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
Phulporn Saengbangpla	M.Sc (Machester,UK)
Pramote Dechaumphai	Ph.D. (Virginia)
Ekachai Leelarasmee	Ph.D. (California)
Asi Bunyajitradulya	Ph.D. (California)
Siriporn Damrongsakkul	Ph.D. (London)
Atiwong Suchato	Ph.D. (Massachusetts)
Patama Visuttipitukul	Ph.D. (Tokyo)
Sunhapos Chatranuwathana	Ph.D. (Michigan)
Chaodit Aswakul	Ph.D. (London)
Yan Zhao	Ph.D. (London)
Surapong Sirikulvadhana	M.S (Michigan)
Varong Pavarajarn	Ph.D. (Oregon)

Professors
Electrical Engineering
Pramote	Dechaumphai,	Ph.D.(USA)

Associate Professors
Mechanical Engineering
Asi	Bunyajitradulya	Ph.D.(UC.Lrvine)
Kuntinee	Maneeratana	Ph.D.(London)
Pongtorn	Charunyakorn	Ph.D.(Miami)

Metallurgical Engineering
Seksak	Asavavisithchai	Ph.D.(Nottingham)

Computer Engineering
Atiwong	Suchato	Ph.D.(MIT)

Assistant Professors
Electrical Engineering
Thavatchai	Tayjasanant	Ph.D.(Alberta)
Manap	Wongsaisuwan	Ph.D.

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

Metallurgical and materials Engineering
Itthipon	Diewwant,	Sc.D.(MIT)

Lecturer
Mechanical Engineering
Chirdpun	Vitoonraporn	Ph.D.
Tawan	Papapote	Ph.D.(Lllinois)
Sawat	Luengruengrit	D.Eng.(Tokyo)

ISE Staff
Prabhath	De Silva	Ph.D.(USA)
Pinunta	Rojratsirikul	Ph.D.(Bath, UK)
Borrdephong Rattanagraikanakorn		Ph.D.(London)
Joshua	Staubs	Ph.D.(Virginia)

Guest Lecturer
Boonchai	Watjatrakul	Ph.D.
Wasunthara	Manklasavadi	Ph.D.
Pinanta	Rojratsirikul	Ph.D.
Anurak	Athasit	Ph.D.(France)
Jeerasak	Pitakarnnop	Ph.D.(France)
Sant	Sangwornrachasup	Ph.D.
Wicha	Mektrakran	B.Eng(USA)
Agaphas	Teparagul	

Curriculum
Total number of credits requirement	146	credits
General Education	31	credits
Core Courses	109	credits
Basic Sciences	18	credits
Basic Engineering	31	credits
Compulsory	54	credits
Approved Electives	6	credits
Free Electives	6	credits

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1. General Education		**31**	**credits**
Social Science		3	credits
Humanity		3	credits
Science and Mathematics		3	credits
Interdisciplinary		3	credits
Foreign Language		16	credits
5501112	Communicative English I	3	3(3-0-6)
5501123	Communicative English II	3	3(3-0-6)
5501213	Technical Communication I	2	2(2-0-4)
5501224	Technical Communication II	2	2(2-0-4)
5501315	Technical Communication III	2	2(2-0-4)
5501326	Technical Communication IV	2	2(2-0-4)
5501417	Technical Communication V	2	2(2-0-4)
General Education (Special)		3	credits
2140111	Exploring Engineering World	3	3(3-0-6)

2. Core Courses   **109**   **credits**

	Basic Sciences	*18*	*credits*
2301107	Calculus I		3(3-0-6)
2301108	Calculus II		3(3-0-6)
2302103	General Chemistry Laboratory		1(0-3-0)
2302105	Chemistry for Engineers		3(3-0-6)
2304153	Physics for Engineers		3(3-0-6)
2304154	Physics and Electronics for Engineers		3(3-0-6)
2304193	Physics Laboratory for Engineers		1(0-3-0)
2304194	Physics and Electronics Laboratory for Engineers		1(0-3-0)

