

**AEROSPACE ENGINEERING CURRICULUM
(INTERNATIONAL PROGRAM)**

Aerospace engineers play an invaluable role in the development of modern aircraft and spacecraft. Ever since the advent of the first flying machines, new technologies have propelled us faster, further and more efficiently than ever before. Today there is an ever-increasing need for human resources with the capability to not only repair, maintain and construct today's aircraft, but also to look to the future and design those of tomorrow.

Global air travel is expanding at an unprecedented pace, prompting the foundation of many new commercial airlines in Southeast Asia. What's more, only aerospace engineers can provide the necessary innovation to advance strategic defence and satellite technologies. At a time when the big players in space travel are looking to set up lunar bases and manned missions to Mars, aerospace engineers are in high demand. Our AERO curriculum, developed by a collaboration of Chulalongkorn University with the Royal Thai Air Force, is tailor-made to meet this new hunger for aerospace expertise. Are you a high flyer?

Each student is required to accumulate a minimum of 139 credits to graduate for Bachelor of Engineering Program in Aerospace Engineering (International Program) which also includes 2 credits of industrial training and 3 credits of senior project.

Curriculum board

Asi	Bunyajitradulya	Ph.D.(UC.Lrvine)
Niphon	Wansophark,	D.Eng.(Chula)
Thavatchai	Tayjasanant	Ph.D.(Alberta)
Tawan	Papapote	Ph.D.(Lllinois)
Joshua	Staubs	Ph.D.(Virginia)
Pinunta	Rojratsirikul	Ph.D.(Bath, UK)

Professors

Electrical Engineering

Pramote	Dechaumphai,	Ph.D.(USA)
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Associate Professors

Mechanical Engineering

Asi	Bunyajitradulya	Ph.D.(UC.Lrvine)
Kuntinee	Maneeratana	Ph.D.(London)

Metallurgical Engineering

Seksak	Asavavisithchai	Ph.D.(Nottingham)
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Assistant Professors

Electrical Engineering

Thavatchai	Tayjasanant	Ph.D.(Alberta)
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Mechanical Engineering

Niphon	Wansophark,	D.Eng.(Chula)
Chittin	Tangthieng,	Ph.D.(Penn State)
Nopdanai	Ajavakom	Ph.D.(UC Berkeley)
Alongkorn	Pimpin,	Ph.D.(Tokyo)
Thanyarat	Singhanart	Ph.D.(Tokyo)

Lecturer

Mechanical Engineering

Chirdpun	Vitoonraporn	Ph.D.
Tawan	Papapote	Ph.D.(Lllinois)

ISE Staff

Prabhath	De Silva	Ph.D.(USA)
Pinunta	Rojratsirikul	Ph.D.(Bath, UK)
Joshua	Staubs	Ph.D.(Virginia)

Guest Lecturer

Boonchai	Watjatrakul	Ph.D.
Pinanta	Rojratsirikul	Ph.D.
Jeerasak	Pitakarnnop	Ph.D.(France)
Wicha	Mektrakran	B.Eng(USA)
Agaphas	Teparagul	

Curriculum

Total number of credits requirement	143	credits
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General Education	30	credits
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Core Courses	107	credits
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Basic Sciences	18	credits
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Basic Engineering	28	credits
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Compulsory	49	credits
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Approved Electives	12	credits
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Free Electives	6	credits
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1. General Education 30 credits

Social Science	3	credits
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Humanity	3	credits
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Science and Mathematics	3	credits
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Interdisciplinary	3	credits
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Foreign Language	12	credits
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5501112	Communicative English I	3	3(3-0-6)
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5501123	Communicative English II	3	3(3-0-6)
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5501214	Communication/Presentation	3	3(3-0-6)
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5501225	Technical Writing	3	3(3-0-6)
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General Education (Special)	6	credits
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2140111	Exploring Engineering World	3	3(3-0-6)
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2145211	Introduction to Aerospace Engineering	3	3(3-0-6)
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2. Core Courses 107 credits

