Subject Number: ANTE 436
Subject: Designs of Aircraft
Units: 7
Weekly Hours: Theoretical: 3
Experimental: 1
Tutorial :

Week	Contents
1	**Introduction** - Design and development of aircraft - Design stages - Preliminary design department
2	**Airworthiness** - Definition - BCAR - FAR - Crash airworthiness
3 4 5	**Fuselage design** - Main characteristics - Fuselage design requirements - Shape of fuselage - Cabin cross section layouts - Cabin cross-section dimensions - Cabin length - Cockpit - Fuselage main dimensions Quick method General method - Fuselage weight
6 7 8 9	**Wing design** - Basic requirements - Wing location - Wing geometric characteristics - Evaluation of wing size - Evaluation of SMC - Evaluation of MAC - Analytical method - Graphical method - Diagrammatical method - Airfoils, requirements & definitions - Airfoils coding - High lift devices - Wing aerodynamic characteristics - Lift coefficient increment due to T.E. flaps Split flaps Single slotted flaps Double slotted flaps - Wing weight

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10 11	**Empennage design** - Tail surfaces functions - Types of surface control system - Tail surface configuration - Horizontal tail plane - Vertical tail plane - Empennage weight
12 13 14	**Under-carriage design** - General requirements - Runways classification - Types of undercarriage - Tailoring u.c. to bearing capacity of A/F - LCN For single wheel - LCN For two or more wheels - Type, size and inflation pressure of tires - Shock absorption. Leg length - Ground load factor - Ground load cases - Structural load cases - Weight of u.c
15 16	**Preliminary weight analysis** - Weight break down - Surface controls group - Engine section or nacelle group - Propulsion group. Engine weight (dry) - Airframe services and equipments - Operational loads - Crew weight - Payload - Fuel weight (based on flight stages) - Fuel weight (based on aircraft type) (calculation by using graphics)
17	**Choice of engines** - Take off stages - Computing of static thrust - Computing minimum required thrust
18 19	**Center of gravity** - Evaluation of aircraft center of gravity - Loading and balancing diagram - Wing location according to aircraft center of gravity
20	**Payload-range diagram** - Limiting weight definitions - For turbo-jet aircraft - For turbo-prop aircraft

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21 22	**Flight and gust envelope** - Load factor - Load factor at steady pullout - Load factor at correctly banked turn - Flight envelope - Gust envelope - Flight - gust envelope
23	**Wing and tail loads (for flight-gust envelope)** - Aircraft pitching moment of inertia - Load calculation at level flight with angular acceleration
24 25 26	**Span wise air and inertia load distribution** - Air load distribution Schrenk method - Air load distribution Diederich method - Wing group inertia load distribution - Fuselage group inertia load distribution
27 28 29	**Drag estimation** - Area drag method: Wing Empennage Fuselage - Area drag method: Cockpit Undercarriage Nacelle Wing/fuselage interference - Empirical method for cruising stage - Induced drag coefficient of wing with part-span flap
30	**Structural design** - Aircraft main part structural design

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Subject Number: ANTE 435
Subject: Aircraft Propulsion Systems Technology and Design
Units: 5
Weekly Hours: Theoretical: 2
Experimental: 1
Tutorial : 1

Week	Contents
1	**Introduction** - Classification of propulsion systems - The thrust equation
2	**Engine performance** - Engine performance and A/C range
3 4 5	**Theory of jet propulsion** - Turbo jet engine - Turbo fan engine - Turbo prop engine - Turbo shaft engine - Ram jet engine
6 7	**Design of centrifugal compressors** - Impeller design - Diffuser design - Volute design
8 9 10	**Design of axial flow compressors** - Compressor aerodynamics - Repeating stage , repeating raw - Mean line design - Axial variation - Radial variation - Mechanical design
11	**Compressors technology** - Materials - Manufacturing technology - Balancing
12 13	**Design of combustion system** - The process (ignition, stability, length scaling, diffusers) - After burner design - Flame holding - Fuel injection
14	**Combustion chambers technology** - Materials - Manufacturing technology
15	**Design of axial flow turbines** - Turbine aerodynamics - Zero exit swirl, constant axial velocity