	Basic Engineering	*31*	*credits*
2140301	Industrial Training		2(0-6-0)
2182203	Probability and Statistics For Engineers		3(3-0-6)
2183101	Engineering Graphics		3(2-3-4)
2183211	Engineering Mechanics		4(4-0-8)
2183231	Dynamics		3(3-0-6)
2189101	Engineering Materials		3(3-0-6)
2190101	Computer Programming		3(3-0-6)
2190151	Computer Programming Laboratory		1(0-3-0)
2301215	Multivariable Calculus		3(3-0-6)
2301216	Linear Algebra and Differential Equations		3(3-0-6)
2301317	Methods of Applied Mathematics		3(3-0-6)

	Compulsory	*54*	*credits*
2145211	Introduction to Aerospace Engineering		3(3-0-6)
2145221	Introduction to Aircraft Design		1(1-0-4)
2145230	Aircraft Electricity and Electronics		3(3-0-6)
2145290	Aerospace Engineering Seminar I		1(1-0-2)
2145311	Aerodynamics I		3(3-0-6)
2145312	Aerodynamics II		3(3-0-6)
2145321	Aircraft Structure I		3(3-0-6)
2145322	Aircraft Structure II		3(3-0-6)
2145324	Modeling and Control of Dynamic Systems		3(3-0-6)
2145325	Flight Mechanics		3(3-0-6)
2145361	Aerospace Engineering Experimentation and Laboratory I		2(1-3-2)
2145362	Aerospace Engineering Experimentation and Laboratory II		2(1-3-2)
2145363	Aerospace Engineering Experimentation and Laboratory III		2(1-3-2)
2145390	Aerospace Engineering Seminar II 1(1-0-2)		
2145402	Aircraft Propulsion		4(4-0-8)
2145451	Aircraft Design		4(4-0-8)
2145490	Aerospace Engineering Seminar III		1(1-0-2)
2145499	Aerospace Engineering Project		3(3-0-6)
2183221	Thermodynamics		3(3-0-6)
2183222	Fluid Mechanics		3(3-0-6)
2183381	Numerical Methods for Engineers		3(3-0-6)

	Approved Electives	*6*	*credits*
2145420	Avionics		3(3-0-6)
2145421	Introduction to Computational Fluid Dynamics		3(3-0-6)
2145422	Gas Dynamics		3(3-0-6)
2145495	Independent Studies		3(0-6-3)

2145497	Selected Topics in Aerospace Engineering I	3(2-3-4)
2145498	Selected Topics in Aerospace Engineering II	3(2-3-4)
2183431	Mechanical Vibrations	3(3-0-6)
2184303	Engineering Management	3(3-0-6)

3. Free Electives   **6**   **credits**

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

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OURSE NO.	SUBJECT	CREDITS
FIRST SEMESTER		
2190101	Computer Programming	3
2190151	Computer Programming Laboratory	1
2301107	Calculus I	3
2302103	General Chemistry Laboratory	1
2302105	Chemistry for Engineers	3
2304153	Physics for Engineers	3
2304193	Physics Laboratory for Engineers	1
5501112	Communicative English I	3
		18
SECOND SEMESTER		
2140111	Exploring Engineering World	3
2183101	Engineering Graphics	3
2189101	Engineering Materials	3
2301108	Calculus II	3
2304154	Physics and Electronics for Engineers	3
2304194	Physics and Electronics Laboratory for Engineers	1
5501123	Communicative English II	3
		19
THIRD SEMESTER		
2145211	Introduction to Aerospace Engineering	3
2183211	Engineering Mechanics	4
2183221	Thermodynamics	3
2301215	Multivariable Calculus	3
2301216	Linear Algebra and Differential Equations	3
5501213	Technical Communication I	2
		18
FOURTH SEMESTER		
2145221	Introduction to Aircraft Design	1
2145230	Aircraft Electricity and Electronics	3
2145290	Aerospace Engineering Seminar I	1
2182203	Probability and Statistics for Eng.	3
2183222	Fluid Mechanics	3
2183231	Dynamics	3
2301317	Methods of Applied Mathematics	3
5501224	Technical Communication II	2
		19