<i>Basic Sciences</i>	18	credits
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2301107	Calculus I	3	3(3-0-6)
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2301108	Calculus II	3	3(3-0-6)
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2302103	General Chemistry Laboratory	1	1(0-3-0)
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2302105	Chemistry for Engineers	3	3(3-0-6)
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2304153	Physics for Engineers	3	3(3-0-6)
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2304154	Physics and Electronics for Engineers	3	3(3-0-6)
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2304193	Physics Laboratory for Engineers	1	1(0-3-0)
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2304194	Physics and Electronics Laboratory for Engineers	1	1(0-3-0)
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<i>Basic Engineering</i>	28	credits
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2140301	Industrial Training	2	2(0-6-0)
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2182203	Probability and Statistics For Engineers	3	3(3-0-6)
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2183101	Engineering Graphics	3	3(2-3-4)
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2183211	Engineering Mechanics	4	4(4-0-8)
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2183231	Dynamics	3	3(3-0-6)
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2189101	Engineering Materials	3	3(3-0-6)
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2145217*	Scientific Programming	3	3(3-0-6)
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2190151	Computer Programming Laboratory	1	1(0-3-0)
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2301215	Multivariable Calculus	3	3(3-0-6)
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2301216	Linear Algebra and Differential Equations	3	3(3-0-6)
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<i>Compulsory</i>	49	credits
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2145221	Introduction to Aircraft Design	1	1(1-0-4)
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2145420	Avionics	3	3(3-0-6)
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2145290	Aerospace Engineering Seminar I	1	1(1-0-2)
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2145311	Aerodynamics I	3	3(3-0-6)
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2145312	Aerodynamics II	3	3(3-0-6)
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2145326*	Aircraft Structure	3	3(3-0-6)
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2145328*	Aircraft Stability and Control	3	3(3-0-6)
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2145327*	Aircraft Performance	3	3(3-0-6)
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2145361	Aerospace Engineering Experimentation and Laboratory I	2	2(1-3-2)
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2145362	Aerospace Engineering Experimentation and Laboratory II	2	2(1-3-2)
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2145363	Aerospace Engineering Experimentation and Laboratory III	2	2(1-3-2)
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2145390	Aerospace Engineering Seminar II	1	1(1-0-2)
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2145329*	Aircraft Propulsion	3	3(3-0-6)
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2145461*	Aircraft Design	3	3(3-0-6)
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2145490	Aerospace Engineering Seminar III	1	1(1-0-2)
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2145479*	Aerospace Engineering Project Proposal	3	3(1-3-5)
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2145489*	Aerospace Engineering Project	3	3(0-6-3)
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2183221	Thermodynamics	3	3(3-0-6)
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2183222	Fluid Mechanics	3	3(3-0-6)
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2183381	Numerical Methods for Engineers	3	3(3-0-6)
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<i>Approved Electives</i>	12	credits
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2145421	Introduction to Computational Fluid Dynamics	3	3(3-0-6)
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2145422	Gas Dynamics	3	3(3-0-6)
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2145462*	Topics in Aerospace Engineering I	3	3(3-0-6)
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2145463*	Topics in Aerospace Engineering II	3	3(3-0-6)
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2145465*	Topics in Engineering I	3	3(3-0-6)
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2145466*	Topics in Engineering II	3	3(3-0-6)
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2145480*	Topics and Projects in Aerospace Industry I	3	3(2-3-4)
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2145482*	Topics and Projects in Aerospace Industry II	3	3(2-3-4)
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2145483*	Topics and Projects in Aerospace Industry III	3	3(2-3-4)
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2145484*	Topics and Projects in Aerospace Industry IV	3	3(2-3-4)
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2145485*	Topics and projects in Aerospace Engineering I	3	3(2-3-4)
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2145486*	Topics and projects in Aerospace Engineering II	3	3(2-3-4)
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2145495	Independent Studies	3	3(0-6-3)
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2145487*	Topics and projects in Aerospace Engineering I	3	3(2-3-4)
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2145488*	Topics and projects in Aerospace Engineering II	3	3(2-3-4)
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2145489*	Topics and projects in Aerospace Engineering I	3	3(2-3-4)
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2145486*	Topics and projects in Aerospace Engineering II	3	3(2-3-4)
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2145495	Independent Studies	3	3(0-6-3)
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3. Free Electives 6 credits

