

Indian Institute of Engineering Science and Technology, Shibpur
BE (Aero) Part IV 8th Semester Final Examination, 2014

Aircraft Design and Optimisation
(AE 803)

Time: 3 hours 30 minutes

Full Marks: 100

Answer each half on separate Answer Scripts

First Half

1. Configure an aircraft having following specifications/mission requirements

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- a) Weight of the aircraft between 1200 to 1500 kg
- b) Cruise altitude 6km
- c) Cruise speed 90m/s at cruise altitude
- d) Take off distance less than 700m
- e) Wing has reflex aerofoil
- f) Draw a neat sketch showing at least three views
- g) The aircraft has pusher engine and not puller engine

Second Half

2. For the aircraft used in the design exercise in class, draw the V-n diagram (with and without gust correction) in terms of equivalent air-speed. Explain every point on the V-n diagram. Also answer the following questions:

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(a) Why is the V-n diagram important for structural design?

(b) Explain how the gust effect is accounted for.

(c) What do mean by the limit load factor and the ultimate load factor? What are typical values for a manned aircraft, for a missile and for a UAV?

2. Give the expression for the bending moment, shear force and torque distribution for the wing of the aircraft (use only semi-span) configuration finally chosen by you, corresponding to the worst load obtained from the V-n diagram above.

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3. Using the 2-spar wing-box design developed in class, determine the state of stress in the skin, spar-caps, spar web, and the stiffeners for a section at 0.1 m from the root AND 0.1m from the tip. Use idealized sections to get the stress distribution (i.e. the spar cap and the stiffeners carry bending axial loads, with lumping of the skin's contribution). Clearly indicate the material used, its properties, thicknesses and other dimensions of all the structural elements used. (Give detailed diagram of the cross-section).

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