ERCIYES UNIVERSITY

FACULTY OF AERONAUTICS AND ATRONAUTICS

ASTRONAUTICAL ENGINEERING

Course Contents (English)

Semester 1 (Fall)

UZM101 Introduction to Astronautical Engineering

Introduction to Rocket and Satellite Technologies, Communication, Materials, Spacecraft Design and Robotics. The development of our country in space technologies and the issues of science and engineering ethics.

UZM103 Calculus I

Single Variable Functions. Limit and Continuity. Derivative. Applications of derivative. Uncertainty Situations (L'Hopital Rule). Asymptotes, Curve Drawing. Integral (Indefinite Integral), Fundamental Theory of Integral Account. Integral Techniques (indefinite integral). Applications of Integral (Definite integral). Polar Coordinates, Transient Functions.

UZM 105 Physics I

Units and Physical Quantities; Vectors; Motion Along a Straight Line; Motion in Two or Three Dimensions; Newton's Laws of Motion; Application of Newtons Laws; Work and Kinetic Energy; Potential Energy and Energy Conservation; Momentum, Impulse, and Collisions; Rotation of Rigid Bodies; Dynamics of Rotational Motion; Equilibrium and Elasticity; Periodic Motion

UZM 107 Chemistry

Matter: properties and measurement atoms and the atomic theory, electron structure, periodic table and atomic properties, chemical bonding, chemical reactions, reactions in aqueous solutions, Gases, thermochemistry, chemical bonding (bonding basic concepts and theories), intermolecular forces: liquids and solids, solutions and their physical properties, chemical equilibrium, and principles, acids and bases, spontaneous change: entropy and Gibbs energy.

UZM 109 Introduction to Computer and Information Systems

Basic computer structure: Terminology in computer science; Processing of fundamental computer elements and their interactions with each other; Information in single and multi-command words; Basic terms related to memory; Processes in basic memory elements;

Advantages and disadvantages of variable memory elements; Controlling of coding system; Topics in importance of coding in flight instruments;

UZM 111 Turkish Language I

What's a language? Turkish language and culture. What is Culture? What is communication? Language and Communication: understanding, explaining, reading, writing, speaking (language skills); Language-brain, language-thought connection, language-culture connection, language-community connection, Language and Communication: Thinking, expression, listening, identifying career, to belong to a culture; language in terms of depth (historical, contemporary ...), use language in terms of size (personal, social ...); World languages and Turkish, Earth languages, The Language of Turkish place among the world's languages and spreading area; Grammar: The sections of Grammar Historical Development of Turkey; Turkish syllables, Phonetics Turkish sound structure, Turkish syllables, vowel harmony, accent, intersection, tone, melody sound events.

UZM 113 Ataturk's Principles And The History Of The Turkısh Renovation-I

Introduction to concepts relating to the course. A General view on Reasons of the decline of the Ottoman Empire and Preparation of the Turkish Revolutions. Movements for modernisation of the Ottoman State. Ideological movements -War of Tarabulus - First and Second Balkan Wars. Entering of Ottoman Empire into of The First World War. Effects of the First World War. Armenian Question. Approving of Mondros Agreement- Political plans and Starting of Occupies-Actions of the minorities in the Ottoman State-National Societies-Societies related to foreigners. Mustafa Kemal; Leader of the National Combat- His going to Samsun. Congresses-Declaration of Amasya-Congresses of Balikesir and Alaşehir-Congress of Erzurum-Congress of Sivas-Congress of Amasya. Inauguration of Turkish National Grand Assembly- Agreement of Sevr. Military Combats and Fronts- Eastern Front- Fronts of South Anatolia and South-Eastern Anatolia-Front of Thrace-Western Front- 1th and 2nd İnönü Battles. Battles of Eskişehir and Kütahya- Pitched Battle of Sakarya-Pitched Battle of Commandeering in Chief-Cease-fire Agreement of Mudanya.

