Sanjay Ghodawat University

Kolhapur

School of Engineering & Technology

Department of Aerospace Engineering

B. Tech. Aeronautical Engineering
(Third Year)

Curriculum Book

(Programme Structure and Course Contents)

Academic Year 2024 -25

Curriculum Structure for Bachelor of Technology (Aeronautical Engineering)

Part-I AY 2024-25 (Batch 2022-26)

SEMESTER V

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT Marks	Mini. Passing %	
UAE501 (PC)	High speed Aerodynamics	3	1	-	4	Theory & Tutorial	FA	50	50	40%	40%
							SA	100	50	40%	
UAE502 (PC)	Aircraft Structure-I	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UAE503 (PC)	Aircraft Design	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UAE55X (PE)	Program Elective III	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UST55X	University Open Elective	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UNM005 (NCMC)	Industrial Safety Training	-	-	2	NC	Practical	FA	100	100	40%	40%
Total		***15***	***1***	***10***	***20***		***Total Hrs:26 Total Credit: 20***				

L: Lecture; T: Tutorial; P: Lab Practical; J: Project or activity based learning; FA: Formative Assessment (Theory and/or Practical); SA: Summative Assessment-End Semester Examination; PC: Program Core Course; PE: Program Elective; UC: University Core; NC: Non-Credit Course; UMNCC: University Mandatory Non- Credit Course, UE-University Elective, FA-Formative Assessment, SA-Summative Assessment

Program Elective – III	
Course Code	**Course title**
UAE551	Composite Materials and Structures
UAE552	Aircraft Electrical Systems and Maintenance

University Open Elective I (Semester V)		
Course Code	**Course Title**	**Department**
UST551	Renewable Energy	Mechanical
UST552	Water Power Engineering	Civil
UST553	Fundamental of Aeronautical Engineering	Aeronautical
UST554	Internet of Things	E&C
UST555	Network Security	CSE
UST556	Business Intelligence	AIML
UST557	Energy Management & Energy Audit	Electrical

Curriculum Structure for Bachelor of Technology (Aeronautical Engineering)
Part-I AY 2024-25 (Batch 2022-26)
SEMESTER VI

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE601 (PC)	Finite Element Method	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UAE602 (PC)	Aircraft Structure-II	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UAE603 (PC)	Flights Dynamics	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UAE65X (PE)	Program Elective IV	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UST65X (OE)	University Open Elective II	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UNM006 (NCMC)	Creativity and Innovations	-	-	2	NC	Practical	FA	100	100	40%	40%
Total		***15***	***-***	***12***	***20***	***Total Hrs:27 Total Credit: 20***					

L: Lecture; T: Tutorial; P: Lab Practical; J: Project or activity based learning; FA: Formative Assessment (Theory and/or Practical); SA: Summative Assessment-End Semester Examination; PC: Program Core Course; PE: Program Elective; UC: University Core; NC: Non- Credit Course; UMNCC: University Mandatory Non- Credit Course, UE-University Elective, FA-Formative Assessment, SA-Summative Assessment

Program Elective – IV	
Course Code	**Course Title**
UAE 651	Vibration and Aero elasticity
UAE 652	Airframe Maintenance and Repair

University Open Elective II (Semester VI)		
Course Code	**Course Title**	**Department**
UST651	Total Quality Management	Mechanical
UST652	Construction Project Management	Civil
UST653	Flying Vehicle Systems and Instruments	Aeronautical
UST654	Automotive Electronics	E&C
UST655	Cloud Security	CSE
UST656	Big Data Analytics	AIML
UST657	Introduction to Electric Vehicle.	Electrical

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE501 (PC)	High speed Aerodynamics	3	1	-	4	Theory &Tutorial	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: **Explain**[2] the Properties of Compressible flow

