Jordan University of Science and Technology

Faculty of Engineering

Department of Aeronautical Engineering

Undergraduate Curriculum for the B.Sc. Degree in Aeronautical Engineering

2019

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Vision:

To be a premier institution in aeronautical engineering education and research.

Mission:

To prepare qualified engineers for success and leadership that is recognized internationally for its quality in the conception, design, implementation, and operation of aeronautical-related engineering systems.

Department Objectives:

The educational objectives of the Aeronautical Engineering Program at JUST are to produce graduates who:

1. Engage in productive career in the fields of industry, military, academia, and research, enabled by their technical competence in aeronautical engineering,
2. Advance in responsibility and leadership in public, private, or military sectors in local and regional markets,
3. Demonstrate commitment to personal professional development as well as the sustainable development of the society,
4. Effectively communicate and function in various multidisciplinary environments and engage in life-long learning and professional development, and
5. Understand the ethical, cultural and environmental considerations of the engineering profession.

Learning Outcomes:

By the time of graduation, our graduates should be able to demonstrate the ability to:

a - Apply knowledge of mathematics, science, and engineering in practice.

b - Design and conduct experiments as well as analyze and interpret data.

c - Design systems, components, and processes to meet the desired needs.

d - Function within multidisciplinary teams.

e - Identify, formulate, and solve engineering problems.

f - Understand professional and ethical responsibilities of aeronautical engineers.

g - Communicate effectively.

h - Obtain broad knowledge to understand the implications of engineering solutions within global and societal contexts.

i - Recognize the need for, and possess the ability to engage in, lifelong learning.

j - Possess knowledge of contemporary issues.

k - Use the techniques, skills, and modern engineering tools necessary for engineering practice.

Study Plan of bachelor's degree in Aeronautical Engineering

Numbering and coding system of courses of the study plan.

Course Coding

A two letters (or three letters, if necessary) and three 3-numbers code is given to each course offered by the dept. as shown below:

Department			Level/year	Field	Sequence
A	B	C	X	Y	Z

The Department codes (A, B, C) are selected as follows:

Code	Department	Code	Department
AE	**Aeronautical Engineering**	IE	Industrial Engineering
CE	Civil Engineering	ChE	Chemical Engineering
ME	Mechanical Engineering	BME	Biomedical Engineering
EE	Electrical Engineering	NE	Nuclear Engineering

Course Numbering

- The Aeronautical Engineering courses are tabled and numbered in such a manner to recognize each course regarding its subject area, year or level, and semester offered.
- Ex. AE XYZ: The **AE** symbol in the course number denotes Aeronautical Engineering and (XYZ) is a 3-digits number:

A. The first digit (X) denotes the year level of the course according to student's study plan as follows:

Code	Level/year
1	First year
2	Second year
3	Third year
4	Fourth year
5	Fifth year

B. The second digit (Y) denotes the course field subject as follows:

Second number	Field
0	General/Miscellaneous
1	General Mechanics (Statics, Dynamics & Strength of Materials)
2	Thermodynamics & Propulsion
3	Machine Design, Aircraft Structure & Materials
4	Fluid Mechanics, Gas Dynamics & Aerodynamics
5	Heat Transfer
6	Vibration, Stability & Control
7	Engineering Measurements, Navigation & Aircraft Sensors
8	Aircraft Performance & Maintenance
9	Projects, Special Topics & Training

C. The third digit (Z) denotes the course sequence in its subject area (Odd numbers represent first semester and even numbers represent second semester courses). Example: AE 511 means:

AE	5	1	1
Department	5th year level	General Mechanics field	1st semester sequence / offering

Framework for AE B.Sc. Degree (160 Semester Credits)

The Bachelor of Science (B.Sc.) degree in Aeronautical Engineering in the Faculty of Engineering at JUST is awarded in accordance with the Statute stated in the JUST regulations for B.Sc. awarding issued by the Deans' council based on the 1987 adjusted law for awarding scientific degrees and certifications at JUST and after the successful completion of 160 credit hours (C.H.). The 160 C.H. are distributed as shown in Table (1).

