AIRCRAFT DESIGN AE 322/714

Lecture 1:   INTRODUCTION
Introduction to the aircraft design process & subject, design driver and requirement capture, current and future trends in aircraft design.

Lecture 2: AIRCRAFT TYPES & DESIGN DRIVER TEST CASE 1
Types of aircraft, Design driver (test case 1) : the Barn Owl (wing loading and noise mitigation).

Lecture 3: DESIGN DRIVER TEST CASE 2
Military transport aircraft (roles and categorization),   Design driver (test case 2): procurement of military transport aircraft (ASQR, AON, RFI, RFP, OEMs, DPP 2013/16, LTIPP, rear ramp, pallet loading, payload)

Lecture 4: DESIGN DRIVER TEST CASE 3
Fighter aircraft (roles and categorization), Design driver (test case 3): fifth generation fighter aircraft (QR, ASQR, feasibility studies, stealth, supercruise, supermaneuverability)

Lecture 5: CONFLICT & COMPROMISES IN DESIGN:
Case of Fifth Generation Fighter Aircraft: top level QR vs ASQR, stealth vs aerodynamics/thrust, performance vs weight, thrust-by-weight, feasibility studies

Lecture 6,7: AICRAFT DESIGN HISTORY
Stages (pre-Wright flyer, biplanes, propellers, jet), design signposts and evolution through the ages with special emphasis on aerodynamics. Development through competitions, war, consortium. example of SST : history (TU 144 & Concorde), commercial and technical issues, future of SST.

Lecture 8: AIRCRAFT DESIGN (INDIA)
HT2, HJT, IJT (trainer series), HF 24, LCA/Tejas. Current & future development (LCA Mark 2, AMCA, Ghatak, MTA). Certification issues, HAL and the increasing role of the private sector, DPP-2016 & "Design-in-India".

Lecture 9: AIRCRAFT DESIGN & DEVELOPMENT CYCLE (OVERVIEW)
Overview of design & development cycle: requirement, design, ground test, taxi trials, iron bird, flight testing (commercial vs military), prototypes, weather trials, weaponization, certification.

Lecture 10, 11: STAGES IN AIRCRAFT DESIGN
Conceptual, preliminary & detail design (definition, content, technology, analysis), high and low fidelity tools, funding.

Lecture 12: COSTS: Acquisition cost, direct operating cost, indirect operating cost, life cycle costs, role in design.

<u>Lecture 13, 14, 15: INITIAL SIZING</u>
 Design TOGW, empty weight fraction, mission profiles, fuel-fraction estimation, wetted area aspect ratio, specific fuel consumption.

<u>Lecture 16,17,18: EXAMPLE:</u>
Initial sizing example for DGTOW, Trade studies, Conceptual Sketch: gross (engine placement, tractor vs pusher, canard vs horizontal tail)

<u>Lecture 19,20: AIRFOIL DESIGN</u>
Evolution, nomenclature, types, properties, choice.

<u>Lecture 21, 22,23,24: WING DESIGN</u>
MAC, aspect ratio, sweep, taper, twist, dihedral, rigging, vertical placement, tips, winglet.

<u>Lecture 25, 26: TAIL DESIGN</u>
Tail types, canard vs aft tail, control authority, sizing.

<u>Lecture 27: SIZING RECAP & POINT PERFORMANCE:</u>
Recap of the sizing based on mission profile, point performance (T/W, W/S).

<u>Lecture 28, 29, 30, 31: T/W & W/S ESTIMATION:</u>
definitions, FAR 23, 25, mil specs., quick estimate T/W (statistical, thrust matching), W/S from stall velocity, TO, landing, turn rate, cruise, loiter, climb rate, BVR vs WVR.

<u>Lecture 32, 33,34: REFINED SIZING:</u>
Payload drop, rubber engine vs. fixed engine, refined empty weight, fuselage, wing, tail, CG, control surface sizing.