CO2: **Analyze**[4] different shock waves

CO3: **Analysis**[4] on compressible flow over different devices

CO4: **Explain**[2] significance of linear flow

CO5: **Analysis**[4] of supersonic flow using linear theory

Unit No	Contents	Lecture Hrs
1	**Aspects of Compressible Flow** A Brief Review of Thermodynamics: Perfect Gas, Internal Energy and Enthalpy, First Law of Thermodynamics, Entropy and the Second Law of Thermodynamics, Isentropic Relations. Compressibility, Governing Equations for Inviscid, Compressible Flow, Stagnation Conditions, Some Aspects of Supersonic Flow: Shock Waves	7
2	**Normal Shock Waves** The Basic Normal Shock Equations, Speed of Sound, Special Forms of the Energy Equation, Calculation of Normal Shock- Wave Properties, Measurement of Velocity in a Compressible Flow- Subsonic Compressible Flow, Supersonic Flow.	7
3	**Oblique Shock and Expansion Waves** Oblique Shock Relations**,** Supersonic Flow over Wedges and Cones**,** Shock Interactions and Reflections, Detached Shock Wave in Front of a Blunt Body, Prandtl-Meyer Expansion Waves, Shock-Expansion Theory: Applications to Supersonic Airfoils.	7
4	**Compressible Flow through Nozzles, Diffusers and Wind Tunnels** Governing Equations for Quasi-One-Dimensional Flow, Nozzle Flows, Diffusers, Supersonic Wind Tunnels.	7

5	**Linear Theory** Velocity Potential Equation, Linearized Velocity Potential Equation, Prandtl-Glauert Compressibility Correction, Improved Compressibility Corrections, Critical Mach number-Comment on the Location of Minimum Pressure (Maximum Velocity), Drag- Divergence Mach number: Sound Barrier, Area Rule, Supercritical Airfoil.	**6**
6	**Linearized Supersonic Flow** Derivation of the Linearized Supersonic Pressure Coefficient Formula, Application to Supersonic Airfoils, Viscous Flow: Supersonic Airfoil Drag.	**6**

Text Books:

1. J D Anderson. Fundamental of Aerodynamics, McGraw hill Education, 5thedn, 2011.
2. Hughton and carpenter. Aerodynamics for Engineering Students, Butterworth-Heinemann– 5thedn.2003
3. E Radhakrishnan. Gas Dynamics. Prentice Hall India learning Pvt. Ltd. 5th Revised edn, 2014.

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE502 (PC)	Aircraft Structure-I	3	-	2	4	Theory &Practical	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: **Ability**[2] to perform linear static analysis of determinate and indeterminate aircraft structural components

CO2: **Ability**[3] to design the component using different theories of failure

CO3: **Calculate**[2] the response of statically indeterminate structures under various loading conditions.

CO4: **Calculate**[2] the reactions of structures using strain energy concept.

CO5: **Create**[3] a structure to carry the given load.

Unit No	Contents	Lecture Hrs
1	**Statically determinate & indeterminate structures** Plane truss analysis – method of joints – method of sections – principle of super position, Clapeyron‟s 3 moment equation and moment distribution method for indeterminate beams.	7
2	**Energy methods** Strain Energy in axial, bending, torsion and shear loadings. Castigliano‟s theorems and their applications. Energy theorems – dummy load & unit load methods – energy methods applied to statically determinate and indeterminate beams, frames, rings & trusses.	7
3	**Columns** Euler‟s column curve – inelastic buckling – effect of initial curvature – Southwell plot – columns with eccentricity – use of energy methods – theory of beam columns – beam columns with different end conditions – stresses in beam columns.	7
4	**Failure theories** Ductile and brittle materials – maximum principal stress theory - maximum principal strain theory - maximum shear stress theory - distortion energy theory – octahedral shear stress theory.	7
5	**Induced stresses :**Thermal stresses – impact loading – Fatigue – Creep - Stress Relaxation	6
6	**Aircraft Structural Repair** Types of structural damage, Non-conformance, Rework, Repair, Allowable damage Limit, Repairable damage limit, Overview of ADL Analysis, Types of repair, repair considerations and best practices	6

Text Books:

1. Mechanics of Materials‟ by James M. Gere & Barry J Goodno, cengage Learning Custom Publishing; 8th edition, 2012.
2. Megson T M G, `Aircraft Structures for Engineering students‟ Butterworth-Heinemann publisher, 5th edition, 2012.
3. N.C. Pandya, C.S. Shah, “Elements of Machine Design”, Charotar Publishing House, 15th edition, 2009.

