Course Descriptions

❐ Undergraduate Program

AE100 Sky and Space
This coursework deals with the basics of flying in the air and through the space with the coverage of the history of flight, flight principles, materials and structures for flight vehicles, propulsion systems, space environment, satellites and their orbits, deep space exploration, and human beings in space. Students will join field tours to Korea Aerospace Research Institute twice and need to make group presentations.

AE200 Introductory Space Projects
This course introduces the fundamental operational principles for the space systems. Lectures and labs on fundamentals of space systems engineering and various issues on design and operation of launch vehicles / spacecraft and related disciplines (fluid, structure, propulsion, dynamics / control and communication) will be provided.

AE208 Aerospace Engineering Laboratory Ⅰ
This course serves as an introduction to the fundamental principles of instrumentation and measurements. Basic statistics, error analysis, digital data acquisition, or signal processing methods are discussed in detail. These fundamental principles are then applied to specific experiments related to thermodynamics.

AE210 Aerospace Thermodynamics
This lecture covers definition and concepts related to thermodynamic laws. 1st and 2nd laws of thermodynamics are explained. Properties of pure substances including ideal gases and real gases are covered in processes of energy conversion systems such as heat engines and heat pumps. Chemical equilibrium condition is derived from the fundamental law of the nature.

AE220 Aerodynamics Ⅰ
The course covers fundamental principles of aerodynamics. When a body is in motion through air, the body experiences forces and moments. In this course, various fundamental concepts and mechanisms regarding fluid statics, integral/differential forms of basic equations, dimensional analysis and similitude, incompressible inviscid flow, and internal incompressible viscous flow will be studied.

AE230 Mechanics of Aerospace Materials
This course introduces the mechanics for the elementary structural members such as bars, torsion bars, and beams. The concepts for stress and strain, stress-strain relationship, deformation, statically determinate and indeterminate structures are covered.

AE250 Aerospace Dynamics
Basic principles of dynamics are introduced in this course. Rotating and inertial coordinate frames are used to describe dynamic motion of a number of example problems. Absolute and relative motion descriptions are introduced depending upon the types of problems. Principles of work-energy and conservation of angular and linear momentum are presented with example systems. Systems of particles are also discussed with definition of the center of mass. Both particle dynamics and rigid body dynamics including rotational degree-of-freedom are covered extensively. We also cover definition of angular momentum with respect to different base points. Various aerospace vehicle examples are used to help understanding basic concepts.

AE280 Software Application in Aerospace Engineering
This course deals with basic scientific programming in Aerospace Engineering applications, utilizing widely-used programming languages such as MATLAB. The class consists of introductory lectures about the technical contents/theory and lab practice sessions for

hands-on problem solving. This course emphasizes on problem solving & analysis rather than specific details of programming skills. Based on the basic concepts, advanced topics such as data structure, Graphic User Interface, algorithm analysis are also covered.

AE300 Flight Mechanics Project

This course addresses basic concepts of aircraft performance and stability based on the force and moment balance of an aircraft in flight; theoretical analysis is accompanied with hands-on exercises/experiments. Characteristics of the forces (lift, drag, gravity, thrust) acting on the aircraft and their relationship to flight conditions are discussed, leadnig to aircraft performance notions such as range, endurance, rate of climb, and flight envelope. Also, by analyzing the moment balance of an aircraft in flight, the concepts of static and dynamic stability in the longitudinal and lateral directions are introduced & discussed.

AE307 Aerospace Engineering Laboratory II

This course is the second course of a two-semester laboratory course sequence dealing with experiments in aerodynamics and structure. The topics include wind tunnel testing (low-speed and high-speed), flow visualization, strain/stress, buckling, and photoelasticity.

AE310 Propulsion System

A propulsion system refers to a device that transforms energy stored in a chemical compound into propulsive power in a flight vehicle. The majority of propulsion systems are built upon heat engines in order to release the chemical energy into heat that is eventually converted to mechanical power. In this course, students learn how basic knowledge of thermodynamics, fluid mechanics, and gas dynamics is applied to the design and performance evaluation of aerospace propulsion systems.

AE311 Aerospace Heat Transfer

Fundamental concepts of basic heat transfer modes in various type of coordinates are introduced. Conduction, convection and radiation heat transfers in diverse configuration and flow conditions are covered. Also see course description of the same course in Department of Mechanical Engineering.