Table 1: Distribution of credit hours

Classification	Credit hours		
	Compulsory	Elective	Total
University requirements	16	9	25
Faculty requirements	32	0	32
Department requirements	94	9	103
Total	142	18	160

Degree Requirements:

University Requirements (25 Credit Hours)

Students are required to study a total of 25 credit hours (16 compulsory and 9 electives), as follows:

a- Compulsory University Requirements: (16 Credit Hours)

Table 2: University compulsory courses (16 credit hours)

Course No.	Course title	Credit hours	Theoretical	Practical
MS 100 (1)	Military sciences	3	3	-
ARA 101	Arabic language	3	3	-
HSS 110	Social responsibility	3	3	-
HSS119(2)	Entrepreneurship and Innovation	2	2	-
LG 112	English language 2	3	3	-
HSS129	General skills	2	2	-

(1) This course is required from Jordanian students only; non-Jordanian students can take a substitute for this course from the university elective courses.

(2) Faculty of Engineering students must take "HSS119A" Introduction to Engineering Innovation and Entrepreneurship instead of "HSS119" Entrepreneurship and Innovation.

Notice: All non-Arabic speaking students in the university are required to study the following courses shown in Table (3):

Table 3: Courses for non-Arabic Speaking Students

Course No.	Course title	Credit hours	Theoretical	Practical
ARB 101A	Fundamentals of Arabic Language for non-Arabic speaking students (as a substitute for the course ARB 101)	3	3	-
HSS 110A	Social responsibility (in English) (as a substitute for the course HSS 110)	3	3	3

b- University Elective: (9 Credit Hours)

A total of 9 credit hours is required.

Faculty Requirements: (32Credit Hours)

The faculty course requirements include a total of 32 credit hours, as shown in Table (4)

Table 4: Faculty of Engineering requirements

Course No.	Course title	Credit hours	Theoretical	Practical	Prerequisite or co-requisite
NE100*	Introduction in Engineering	1	1	-	--
Math 101	Calculus 1	3	3	-	---
Math 102	Calculus 2	3	3	-	Math 101
Math 201	Intermediate Analysis	3	3	-	Math 102
Math 203	Ordinary Differential Equations I	3	3	-	Math 102
Phys 101	General Physics 1	3	3	-	---
Phys 102	General Physics 2	3	3	-	Phys 101
Phys 107	General Physics Lab	1	-	1	Pre/Co Phys 102
Chem 101	General Chemistry 1	3	3	-	---
Chem 102	General Chemistry 2	3	3	-	Chem 101
Chem 107	General Chemistry Lab	1	-	1	Pre/Co Chem 102
CS 114	Programming for Engineers	3	2	2	---
ME 100	Engineering Workshops	1	-	1	Pre/Co ME 103

ME 200	Engineering Drawing - A	1	-	1	---
Total		**32**	**27**	**6**	

* Online Course

Department Requirements: (103 Credit Hours)

The course requirements include a total of 103 credit hours divided into two groups:

a) **Department Compulsory Courses (94 credit hours):** Students have to take 95 credit hours from Table (5):

Table 5: Department compulsory courses (95 credit hours)

Course Number	Course Name	Cr. hr.	Theoretical	Practical	Prerequisite or Co-requisite
ME 103	Engineering Workshops Theoretical	1	1	-	---
AE 201	Introduction to Aeronautical Engineering *	3	3	-	ME 100
AE 204	Solid Modeling *	2	-	2	ME 200
ME 211	Statics	3	3	-	Phys 101
AE 212	Dynamics	3	3	-	ME 211 (PASS)
AE 214	Strength of Materials	3	3	-	ME 211 (PASS)
AE 303	Applied Math for Engineers	3	3	-	Math 201 (PASS), Math 203 (PASS)
EE 303	Fundamentals of Electrical Engineering (none EE students)	3	3	-	Phys 102, Math 102
ME 311	Mechanics of Machinery	3	3	-	AE 212 (PASS)
ME 320	Fundamentals of Electronics and Digital Logic	3	3	-	EE 303
AE 321	Thermodynamics	3	3	-	Phys 101 (PASS), Math 203 (PASS), Chem 102 (PASS)
AE 332	Aircraft Structural Materials	3	3	-	AE 214 (PASS)
AE 341	Fluid Mechanics	3	3	-	Phys 101 (PASS), Math 203 (PASS)