UZM 115 Foreign Language I

Tenses (present, present continuous); Tenses (past, past continuous); Tenses (present perfect, present perfect continuous); Present tenses for the future; going to, will/shall; Modal verbs (can, could, must may); Modal verbs (have to, must, should, would); if and wish; Passive voice; Reported speech; Questions and auxiliary verbs; -ing and to; Articles and nouns; Reading and speaking; Reading and speaking (continued)

Semester 2 (Spring)

UZM 102 Computer Aided Drafting

Teaching the basic commands of AutoCAD-2D; AutoCAD application examples with geometric drawings; Teaching the basic concepts of engineering drawing such as the scale and dimensioning; Teaching drawing of standard views and doing application examples; Doing application examples with standard views;Teaching drawing of isometric views, teaching drawing a isometric view from standard views and doing application examples; Doing application examples with standard views and isometric views; Teaching drawing of special views and doing application examples relevant to the theme; Teaching drawing of section views and teaching the section types and doing application examples

UZM 104 Mathematics II

Infinite sequences and Series, Polar Coordinates, Vectors in Space, Vector-valued Functions, Multivariate Functions and Partial Derivatives, Multiplicative Integrals.

UZM 106 Physics II

Point electric charges, features and Coulomb force; Point charge electric field of the electric field and the motion of charged particles; Continuous load of the electric field, electric field lines; Electric flux and Gauss's law, Gauss's law applications in dielectrics and conductors; Faraday's Law; Dielectric capacitors and the stored energy , problem solving. Current and resistance, Ohm's law and its applications, resistance and temperature problems; Direct current circuits , electromotive force , mixed circuit analysis; RC circuits , filling and discharging of capacitors , electrical measuring devices; Magnetic field, magnetic field sources . Ampere's law; Maxwell's Equations.

UZM 108 Statics

Static principles, the vector of the particle force balance, a couple of momentum, equilibrium of rigid bodies, planar forces, center of gravity, Pappus-Guldinus Theorem, distributed loads, and hydrostatic forces, support reactions and support, Gerber beam frames, simple machines, scissors, cables, friction, virtual work.

UZM 110 Introduction to Computer Programming

Flow diagrams; Computer programming; the general structure of the Python programming language and concepts; fundamentals of software development in the Python programming language; operators and expressions in python; problem solving, assignment and input/output commands; Electoral structures and loops, functions, and algorithms

UZM 112 Turkish Language II

The sentence elements, sentence analysis and application, literature and the world of thought-reading and analysis of related works and rhetorical practices, written composition types and application, operating system and their correction, the rules of preparation of scientific manuscripts (reports, articles, papers, etc.), the selected texts in the history of Turkish and world literature and thought on the basis of the student's rhetorical development of correct and good speaking and writing skills and related practices.

UZM 114 Ataturk’s Principles And The History Of The Turkısh Renovation-II

The Lausanne Peace Conference. Proclamation of the Republic and Reactions; Abolition of the Caliphate. The Progressive Republican Party and the Sheikh Sait Rebellion. The Free Republican Party and the Menemen Incident; The Separation of Atatürk Inönü. An Overview of the Revolutions and Their Objectives; Innovations in the Field of Law; The Organization-i Esasiye Law of 1924; The Adoption of the Turkish Civil Code; The Adoption of Other Basic Laws; Women's Rights.

Revolutions in Social Life. Revolutions in Education and Culture; A Look at the Pre-Republican Education System; Radical Change in the Education and Training System: The Law on Monotheism Education; The Adoption of the New Turkish Alphabet; New Understanding of History and Language; Darulfunun to Istanbul University; Fine Arts. Developments in the Economic Field; The Recent Ottoman Economy; The Turkish Economic Congress and Its Results; Economic Activities in the Early Years of the Republic; Transition to the Practice of Statism. Atatürk's Principles and integrative principles. Turkish Foreign Policy during the Period of National Struggle (1919-1923). Turkish Foreign Policy in the era of Mustafa Kemal Ataturk (1923-1938). Ismet INÖNÜ Period (1938-1950). The Period of Adnan Menderes (1950-1960). The 1960 Coup and its aftermath (1960-1971). March September 12, 1971 Memorandum, September 12, 1980 Coup and its aftermath (1971-1990)

UZM 116 Foreign Language II

General Review: verbs, get, +adverb/preposition, rollover clauses, formal and informal use of language; types of conditional sentences: If Clause type I, If Clause Type II; time stating sentences; punctuation; adjective clauses: defining and non - defining; the use of participles; tenses of the participle in the sentence the use of the particular use of the verb participle; possessive structures: genitive "s", "of the' structure; use of language; highlighting; language levels; expressing assumptions: hypothetical sentences; the present subjunctive: Present Simple, Past Simple; advanced listening and note taking skills.