AE320 Aerodynamics II

Study on forces and moments of solid bodies due the interaction with air flow. Assuming that fluids are inviscid and incompressible, mathematical description and derivation of the governing equations are covered in accordance with the conservation mass, momentum, and energy principles. Derivation of the Bernoulli's equation, the concept of circulation, the Kutta-Joukowsky theorem, and the mechanism of the generation of lift and moment are included followed by the two-dimensional thin airfoil theory and the three-dimensional lifting-line theory.

AE321 Compressible Aerodynamics

Flow characteristics of gases having density variation throughout the flow domain show a significant difference when compared with those of incompressible flows. An understanding and knowledge of compressible flows are one of the essential elements in aerospace engineering. In this course, the theory and application of compressible gases are studied.

AE330 Aerospace Structures I

Basic structural elements including wing and fuselage, aerospace materials, basic elasticity, torsional problems for closed single-cell and multi thin-walled sections, bending and flexural shear, flexural shear flow in thin-walled sections, failure criteria for isotropic materials, and elastic buckling will be discussed in this subject.

AE331 Aerospace Structures II

This coursework deals with the deflection and buckling analyses of plates and stiffeners in a typical semi-monocoque structure for flight vehicles. Composite structures are to be introduced with the consideration of constituent elements, processing methods, and design point of view.

AE350 Aerospace Control Engineering

Knowledges on system modeling and classical control are very important for understanding flight mechanics and aircraft control. The class will be presented with systematic modeling techniques and various analysis methods such as transfer function, Nyquist plot, Bode plot, and root locus. We also learn the basic control system design using PID and other approaches. The basic concepts on modern control in state-space are also introduced.

AE370 Numerical Methods
This course covers numerical modeling, computers and error analysis, roots of equations, linear algebraic equations, curve fitting, numerical differentiation and integration, ordinary differential equations, and partial differential equations.

AE400 Aerospace System Design I
A standardized aircraft design procedure is described including aspects of aircraft aerodynamics, performance, stability and control, structures, and propulsion in a single-system approach to create configuration of an aircraft to perform a specific mission. Determination of take-off weight, choice of aerodynamic configuration, selection of powerplant and their integration are covered. Students practice performing conceptual design using the design principles learned in this class.

AE401 Aerospace System Design II
This course provides an opportunity to apply the design method covered by Aerospace System Design I as well as engineering principles taught in other lower level undergraduate courses in the process of design of an aerospace system or subsystems, procurement of parts, fabrication, system integration, and performance evaluation, including final report with recommendations for improved design. Students experience entire stages of engineering activities from scratch to functioning engineering artifacts.

AE405 Satellite Systems
The primary objective of this course is to introduce fundamentals of spacecraft systems. With this goal in mind, topics such as basics of orbital mechanics, orbit transfer, rendezvous, station keeping and geostationary spacecraft mission are covered. In addition, attitude dynamics of rigid spacecraft are introduced in conjunction with basic principles of spacecraft attitude control. An introduction to spacecraft sub-systems for small-scale satellites is provided on a frequent basis.

AE410 Combustion Engineering
Combustion is an essential phenomenon to extract heat from various type of fuels. An understanding of combustion is necessary for design of efficient power and propulsion systems. This lecture covers thermodynamics and fluid mechanics of multi-species gas system. Thermodynamic principles that governs chemical equilibrium are reviewed and evaluation of adiabatic flame temperature is deduced. Issues of laminar and turbulent flames, diffusion and premixed flames are discussed.

AE420 Viscous Aerodynamics
This is an introductory course to viscous flows. Flow physics of compressible boundary layer, skin friction, convective heat transfer, transition, turbulence, and turbulent boundary layer are studied along with mathematical derivation and description from the Navier-Stokes equations.

AE435 Vibration & Basic Aeroelasticity
This course deals with basic vibratory behaviors of flight vehicles. The governing equations for the vibration of mechanical systems are derived. The analysis methods for the free and forced vibrations of the linearized 1-DoF, 2-DoF and M-DoF systems are studied. Introduction to aeroelasticity, which is the study concerned with the interaction among inertia, elastic, and aerodynamic forces, is provided.

AE450 Flight Dynamics and Control
In the beginning, students are introduced to equations of motion of aircraft, and to the linearized and decoupled equations. Various stability/control augmentation systems such as pitch attitude control, normal acceleration control, turn coordination, yaw damper are then treated. Guidance problems such as instrument landing and path tracking are also discussed with longitudinal and lateral autopilot.