AE 344	Aerodynamics I	3	3	-	AE 201, AE 321, AE 341
IE 351	Economics &Engineering Management	2	2	-	Math 201
AE 370	Instrumentation	3	3	-	EE 303, AE 341
AE 372	Instrumentation Lab.	1	-	1	Pre/Co AE 370
AE 405	Numerical Methods for Engineers	3	3	-	CS 114, AE 303
AE 413	Mechanics of Materials Lab	1	-	1	AE 332, Pre/Co AE 372
AE 431	Machine Elements Design	3	3	-	AE 204, AE 332
AE 443	Gas Dynamics	3	3	-	AE 344 (PASS)
AE 444	Aeronautics Lab I	1	-	1	AE 413, AE 443
AE 452	Heat Transfer	3	3	-	AE 405, AE 443
AE 461	Mechanical Vibrations	3	3	-	AE 212 (PASS), AE 303
AE 464	Automatic Control	3	3	-	AE 461
AE 482	Aircraft Performance	3	3	-	AE 344 (PASS)
AE 484	Aircraft Maintenance Systems	3	3	-	AE 303, AE 344 (PASS)
AE 490	Engineering Training	3	-	3	Completion of 117 credit hours
AE 523	Propulsion	3	3	-	AE 344 (PASS)
AE 533	Aircraft Structure I	3	3	-	AE 431
AE 538	Aircraft Design	3	3	-	AE 482
AE 544	Aeronautics Lab II	1	-	1	AE 444, AE533, AE563
AE 563	Aircraft Stability & Control	3	3	-	AE 344 (PASS), AE 464
AE 574	Introduction to Avionics Systems	3	3	-	ME 320, AE 344 (PASS), AE 370, AE464
AE 591	Graduation Project I	1	-	1	Completion of 117 C.H.
AE 592	Graduation Project II	3	-	3	AE 591+ AE 490
TOTAL		**94**	**81**	**13**	

*** Online Course**

b) Department Elective Courses (9 credit hours): The student should study at least 6 credit hours from the technical electives listed in Table (6). The remaining 3 credit hours should be chosen either from Table (7) or any course of (500) level in the college of Engineering curriculum.

Table 6: Aeronautics Technical Electives

Course No.	Course title	Credit hours	Theoretical	Practical	Prerequisite or co-request
AE 505	Finite Elements Method	3	3	-	AE 405, AE 533
AE 506	MicroElectro Mechanical Systems (MEMS)	3	3	-	AE 332, AE 452
AE 507	Finite Elements Methods in Aerospace Structures	3	3	-	AE 405, AE 533
AE 532	Manufacturing Processes	3	3	-	AE 431
AE 534	Aircraft Structures II	3	3	-	AE 533
AE 536	Aeroelasticity	3	3	-	AE 344, AE 533
AE 537	Composite Materials	3	3	-	AE 332
AE 539	Fracture Mechanics	3	3	-	AE 431
AE 545	Computational Fluid Dynamics	3	3	-	AE 443, AE 452
AE 546	Aerodynamics II	3	3	-	AE 344
AE 547	Boundary Layer Theory	3	3	-	AE 443, AE 452
AE 564	Rotary Wing Aircrafts	3	3	-	AE 563
AE 576	Aircraft Navigation	3	3	-	AE 370, AE464 (PASS)
AE 593A	Special Topics in Aeronautics – A*	3	3	-	Completion of 120 Cr. Hr
AE 593B	Special Topics in Aeronautics - B	2	2	-	Completion of 120 Cr. Hr
AE 593C	Special Topics in Aeronautics - C	1	1	-	Completion of 120 Cr. Hr