UZM 118 Career Planning

Your Career Journey Has Started First Stop: Career Center, Intelligence and Personality, Personal Characteristics, The Key to Making a Difference in Your Career Path: Skills, What is a Career? How Do I Prepare for My Career? Sector Days- Non-Governmental Organizations, National Sector Days- Non-Governmental Organizations International, Sector

Days Public Sector, Sector Days- Private Sector, Sector Days-Academy, Sector Days-Entrepreneurship, Talent Gate I am Writing My First Resume, Course Evaluation.

Semester 3

UZM 201 Dynamics

Kinematics of particles, linear motion, Plane curvilinear motion, Rectangular coordinates, normal and tangential coordinates, polar coordinates; relative motion; plane kinematics of rigid bodies, rotation, absolute motion, relative velocity, instantaneous center of zero velocity, Relative acceleration; motion relative to the rotating axis; the three-dimensional dynamics of rigid bodies; fixed axis rotation.

UZM 203 Fundamentals of Electricity and Electronics

Electric terminology, charge, current, voltage, power, energy. DC Circuits. Basic laws, resistances, Ohm’s law, Kirchhoff’s laws, elements in serial and parallel, Wye-Delta conversions. Methods of Analysis, node and mesh/loop analysis, Resistive Network Analysis, Thevenin’s Theorem, Norton’s Theorem, Capacitors and Inductors. AC Circuits. AC Network Analysis, Operational Amplifiers. Electronics, Analog Electronics. Semiconductors and Diodes. Transistor Fundamentals. Digital Electronics, Logic Circuits.

UZM 205 Aerospace Materials

Introduction to aerospace materials; metallic alloys for aerospace applications; metal forming, composite materials for aerospace applications, composite production methods; Smart materials; nano-materials; high-temperature materials for aerospace applications; Corrosion, wear and erosion; fracture mechanics and Fatigue failure mechanisms; non-destructive evaluation methods.

UZM 207 Strength of Materials

Deformable bodies stability, internal forces in structural members; shear force and bending moment diagrams of structural elements; stress, normal stress, shear stress; stresses in oblique plane, allowable stress, factor of safety, shape-shifting Concept: strain rate (strain), Angle of change; mechanical properties of materials, stress-strain diagrams, hooks Law; general installation Form: the generalized hook's law: axial loading, Saint Venant's principle, and specific statically indeterminate Problems; Thermal Stress, Stress Stacking; Plane shape change condition, Properties of plane shape change; Fracture criteria, Comparison of fracture criteria.

UZM 209 Advanced Engineering Mathematics

Linear equation systems and solution methods. Vector spaces, matrices, systems of linear equations, linear transformations, change of basis, eigenvalue problems, quadratic forms and diagonalization. Vector calculus, line, surface and volume integrals. Gradient, divergence, curl. Green, Gauss and Stoke's theorems.

UZM 211 Thermodynamics

Energy transformations and general energy Analysis; properties of pure substances; energy analysis of closed systems; control volume mass and energy analysis of closed systems energy analysis; Control-Volume Analysis of mass and energy; Second Law of thermodynamics; Entropy; Exergy; gas power cycles; gas power cycles

UZM 213 Engineering English

Word order in Sentences; Location; Verb tenses – Simple, Past, Perfect Tenses; Instructions at an Airport, Basic Sentence Structure; Basic Aviation Terminology; Basic Air Communication; Purpose Conjunctions; Possibility, Probability, Necessity, Conditions; Comparisons; Movement; Active and passive; Explaining Problems.

Semester 4

UZM 202 Fluid Mechanics

Basic Concepts; Fluid dynamics; Bernoulli's Theorem, venturi; Fluids and physical properties; Fluid statics; Kinematics of fluids; Potential flows; Fluid kinetics (Equations of Motion); Lubrication problems, the current flow between rotating coaxial cylindrical tubes); The impulse-momentum equation and applications; Free and Forced Vortex movements; Dimensional analysis and its applications. Specific gravity and density; Viscosity, fluid resistance of the flow effects.

UZM 204 Differential Equations

Introduction to differential equations. Solutions and initial value problems. Direction field; First-order Differential Equations: Equations that can be divided into their variables. Linear differential equations; Variable substitution and transformations. Mathematical models containing first-order equations; Second-Order Differential Equations: Linear homogeneous equations. Characteristic equations with complex roots; Inhomogeneous differential equations: The method of indefinite coefficients; The method of variation of parameters. Equations with variable coefficients; Applications of second-order differential equations; Theory of Linear Differential Equations of higher order; Series Solutions of Differential Equations: Power series and analytical functions. Serial Solutions of Differential Equations: Frobenius method; Laplace Transforms: Introduction and definition. Laplace transform properties; Laplace Transforms: Inverse Laplace transform. Solution of the initial value problem by Laplace method; Transformations of discontinuous and periodic functions.