List of Experiments

1. Determination Of Young’s Modulus By Using Simply Supported Beam
2. Determination Of Young’s Modulus By Using Cantilever Beam
3. Determination Of Deflection By Using Cantilever Beam
4. Deflection In Simply Supported Beam With An Eccentric Point Load
5. Deflection In Cantilever Beam With An Eccentric Point Load
6. Deflection In Simply Supported Beam Under Symmetric Loading
7. Verification Of Maxwell’s Reciprocal Theorem
8. Deflection At Midpoint Using Four Point Bending Beam
9. Verification Of Superposition Theorem Tip Deflection Of Cantilever Beam By Applying Two Transverse Loads
10. Verification Of Superposition Theorem Tip Deflection Of Simply Supported Beam By Applying Two Transverse Loads

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE503 (PC)	Aircraft Design	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: **Explain[2]** various methodologies of aircraft design, configuration and layout of aircrafts.

CO2: **Analyze[4]** the different Parameters to Design Aircraft

CO3: **Analyze[4]** the sizing and constraint of aircraft engine in terms of estimation of design gross weight

CO4: **Explain[2]** the concepts of Operational and Environmental Issues

CO5: **Analyze[4]** advanced supersonic aircraft design concepts

Unit No	Contents	Lecture Hrs
1	**Aircraft Design** Three phases in aircraft design, Review of computer based aircraft design methodologies, differences between LTA and HTA aircraft, type of civil and military aircraft	7
2	**Configuration and Layout** Types and comparison of wing, tail, fuselage, landing gear, wingtail combinations, power plant (types, numbers, locations), unconventional aircraft configurations.	6
3	**Sizing and Constraint Analysis** Initial sizing, estimation of design gross weight, rubber engine sizing and fixed engine sizing, refined sizing method and constraint analysis.	7
4	**Estimation Methodologies** Lift and drag coefficient, design loads, component mass breakdown, acquisition cost, direct operating cost.	7
5	**Operational and Environmental Issues** Range-payload diagram, Theory of V-n diagram, noise and emission levels, special considerations such as stealth, survivability, maintainability	7
6	**Advanced Concepts in Aircraft Design** Supersonic aircraft design, very large aircraft, morphing aircraft.	6

Text Books:

1 Raymer, D. P., Aircraft Design - A Conceptual Approach, AIAA Educational Series, 4th Ed., 2006

2 Brandt, S. A., Stiles, R. J., Bertin, J. J., Whitford, R., Introduction to Aeronautics: A Design Perspective, AIAA Educational Series, 2nd ed., 2004.

3 Jenkinson, L. R., Simpkin, P. and Rhodes, D., Civil Jet Aircraft Design, Arnold Publishers, London, 1999

4 Fielding, J., Introduction to Aircraft Design, Cambridge Aerospace Series, Cambridge University Press, 1999.

List of Experiments

1. Comparative studies of different types of airplanes and their specifications and performance details with reference to the design work under taken.
2. Calculate Preliminary weight estimation, Selection of design parameters, power Plant selection, aerofoil selection, fixing the geometry of Wing, tail, control surfaces Landing gear selection.
3. Preparation of layout drawing,
4. Construction of balance and three view diagrams of the airplane under consideration
5. To conduct experiment using windtunnel to determine drag coefficient
6. Conduct test on aircraft model with different parameters
7. Conduct Stability analysis of the developed aircraft
8. Conduct structural analyze of the aircraft model using Nastran patran
9. Analyze variation in lift and drag with different control surface size
10. Draw the Three View Diagram of designed aircraft

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE551	Composite Materials and Structures	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: **Explain[2]** the Micro and Macro mechanics aspects of composite materials

CO2: **Analyze[4]** the stresses and strains in a laminate using laminated plate theory

CO3: **Analyze[4]** the elastic properties and predict the failure layer of fiber reinforced composites

CO4: **Explain[2]** the theory of coating used in composite material

CO5: **Explain[2]** various concepts of sandwich construction and bending and shear flow in beam

Unit No	Contents	Lecture Hrs
1	**Micromechanics** Introduction – Advantages and application of composite materials – types of reinforcements and matrices – micro mechanics – mechanics of materials approach, elasticity approach- bounding techniques – fiber volume ratio – mass fraction – density of composites. Effect of voids in composites	7
2	**Macro mechanics** Generalized Hooke‟s Law – Elastic constants for anisotropic, orthotropic and isotropic materials – macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis, and determination of in plane strengths of a lamina – experimental characterization of lamina. Failure theories of a lamina.	7
3	**Laminated Plate Theory** Governing differential equation for a laminate. Stress – strain relations for a laminate. Different types of laminates in plane and flexural constants of a laminate.	7
4	**Stresses and strain in laminate** Hygrothermal stresses and strains in a laminate. Failure analysis of a laminate. Impact resistance and inter laminar stresses. Netting analysis	7
5	**Theory of Coating** Relation between stresses in coating and specimen, use of failure theories in brittle coating, moiré method of strain analysis	6
6	**Sandwich Constructions** Basic design concepts of sandwich construction – materials used for sandwich construction failure modes of sandwich panels – bending stress and shear flow in composite beams.	6