*** Online Course**

Study Plan for the B.Sc. Degree in Aeronautical Engineering

First Year (Preparatory Year for the College of Engineering)											
First semester						Second semester					
Course No.	Course Name	Credit Hours	Weekly hours		Prerequisite	Course No.	Course Name	Credit Hours	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
NE 100	Introduction to Engineering	1	1	-	-	ME 100	Engineering Workshops	1	-	3	-
ME 200	Engineering Drawing A	1	-	3	-	NE 114	Programming For Engineers	3	2	2	-
HSS 119 A	Introduction to Engineering Innovation and Entrepreneurship	2	2	-	-	MATH 102	Calculus 2	3	3	-	MATH 101
MATH 101	Calculus 1	3	3	-	-	CHEM 102	General Chemistry 2	3	3	-	CHEM 101
PHYS 101	General physics 1	3	3	-	-	CHEM 107	General Chemistry lab.	1	-	3	CHEM 102 (or Co.)
CHEM 101	General Chemistry 1	3	3	-	-	PHYS 102	General Physics 2	3	3	-	PHYS 101
ARB 101	Arabic Language	3	3	-	-	PHYS 107	General Physics lab.	1	-	3	PHYS 102 (or Co.)
Total		**16**	**15**	**3**		**Total**		**15**	**11**	**11**	

SECOND YEAR											
First semester						Second semester					
Course No.	Course name	Total Credit	Weekly hours		Prerequisite	Course No.	Course name	Total Credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
MS 100	Military Science	3	3	-	---	Math 203	Ordinary Differential Equations I	3	3	-	Math 102
HSS110	SOCIAL RESPONSIBILITY	3	3	-	---						
Eng 112	English Language 2	3	3	-	-	AE 204	Solid Modeling	2	-	6	ME 200
ME 103	Engineering Workshops Theoretical	1	1	-	---	AE 212	Dynamics	3	3	-	ME 211 (PASS)
AE 201	Introduction to Aeronautical Engineering	3	3	-	ME 100	AE 214	Strength of Materials	3	3	-	ME 211 (PASS)
Math 201	Intermediate Analysis	3	3	-	Math 102	HSS129	GENERAL SKILLS	2	2	-	----
ME 211	Statics	3	3	-	Phys 101	-	University Elective	3	3	-	---
Total		**19**	**19**	**-**		**Total**		**16**	**14**	**6**	

THIRD YEAR											
First semester						Second semester					
Course No.	Course name	Total credit	Weekly hours		Prerequisite	Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
AE 303	Applied Math for Engineers	3	3	-	Math 201 (PASS), Math 203 (PASS)	ME 311	Mechanics of Machinery	3	3	-	AE 212 (PASS)
EE 303	Fundamentals of Electrical Engineering (none EE students)	3	3	-	Phys 102, Math 102	ME 320	Fundamentals of Electronics and Digital Logic	3	3	-	EE 303
AE 321	Thermodynamics	3	3	-	Phys 101 (PASS), Math 203 (PASS), Chem 102 (PASS)	AE 332	Aircraft Structural Materials	3	3	-	AE 214 (PASS)
AE 341	Fluid Mechanics	3	3	-	Phys 101 (PASS), Math 203 (PASS)	AE 344	Aerodynamics I	3	3	-	AE 201, AE 321, AE 341
IE 351	Economics &Engineering Management	3	3	-	Math 201	AE 370	Instrumentation	3	3	-	EE 303, AE 341
-	-	-	-	-	-	AE 372	Instrumentation Lab.	1	-	3	Pre/Co AE 370
Total		**15**	**15**	**-**		**Total**		**16**	**15**	**3**	

FOURTH YEAR											
First semester						Second semester					
Course No.	Course name	Total credit	Weekly hours		Prerequisite	Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
AE 405	Numerical Methods for Engineers	3	3	-	CS 114, AE 303	AE 444	Aeronautics Lab I	1	-	3	AE 413, AE 443
AE 413	Mechanics of Materials Lab.	1	-	3	AE 332, Pre/Co AE 372	AE 452	Heat Transfer	3	3	-	AE 405, AE 443
AE 431	Machine Elements Design	3	3	-	AE 204, AE 332	AE 464	Automatic Control	3	3	-	AE 461
AE 443	Gas Dynamics	3	3	-	AE 344 (PASS)	AE 482	Aircraft Performance	3	3	-	AE 344(PASS)
AE 461	Mechanical Vibrations	3	3	-	AE 212(PASS), AE 303	AE 484	Aircraft Maintenance Systems	3	3	-	AE 303, AE 344(PASS)
	University Elective	3	3	-			University Elective	3	3	-	
Total		**16**	**15**	**3**		**Total**		**16**	**15**	**3**	