UZM 206 Signals and System Modeling

Basic concepts for continuous-time / discrete-time signals and systems. Representation of linear time-invariant continuous and discrete systems (singularity functions, complex exponentials, differential and difference equations, Fourier representations, Laplace and z-transforms, convolution theorem, Parseval's relation, uncertainty principle and eigenfunctions of the Fourier operator, sampling theory and time scaling-shifting). Characterization and analysis of linear time-invariant continuous and discrete systems in the time-domain and frequency-domain (poles and zeros, impulse and step responses, frequency responses). Applications for signal processing, filtering, feedback and automatic control.

UZM 208 Probability and Statistics

Basis concepts of probability, descriptions of events space, descriptions of relative frequency of probability; Probability theorems, Joint and conditional probability; Independent events, Bayes theorem; Random variable, Probability density and distribution functions; Expected value and variance; Multidimensional random variables, Correlation, regression analysis; Discrete distributions; Chebyshev inequation; Continuous random variables; Gaussian distribution and properties; Two dimensional random variables; Function that produces moment , z transform; Collection and arrangement of data; Means and scales of distribution; Indexes, statistical inference; Hypothesis tests.

UZM 210 Numerical Methods

Definition and Importance of Numerical Analysis, Mathematical Model Concept, Error Analysis; Taylor Series Numerical Error; In practice, MATLAB numerical definition; Finding the root equation, Indoor Methods; Finding the root equation, Open Methods; Muller Methods; Solution of Linear Equations, Gauss Elimination Method, Graphical Method, Cramel Rule, Gauss Jordan Method; Solution of Linear Equations, Gauss Seidel Method, Curve Fitting, fitting of the polynoms, Exponasiyel, Power and the saturation rate equation curve fitting; Interpolation, Linear, quadratic, Newton and Langrange interpolation; Numerical interpolation, Newton-Cotes integration formulas (trapezoidal, Simpson's rules (1/3 and 3/8)); Solution of Ordinary Differential Equations, Euler's equation, Heun's method, Runge Kunta Midpoint Equations, Equations 4. Point-to-Order Runge Kunta; Solution of Multiple Ordinary Differential Equations, Runge-Kutta Methods.

UZM 212 Mechanical Vibrations

Basic Concepts; Single degree of freedom vibration; Single degree of freedom vibration; Damped- undamped linear system, free-forced vibrations; Vibration isolation theory; Coulomb damping; Effective mass; Structural damping; Critical speeds of shafts, shaft lateral oscillations of the system; Two-Degree of Freedom Systems, Motion, damped-undamped free-forced vibrations; Two-Degree of Freedom Systems, Motion, damped-undamped free-forced vibrations; Two-Degree of Freedom Systems, Motion, damped-undamped free-forced

vibrations; Natural Modes, Coordinate Transformation, Natural Coordinates, modal analysis; Natural Modes, Coordinate Transformation, Natural Coordinates, modal analysis.

UZM 214 Academic Writing in English

What is scientific writing; Origins of scientific writing; what a scientific paper is; types of scientific papers; manuscripts and thesis?; How to prepare the title; how to list the authors and addresses; how to prepare the abstract; how to prepare the long abstract; How to write the instruction; How to write the materials and methods section; How to write the results; how to present the results effectively; samples of tables and graphics; How to write the discussion section; How to write the conclusion section; How to state the acknowledgments; how the references are shown; how attribution is made to the references; Ethics, rights and permissions, How and when to use abbreviation; Samples of academic paper writing

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Semester 5

UZM 301 Aerodynamics

Fundamental principles and basic definitions; Fundamental equations; Potential flow; Aerodynamic forces; Factors affecting aerodynamic forces; Boundary layer theory; Analysis of airfoil and airfoil characteristics; Classical thin airfoil theory; Vortex panel method; Airfoil basics for incompressible flow; Airfoil basics for compressible flow; Compressibility and speed ranges, Mach number.

UZM 303 Space Structures

Aerospace materials, airworthiness, air vehicle structural loads, thin-walled stiffened open section and closed section beams bending, torsion and shear analyses; structural idealization; stress analyses for airplane structures; experimental stress analysis.