Text Books:

1. Madhuji Mukhapadhyay. Mechanics of Composite Materials, University Press, 2004.
2. Autar K Kaw.Mechanics of Composite Materials, CRC Press, 1997.
3. Agarwal, B.D., and Broutman, L.J. Analysis and Performance of Fibre Composites. John Wiley and Sons. Inc., New York, 1995.
4. Lubin, G.Handbook on Advanced Plastics and Fibre Glass, Von Nostrand Reinhold Co., New York, 1989.

List of Experiments

1. Study of FRP Composites with application
2. Demonstration of FRP/CFRP composite samples
3. Tensile testing of CFRP/GFRP
4. Compression testing of CFRP/GFRP
5. Flexural testing of CFRP/GFRP
6. Preparation of FRP Laminate by Hand layup method
7. Fatigue tensile testing of CFRP/GFRP
8. Fatigue compression testing of CFRP/GFRP
9. Fatigue Flexural testing of CFRP/GFRP

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE552	Aircraft Electrical Systems Maintenance	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: **Discuss**[2] the basics of Electrical Theory

CO2: **Explain**[2] different Aircraft elements and their maintenance

CO3: **Apply**[3] the electrical concepts in aviation industry

CO4: **Describe**[2] principles, operation and troubleshooting of aircraft systems

CO5: **Analyze**[4] power distribution systems in aircraft

Unit No	Contents	Lecture Hrs
1	**Electrical Theory** Ohms law, Kirchoff's laws and Electromagnetic Induction; their applicability in the aircraft industry. Alternating Current and calculation of Instantaneous value, RMS value, frequency and amplitude from the given data; star and delta connections and calculation of power in three phase system. Series and parallel resonance of AC circuits and their use; calculation of resonant frequency of a circuit from a given information; effect of change in the frequency on the impedance, current and phase angle. Composition, performance (stability and tolerance) and limitations of the fixed resistors (carbon composition, carbon film, wire wound and metallic film) and description of various types of variable resistors	7
2	**Aircraft Batteries** Construction and principle of operation of Lead acid and Nickel Cadmium batteries, composition of electrolytes and plates. Effect of temperature on capacity, specific gravity, electrolyte resistivity, charger and discharger rates; effect of specific gravity on freezing temperature and resistivity of electrolytes. Methods of charging of batteries; precautions and procedures during charging; mixing and neutralization of electrolytes; importance of ventilation of battery compartments. Knowledge of the inspections to determine conditions and serviceability of batteries; common battery defects and their rectification	7
3	**Generators and Motors** Construction, principle of operation and characteristics of DC and AC Generators and Motors. Knowledge of the construction, principles of operation of voltage regulators; and paralleling of generators. Detailed knowledge of the functional tests, adjustments and trouble shooting of generators and motors. Speed control and reversing the direction of motors.	7
4	**Servomechanisms and Amplifiers** Construction and principles of auto transformers, single and three phase transformers. Construction and principles of operation of saturable reactors and magnetic amplifiers; bias; phase sensitive half wave and inputs and outputs, polarity sensitive inputs and outputs, pushpull outputs and effects of stage gains and cascading on time response Construction, principle and operation of servo motors and rate generators; system response to displacement (position) and rate (velocity) command signals; purpose of pull up and rate feedback signals; causes of hunting and methods of damping; troubleshooting of servomechanism	7

5	**Aircraft System** Principle of operation, inspection and trouble shooting of aircraft galley equipments, aircraft lights, and electrical components and indicating circuits for Landing Gear, Flap System and Airconditioning system etc. Operation and inspection of Aircraft Fire and Smoke Detection and Protection System.	6
6	**Power Distribution** Electrical power distribution systems, the operation and construction of static inverters, rotary inverters and transformer rectifier units.	6