AE455 Global Positioning System

This course will provide an in-depth understanding of GPS architecture, signals, measurements and performance. It is by nature an interdisplinary course, covering subject material in orbit prediction, satellite systems, signal processing, error modeling, and computer programming. It will include detailed consideration of differential GPS since this innovation greatly increases the power and utility of the system.

AE480 Aerospace Applied Electronics

This course covers the fundamental principles of the electrical engineering and electronics, and provides design and experimental experience for the students to develop the capability to apply the principles to engineering practices. The course includes passive and active circuit elements, analog and digital systems, and electronic instrumentation. Embedded CPU are also introduced for understanding the basic structure, programming, and applications.

AE490 Thesis Study

A student registers for this course during the preparation of his thesis based on his analytical and experimental studies.

AE492 Special Lectures in Aerospace Engineering

This course is designed to extend the student's understanding of current topics and issues in aerospace engineering. The specific topics will be announced before the semester begins.

AE493 Special Lectures in Aerospace Engineering II

This course introduces domestic/abroad leading edge technologies in Aerospace annually, so that higher grade undergraduate and graduate students can understand advance technology trends for research direction selection, and acquire information for job finding. Many active researchers in government-funded research institutes and industry will be invited for each specific subjects.

AE495 Individual Study

This course is directed individual research for undergraduate students dealing with a specific area of interest.

AE496 Seminar

Recent advances and related topics in mechanical engineering are presented by invited lecturers.

❐ Graduate Program

AE500 Synthetic Design of Aerospace Systems
In this course, we discuss system design and engineering process for large, complex system design and development Specifically, procedures and techniques form the "V" model in traditional systems engineering will be presented to enhance the students' capability as a system designer/engineer. This course is offered in collaboration with the department of Industrial and Systems Engineering, and cases in various fields will be discussed.

AE501 Multidisciplinary Design Optimization for Aerospace Systems
This course presents the tools and methodologies for design optimization of complex systems. Topics such as system modeling, gradient-based optimization, heuristic methods, multi-objective optimization, techniques for decomposition of the multidisciplinary design, post-optimality analysis will be covered during in-class lectures with design case study for aerospace vehicle design and practiced through assignments and the course project. Special focus on the multi-disciplinary nature of complex engineering systems and its implication to system design will be maintained throughout the course.

AE505 Appraisal of Engineering Projects under Uncertainty
This course aims at providing a systematic framework to assess the value of a complex engineering project such as aerospace systems development under uncertainty. Risk analysis, decision theory, cost-benetif analysis, and project appraisal framework using these concepts will be introduced/discussed by lectures and case studies

AE510 Aerothermochemistry and Combustion
This course covers the following topics: Thermodynamics of gas mixture; conservation equations for multicomponent reacting gas mixtures; diffusion controlled flames; premixed flames; droplet and spray combustion; flame propagation; ignition; deflagration and detonation; reactive boundary layers; turbulent reacting flows

AE511 Radiation and Combustion Phenomena
This course covers the following topics: Effects of radiative heat transfer on combustion phenomena; surface radiation; radiation in absorbing and non-absorbing media; radiation properties; solution methods for radiation; solution methods for reacting flows with radiation.

AE515 Advanced Space Propulsion Systems
This course gives a good overview of space propulsion systems and how they are selected depending on mission requirements. The lecture targets all improvement areas of current propulsion systems as well as advanced concepts such as launch assist technologies, nuclear or propellant-less propulsion. A special focus is on electric propulsion systems such as Field-Emission thrusters for future formation flying missions including the theoretical background, laboratory environments, modeling as well as testing and the latest developments.

AE516 Rocket System Engineering
Elementary principles of the rocket propulsion system are taught in this lecture. This course is offered for senior level undergraduate and graduate students majoring aerospace engineering. Brief history of rocket science and space development will be introduced. Students will practice design calculation to apply basic principles of fluid mechanics and heat transfer to this calculation. The lecture will cover issues of maximum velocity, acceleration, total impulse and derivation of performance parameters from thrust chamber data.

AE520 Advanced Aerodynamics
This course covers the following topics: Conservation principles of mass, momentum, and energy, Inviscid flow and Euler equations, Potential flow theory, Fundamental solutions of potential flow, Lifting line and lifting surface theories, Effects of viscosity and compressibility.

