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Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

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

PERFORMANCE STABILITY AND CONTROL

Subject Code : ASPE-301

Paper ID : [A2927]

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.**

SECTION-A

1. Answer briefly :

(a) What do you mean by '*one engine inoperative condition*'? What is its importance?

(b) Explain the phenomenon of adverse law.

(c) What is aerodynamic balancing?

(d) Define autorotation.

(e) Define '*stick force gradient*' and explain its importance.

(f) Define static stability. Mention the criteria for an aircraft to be statically longitudinally stable.

(g) Define neutral point with the help of a sketch.

(h) What do you understand by '*Cooper-Harper scale*'?

(i) Define '*static margin*' and '*maneuver margin*'.

(j) Explain the working of flaprons and elevens.

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SECTION-B

2. Explain '*weather-cocking effect*'. How does vertical tail contribute to directional stability effect?

3. Define '*lateral stability'* with the help of a sketch. Explain the various factors affecting lateral stability.

4. Explain drag polar for conventional and laminar airfoils with the help of sketches.

5. Derive the expression for speed, lift coefficient and drag coefficient for minimum power condition.

6. 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 $C_L = 2$?

SECTION-C

7. Calculate C_{m_0} and C_{m_α} for complete aircraft from the following geometric and aerodynamic characteristics of an aircraft at Sea Level. Also find stick fixed neutral points. (4, 4, 2)

$W = 25000$ N	$V = 80\ m\,s^{-1}$	$X_{cg} = 0.3\ c$	$X_{ac} = 0.25\ c$
$S_W = 20\ m^2$	$b = 11$ m	$i_w = 1.5$ deg	m.a.c. $= 1.82$ m
$S_{HT} = 4\ m^2$	$l_t = 5.5$ m	$i_t = -1.5$ deg	$\eta = 0.9$
$(C_{L_0})_w = 0.3$	$(C_{L_\alpha})_w = 5.1\ rad^{-1}$	$(C_{m_{ac}})_w = -0.12$	$(C_{m_{ac}})_t = 0.0$
$(C_{L_\alpha})_{Tail} = 4.5\ rad^{-1}$	$(C_{m_\alpha})_f = 0.12\ rad^{-1}$	$(C_{m_0})_f = -0.025$	

8. Write notes on following:

   (a) Phugoid and short period mode

   (b) Experimental determination of maneuver point (stick-fixed case)

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

   (b) Write a note on '*Routh's criteria*'.

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