SUMMER SESSION					
Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab	
AE 490	Engineering Training	3	-	-	Completion of 117 credit hours
Total		**3**	**-**	**-**	

Fifth YEAR											
First semester						Second semester					
Course No.	Course name	Total credit	Weekly hours		Prerequisite	Course No.	Course name	Total credit	Weekly hours		Prerequisite
			Lecture	Lab					Lecture	Lab	
AE 523	Propulsion	3	3	-	AE 344 (PASS)	AE 538	Aircraft Design	3	3	-	AE 482
AE 533	Aircraft Structure I	3	3	-	AE 431	AE 544	Aeronautics Lab II	1	-	3	AE 444
AE 563	Aircraft stability and Control	3	3	-	AE 344 (PASS), AE 464	AE 574	Introduction to Avionics Systems	3	3	-	ME 320, AE 344 (PASS), AE 370
AE 591	Graduation Project I	1	1	-	Completion of 117 credit hours	AE 592	Graduation Project II	3	-	-	AE 490, AE 591
	Technical Elective	3	3	-			Technical Elective	3	3	-	
	Technical Elective	3	3	-							
Total		**16**	**16**	**-**		**Total**		**13**	**9**	**3**	

Aeronautical Engineering Department Course Description

AE 201: Introduction to Aeronautical Engineering (3 CH) (Pre: ME 100)
Role of professional aeronautical engineers, along with the development of fundamental engineering knowledge and skills for flight vehicle design, analysis performance and operation, Introduction to the multiple disciplines related to aeronautical engineering, Engineering ethics, Communication skills, Manufacturing Technology.

AE 204: Solid Modeling (2CH) (Pre: ME 200)
Study of parametric solid modeling as a design/drawing tool using software such as Pro-Engineer, Topics include creation of three-dimensional solid models, assemblies, and renderings, as well as generation of two-dimensional technical drawings from three-dimensional models.

AE 212: Dynamics (3CH) (Pre: ME 211 (PASS))
Dynamics of particles, two- and three-dimensional dynamics of rigid bodies, moment of inertia, work and energy, impulse and momentum for rigid bodies.

AE 214: Strength of Materials (3CH) (Pre: ME 211 (PASS))
Concepts of stress and strain, Stresses and displacements of axially loaded members, The state of stress and strain, Normal, bending, shear, and torsion stresses, Mechanical properties of materials, combined stresses, composite sections, Deflections: integration Method, Moment area method, Buckling of columns.

AE 303: Applied Math for Engineers (3CH)(Pre: Math 201 (PASS), Math 203 (PASS))
Laplace transformation, applications to solutions of ordinary differential equations, Fourier series, half range expansion, Solutions of partial differential equations using separation of variables, Complex numbers and complex functions, Linear Algebra.

AE 321: Thermodynamics (3CH) (Pre: Phys 101 (PASS), Math 203 (PASS), Chem 102 (PASS))
Properties and behavior of a pure substance, First law and second law analysis applied to different systems and control volumes, Thermodynamics applications.

AE 332: Aircraft Structural Materials (3CH) (Pre: AE 214 (PASS))
Structural materials in aircraft industry, Structure of crystalline solids, Imperfections in solids, Mechanical properties, Strengthening mechanisms, Static and fatigue fracture, Phase diagram, Processing conditions-properties relationship, Creep, Corrosion, Introduction to composite materials.

AE 341: Fluid Mechanics (3CH) (Pre: Phys 101 (PASS), Math 203 (PASS))

Fluids and their properties, Conservation equations and their applications, Dimensional analysis and similarity, Two-dimensional inviscid flow, stream function, and velocity potential, Superposition of elementary flow, Incompressible laminar and turbulent flow in pipes, friction factor, Laminar flow between parallel plates and in ducts, Elementary boundary layer flow, skin friction and drag, Pump and pipeline system characteristics.