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16	- Mean line stage design - Other design considerations
17 18	**Mechanical design of axial flow turbines** - Rotor airfoil centrifugal stresses - Rim web thickness - Disc of uniform stress - Disc thermal stresses - Airfoil aspect ratio
19	**Turbines technology** - Materials - Manufacturing technology - Balancing
20	**Design of inlets** - Subsonic inlets - Supersonic inlets
21 22	**Design of nozzles** - Convergent nozzle - Convergent- divergent nozzle - Thrust reversing and thrust vectoring - Nozzle coefficients
23	**Inlets and nozzles technology** - Materials - Manufacturing technology
24	**Accessory drives** - Construction of gearboxes and drives - Engine power off takes - Engine oil system
25	**Engine control systems** - Engine/Airframe interfaces - Control systems
26	**Engine starting** - Fuel/Ignition control - Engine rotation - Throttle levers - Starting sequence
27 28 29 30	**Turbine engine inspection and maintenance** - Inlet and compressor section - Combustion section - Turbine section - Exhaust section

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Subject Number: ANTE 438
Subject: Aircraft Stability and Control
Units: 5
Weekly Hours: Theoretical: 2
Experimental: 1
Tutorial : 1

Week	Contents
1	**Introduction to A/C stability and control** - The freedom of motion of aircraft - Basic axis
2	**Aircraft longitudinal static stability** - Definition of longitudinal static stability and conditions - General equation
3	**Aircraft pitching moment** - Pitching moment coefficient as a function of angle of attack - trimmed conditions
4	**Applications** - Examples
5	**Directional static stability** - General equations - Conditions of stability
6	**The longitudinal equations of motion- A rigid symmetric A/C** - Derivation of longitudinal equations of motion
7	**Applications** - Examples
8	**Longitudinal stability derivatives** - All the longitudinal stability derivatives equations
9	**Equations of motion as a function of stability derivatives** - Derivation of longitudinal equations of motion in terms of the stability derivatives
10	**Applications** - Examples
11	**Longitudinal equations of motion solution** - Response to elevator as a function of input signal
12	**A/C characteristic equation** - Solution of characteristic equation - Types of period oscillation

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13	**Derivation of lateral directional equations of motion and solution** - Derivation of lateral directional equations of motion in terms of the stability derivatives - The solution
14	**Applications** - Examples
15	**Yaw damper from stability and control augmentation** - Principles of yaw damper - General equations - Effect of yaw damper on stability and control of A/C
16	**Introduction to non linear dynamics** - General introduction - Stall dynamic - Wing rock
17	**Applications** - Examples
18	**Gust equations derivation and its applications** - Load factor estimation from the gust - Types of gust - Effect on response
19	**Longitudinal autopilot** - Longitudinal equations of autopilot
20	**Pitch orientation control system** - Deriving basic equations of pitch orientation control system
21	**Flight path stabilization** - Mach hold - Altitude hold
22	**Vertical gyro as the basic attitude reference** - Main idea of the gyro as the indicator of angle
23	**Lateral autopilot** - Main assumptions
24	**Damping of Dutch roll** - The principle of Dutch roll damping
25	**Yaw orientation control system** - Derivation of the main equations
26	**Other lateral autopilot configuration** - Introduction and principles
27	**Lateral transfer function for rudder displacement** - Deriving the transfer function of basic rudder equation of motion

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28	**Lateral transfer function for ailerons** - Deriving the transfer function of ailerons displacement
29	**Lateral transient response for A/C** - Explanation and the calculation methods of transient response
30	**Applications** - Examples

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Subject Number: ANTE 434
Subject: Aircraft Structures
Units: 5
Weekly Hours: Theoretical: 2
Experimental: 1
Tutorial : 1

Week	Contents
1	**Introduction** - General viewing
2	**Structure components** - Skin, Spar, Stiffeners and stringers - Rib, Frame (Ring) - Monocoque, Semi-monocoque - Definitions - Elastic axis, Shear center
3 4	**Aircraft construction materials** - Wood - Aluminum alloys - Magnesium alloys - Steel alloys - Titanium alloys - Plastics - Glass - Composite materials
5	**Wing cross section structure** - Simple box beam - Simple nose - Center box - Multi- flanges cell - Multi-cells - Multi-cells multi flanges
6 7 8 9	**Bending of open and closed section beams** - Introduction - Sign conventions and notations - Resolution of bending moments - Direct stress distribution due to bending - Load intensity, shear force and bending moment relationships - Deflection due to bending - Approximations for thin-walled sections
10	**General stress, strain and displacement relationships** - For open and single cell closed section thin walled beams