AE521 Helicopter Aeromechanics
The course deals with helicopter rotor aerodynamic performance theories such as simple momentum theory and combined annular momentum / blade element theory in axial flights, blade motion and control in forward flight, simplified performance analysis and trim in forward flight,

and estimation of ground effects.

AE522 Computational Fluid Dynamics
This course deals with classification and characteristics of partial differential equations, numerical accuracy, stability and convergence problems, error analysis, grid generation technique, numerical techniques for various types of PDEs. Lastly, inviscid flows and incompressible viscous flows are considered using these techniques.

AE523 Aeroacoustics
This course covers the following topics: Acoustic equations for a stationary homogeneous fluid; multipole expansions of sound field; Kirchhoff integral representation; scattering and diffraction; duct propagation; Lighthill's formulation on the generation of fluid induced sound, Ffowcs-Williams and Hawking for turbulence and surface in motion; vortex sound; jet, propeller and ducted fan noise, and boundary layer noise; sonic boom, effect of uniform flow, friction and heat flow; sound propagation in a homogeneous medium.

AE525 Experimental Aerodynamics
This course introduces various types of measurement techniques in relating to aerodynamics replicating subsonic to hypersonic speeds. Uncertainty analysis, data acquisition/signal processing, and laboratory hands-on experience are covered. As for the measurement techniques, static/dynamic pressure/heatflux, pitot/total enthalpy probes, force/moments, visualization, non-intrusive/intrusive flow-field/surface measurement techniques are included.

AE530 Flight Vehicle Structures
This class introduces structural configuration and materials, load transfer, modeling and design consideration in aircrafts, space launchers, satellites. In addition, The lecture covers use of composites, mechanics issues, fastener and sandwich analysis. Finally, we try to understand big pictures of structural design by solving simple design problems.

AE531 Structural Dynamics
This course covers the following topics: Vibrations of simple and complex structures, bars, strings, rods, beams, and plates; analysis of continuous and multimass systems; finite elements, Galerkin, integral equation; numerical collection; Hamilton's principle and Lagrange's equations; response of structures by modal superposition; vibration of composite materials.

AE532 Mechanics of Composite Materials
This course covers the following topics: Classification and characteristics of composite materials; strain-stress relations of anisotropic materials; classical laminate theory; analysis of symmetric and unsymmetric laminate; interlaminar stress; failure criteria of composite; mechanical testing methods and applications.

AE535 Smart Composite Lab
This course introduces various functional materials, which are the key ingredients for the smart structure implementation, and several laboratory exercises are provided to solidify understanding of the material behaviors. After the lecture on the analysis and design methods for smart structures, students will design and implement structural control system and health monitoring system for term projects.

AE550 Spacecraft Attitude Dynamics and Control
Advanced spacecraft attitude dynamics and control subjects are covered in this course. Classical dynamics approach are introduced to establish a variety of spacecraft attitude dynamics problems. Different attitude kinematics are also discussed to provide thorough understanding on the description of attitude dynamics and kinematics modelling. Attitude control problems using on-off thrusters are explained with simulation results. Recent developments in thruster modulation techniques are addressed. Flexible spacecraft modelling and control law design are presented to provide basic knowledge on recent advances in large spacecraft modeling and control technologies.

AE551 Introduction to Optimal Control
This course addresses optimal control theory and associated numerical methods in the context of flight trajectory optimization. Students learn theoretical concepts on optimality condition in static & dynamic optimization problems, such as Karush-Kuhn-Tucker condition, Hamilton-Jacobi-Bellman equation, Euler-Lagrange equation, and Pontryagin's minimum principle; and then numerical methods such as nonlinear programming, dynamic programming, and pseudo-spectral method for practical applications.

AE552 Advanced Linear Stability and Control
Introduction of eigen-structure assignments, linear quadratic controller, H-infinity control synthesis, nonlinear dynamic inversion, adaptive control using neural networks, and variable structure control will be given first. Application procedure of these techniques to flight control will then be discussed. The students will conduct flight control design by themselves to learn the advantages and the drawbacks of each method.

AE555 Spacecraft Trajectory Guidance and Control
In this course, spacecraft orbit guidance and control problems are discussed. Detailed analysis on guidance and control techniques necessary for mission operations from the launch phase is covered. In particular, lectures are given in the areas such as spacecraft rendezvous and docking, formation flying, inter-planetary mission analysis, optimal orbital maneuver, and guidance and control of reentry vehicles. Simulation study is also paralleled with lectures to provide practical experience.