Text Books:

1. E. H. J. Pallet "Aircraft electrical systems. 3rdedn, Longman Scientific & Technical, 1987
2. Thomas K Eismin. Aircraft Electricity and Electronics", Sixth Edition, McGraw Hill Professional, 2013
3. David Wyatt, Mike Tooley. Aircraft Electrical and Electronic Systems" Second Edition Taylor & Francis Group, 2018

List of Experiments

1. Demonstration of Alarus CH 2000 Electrical systems
2. Testing Cessna DC Alternator Charging system
3. Testing Light Twin Electrical systems
4. To check Air Transport Indication Electrical systems
5. Inspect Aircraft Indication and Warning systems
6. Inspect and identify Aircraft Antenna
7. To Analyze & Troubleshoot DC Generators system
8. To check Communications and Navigation systems in cockpit
9. To demonstrate Fire Warning/ overheat detection and Extinguishing systems

Curriculum Structure for Bachelor of Technology (Aeronautical Engineering)
Part-I AY 2024-25 (Batch 2022-26)
SEMESTER VI

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE601 (PC)	Finite Element Method	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UAE602 (PC)	Aircraft Structure-II	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UAE603 (PC)	Flights Dynamics	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UAE65X (PE)	Program Elective IV	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UST65X (OE)	University Open Elective II	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	
UNM006 (NCMC)	Creativity and Innovations	-	-	2	NC	Practical	FA	100	100	40%	40%
Total		***15***	***-***	***12***	***20***	***Total Hrs:27 Total Credit: 20***					

L: Lecture; T: Tutorial; P: Lab Practical; J: Project or activity based learning; FA: Formative Assessment (Theory and/or Practical); SA: Summative Assessment-End Semester Examination; PC: Program Core Course; PE: Program Elective; UC: University Core; NC: Non- Credit Course; UMNCC: University Mandatory Non- Credit Course, UE-University Elective, FA-Formative Assessment, SA-Summative Assessment

Program Elective – IV	
Course Code	**Course Title**
UAE 651	Vibration and Aero elasticity
UAE 652	Airframe Maintenance and Repair

University Open Elective II (Semester VI)		
Course Code	**Course Title**	**Department**
UST651	Total Quality Management	Mechanical
UST652	Construction Project Management	Civil
UST653	Flying Vehicle Systems and Instruments	Aeronautical
UST654	Automotive Electronics	E&C
UST655	Cloud Security	CSE
UST656	Big Data Analytics	AIML
UST657	Introduction to Electric Vehicle.	Electrical

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE601 (PC)	Finite Element Method	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: **Explain**[2] the basic principles and procedure of FEM

CO2: **Formulate**[3] simple engineering problems using FEM

CO3: **Analyze**[4] the complex engineering problems using FEM

CO4: **Evaluate**[5] axis symmetric problems related to higher order elements

CO5: **Analyze**[4] dynamic problem in different sections

Unit No	Contents	Lecture Hrs
1	**Introduction** Review of various approximate methods – variational approach and weighted residual approach-application to structural mechanics problems. finite difference methods- governing equation and convergence criteria of finite element method.	7
2	**Discrete Truss Elements** Bar elements, uniform section, mechanical and thermal loading, varying section, 2D and 3D truss element.	7
3	**Discrete Beam Elements** Beam element - problems for various loadings and boundary conditions – 2D and 3D Frame elements - longitudinal and lateral vibration. Use of local and natural coordinates.	8
4	**Continuum elements** Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric element	6
5	**Isoparametric elements** Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, stiffness matrix and consistent load vector, evaluation of element matrices using numerical integration.	6
6	**Field problem and methods of solutions** Heat transfer problems, steady state fin problems, derivation of element matrices for two dimensional problems, torsion problems. bandwidth- elimination method and method of factorization for solving simultaneous algebraic equations – Features of software packages, sources of error.	6

Text Books:

1. Introduction to Finite Elements in Engineering" by T R Chandrupatla and A D Belegundu, Pearson
2. Introduction to the Finite Element Method by J N Reddy,McGraw-Hill Education
3. Daryl L.Logon, A First course in Finite Element Methods, Thomson Learning 3rd Edi. 2001
4. Hutton, Fundamentals of Finite Element Method, Mc Graw Hill, 2004.
5. Robert Cook, Concepts & Applications of FEA, etal – Jonhwilley& sons 2002