Any two subjects at the university level that are taught in English

**AEROSPACE ENGINEERING CURRICULUM
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COURSE NO.	SUBJECT	CREDITS	COURSE NO.	SUBJECT	CREDITS
FIRST SEMESTER			FIFTH SEMESTER		
2140111	Exploring Engineering World	3	2145311	Aerodynamics I	3
2145211	Introduction to Aerospace Engineering	3	2145326*	Aircraft Structure	3
2301107	Calculus I	3	2145361	Aerospace Engineering Experimentation and Laboratory I	2
2304153	Physics for Engineers	3	2145327*	Aircraft Performance	3
2304193	Physics Laboratory for Engineers	1	2145420	Avionics	3
5501112	Communicative English I	<u>3</u>	2190151	Computer Programming Laboratory	1
		<u>16</u>	xxxxxxx	General Education	<u>3</u>
					<u>18</u>
SECOND SEMESTER			SIXTH SEMESTER		
2145221	Introduction to Aircraft Design	1	2145312	Aerodynamics II	3
2183101	Engineering Graphics	3	2145329*	Aircraft Propulsion	3
2301108	Calculus II	3	2145328*	Aircraft Stability and Control	3
2302103	General Chemistry Laboratory	1	2145362	Aerospace Engineering Experimentation and Laboratory II	2
2302105	Chemistry for Engineers	3	2145390	Aerospace Engineering Seminar II	1
2304154	Physics and Electronics for Engineers	3	Xxxxxxx	Free Elective	3
2304194	Physics and Electronics Laboratory for Engineers	1	Xxxxxxx	General Education	<u>3</u>
5501123	Communicative English II	<u>3</u>			<u>18</u>
		<u>18</u>			
THIRD SEMESTER			SUMMER SEMESTER		
2145217*	Scientific Programming	3	2140301	Industrial Training	<u>2</u>
2183211	Engineering Mechanics	4			2
2183221	Thermodynamics	3			
2301215	Multivariable Calculus	3			
2301216	Linear Algebra and Differential Equations	3			
5501214	Communication/Presentation	<u>3</u>			
		<u>19</u>			
FOURTH SEMESTER			SEVENTH SEMESTER		
2145290	Aerospace Engineering Seminar I	1	2145363	Aerospace Engineering Experimentation and Laboratory III	2
2182203	Probability and Statistics for Engineers	3	2145479*	Aerospace Engineering Project Proposal	3
2183222	Fluid Mechanics	3	2145461*	Aircraft Design	3
2183231	Dynamics	3	Xxxxxxx	Approved Elective	3
2183381	Numerical Methods for Engineers	3	Xxxxxxx	Approved Elective	3
2189101	Engineering Materials	3	Xxxxxxx	General Education	<u>3</u>
5501225	Technical Writing	<u>3</u>			<u>17</u>
		<u>19</u>			
FIFTH SEMESTER			EIGHTH SEMESTER		
			2145490	Aerospace Engineering Seminar III	1
			2145489*	Aerospace Engineering Project	3
			xxxxxxx	Approved Elective	3
			xxxxxxx	Approved Elective	3
			xxxxxxx	Free Elective	3
			xxxxxxx	General Education	<u>3</u>
					<u>16</u>
TOTAL CREDITS FOR GRADUATION					<u>143</u>

**COURSES DESCRIPTIONS IN
AEROSPACE ENGINEERING
(B.ENG)**

1. General Education

Foreign Language

5501112 Communicative English I 3(3-0-6)
Practice language skills in acquiring information and knowledge from different sources and media in subjects of students' interest under selected themes; collecting information, summarizing and presenting important issues.