AE 344: Aerodynamics I (3CH) (Pre: AE 201, AE 321, AE 341)
Basics of aerodynamics: the concept of lift and drag, source panel method, Kutts-Joukwski theorem, Aerodynamic characteristics of airfoils: airfoil geometry parameters, vortex panel method, Kutta condition, thin-airfoil theory, high-lift airfoil section, Wings of finite span: lifting-line theory, trailing vortices and downwash, vortex-induced drag, vortex-lattice method, Effects of boundary layer interaction, Aerodynamic design.

AE 370: Instrumentation (3CH) (Pre:EE 303, AE 341)
Statistical analysis of experimental data, uncertainty analysis, various statistical distributions and test of goodness of fit, correlation coefficient and multivariable regression, Engineering instrumentation include types of passive/active transducers, electronics for instrumentation, computer-based data acquisition, and experiments on pressure, temperature, force measurements.

AE 372: Instrumentation Lab. (1CH) (Pre/Co: AE 370)
System response and performance, Strain, pressure, force and temperature measurements, Operational amplifiers, Data acquisition.

AE 405: Numerical Methods for Engineers (3CH) (Pre:CS 114, AE 303)
Errors in computations, Roots of equations, System of linear algebraic equations including eigenvalue problems, Interpolations and curve fitting, Numerical integration and differentiation, Ordinary differential equations including boundary and initial value problems, Introduction to numerical solution of partial differential equations.

AE 413: Mechanics of Materials Lab. (1CH) (Pre: AE 332, Pre/Co: AE 372)
Hardness, Tensile, compression, impact, Torsion, Creep, Buckling and fatigue tests, Thin pressure vessels, non-destructive testing, heat treatment, and casting.

AE 431: Machine Elements Design (3CH) (Pre: AE 204, AE 332)
Static and fatigue failure theories, The analysis and design of machine elements including but not limited to shafts, screws, non-permanent joints, ball & roller bearings, and gears.

AE 443: Gas Dynamics (3CH) (Pre: AE 344 (PASS))

One-dimensional gas dynamics, normal and oblique shock waves, Prandtl-Meyer flows, Rayleigh and Fanno-line flow, airfoils in supersonic flow, thin airfoil theory.

AE 444: Aeronautics Lab. I (1CH) (Pre: AE 413, AE 443)
Basic measurements of aerodynamic forces and pressure distribution using low speed wind tunnel, Supersonic flow, flight demonstration, tunnel experiments, Aerospace propulsion (gas turbines), ramjets, etc.), Basic aircraft sensors.

AE 452: Heat Transfer (3CH) (Pre: AE 405, AE 443)
Principles of Heat Transfer, Steady state and transient conduction in different coordinates, extended surfaces, Convective heat transfer, Analysis and empirical relations for forced and natural convection, Radiation heat transfer, radiation exchange between black and gray surfaces, Heat Exchangers, Thermal Stresses.

AE 461: Mechanical Vibrations (3CH) (Pre: AE 212 (PASS), AE 303)
Properties of oscillatory motion, Derivation of governing differential equations, Free and damped vibrations, Harmonically excited motion, rotating and reciprocating unbalance, support motion, Vibration measurements, Vibration isolation, Transient vibrations, Free and forced vibrations in multi-degrees-of-freedom systems, Vibration absorbers, Continuous systems.

AE 464: Automatic Control(3CH) (Pre: AE 461)
Study of continuous-time systems, classical and modern system design methods, transfer function models, state space, dynamics of linear systems, and frequency domain analysis and design techniques, Introduction of controllability and observability, and full-state pole placement controller design.

AE 482: Aircraft Performance (3CH) (Pre: AE 344 (PASS))
Aircraft performance in steady flight, Straight and level flight, Flight limitations, Drag, Power, Performance curves in terms of thrust and power, Gliding flight, Climbing flight, Range and endurance, Other methods of solution to performance problems, Aircraft performance in accelerated flight, Climbing flight, Take off, Landing, Turning flight, Introduction to helicopters.

AE 484: Aircraft Maintenance Systems (3CH) (Pre: AE 303, AE 344 (PASS))
Introduction, Reliability theory, Life testing, Maintained systems, Integrated logistic support (ILS), Aircraft handling, Repair station requirements, Quality systems, Inventory control, Structural repair, Engine maintenance and overhaul, Maintenance of aircraft systems and instruments.