List of Experiments

1. Structural analysis of a tapered wing in ANSYS
2. Structural analysis of a Rectangular wing in ANSYS
3. Structural analysis of a composite wing in ANSYS
4. Structural analysis of a fuselage structure in ANSYS
5. Analysis of a composite laminate structure in ANSYS
6. Structural analysis of a landing gear in ANSYS
7. Thermo structural analysis of a composite laminate structure in ANSYS
8. Structural analysis of a engine turbine blade in ANSYS

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE602	Aircraft Structure-II	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: **Apply**[3] various concepts of mechanics of materials to solve real time structural problems

CO2: **Analyze**[4] the various loads that acts in aircraft components

CO3: **Analyze**[4] plate deflection and bending under various loading conditions

CO4: **Apply**[3] various failure theories to solve aircraft structural problems

CO5: **Explain**[2] various aircraft structural repair and practices

Unit No	Contents	Lecture Hrs
1	**Unsymmetrical bending** Bending of symmetric beams subject to skew loads - bending stresses in beams of unsymmetrical sections – generalized 'k' method, neutral axis method, principal axis method.	7
2	**Shear flow in open sections** Thin walled beams – concept of shear flow – the shear centre and its determination – shear flowdistribution in symmetrical and unsymmetrical thin-walled sections – structural idealization – shear flow variation in idealized sections	6
3	**Shear flow in closed sections single cell** Bredt - Batho theory – single-cell and multi-cell tubes subject to torsion – shear flow distribution in thin-walled single.	8
4	**Shear flow in closed sections multi cell** shear flow distribution in thin-walled single & multi-cell structures subject to combined bending torsion – with walls effective and ineffective in bending – shear centre of closed sections	8
5	**Buckling of plates** Bending of thin plates – rectangular sheets under compression - local buckling stress of thin walled sections – crippling strength estimation – thin-walled column strength – load carrying capacity of sheet stiffener panels – effective width.	6
6	**Stress analysis of wing and fuselage** Loads on an aircraft – the V-n diagram – shear force and bending moment distribution over the aircraft wing and fuselage – shear flow in thin-webbed beams with parallel and non-parallel flanges – complete tension field beams – semi-tension field beam theory.	6

Text Books:

1. Megson T M G , "Aircraft Structures for Engineering Students", Elsevier Ltd, 2007
2. Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw – Hill, N.Y., 1999
3. Bruhn. E.H., "Analysis and Design of Flight Vehicles Structures", Tri-state off-set Company, USA, 1985.

Reference Books:

1. Rivello, R.M., "Theory and Analysis of Flight Structures", McGraw Hill, 1993.
2. Howard D Curtis, "Fundamentals of Aircraft Structural Analysis", WCB-McGraw Hill, 1997

List of Experiments

1. Unsymmetrical Bending of a Cantilever Beam
2. Combined bending and Torsion of a Hollow Circular Tube
3. Shear Centre of a Open Channel Section
4. Shear Centre of a closed Channel Section
5. Buckling load estimation of slender eccentric columns
6. Study of non-destructive testing procedures
7. Tension field beam (Wagner Beam)
8. Shear failure of bolted and riveted Joints

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE603	Flights Dynamics	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: **Apply**[3] the cruising flight performance characteristic to solve at different flight conditions

CO2: **Apply**[3] the maneuvering flight performance characteristic to solve at different flight conditions

CO3: **Explain**[2] the aerodynamics characteristics at different altitudes and its importance

CO4: **Solve**[3] various Stability numerical problems and its derivatives of aircraft

CO5: **Analyze**[4] different axes of aircraft for its stability during maneuvering