5501123 Communicative English II 3(3-0-6)
CONDITION: PRER 5501112

Practice language skills in acquiring analyzing and synthesizing information and knowledge from different sources and media on topics of students' interest under selected themes; summarizing what they have learned and presenting opinions from group discussion.

5501214 Communication and Presentation Skills 3(3-0-6)
CONDITION: PRER 5501123

Practice using English for social communication and giving oral presentation on engineering-related topics.

5501225 Technical Writing 3(3-0-6)
CONDITION: PRER 5501123

Students are to practice extensive academic writing at paragraph level. Selected readings in the related field are included. More discussion and presentation skills are to be taught including listening input.

General Education (Special)

2140111 Exploring Engineering World 3(3-0-6)
Engineering topics related to daily life: energy, resources, environment manufacturing, process, industry, material, automotive, infrastructure, information system and bio engineering

2145211 Introduction to Aerospace Engineering 3(3-0-6)

Basic aerodynamic phenomena and simplified theory, elementary aerospace vehicle performance, stability and control, and design.

2. Core Courses

Basic Sciences

2301107 Calculus I 3(3-0-6)
Limit, continuity, differentiation and integration of real-valued functions of a real variable and their applications; techniques of integration; improper integrals

2301108 Calculus II 3(3-0-6)
CONDITION: PRER 2301107

Mathematical induction; sequences and series of real numbers; Taylor series expansion and approximation of elementary functions; numerical integration; vectors, lines and planes in three-dimensional space; calculus of vector valued functions of one variable; calculus of real valued functions of two variables; introduction to differential equations and their applications.

2302103 General Chemistry Laboratory 1(0-3-0)

Standard solution preparation; qualitative analysis; titration; electrochemistry; pH metric titration; spectroscopy; calculation and evaluation of data; calibration curve; introduction to polymer.

2302105 Chemistry for Engineers 3(3-0-6)

Stoichiometry and basis of the atomic theory; properties of the three states of matter and solution; thermodynamics; chemical equilibrium; Oxidation; chemical kinetics; the electronic structures of atoms and the chemical bond; periodic table; nonmetal and transition metal.

2142153 Physics for Engineers 3(3-0-6)

Mechanics of particles and rigid bodies, properties of matter, fluid mechanics, heat, vibrations and waves, elements of electromagnetism, optics, modern physics.

2304154 Physics and Electronics for Engineers 3(3-0-6)

Electricity; DC circuit; AC circuit; basic electronics; solid state devices; electrical actuators.

2304193 Physics Laboratory for Engineers 1(0-3-0)

Measurement and precision; experiments on simple harmonic motion, radius of gyration, dynamics of rotation, velocity of sound, viscosity of fluids.

2304194 Physics and Electronics Laboratory for Engineers PHYS ELEC LAB ENGS 1(0-3-0)

Resistance and electromotive force measurements; experiments on amp meter, voltmeter, oscilloscope, AC circuit, transistor, lenses and mirrors, polarization, interference, diffraction.

Compulsory Courses

2140301 Industrial Training 2(0-6-0)

Engineering practice in related areas under supervision of experienced engineers in private sectors or government agencies.

2182203 Probability and Statistics for Engineers 3(3-0-6)
CONDITION: PRER 2301108

Engineering basis in statistics and probability; discrete and continuous probability distribution; joint probability distribution; parameter estimation: estimator, bias, consistency; point estimation; interval estimation; engineering applications in measurement and uncertainty, linear regression, introduction to random process; integration of statistics in engineering applications; case studies.

2183101 Engineering Graphics 3(2-3-4)

Lettering; orthographic projections; sketching and drawing; pictorial drawing; dimensioning; tolerancing and geometrical tolerancing; section; working drawing; mechanical parts drawing; introduction to CAD.

2183211 Engineering Mechanics 4(4-0-8)

Analysis of force systems and their equilibrium as applied to engineering systems; stresses and strains; mechanical properties of materials; Hooke's law, elastic modulus, stress in beam, shear force, bending moment diagram, torsion, buckling of columns, Mohr's circle.

