracking radars, and target classification are some of the subjects of the course. *Merrill I. Skolnik, Introduction to Radar Systems* is the official book used in the course. Learning outcomes are:

1. Understanding the working principles of surveillance radar
2. Understanding pulsed radar transmitter/receiver configurations
3. Understanding signal processing techniques
4. Understanding radar antenna systems.

Remote Sensing, AST 482

This course provides an introduction to remote sensing and image interpretation, and as a reference for the burgeoning number of practitioners who use geospatial information and analysis in their work. Content of the course include digital image acquisition and analysis, while retaining basic information about earlier analog sensors and methods (from which a vast amount of archival data exist, increasingly valuable as a source for studies of long-term change). Expanded coverage of radar systems and of 3D remote sensing more generally, including digital photogrammetric methods such as structure-from-motion (SFM). "*Remote Sensing and Image Interpretation*" of Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman is the main resource of the course. At the end of the course, students

1. develop an understanding of the Energy Sources and Radiation Principles
2. develop an understanding of Energy Interactions in the Atmosphere
3. develop an understanding of Energy Interactions with Earth Surface
4. develop an understanding of Data Acquisition and Digital Image Concepts
5. learn Characteristics of Remote Sensing Systems
6. learn Successful Application of Remote Sensing

Aerospace Control Systems, AST 483

The main objective of this course is to present a unified approach for automatic control of atmospheric and space flight vehicles. Content of the course includes Plant Model, Properties of a System, Automatic Controllers, Linear Systems, Aerospace Vehicle Guidance and Control, Flight Dynamic Models, Control Design Techniques, Automatic Control of Spacecraft and Rockets. *Automatic Control of Atmospheric and Space Flight Vehicles Design and Analysis with MATLAB and Simulink* of Ashish Tewari is the official book used in the course. At the end of the course, students

1. Predict the response of a linear system to an arbitrary input
2. Understand the concept and significance of the modes of a system and their relation to the nature and duration of the transient response
3. Determine the shape of the Bode diagrams of a system from its transfer function, and conversely, be able to determine the transfer function from the Bode diagrams
4. Determine the stability and performance characteristics of a feedback system, and how these properties change as a function of the loop gain
5. Design a feedback control loop and compensator for a given dynamic system, so that the overall system meets specified transient and steady-state performance targets, as well as robust stability requirements
6. Confidently use MATLAB to carry out the calculations