

PARUL UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
B.Tech. Summer 2018 - 19 Examination

Semester: 7

Subject Code: 03101402

Subject Name: Flight Mechanics

Date: 10/05/2019

Time: 10.30 am to 1.00 pm

Total Marks: 60

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 Objective Type Questions - (Each of one mark)**(15)**

1. If an airplane is to remain in steady uniform flight, then _____ as well as _____ about the centre of gravity must both be equal to 0.
2. The ratio of dynamic pressures of tail to wing is called _____
3. Stick fixed static margin = _____
4. _____ is adjusted to ensure positive C_{m_0} in tail contribution.
5. Rudder lock is prevented by adding _____
6. What is rolling moment due to rate of roll is called?
7. What is yawing moment due to rate of yaw is called?
8. What is rolling moment due to rate of yaw is called?
9. What is the time response if the damping ratio is less than -1?
10. What type of root we will get when damping ratio is greater than 1?
11. The conditions for longitudinal stability are:
 - a) $\frac{dC_m}{d\alpha} > 0$ and $C_{m_0} > 0$
 - b) $\frac{dC_m}{d\alpha} < 0$ and $C_{m_0} > 0$
 - c) $\frac{dC_m}{d\alpha} < 0$ and $C_{m_0} < 0$
 - d) $\frac{dC_m}{d\alpha} > 0$ and $C_{m_0} < 0$
12. For overall contribution, which of these is true to satisfy conditions of longitudinal stability:
 - a) Aerodynamic centre must lie in the same location of center of gravity
 - b) Center of gravity must lie exactly above the aerodynamic center
 - c) Aerodynamic centre must lie aft of center of gravity
 - d) Center of gravity must lie aft of the aerodynamic center
13. The change in local flow angle with angle of attack varies along the fuselage, what happens in the region between the wing's leading edge and trailing edge?
 - a) $\frac{\partial \epsilon_u}{\partial \alpha} > 1$
 - b) $\frac{\partial \epsilon_u}{\partial \alpha} < 1$
 - c) $\frac{\partial \epsilon_u}{\partial \alpha} = 0$
 - d) Varies linearly from 0 to $(1 - \frac{\partial \epsilon_u}{\partial \alpha})$
14. Pitching moment about the aerodynamic centre for a reflexed trailing edged airfoil is
 - a) Positive
 - b) Negative
 - c) Zero
 - d) Does not depend on airfoil
15. Condition for rudder lock
 - a) $(\delta_r)_{free} < (\delta_r)_{req}$
 - b) $(\delta_r)_{free} > (\delta_r)_{req}$
 - c) $(\delta_r)_{free} = (\delta_r)_{req}$
 - d) $(\delta_r)_{free} = (\delta_r)_{req} = 0$

- Q.2** Answer the following questions. (Attempt any three) **(15)**
- A) Derive the wing alone contribution to the Pitching Moment.
 - B) Explain the contribution of Power to $C_{n\beta}$.
 - C) Derive an expression for elevator control power and elevator effectiveness.
 - D) Derive the contributions of wing and fuselage to $C_{n\beta}$.

- Q.3** A) Derive the rigid body equations of motion. **(07)**
B) What are the equations for the lateral stability derivatives? **(08)**

OR

- B) What are the equations for the lateral stability coefficients? **(08)**
- Q.4** A) Write short notes on Stability after stall, autorotation & spin. Also write a short note on Stability with Automatic control. **(07)**

OR

- A) Obtain the approximation for Spiral mode, Rolling motion and Dutch roll mode. **(07)**
- B) Consider the characteristic equation $\lambda^2 + \frac{c}{m}\lambda + \frac{k}{m} = 0$, obtain the solution of differential equation, nature of roots and define the type of motion for different cases. **(08)**