UZM 305 Automatic Control

Introduction to Automatic Control and basic definitions; mathematical modeling of physical systems; mathematical modeling of physical systems; transfer functions, block diagrams, signal flow Graphs; analysis with state variables, state variables in the analysis, the closed-loop System Characteristics; Performance of control systems; control systems Performance; stability of linear control systems; root locus method; the root-locus Method; frequency domain analysis of control systems; frequency domain analysis of control systems.

UZM 307 Measuring Techniques

Metrology in General Concepts; Static And Dynamic Structure of Sensors; Dimensional Measurement Devices and Applications; Current, Voltage, Resistance Wheatstone Bridge Measurement; Pressure Measuring Devices and Applications; Applications Of Pressure Measurement Devices, Temperature, Torque, Acceleration, Pressure, Optical, And Ultrasonic Measurement Devices and Applications; Applications For Flow Measurement, Flow, Speed, Displacement, Speed, Electrical Measuring İnstruments and Their Applications; The Noise of Extracting From the Measured Quantities; The Error / Uncertainty Analysis.

UZM 309 Space Environment

Introduction to the space environment. Basic concepts of space. The location of our Earth in space and the characteristics of the space environment around us; The Neutral and Plasma Environment; The Earth's atmospheric layers; The Magnetosphere; Cosmic rays; The Sun, Solar Activities, Solar wind, Solar radiation, Cosmic rays, SEP events; The magnetic environment. Interaction of the Solar-Earth space environment, Magnetosphere, Magnetospheric variability, Radiation belts; Ionosphere. Ionospheric variability. Radio wave propagation and communication systems; Effects of the sun and magnetosphere on the neutral and plasma environment. Heat, friction, geomagnetic and magnetospheric storms; Satellite orbits, Low orbit satellites, Polar orbit satellites, Geosynchronous satellites; The concept of Space Weather, observation methods in space; Neutral gas flow around the satellite. The effect of the neutral environment on the satellite.

UZM 311 Orbital Mechanics

Dynamics of Point Masses: Kinematics. Mass, Force and Newton’s Law of Gravitation. Newton’s Law of Motion. Time Derivatives of Moving Vectors. Relative Motion; Two-Body Problem: Equations of Motion in an Inertial Frame. Equations of Relative Motion. Angular Momentum and the Orbit Formulas. The Energy Law. Circular Orbits; Two-Body Problem: Elliptic Orbits. Parabolic Trajectories; Two-Body Problem: Hyperbolic Trajectories. Perifocal Frame. Lagrange Coefficients; Two-Body Problem: Restricted Three-Body Problem (Lagrange Points, Jacobi Constant); Orbital Positions as a Function of Time: Time since Periapsis. Circular Orbits. Elliptic Orbits; Orbital Positions as a Function of Time: Parabolic Trajectories. Hyperbolic Trajectories. Universal Variables; Orbits in Three Dimensions. Ground Tracks; Preliminary Orbit Determination: Gibbs’ Method of Orbit Determination from Three Position Vectors. Lambert’s Problem; Preliminary Orbit Determination: Sidereal Time. Orbit Determination from Angle and Range Measurements; Orbit Maneuvers: Impulsive Maneuvers. Hohmann Transfer. Bi-Elliptic Hohmann Transfer. Other Maneuvers; Interplanetary Trajectories

UZM T01 Technical Elective I

Semester 6

UZM 302 Experimental Engineering

Presentation of laboratory experiments; Standard experiments: boundary layer flows; Standard experiments: determination of drag coefficient of a cylinder; Preparation for Structural and Control Experiments; Standard experiments: structural mechanics tests (impact test and static strain measurements); Standard experiments: Control and electrical

measurements (RC circuit, RLC circuit, Op-Amp circuit measurements); Reporting and discussion of results

UZM 304 Heat Transfer

Introduction to heat transfer, general heat conduction equation. Heat conduction in one-dimensional continuous regime, heat conduction in cylindrical and spherical elements. Continuous heat conduction, thermal resistances, critical insulation radius, heat transfer on the wings. Fundamentals of convection, convection boundary layers, laminar and turbulent flow, external flow, parallel flow on a flat plate, transport calculation methodology, flow on pipe bundles. Internal flow, hydrodynamic review. Natural convection, flow on a vertical surface, empirical correlations: external natural convection external flows, basic principles of radiation, black body radiation, shape factor, heat transfer by radiation.