2183231 Dynamics 3(3-0-6)

Kinematics of three-dimensional curvilinear motion of a particle; kinetics of a particle: force and acceleration, work and energy, impulse and momentum; kinematics of planar motion of a rigid body: force and acceleration, work and energy, impulse and momentum; introduction to kinematics and kinetics of three-dimensional motion of a rigid body.

2189101 Engineering Materials 3(3-0-6)

Important engineering materials: metals, plastics, asphalt, wood and concrete; macroscopic and microscopic structure which are correlating with properties of the engineering materials; production process of products from engineering materials.

2145217* Scientific Programming 3(3-0-6)

Use of Python, R, or similar tool to understand computing for scientific purposes. Includes data management, numerical computations, symbolic computing, data visualization, data analysis, parallel

computing, and high-performance computing. Use of real-life case studies in scientific computing.

2190151 Computer Programming Laboratory 1(0-3-0)

Computer programming in Engineering; reviews of computer programming concepts; hands on experience on computer programming using contemporary engineering tools.

**2301215 Multivariable Calculus 3(3-0-6)
CONDITION: PRER 2301108**

Vector; curves, planes and surfaces; derivatives of vector-valued functions; partial, total and directional derivatives; implicit differentiation; maxima-minima; gradient, divergence, curl; scalar and vector fields; line integral; surface integral and volume integral; integral theorems of vector analysis.

**2301216 Linear Algebra and Differential Equations 3(3-0-6)
CONDITION: PRER 2301108**

System of linear algebraic equations; linear spaces; inner products; eigenvalues and eigenvectors; principal axis theorem; higher-order linear differential equations; method of variation of parameters; system of first-order linear differential equations; qualitative analysis and dynamical system.

2145221 Introduction to Aircraft Design 1(1-0-4)

Introduction to aircraft systems, fundamental to aircraft systems, elements of aerodynamics, airfoils, and wings, aspect of vehicle conceptual design.

2145420 Avionics 3(3-0-6)

Basic avionic system, air data systems, flight instruments, terrestrial en-route – radio navigation systems, terrestrial landing aids, satellite navigation system, radar systems, indicators and displays, airborne radio communications, autopilot and flight-management system, avionics systems integration.

**2145290 Aerospace Engineering Seminar I 1(1-0-2)
Discussion on the topics of aerospace engineering**

**2145311 Aerodynamics I 3(3-0-6)
CONDITION: PRER 2183222**

Properties of air, standard atmosphere, conservation principles, continuity, momentum, Euler's Equation, rotationality, circulation, vortex, lift, drag, potential flow, airfoil characteristics, thin airfoil theory, cambered and flapped airfoil, high lift devices, finite wing theory, panel and vortex lattice methods.

**2145312 Aerodynamics II 3(3-0-6)
AERODYNAMICS II
CONDITION: PRER 2183221
and 2145311**

Fundamental of compressible flow, acoustic waves, normal and oblique shock waves, expansion waves, Prandtl-Meyer flow, convergent-divergent nozzle, flow with friction and heat transfer, unsteady wave motion, perturbation theory, linearized flow and theory of characteristics.

2145326* Aircraft Structure 3(3-0-6)

Overview of aircraft structural external loads analysis including criteria, design, analysis, fatigue, certification, validation, and testing. Covers FAR 23 and FAR 25 airplane loads requirements. Includes introduction to the use of finite element package in structural analysis. Course will provide students with an understanding of fuselage/wing design and analysis including frames and ribs. Also provides an introduction to structural dynamics including aeroelasticity.

2145328* Aircraft Stability and Control 3(3-0-6)

Equilibrium and stability; functions of aircraft controls; static stability and trim; stability derivatives for longitudinal motions; stick-fixed, stick-free and control stick forces; wing and tail contributions; maneuver stability; roll stability and roll control; yaw stability and yaw control; dynamic behavior of aircraft and equations of motion; phugoid and short period oscillation; Dutch roll; spiral mode and roll subsidence; dihedral effect and weathercock stability

2145327* Aircraft Performance 3(3-0-6)

Principles of jet and propeller aircraft performance; equations of motions; cruise flight, climb and descent; turning flight; takeoff and landing performance; range and endurance; payload-range diagram; maneuvering V-n diagram.