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11 12 13	**Shear stress** - Shear of thin-walled open tubes, without booms - Shear of thin-walled closed sections beams, without booms - Twist and warping of closed section beams - Shear center
14	**Pure torsion** - Torsion of open section beams - Bredth-Batho formula - Torsion of closed section beams
15	**Analysis of combined open and closed sections** - Bending - Shear - Torsion
16	**Structural idealization** - Idealization of open and closed beam sections
17	**Effect of idealization** - Bending, shear and torsion of open and closed section beams
18	**Deflection** - Deflection of open and closed section beams
19	**Span-wise taper effect** - Single web beam. - Open and closed sections - Beams having variable string areas
20 21	**Fuselage** - Bending - Shear - Torsion - Fuselage frame analysis - Cut-outs in fuselage
22 23 24 25 26 27 28	**Wing** - Bending - Torsion - Shear - Shear center - Taper effect - Method of successive approximation/ Torsion - Method of successive approximation/ Shear - Deflection - Wing ribs analysis - Cut-outs in wings

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29 30	**Fatigue** - Safe life and fail-safe design -Fatigue strength of components - Goodman method - Miner & palmgren method - s-n curve - Prediction of aircraft fatigue life

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Subject Number: ANTE 439
Subject: Aircraft Systems and Maintenance
Units: 6
Weekly Hours: Theoretical: 2
Experimental: 2
Tutorial :

Week	Contents
1	**Aircraft systems** - Introduction - Basic definitions
2	**Basic components used in aircraft mechanical systems** - Aircraft hardware - Pumps - Valves and pipes - Filters and cocks
3 4 5	**Fuel system** - Fuel system components - Fuel system operating modes - Integrated civil aircraft systems - Troubleshooting - Maintenance
6 7 8	**Hydraulic system** - Hydraulic system components - Types of hydraulic systems used in the modern aircrafts - Troubleshooting - Maintenance
9 10	**Pneumatic system** - Pneumatic system components - Troubleshooting - Maintenance
11 12 13 14	**Environmental control systems** - The need for a controlled environment - Environmental control system design - Cooling systems - Air distribution system - Air conditioning system - Oxygen system - cabin pressurization - De-ice systems - Troubleshooting - Maintenance
15	**Emergency systems** - Warning systems - Fire detection and suppression

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	- Emergency power sources
	- Emergency oxygen
	- Emergency systems maintenance
	Flight control systems
16	- Flight control surfaces
	- Flight control linkage systems
	- High lift control systems
17	- Trim and feel
	- Flight control actuation
	- Fly-By-Wire control laws
18	- Troubleshooting
	- Maintenance
19	**Landing gear systems**
	- Construction
	- Landing gear system maintenance
	- Inspection and maintenance of brake system and Tires
	Airframe
20	- Inspection
	- Maintenance
21	**Inspection fundamentals**
	- General
22	- Required inspections
23	- CHECKLIST
	- Aircraft Logs
24	- Special inspections
	- Publications Bulletins Maintenance manual
	Overall manual
	Structural repair manual
25	Parts catalog
	- Federal Aviation Regulation (FAR)
	- Airworthiness directives
	- Type certificate data sheets
	Ground handling and support equipments
26	- General
	- Starting engines
	- Power units
27	- Air conditioning and heating units
	- Ground support air start units
	- Preoiling equipment
	- Aircraft fueling
28	- Servicing aircraft with oil
	- Aircraft Tiedown
	- Movement of aircraft
	- Maintenance safety

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29 30	CAA License - Qualifications structure - EASA66/JAR66 syllabus modules and applicability - Examinations and levels

Subject Number: CREQ 449
Subject: Computer Added Engineering
Units: 2
Weekly Hours: Theoretical:
Experimental: 3
Tutorial :