AE 490: Engineering Training (3 CH) (Pre: Completion of 117 credit hours)

Eight weeks of practical training in an institution (university, company, etc.) that is accredited by the aeronautical engineering department and faculty of engineering at JUST for training purposes in the field of aeronautical engineering, The training should be under the supervision of a staff member, Students have to submit a report about their achievements during training in addition to any other requirements assigned by the department.

AE 505: Finite Elements Method (3CH) (Pre: AE 405, AE 533)
Fundamental concepts of the finite element method for linear stress and deformation analysis of structural components, Topics include the development of truss, beam, frame, plane stress, plane strain, axisymmetric, and solid elements, One and two dimensional heat transfer, Potential flow, Finite element software will be used for solving practical engineering problems.

AE 506: MicroElectroMechanical Systems (MEMS) (3CH) (Pre: AE 332, AE 452)
Fabrication and design fundamentals for Microelectromechanical Systems (MEMS): on-chip sensor and actuator systems having micron-scale dimensions, Basic principles covered include microstructure fabrication, mechanics of silicon and thin-film materials, electrostatic force, capacitive motion detection, fluidic damping, piezoelectricity, piezo-resistivity, and thermal micromechanics, Applications covered include pressure sensors, micro-mirror displays, accelerometers, and gas micro-sensors and microfluidic systems.

AE 507: Finite Elements Methods in Aerospace Structures (3CH) (Pre: AE 405, AE 533)
Introduction to the advanced matrix methods in treating aerospace structures, Static analysis of wing, fuselage, and rocket structures, Stability and large displacement of ribs, stringers, and skins, Vibration of wing-fuselage combinations, Structural damping, Vibration of stretched or compressed wing panels.

AE 523: Propulsion (3CH) (Pre: AE 344 (PASS))
An integrated approach to the application of engineering principles to propulsion systems, Topics include: turboprops, turbojets, turbofans, turbo shaft, ramjets, scramjets and rocket engines, beside intakes, compressors, fans, turbines and propelling nozzles.

AE 532: Manufacturing Processes (3CH) (Pre: AE 431)
Introduction to rolling, drawing, machining, and joining (welding, soldering, adhesive bonding, and mechanical fastening), sheet-metal forming processes, and fabrication of composite materials, Introduction to heat treatment, plasma coating, and nondestructive testing (NDT).

AE 533: Aircraft Structure I (3CH) (Pre: AE 431)

Principles of stressed skin construction: materials and structural components of aircraft, Airworthiness and Airframe Loads, Bending, shear and torsion of open and closed thin-walled beams, Structural idealization, Stress analysis of aircraft components: wing spars and box beams, fuselages, wings, fuselage frames and wing ribs and laminated composite structures.

AE 534: Aircraft Structures II (3CH) (Pre: AE 533)
Energy principles, matrix analysis of structures, introduction to finite element methods, Application to aircraft structural elements, Introduction to composite material in aircrafts and introduction to classical laminated plate theory, Elementary aero-elasticity.

AE 536: Aeroelasticity (3CH) (Pre: AE 344, AE 533)
Wing divergence control reversal, Lift effectiveness, Swept wing aero elasticity, Vibrations of structure, unsteady aerodynamic forces and moment, Flutter of a single degree of freedom system, Methods of flutter analysis.

AE 537: Composite Materials (3CH) (Pre: AE 332)
Application of composite materials in aerospace industry, Fiber reinforced composites, Stress, strain, and strength of composite laminate, Failure criterion, Environmental effect, Design of composite structure.

AE 538: Aircraft Design (3CH) (Pre: AE 482)
Conceptual design of a modern airplane to satisfy a given set of requirements, Estimation of size, selection of configuration, weight and balance, and performance of airplane, Sizing of cockpit, passengers' cabin, cargo compartment, and weapon carriage considerations, Conic shape lofting of fuselage and wings for design layout.

AE 539: Fracture Mechanics (3CH) (Pre: AE 431)
Investigation of linear elastic and elastic-plastic fracture mechanics, Topics include microstructural effects on fracture in metals, toughening mechanisms, crack growth resistance, Fatigue damage and dislocation substructures in single crystals, stress- and strain-life approach to fatigue, fatigue crack growth models and mechanisms, variable amplitude fatigue.

