Reg.No. \_\_\_\_\_\_\_\_\_\_\_\_



**End Semester Examination – Nov/Dec– 2017**

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| **Code :** | **14AE2015** | **Duration :** | **3hrs** |
| **Sub. Name :** | **AIRCRAFT STABILITY AND CONTROL** | **Max. marks :** | **100** |

**ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)**

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| **Q. No.** | **Sub Div.** | **Questions** | **Course**  **Outcome** | **Marks** |
| 1. | a. | Given a rectangular wing of aspect ratio 6 and area 55.8 m2. The wing section employed is an NACA 4412 airfoil with aerodynamic centre at 0.24 c and Cmac = -0.088. The c.g. of the wing lies on the wing chord, but 15 cm ahead of the a.c. Calculate the following. i. The lift coefficient for which the wing would be in equilibrium (Cmcg= 0). Is this lift coefficient useful?Is the equilibrium statically stable?  ii. Calculate the position of c.g. for equilibrium at CL = 0.4. Is this equilibrium statically stable? | CO2 | 16 |
| b. | What are the different types of Stability and Explain it. | CO2 | 4 |
| (OR) | | | | |
| 2. |  | The Wing-Fuselage pitching moment characteristics of High-Wing, Single Engine general Aviation airplane follow, along with pertinent Geometric data Cmcg= -0.05-0.0035α, Sw=178ft2, bw=35.9ft, Cw= 5ft, Xcg/C=0.1, ARw=7.3, Clαw=0.07/deg, iw=2deg, Clα=0=0.26. Estimate the horizontal tail area and tail incidence angle.so the complete airplane has Cmcg= 0.15-0.025α.Assume the following with regard to the horizontal tail lt= 14.5ft, ARt= 4.85ft, Clαt=0.073/deg. | CO2 | 20 |
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| 3. | a. | Derive the contribution of aircraft wing in static stick fixed longitudinal Stability. | CO2 | 12 |
| b. | Derive the stick fixed Neutral point and Discuss the effect of Neutral Point in staic longitudinal Stability. | 8 |
| (OR) | | | | |
| 4. | a. | Derive the staic stick free longitudinal Stability derivative for the complete Aircraft | CO2 | 12 |
| b | A wing section being tested in a wind tunnel is hinged at its leading edge, with freedom to rotate about the hinge axis. Calculate the equilibrium floating angle of the wing at a tunnel speed of 100 kmph, given that: wing weight is 250 N/m2, c.g. location at 0.4 c, a.c. location at 0.24c, Cmac = -0.04, α0L = -30, dCl / dα = 0.105 deg-1. Assume standard sea level conditions. Is the equilibrium statically stable? | 8 |
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| 5. | a. | An airplane with the following characteristics is coming in to land at sea level at a speed of 1.2 times the stalling speed. What would be the amount ofrudder deflection required if cross wind of 10 m/s is  encountered by the airplane?  W/S = 1500 N/m2, Vv = 0.05, CLαv =2.87 rad-1 , C nβ = 0.071 rad-1, CLmax = 1.8, ηv = 1.0 , τ rudder = 0.5. | CO3 | 10 |
|  | b. | Obtain the minimum control speed in the event of an engine failure for the following airplane:  S = 65 m2, Sv = 6.5 m2, lv = 10.5 m, BHP = 880 kW (per engine), propeller efficiency = 75%, yp = 4.2 m, dCLv / dδr = 0.02 deg-1, (δr)max = 25º. | 10 |
| (OR) | | | | |
| 6. |  | Explain the following   1. Distinguish between sideslip and yaw 2. What is the purpose of a dorsal fin and how is it achieved? 3. Cross Wind landing 4. Spin Recovery | CO3 | 20 |
|  |  |  |  |  |
| 7. | a. | A light airplane has a wing of rectangular planform 12.8 m span, 2.14 m chord and CLmax of 1.5. The wing loading is 850 N/m2. The airplane is rolled through 45 deg in one second when flying at three times its stalling speed. Estimate the rolling moment created by the ailerons assuming steady motion. | CO3 | 12 |
| b. | What are the different types of Aerodynamic Balancing and explain it. | 8 |
| (OR) | | | | |
| 8. | a. | Distinguish between the following:   1. Trim tab and Balance tab 2. Aerodynamic balancing and mass balancing 3. Frise aileron and Differential aileron. | CO3 | 6 |
| b. | An airplane is rolling at a role rate ‘p’, at a flight velocity ‘V’ and an altitude where the ambient density is 'ρ' . Show that the rolling moment created by ailerons, assuming steady motion, is given by:    where, a = slope of lift curve of wing.  Comment on the variation of L’a with roll rate, flight velocity and flight altitude. | 14 |
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|  | | **Compulsory:** |  |  |
| 9. |  | Explain the following term   1. Spin 2. Sprial Instability | CO3 | 20 |

ALL THE BEST