UZM 306 Compressible Aerodynamics

Compressible Flow: Some Preliminary Definitions; Thermodynamic Repetition; Compressibility. Conservation Equations For Inviscid Compressible Flow; Total Definition Of Terms; Shock Waves; Normal Shock Waves; Basic Normal Shock Equations; Normal Shock Waves; Speed Of Sound; Special Forms Of The Energy Equation; Normal Shock Waves: When The Stream Is Compressed?; Calculation of Properties of Normal Shock Wave; Measurement of Velocity in Compressible Flow; Oblique Shocks and Expansion Waves: Oblique Shock Equations; Oblique Shocks and Expansion Waves; The sound the higher the current and the wedge around the cone, Shock Interactions and reflections; Oblique Shocks and expansion waves; blunt-nosed body in front of the shock wave Discrete; Prandtl-Meyer expansion waves; Oblique Shocks and expansion waves; Shock-expansion theory of waves: ultrasonic applications for wing profiles; Lule, emitter and compressible flow in a wind tunnel; conservation equations for one dimensional flow Like; Lule, emitter and in the wind tunnel compressible flow; compressible isentropic flow in ringlets; Spreaders; supersonic wind tunnels

UZM 308 Attitude Determination And Control

Objective and types of the attitude determination and control systems, Coordinate systems, Attitude parameters: Euler angles, quaternions, Gibbs vector, The external forces and moments affecting the space vehicle, Attitude kinematics and dynamics, Euler’s equations, Reference directions in attitude determination, Attitude determination methods, Error analysis of attitude determination, Attitude sensors, Attitude control methods, Attitude control actuators, Momentum exchange techniques, Attitude stabilization methods, Attitude maneuver control.

UZM 310 Spacecraft Telecommunications

Fourier analysis of signals, generation and propagation of electromagnetic waves, amplitude

and angle modulation, analog/digital communication, antenna, ground stations, orbits used for communication, error correction coding, link budget

UZM T02 Technical Elective II

UZM S02 Non-Technical Elective I

Semester 7

UZM 401 Rocket Propulsion Systems

Classification, Definition and Fundamentals of Rocket Propulsion; Nozzle Theory and Thermodynamic Relations, Flight Performance, Chemical Rocket Propellant Performance Analysis, Liquid Propellant Rocket Engine Fundamentals, Solid Propellant Rocket Fundamentals, Electric Propulsion.

UZM 403 Occupational Health And Safety I

Introduction Occupational Health and safety culture; National Occupational Health and safety management system approach to occupational Health and Safety; Occupational Health and safety legislation; occupational health and safety services to be executed by the employer; the concept of occupational accident and disease and its attendant costs.

UZM 405 Astronautical Engineering Design I

Satellite tasks and design process; Model Satellite Mass and power analysis; Subsystem and system development; Use and development of a model satellite; Software required to manage the satellite; Satellite communication and ground operations.

UZM 407 Spacecraft Systems Design I

A system view of spacecraft. Payloads and Missions. Mission analysis. The space environment. Dynamics of spacecraft. Orbital mechanics. Propulsion systems. Launch vehicles. Atmospheric re-entry. Spacecraft structures. Attitude control. Electrical power systems. Thermal control of spacecraft. Telecommunications. Telemetry and command. Ground control.

UZM T02 Technical Elective III

Non-Technical Elective II

Semester 8

UZM Occupational Health And Safety II

Notification and the legal consequences of occupational accidents and diseases; Occupational Health and safety risk factors; individual and organizational factors in occupational health and Safety; Occupational Health and safety records to be kept.

UZM 402 Astronautical Engineering Design II

Satellite tasks and design process; Model Satellite Mass and power analysis; Subsystem and system development; Use and development of a model satellite; Software required to manage the satellite; Satellite communication and ground operations.

UZM 404 Spacecraft Systems Design II

Tasks of spacecraft, systems engineering, project definition; Spacecraft subsystems, mass and power budgets margin, other margins, trade study; task and trajectory reviews; space environment; propulsion systems; the determination of spacecraft orientation and control; Electrical power systems; thermal control; Command and data management; Communication; structure and mechanisms; Launch systems and operations; to operate the spacecraft and ground station operations; project reporting, presentation and evaluation.

UZM T04 Technical Elective IV

UZM 410 Summer Practice