COURSE NO.	SUBJECT	CREDITS
FIFTH SEMESTER		
2145311	Aerodynamics I	3
2145321	Aircraft Structure I	3
2145324	Modeling and Control of Dynamic Systems	3
2145361	Aerospace Engineering Experimentation and Laboratory I	2
2183381	Numerical Methods for Engineers	3
5501315	Technical Communication III	2
xxxxxxx	General Education	3
		19
SIXTH SEMESTER		
2145312	Aerodynamics II	3
2145322	Aircraft Sturcture II	3
2145325	Flight Mechanics	3
2145362	Aerospace Engineering Experimentation and Laboratory II	2
2145390	Aerospace Engineering Seminar II	1
5501326	Technical Communication IV	2
xxxxxxx	General Education	3
		17
SUMMER SEMESTER		
2140301	Industrial Training	2
		2
SEVENTH SEMESTER		
2145363	Aerospace Engineering Experimentation and Laboratory III	3
2145402	Aircraft Propulsion	4
2145451	Aircraft Design	4
5501417	Technical Communication V	2
xxxxxxx	Approved Elective	3
xxxxxxx	General Education	3
		18
EIGTHTH SEMESTER		
2145499	Aerospace Engineering Project	3
2145490	Aerospace Engineering Seminar III	1
xxxxxxx	Approved Elective	3
xxxxxxx	Free Elective	3
xxxxxxx	Free Elective	3
xxxxxxx	General Education	3
		16

TOTAL CREDITS FOR GRADUATION   **146**

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.

5501213 Technical Communication I   2(2-0-4)
Students are to practice academic writing at paragraph level. Selected readings in the related field are included. Discussion and presentation skills are to be taught including listening input.

5501224 Technical Communication II   2(2-0-4)
CONDITION: PRER 5501213
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.

5501315 Technical Communication III   2(2-0-4)
CONDITION: PRER 5501224*
Students are to develop ability in technical writing and academic essay writing. Selected readings in the related field are included. Academic presentation skills are to be taught including listening input in the related field.

5501326 Technical Communication IV   2(2-0-4)
CONDITION: PRER 5501315*
Students are to write technical reports and do academic presentations. Selected readings in technical discourse and listening input are included.

5501417 Technical Communication V   2(2-0-4)
CONDITION: PRER 5501326*
Students are to write academic articles and do academic presentations. Students are to develop their writing processes and presentation skills to bring their proficiency to the highest level in the related field.

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

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   3(3-0-6)
Engineers
Electricity; DC circuit; AC circuit; basic electronics; solid state devices; electrical actuators.

2304193 Physics Laboratory for   1(0-3-0)
Engineers
Measurement and precision; experiments on simple harmonic motion, radius of gyration, dynamics of rotation, velocity of sound, viscosity of fluids.

2304194 Physics and Electronics   1(0-3-0)
Laboratory for Engineers PHYS ELEC LAB ENGS
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   3(3-0-6)
Engineers
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; to lerancing 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.

2190101   Computer Programming   3(3-0-6)
Introduction to computer systems; problem-solving using computers; programming in high-level languages; program structure, programming style and convention; control statements, data handling and processing; subprograms; classes and objects.

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   3(3-0-6)
**   Equations**
CONDITION: PRER 2301108
System of linear algebraic equations; linear spaces; inner products; eigenvalues and eigenvectors; principal axic theorem; higher-order linear differential equations; method of variation of parameters; system of first-order linear differential equations; qualitative analysis and dynamical system.

2301317   Methods of Applied Mathematecs   3(3-0-6)
CONDITION: PRER 2301215
Series solution; special functions; Laplace transforms; Fourier series and Fourier transforms; convergence theory; boundary value problems; linear partial differential equations; introduction to tensors; complex variables; analytic functions; line and contour integral; Laurent series; residue theorem.