Unit No	Contents	Lecture Hrs
1	**Cruising flight performance** Forces and moments acting on a flight vehicle - Equation of motion of a rigid flight vehicle - Different types of drag –estimation of parasite drag co-efficient by proper area method- Drag polar of vehicles from low speed to high speeds - Variation of thrust, power with velocity and altitudes for air breathing engines	7
2	**Manoeuvering flight performance** Range and endurance - Climbing and gliding flight (Maximum rate of climb and steepest angle of climb, minimum rate of sink and shallowest angle of glide) -Turning performance (Turning rate turn radius). Bank angle and load factor – limitations on turn - V-n diagram and load factor	6
3	**Aerodynamic characteristics and importance of stability, stability derivatives** Airfoils, wings and bodies: geometry, nomenclature. Aerodynamic characteristics. Effect of geometry, Reynolds Number, Mach Number. Measures of aerodynamic performance. Performance augmentation methods. Degree of freedom of a system - Static and dynamic stability - Need for stability in airplanes - Purpose of controls -Inherently and marginally stable airplanes	8
4	**Static longitudinal stability** Static, Longitudinal stability - Stick fixed stability - Basic equilibrium equation - Stability criterion - Effects of fuselage and nacelle - Influence of CG location - Power effects - Stick fixed neutral point - Stick free stability-Hinge moment coefficient - Stick free neutral points-Symmetric maneuvers - Stick force gradients - Stick _ force per 'g' - Aerodynamic balancing.	6
5	**Lateral and directional stability** Dihedral effect - Lateral control - Coupling between rolling and yawing moments - Adverse yaw	8

effects - Aileron reversal - Static directional stability - Weather cocking effect - Rudder requirements - One engine inoperative condition - Rudder lock.

6 Dynamic stability **6**

Introduction to dynamic longitudinal stability: - Modes of stability, effect of freeing the stick Brief description of lateral and directional. Dynamic stability - Spiral, divergence, Dutch roll, auto rotation and spin.

Text Books:

1. Nelson, R.C. Flight Stability and Automatic Control, McGraw-Hill Book Co., 2004
2. McCornick. W., Aerodynamics, Aeronautics and Flight Mechanics, John Wiley, NY, 1979
3. Mc.Cormic, B.W., Aerodynamics, Aeronautics and Flight Mechanics, John Wiley 1995

List of Experiments

1. Create a .M file to compute the temperature, pressure and density with respect to altitude less than 68km and plot the respective graphs by using MATLAB.
2. Develop the following MATLAB m- file by considering Cessna 172 data (sea-Level) a) CL vs AoA b)CL vs CD
3. Solve the following fourth degree polynomial numerically by using MATLAB to Find Maximum airspeed for a Jet engine aircraft
4. Create a simulink model and an m-file to run a simulation of the motion of the aircraft. The result of the model should be the state vector X and output vector Y and the forces and moments as function of time show the structure of your model in a few graphs.
5. Create a simulink model and an m-file to run a simulation of the motion of the airship. The result of the model should be the state vector X and output vector Y is function of time. Assume that the centre of mass is placed on x-axis and the air density remains constant.
6. Conduct Wind Analysis using MATLAB
7. To check Flight Instruments using MATLAB
8. Perform Flight Simulator Interface using MATLAB
9. Flight Actuators using MATLAB

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE 651	Vibration and Aero elasticity	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: **Analyze**[3] single degree & multi degree of freedom systems.

CO2: **Apply**[3] the methods to calculate force and deflection of the structure

CO3: **Apply**[3] the approximation methods for various system

CO4: **Evaluate**[5] frequencies and dynamic response of continuous systems

CO5: **Explain**[2] the role of aero elasticity in aircraft

Unit No	Contents	Lecture Hrs
1	**Basic concepts** Simple Harmonic Motion, Terminology, Degrees of freedom, Newton's Law, D'Alembert's principle, Energy Methods, Rayleigh's and Equilibrium Method.	7
2	**Single degree of freedom systems** Free vibrations, Damped vibrations, Forced vibrations, with and without damping, Support excitation, Vibration measuring instruments	7
3	**Multi degrees of freedom systems** Two degrees of freedom systems ,Static and dynamic couplings Vibration absorber, Principal coordinates, Principal modes and orthogonal condition ,Eigen value problems, Hamilton's principle, Lagrangian equation and application ,Vibration of elastic bodies, Vibration of strings, Longitudinal, Lateral and Torsional vibrations.	7
4	**Force deflection properties of structures** Constraints and generalized coordinates, Virtual work and generalized forces, Force, deflection influence functions, stiffness and flexibility methods.	7
5	**Approximate methods** Approximate methods of evaluating the Eigen frequencies and the dynamics response of continuous systems, Matrix methods of dynamic stress analysis, Rayleigh's and Holzer Methods and Matrix Iteration to find natural frequencies	6
6	**Elements of aero elasticity** Concepts, Coupling, Aero elastic instabilities and their prevention, Basic ideas on wing divergence, Loss and reversal of aileron control, Flutter and its prevention.	6