Week	Contents
1	**Introduction to CAE** - Characteristics of CAE and its importance
2	**Introduction to Modeling** - Dealing with real physical objects - Treating them as CAE models
3 4	**Modeling of 3-Dimensional Problems** - Some examples of solid objects of real problems - Loads & boundary conditions - Utilization of symmetry to simplify problems modeling
5 6 7	**Reduction to Plane Problems** - Importance & conditions of reduction to plane problems - Reduction to axi- symmetrical models - Modeling 2-D plane stress, plane strain, and fluid flow
8	**Bar, Beam, Problems** - Analysis of bar, beam problems
9	**Plate Problems** - Condition of reduction to plate model - Load, Symmetry
10	**Meshing; 2-D** - Types of mesh - Methods of meshing
11	**Meshing 3-D** - Types of mesh - Methods of meshing
12	**Meshing Bar, Beam, and Plate** - Types of mesh - Methods of meshing
13	**Load – Structural** - Types & implementation of structural loads
14	**Load – Thermal** -Types & implementation of thermal loads

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15	**Load – Fluid** - Types & implementation of fluid- flow loads
16	**Solution- Structural** - Static structural problems
17	**Solution – Dynamic** - Dynamic structural problems
18	**Solution – Thermal** - Heat transfer problems
19	**Solution- Fluid** - Fluid flow problems
20 21	**Results** - Types of results - Visual contours & data results - Results at internal sections - Animation
22	**Report Generation** - Software- dependent generation of eng. Reports of analyzed problems
23 24 25 26	**Applications** - Static 3D stress analysis problem - Steady- state heat transfer problem - Laminar flow problem - Modal analysis problem
27	**Importing Geometry** - Types & standards of solid geometry - Importing from CAD systems
28	**Contact Problems** - Introduction to contact problems - Software- specific implementation
29	**Plastic Deformation** - Non-linear material behavior and solution
30	**Phase- change problems** - Analysis & implementation of phase- change problems

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Subject Number: ANTE 418
Subject: Automatic Control
Units: 5
Weekly Hours: Theoretical: 2
Experimental: 1
Tutorial : 1

Week	Contents
1	**Introduction and definitions** - Basic definitions about the concepts of control
2	**Mechanical system and Transfer Function** - Definition of transfer function - Deriving the transfer function for three basic parts of mechanical system
3	**Series and parallel connections in mechanical systems** - Transfer function for mechanical system while connected it at series and parallel - Examples
4	**Torsional system** - Deriving the transfer function for three basic parts of torsional System
5	**Electrical system, series and parallel connections** - Deriving the transfer function for three basic parts of electrical system connected in parallel and series
6	**Thermal and fluid systems** - Deriving the transfer function for thermal and fluid systems - Examples
7	**Hydraulic system** - The basic concept of working the hydraulic system - Deriving the transfer function of the system
8	**Hydraulic servomotor system** - Leverage system and deriving the transfer function for three cases of fixing - Method of connection with hydraulic system

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9	**Pneumatic system** - The basic concept of working the pneumatic system - Deriving the transfer function of the system
10	**Block diagram** - The principles of block diagram - The basic nine rules for reduction the block diagram
11	**Block diagram reduction** - Method of reduction of block diagrams of multi-input and output
12	**Types of control and Laplace transformations** - Types of control methods and basic functions of Laplace transformation
13	**Test signals** - The different types of test signals
14	**Response of first order system** - Method of computing the response of first order system - Examples
15	**Response of second order system** - Method of computing the response of second order system - Examples
16	**Response specifications** - The specification of response which determine the stability of system
17	**Steady state error** - Computing the steady state error by using Toyler method and normal method and compare between them
18	**Response improvement** - The methods of response improvement - Examples
19	**System stability** - The concept of system stability and its effect on control process
20	**Routh criterion** - The Routh criterion for computing the stability of system
21	**Applications of Routh criterion** - Some applications about Routh criterion - Examples
22	**Root-locus method** - The root-locus method for computing system stability