AE 544: Aeronautics Lab. II (1CH) (Pre: AE 444, AE533, AE563)
Short period oscillation, The phugoid oscillation, Trim curves and neutral point determination, Bending of Aircraft Wing (Symmetric Wing, The Role of the Shear Center), Torsion of Airfoils (Two-cell Section, Effect of the Spar), Thin-walled Shear Beams (Three Stringer Beams, The Role of the Shear Center), Structural Dynamics (Vibration of Beam, Various Vibration Modes of a Cantilevered Plate), Whole-field Stress Analysis (Photo elasticity of Grooved Specimen, Effect of Notch Geometry).

AE 545: Computational Fluid Dynamics (3 CH) (Pre: AE 443, AE 452)

Introduction to computational fluid dynamics and heat transfer using the finite-volume method, Extensive code development, Application of a commercial CFD solver to a problem of interest.

AE 546: Aerodynamics II (3CH) (Pre: AE 344)
Dynamics of a compressible flow field, Prandtl-Meyer flow, Mach lines and characteristics, Linearized compressible subsonic flow: flow about a thin wing, swept wings at transonic speed, Two-dimensional, supersonic flows over wings and airplane configuration: conical-flow method, singularity-distribution method, High-lift configurations: multielement airfoils, Drag reduction methods: laminar-flow control, Aerodynamics design tools.

AE 547: Boundary Layer Theory (3CH) (Pre: AE 443, AE 452)
Derivation of the boundary layer equations, Exact, approximate, and numerical solution techniques, Boundary layers in compressible flow, Separation, Unsteady boundary layers, Stability and transition, Turbulent boundary layers, Integral, differential, & numerical methods for solving problems associated with transfer of heat in a viscous fluid.

AE 563: Aircraft Stability and Control (3CH) (Pre: AE 344 (PASS), AE 464)
Atmospheric properties, and aerodynamics, Static stability and control, Equations of motion, forces and moments, Controls-fixed longitudinal dynamics, Controls-fixed lateral/directional dynamics, Review of modern control theory, Application to autopilot design.

AE 564: Rotary Wing Aircrafts (3CH) (Pre: AE 563)
Fundamentals of aerodynamics and fluid flow concepts for developing rotary wing aircraft performance, Two-dimensional aerodynamic characteristics of airfoils and their application in helicopter design, Means for augmenting lift and the effects of various types of high lift devices on the aerodynamic characteristics, Aerodynamics of finite aspect ratio wings leading to the fundamentals of airplane performance calculation, Theory of helicopter hovering and vertical flight including autorotation and the aerodynamic behavior of the rotor and helicopter in forward flight.

AE 574: Introduction to Avionics Systems (3CH) (Pre: ME 320, AE 344 (PASS), AE 370, AE464)
Flight instruments and sensors, Introduction to aeronautical navigation systems, Introduction to communication systems, Electronic Warfare, Displays, Automatic flight control systems and actuators.

AE 576: Aircraft Navigation (3CH) (Pre: AE 370, AE464 (PASS))
Fundamentals of aircraft navigation systems, Techniques in celestial and inertial navigation, Global Positioning System (GPS) principles, Least squares estimation and Kalman filtering for optimal estimation of stochastic systems.
AE 591: Graduation Project I (1 CH) (Pre: Completion of 117 credit hours)

Provides students the opportunity to individually explore an aeronautical engineering problem or issue within their field of study and apply their education to solving the problem for the benefit of the local community and society as a whole. Students produce a short report that documents the application of previous learning, experience and knowledge to the problem at hand, and evaluates the results.

AE 592: Graduation Project II (3CH) (Pre: AE 490, AE 591)
Students perform the experimental and/or practical phases associated with solving the aeronautical engineering problem addressed in Graduation Capstone Project I. Students produce a full technical report that documents the research, design, results, analysis, and recommendations of the study, followed by a final presentation and defense.

AE 593A: Special Topics in Aeronautics - A (3CH)
Pre: Department approval

AE 593B: Special Topics in Aeronautics - B (2CH)
Pre: Department approval

AE 593C: Special Topics in Aeronautics - C (1CH)
Pre: Department approval