Text Books:

1. R.W. Clough and Penzien, Dynamics of Structures, McGraw Hill 2nd Edition.
2. Singiresu. S. Rao, Mechanical Vibrations, Pearson Education LPE.
3. Fung Y.C., An Introduction to the Theory of Aero elasticity, John Wiley and Sons, New York
4. Bisplinghoff R. L., Ashley H and Hoffman R.L., Aero elasticity, Addision Wesley Publication, New York.
5. Tse. F.S., Morse, I.F., Hinkle, R.T., Mechanical Vibrations, Prentice Hall,New York
6. Scanlan R.H. and Rosenbaum R., Introduction to the study of Aircraft Vibration and Flutter, John Wiley and Sons. New York

List of Experiments

1. Demonstration of equivalent spring mass system.
2. Experiment to determine forced vibration characteristics
3. Determination of logarithmic decrement for single DOF damped system
4. Determine natural frequency due to torsional vibration of two rotors without damping
5. Determine natural frequency due to free vibration of a coupled pendulum and double pendulum
6. Demonstrate different types of exciters for vibration analysis
7. Determine vibration parameters using vibration instruments
8. Determine natural frequency by Holzer method.
9. Determine natural frequency by Raleigh‟s or Matrix Iteration Method.

Course Code	Course Title	L	T	P	C	Evaluation Scheme					
						Component	Exam	Marks	WT	Mini. Passing %	
UAE 652	Airframe Maintenance and Repair	3	-	2	4	Theory & Practical	FA	50	50	40%	40%
							SA	100	50	40%	

Course Outcomes: After the completion of this course, the student will able to,

CO1: Differentiate[2] the joining techniques used in aircraft industry

CO2: Explain[2] the sheet metal repair procedures in the aircraft maintenance process

CO3: Compare[3] repair procedure in plastic and composite material component of aircraft

CO4: Explain[2] the procedure of basic aircraft maintenance and safety Procedure

CO5: Explain[2] safety practices in terms of hazardous materials

Unit No	Contents	Lecture Hrs
1	**Welding Equipment and Techniques** Fundamentals of Welding, Oxyacetylene Welding , Gas Welding Techniques, Electric-Arc Welding , Inert-Gas Welding, Aircraft Tubing Repair , Special Welding Repairs , Soldering and Brazing	7
2	**Sheet-Metal** Design Philosophies, Factors Affecting Sheet-Metal Part and Joint Design Hand Tools for Sheet-Metal Work , Fabrication of Sheet-Metal Parts Sheet-Metal Inspection , Sheet-Metal Repair , Repair Practices.	7
3	**Plastics and Composites** Fundamentals of Plastic Materials, Working with Plastic Materials, Installation, Maintenance, and Repair of Plastic Materials, Introduction to Composites, Laminated Structures, Major Components of a Laminate, Strength Characteristics, Description of Sandwich Structures, Inspection and Repair of Composites	8
4	**Assembly and Rigging** Aircraft Assembly, Aircraft Rigging , Fixed-Surface Alignment , Aircraft Flight Controls, Secondary Flight-Control Surfaces, Control-System, Components, Control Surface Rigging, Balancing Control Surfaces, Inspection and Maintenance, Helicopter Flight Controls	6
5	**Auxiliary Systems** Fire Protection Systems, Ice Protection Systems, Rain-Removal Systems, Water and Waste Systems, Position and Warning Systems, Auxiliary Power Units	6

6	**Hazardous Materials and Safety Practices** Hazardous Materials, OSHA‟s Hazardous Communications Standards, Disposal and Accidental Releases of Hazardous Materials, Troubleshooting Process	6

Text Books:

1. Kroes, Watkins, Delp, Aircraft Maintenance and Repair, McGraw-Hill, New York, 1992
2. Larry Reithmeir, Aircraft Repair Manual, Palamar Books, Marquette, 1992

List of Experiments

1. Aircraft wood gluing-single scarf joints
2. Aircraft wood gluing double scarf joints
3. Welded single & double V-joints.
4. Fabric & Riveted Patch repairs
5. Tube bending and flaring
6. Sheet metal forming rectangular pan
7. Sheet metal forming Cone.
8. Preparation of glass epoxy of composite laminates and specimens.