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23	**Rules of Root-locus method** - Basic rules of root-locus method - Examples
24	**Polar-plot diagrams** - The polar plot for computing system stability
25	**Principles of polar-plot diagrams** - The method of polar plot diagram for computing the gain - Examples
26	**Logarithmic Scales and Bode Plots** - Basic principles of logarithmic scale and Bode plots
27	**Construction of Bode Plots for Continuous-Time Systems** - The method of construction of Bode plots - Examples
28	**Analysis of control system in state space** - Principles and basic assumptions for state space method
29	**State space representation of transfer function of system** - The state space representation - Examples
30	**Solving the time invariant state equations** - The solution method of time invariant state equations

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Subject Number: ANTE 437
Subject: Aircraft Vibration
Units: 6
Weekly Hours: Theoretical: 2
Experimental: 2
Tutorial :

Week	Contents
1	**Introduction** - Basic concepts of vibration and applications - Calculation of degree of freedom for systems
2	**Oscillatory motion** - Introduction to oscillatory motion - Simple harmonic motion - Displacement velocity and acceleration relations
3	**Free vibration of an undamped single degree of freedom system** - Derivation of basic equation - Solving the eq. of motion and finding the natural frequency - Examples
4	**Simple energy method (Raleigh principle)** - conservative and non-conservative systems - Applying the simple energy method for different systems to find eq. of motion and natural frequency
5	**Free vibration of viscous damped single degree of freedom system** - Types of damping - Formulation and solving the equation of such system for different damping ratio - Examples
6	**Equivalent springs and dampers** - Equivalent spring and damping for parallel and series connection - Examples
7	**Logarithmic decrement** - Formulation of the basic eq. of logarithmic decrement - Calculation the time for the decay of signal - Examples

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8	**Forced vibration of single degree of freedom system** - Formulation of the basic eq . of motion for damped and undamped forced vibration - Behavior of the amplitude with w/wn (eq . of resonance)
9	**Forced vibration for constant force** - Behavior of the system with constant excitation force - Formulating the steady state and transient solution - Examples
10	**Forced vibration for sinusoidal force (Resonance conditions)** - Behavior of the system with sinusoidal force - Formulation and solution of eq. - Equation for resonance - Examples
11	**Rotating unbalance** - Explaining the unbalance forces - Applications and examples
12	**Support motion** - Support motion and how this motion affect the motion of the system - Examples
13	**Vibration isolation** - Transmissibility - Discussion of transmissibility behavior with w/wn for different damping ratios - Examples
14	**Vibration measuring instrument** - The eq. of motion if the measuring device excited by a base force - Amp., Vel., and acceleration that the device measure - Examples
15 **16**	**Two degree of freedom system** - The equations of motion for 2- degree system - Estimating the natural frequency and their mode shap - Coordinate coupling - Semi definite system - Examples

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17	**Mode shapes** - The mode shapes for different systems of two Degree of freedom - Examples
18	**Lagrange equation** - Lagrange ,eq. for damped & undamped system free and forced Vib . - Applying it for several times - Examples
19	**Dynamic absorber (undamped)** - formulation of the eq. of dynamic absorber without damping - Examples
20	**Damped vibration absorber** - formulation the eq. of dynamic absorber with damping - Examples
21	**Multiple degree of freedom system** - Formulating the eq, of motion for multiple degree of freedom systems - Finding the natural freq and their mode shapes
22	**Influence coefficient matrix and stiffness matrix** - Finding the eigen values and hence the natural frequencies and the eigen vector (mode shape) for multiple degree of freedom systems
23	**Wing moment of inertia** - Calculating the wing equivalent moment of inertia - Examples
24 **25** **26**	**Torsional vibration** - Single degree of freedom systems - Two degree of freedom systems - Multiple degree of freedom systems (using holzer method) - Torsional vibration for stepped shaft - Torsional vibration for shaft with Gears

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27	**Dunkerley's equation for aircraft wing system** - Estimating and application of 1st natural frequency for a system of external loads on aircraft wing
28	**Rayliegh's equation for aircraft wing** - Application of Rayliegh's equation to aircraft wing with lump masses, distributed and combined loads
29 30	**Application of iterative technique for aircraft wing and tail** - Estimating the natural frequencies of aircraft wing and tail using the iterative technique from the lowest natural frequency and sweeping matrix - Estimating the highest mode and natural frequencies using the iterative technique and stiffness matrix

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