

Total No. of Pages : 03

Total No. of Questions : 09

B.Tech.(Aerospace Engg.) (2012 Onwards) (Sem.-5)

PERFORMANCE STABILITY AND CONTROL

Subject Code : ASPE-301

M.Code : 71835

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY** consisting of **TEN** questions carrying **TWO** marks each.
2. **SECTION-B** contains **FIVE** questions carrying **FIVE** marks each and students have to attempt **ANY FOUR** questions.
3. **SECTION-C** contains **THREE** questions carrying **TEN** marks each and students have to attempt **ANY TWO** questions.
4. Use of scientific calculator is permitted.

SECTION-A

1. Answer briefly :

- Explain the working of 'Flaprons' and 'Elevons'.
- Define static stability. Mention the criteria for an aircraft to be statically longitudinally stable.
- Define neutral point with the help of a sketch.
- What do you understand by 'Cooper-Harper scale'?
- Define 'Weather-cocking Effect'.
- Explain the phenomenon of 'Roll Reversal'.
- What is aerodynamic balancing?
- Explain the phenomenon of spin.
- Define 'stick force gradient' and explain its importance.
- Explain 'one engine inoperative condition'.

SECTION-B

- Q2 Define drag and classify drag. Draw and label drag polar for symmetrical and cambered airfoils. (5)
- Q3 Derive expressions for lift coefficient, drag coefficient and velocity for minimum power condition. (5)
- Q4 Define static margin. An aircraft is having static margin and center of gravity location as 5 % and 27 % of mean aerodynamic chord during cruise flight. Calculate the neutral point of the aircraft. (2, 3)
- Q5 Define 'dihedral effect' with the help of a sketch. Explain the effect of wing sweep, flap and power on dihedral effect using plots. (2, 3)
- Q6 If the slope of the pitching moment curve for a given airplane is $(dC_m/dC_L) = -0.15$ and the pitching moment coefficient at zero lift is 0.10, at what lift coefficient the airplane will be in trim? How much pitching moment coefficient must be supplied to achieve trim at $C_L = 3$? (5)

SECTION-C

- Q7 An aircraft is having following geometric and aerodynamic characteristics at Sea Level.

$W = 25000 \text{ N}$	$V = 80 \text{ ms}^{-1}$	$X_{cg} = 0.3c$	$X_{ac} = 0.25c$
$S_w = 20 \text{ m}^2$	$b = 11 \text{ m}$	$i_w = 1.5 \text{ deg}$	$m.a.c. = 1.82m$
$S_{HT} = 4 \text{ m}^2$	$l_t = 5.5 \text{ m}$	$i_t = -1.5 \text{ deg}$	$\eta = 0.9$
$(C_{L_o})_w = 0.3$	$(C_{L_\alpha})_w = 5.1 \text{ rad}^{-1}$	$(C_{M_{ac}})_w = -0.12$	$(C_{m_{ac}})_t = 0.0$
$(C_{L_\alpha})_{Tail} = 4.5 \text{ rad}^{-1}$	$(C_{m_\alpha})_f = 0.12 \text{ rad}^{-1}$	$(C_{m_o})_f = -0.025$	

Calculate :

- a) C_{m_o} contribution due to wing and horizontal tail (2, 2)
- b) C_{m_α} contribution due to wing and horizontal tail (2, 2)
- c) Stick fixed neutral point (2)

Q8 Write notes on following :

- a) Short period mode and Phugoid mode (5)
- b) Experimental determination of maneuver point (stick-free case) (5)

Q9 a) Explain the phenomena of Dutch roll and Spiral instability. (5)

- b) Write a note on 'Routh's Criteria'. (5)

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NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.