2145361 Aerospace Engineering Experimentation and Laboratory I 2 (1-3-2)

Concepts in experimentation; introduction to systematic design of an experiment using data reduction diagram (DRD): setting up objectives of an experiment, constructing the set of data reduction diagrams (DRDs) of the experiment according to the objectives; measurement and instrument; uncertainty analysis; basic experiments and laboratories in thermodynamics; fluid mechanics and aerodynamics; dynamics; solid mechanics.

**2145362 Aerospace Engineering Experimentation and Laboratory II 2 (1-3-2)
CONDITION: PRER 2145361**

Experiments and laboratories in aerodynamics, structure, propulsion, performance, dynamics and control.

**2145363 Aerospace Engineering Experimentation and Laboratory III 2(1-3-2)
CONDITION: PRER 2145362**

Concepts in experimentation and design of an experiment; setting up specifications and objectives of an experiment; systematic design of an experiment according to the specifications and objectives using different kinds of tools; outlining the process of extracting experimental results and conclusions from the designed experiment; outlining data collection and data analysis schemes outlining experimental project phases, tasks, and schedule; design documentation and review by oral and written presentation; practices in the design of an experiment in the project-based setting; introduction to modern instrumentation and data acquisition through demonstration.

**2145329* Aircraft Propulsion 3(3-0-6)
CONDITION: PRER 2183221 and 2183222**

Introduction to propulsion, air-breathing and non-air-breathing engines; brief review of the thermodynamics and compressible flow; basic thrust equation of aircraft gas turbine and jet engines; Brayton cycle, axial flow turbomachines, momentum theory and blade element theory; gas turbine component performance, inlet, compressor, turbine and nozzle; cycle analysis of gas turbine engines, rocket, ramjet, turbojet, turbofan and turboprop covering introduction to preliminary propulsion design

2145461* Aircraft Design 3(3-0-6)

Fundamentals of aircraft design process including wing design, tail design, and undercarriage arrangement. Also covers initial take-off mass estimation, detailed mass calculation, and mission fuel requirement. Incorporates principles from prior aerospace engineering courses including center of gravity calculation, basic aerodynamics estimation, static stability and control analysis, propulsion consideration and analysis, performance analysis, aircraft

cost prediction, preliminary and detailed design concepts, quality control of aircraft design.

2145390 Aerospace Engineering Seminar II 1(1-0-2)
Discussion on the topics of aerospace engineering.

2145490 Aerospace Engineering Seminar III 1(1-0-2)
Discussion on the topics of aerospace engineering.

2145479* Aerospace Engineering Project Proposal 3(1-3-5)

Identify the aerospace engineering project of interest and propose the project to be conducted in 2145499 Aerospace Engineering Project course. This necessarily constitutes at least the followings.

1) Identify the motivation for the project with specific and relevant applications, background knowledge, and underlying ideas, of the project.

2) Formulate clear problem/objective and scope of the project. If it is a design project, engineering specifications of the design must be provided.

3) Propose, in principle, the approach you will be using in solving the problem, and/or the conceptual design, and/or the principle of your experiment or simulation.

4) Some preliminary solution, and/or design, and/or experimental or simulation results, demonstrating the effectiveness of your proposed approach in (3), or the ineffectiveness of your approach in (3) and the potential remedies/alternatives for the approach, must be provided. Group or individual project. The students must propose the project in writing and oral presentation.

Remark: Engineering specifications are derived from necessities, needs, and preferences of the use, constraints and conditions, as well as safety, environmental, manufacturability, and economic considerations

2145489* Aerospace Engineering Project Condition: Prerequisite 2145479* 3(0-6-3)

Completion of the aerospace engineering project. The students must demonstrate systematic and sound approach in conducting the project, from beginning to end. Some degree of the evaluation of the project must be provided. Report and present the project professionally.