AE580 GNSS Remote Sensing
This course introduces GNSS remote sensing techniques with an emphasis on geodesy applications. The lecture will cover GNSS signal characteristics, remote sensing techniques, space weather and ionospheric effects, precise positioning techniques including real time kinematics and precise point positioning.

AE590 Special Topics in Aerospace Engineering II
This course discusses special and/or advanced topics in the field of aerospace engineering for graduate students and senior undergraduate students.

AE620 Advanced Gas Dynamics
The present course deals with compressible isentropic flows, method of characteristics of two-dimensional potential and rotational flows, method of characteristics of axisymmetric potential flows, numerical solution of TSD equation, FPE, and unsteady transonic small perturbation flows, and introduction to inverse airfoil design technique.

AE621 Hypersonic Aerodynamics
This course covers the following topics: Hypersonics similarity laws; aerodynamic force coefficients; approximate closed-form solution for two-dimensional airfoils; three-dimensional hypersonic flow; angle-of attack effect; minimum-drag bodies; hypersonic small-perturbation theory and application; slender body theory; Newtonian flow theory; stability derivatives and re-entry problem; real gas effect; magneto-aerodynamics; aerodynamic heating and skin friction.

AE623 Unsteady Fluid Flows
This course covers the following topics: Unsteady motion of airfoils, wings and bodies in incompressible potential flows; boundary layers and Navier-Stokes flows, transonic and supersonic flows; impulsive starting of motion; oscillatory motions; unsteady turbulent flow and unsteady separation; time-dependent fluid flow and the resulting motion and forces.

AE630 Theory of Plates and Shells
This course covers the following topics: bending of plates; stress analysis; rectangular and circular plates; approximate solution methods; general theory of thin shell; analysis of isotropic circular cylindrical shell; pressurized tank; bending theory of shells of revolution.

AE631 Aeroelasticity
This course covers the following topics: Concepts of aeroelasticity; static aeroelasticity and divergence problems; dynamic aeroelasticty and flutter problems; typical section models; one dimensional structures; two dimensional structures; unsteady aerodynamics (subsonic, supersonic

and transonic); strip theory; lifting surface theory; supersonic and panel flutter; dynamic response of unrestrained vehicles.

AE650 Navigation and Guidance

In this class, fundamentals of inertial navigation and GPS are introduced, and detail algorithms of strapdown inertial navigation are also discussed. For integrated navigation, Kalman filtering is studied in depth. Guidance laws for aircraft en-route flight and missile systems are also reviewed. Students are expected to conduct extensive computer simulations of GPS / INS navigation systems.

AE651 Advanced Navigation Systems and Applications

This course introduces navigation system design with an emphasis on aviation and unmanned system applications. The lectures will cover navigation performance requirements, navigation system error models, risk classification, fault-tree analysis, navigation system hazard mitigation, and safety assesment.

AE655 Experiments in Flight Control

The primary goal of this course is to provide students with practical hand-on experience in aerospace flight control system design and analysis. Specific tasks will be assigned to students at the beginning of the semester. Depending on the size of the tasks, it could be individual basis or group projects. Students perform their own tasks during the semester during a laboratory hour. The tasks are very much relevant to flight control system design. Some examples are spacecraft attitude determination experiment, predictive estimation experiment, UAV communication system analysis, flexible launch vehicle control, autonomous docking experiment, INS/GPS, vibration control, rotary wing UAV auto-pilot design, navigation by image data, etc.

AE810 Special Topics in Propulsion and Combustion

Advanced and contemporary theories and their applications in the field of propulsion and combustion that are not adequate to be included in a regular class are covered in this lecture.

AE820 Special Topics in Aerodynamics

Theories which are not covered in regular class in the field of aerodynamics are presented here in this course. This course also introduces current research activities and relevant references.

AE830 Special Topics in Flight Vehicle Structures

Theories which are not covered in regular class in the field of flight vehicle structure are taught in this course. This course also introduces current research activities and references.

AE850 Special Topics in Flight Mechanics and Control

Theories which are not covered in regular class in the field of flight dynamics and control are taught in this course. This course also introduces current research activities and references.

AE890 Special Topics in Aerospace Engineering

Theories which are not covered in regular class in the field of aerospace engineering are taught in this course. This course also introduces current research activities and references.

AE960 Thesis (M.S. Program)

AE966 Seminar (M.S. Program)

AE980 Thesis (Ph.D Program)