2145211   Introduction to Aerospace   3(3-0-6)
**   Engineering**
Basic aerodynamic phenomena and simplified theory, elementary aerospace vehicle performance, stability and control, and design.

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.

2145230   Aircraft Electricity   3(3-0-6)
**   and Electronics**
DC and AC circuits analysis, electrical control devices, analog and digital electronics, electric measuring instruments, electric motors, aircraft electrical systems, radio theory, aircraft communication and navigation systems, autoflight systems.

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.

2145321   Aircraft Structure I   3(3-0-6)
Introduction to design of aerospace structures, review of concepts of stress, deformation, strain, and displacement and the equations of elasticity, two-dimensional problems in elasticity, energy methods of structural analysis, principles of virtual displacements and virtual forces, bending of thin plates, structural instability, introduction to finite element.

2145322   Aircraft Structure II   3(3-0-6)
CONDITION: PRER 2145321
Principles of stressed skin construction, thin-walled beam, bending, shear and torsion of open and closed thin-walled beam, stress analysis of aircraft components, tapered beam, fuselage, wings, fuselage frames and wing rib, airworthiness and aeroelasticity, factors of safety flight envelop, load factor determination, fatigue.

2145324   Modeling and Control   3 (3-0-6)
**   of Dynamic Systems**
Introduction to modeling, analysis, and control of dynamic systems; modeling of mechanical, electrical and electromechanical system; Laplace Transforms and transfer function techniques; frequency response and Bode diagrams; analysis and design of feedback control systems; control system representation and characteristics; system performance specifications; stability analysis and conditions; Root-Locus and frequency response analysis and design; systems compensation and controller design.

2145325   Flight Mechanics   3(3-0-6)
CONDITION: PRER 2183231
and 2145324
Performance, stability, and control of aircraft; general equations of motion for rigid aircraft, aerodynamic forces and moments; flight paths; small disturbance theory, stability derivatives, longitudinal and lateral stability; response to control inputs and to atmospheric disturbances; automatic flight control.

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 schemesl 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.

2145390 **Aerospace Engineering Seminar II** **1(1-0-2)**

Discussion on the topics of aerospace engineering.

2145402 **Aircraft Propulsion** **4(4-0-8)**
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 engines; Brayton cycle, propellers, momentum theory and blade element theory; gas turbine component performance, inlet, compressor, turbine and nozzle; cycle analysis of gas turbine engines, ramjet, turbojet, turbofan and turboprop.

2145451 **Aircraft Design** **4(4-0-8)**
CONDITION: PRER 2145221

Fundamentals of aircraft design process, wing design consideration, tail design consideration, undercarriage arrangement consideration, initial take-off mass estimation, detailed mass calculation, mission fuel requirement; 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.

2145490 **Aerospace Engineering Seminar III** **1(1-0-2)**

Discussion on the topics of aerospace engineering.

2145499 **Aerospace Engineering Project** **3(0-6-3)**

Group or individual projects on a subject related to aerospace engineering.

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: pathlines, streamlines, and streaklines; 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 folws 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

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, avionic systems integration.

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.

2145495 **Independent Studies** **3(3-0-6)**

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

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.

2145497 **Selected Topics in Aerospace Engineering I** **3(2-3-4)**

Selected interesting topics in aerospace engineering.

2145498 **Selected Topics in Aerospace Engineering II** **3(2-3-4)**

Selected interesting topics in aerospace engineering.

2183431 **Mechanical Vibrations** **3(3-0-6)**

Analysis of system with single and multi degree of freedom; torsional vibration; free and forced vibration; determination of natural frequencies of structures; discrete system; Modal analysis; methods and techniques to reduce and control vibration; Lagrange's equations.

2184303 Engineering Management 3(3-0-6)

Modern management principles; methods of increasing productivity; human relations; industrial safety; pollution problems; commercial laws; basics of engineering economy, finance, marketing and project management.