2183221 Thermodynamics 3(3-0-6)

Basic concepts; thermodynamic state and process; properties of pure substances and ideal gases; energy; the first law of thermodynamics and the first law analysis for isolated, closed, and open systems; entropy; the second law of thermodynamics and the second law analysis for isolated, closed, and opens systems; gas power cycles; Carnot, Otto, and Brayton cycles; refrigeration cycle; introduction to gas mixtures; introduction to combustion.

2183222 Fluid Mechanics 3(3-0-6)

Basic concepts in physics: physical quantity and physical quantity relations, dimensions of physical quantity and the principle of dimensional homogeneity, dimensionless variables; basic concepts in fluid mechanics: continuum assumption, methods of description: Lagrangian and Eulerian descriptions, field quantity and classification of flow fields; geometric and kinematics of fluid motion: path lines, streamlines, and streak lines; forces and stressed in fluids: pressure and pressure force, shear stress and shear force: convection flux and Reynold's transport theorem; physical laws of finite control volume: conservations of mass, linear momentum, and energy; conservation of angular momentum with application to turbomachines; physical laws of infinite control volume: conservation of mass and linear momentum, introduction to Navier-Stokes and Euler's equations; Bernoulli's equation from momentum and conservation of mechanical energy viewpoints; introduction to vorticity and vortex; dimensional

analysis: Buckingham's PI theorem, similarity, and model testing; internal viscous flows, energy consideration in pipe flows and piping system; external flows, boundary layer, and aerodynamic force and moment; applications: turbomachines, model testing, piping and pumping system, aerodynamic force and moment.

2183381 Numerical Methods for Engineers 3(3-0-6)

Basic methods for obtaining numerical solutions by a digital computer, including methods for the solutions of algebraic and transcendental equations, simultaneous linear equations, ordinary and partial differential equations, and curve fitting techniques, comparison of various methods with respect to computational efficiency and accuracy.

Approved Electives

2145421 Introduction to Computational Fluid Dynamics 3(3-0-6)

Physical and mathematical foundations of computational fluid mechanics with emphasis on applications; solution methods for model equations, the Euler and the Navier-Stokes equations; classification of partial differential equations and solution techniques.

2145422 Gas Dynamics 3(3-0-6)

Introduction to gas dynamics, covering fundamental concepts in thermodynamics and fluid dynamics; molecular and continuum concepts for fluids, first and second laws of thermodynamics, conservation laws for moving fluids, one-dimensional compressible flows, shock and expansion waves, flows in nozzles, and two- and three-dimensional compressible flows.

2145462* Topics in Aerospace Engineering I 3(3-0-6)

Selected technical topics in aerospace engineering.

2145463* Topics in Aerospace Engineering II 3(3-0-6)

Selected technical topics in aerospace engineering.

2145465* Topics in Engineering I 3(3-0-6)

Selected technical topics in engineering.

2145466* Topics in Engineering II 3(3-0-6)

Selected technical topics in engineering.

2145480* Topics and Projects in Aerospace Industry I 3(2-3-4)

Topics and projects in aerospace industry. An engineering project in aerospace engineering is required.

2145482* Topics and Projects in Aerospace Industry II 3(2-3-4)

Topics and projects in aerospace industry. An engineering project in aerospace engineering is required.

2145483* Topics and Projects in Aerospace Industry III 3(2-3-4)

Topics and projects in aerospace industry. An engineering project in aerospace engineering is required.

2145484* Topics and Projects in Aerospace Industry IV 3(2-3-4)

Topics and projects in aerospace industry. An engineering project in aerospace engineering is required.

2145485* Topics and projects in Aerospace Engineering I 3(2-3-4)

Topics and projects in aerospace engineering. An engineering project in aerospace engineering is required.

2145486* Topics and projects in Aerospace Engineering II 3(2-3-4)

Topics and projects in aerospace engineering. An engineering project in aerospace engineering is required.

2145495 Independent Studies 3(0-6-3)

Self-study on topic relate to aerospace engineering with consent of the instructor, the study may theoretical or experimental in nature.