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

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**End Semester Examination – Nov / Dec – 2019**

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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. | Derive the contribution of aircraft tail in static stick fixed longitudinal Stability. | CO2 | 12 |
| b. | Derive the stick fixed Neutral point and discuss the effect of Neutral Point in static longitudinal Stability. | 8 |
| **(OR)** | | | | |
| 2. |  | The Wing-Fuselage pitching moment characteristics of High-Wing, Single Engine general Aviation airplane follow, along with pertinent Geometric data of Cmcg= -0.05-0.0035α (only for wing and Fuselage), Sw=165m2, bw=11m, Cw= 1.55m, Xcg/C=0.1, ARw=7.3, dcl/dα =0.07/deg, iw=2deg, Clα=0=0.26. Estimate the horizontal tail area and tail incidence angle, so that the complete airplane has Cmcg= 0.15-0.025α. Assume the following with regard to the horizontal tail lt= 4.5m, ARt= 4.85, dcl/dα =0.073/deg, ŋ=1. | CO2 | 20 |
|  |  |  |  |  |
| 3. | a. | Define and derive the Elevator effectiveness term. | CO2 | 10 |
| b. | Define Stick Force. | 4 |
| c. | Illustrate the influence of the Stick force Gradient in design of control System. | 6 |
| **(OR)** | | | | |
| 4. |  | 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 | 20 |
|  |  |  |  |  |
| 5. | a. | Derive the contribution of the sweep back wing in static Longitudinal Stability. | 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. Derive the Required Rudder Angle 2. Rudder Lock 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 450 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. | Explain in detail the different types of Aerodynamic Balancing. | 8 |
| **(OR)** | | | | |
| 8. |  | Explain the following terms.   1. Weather cock stability | CO3 | 4 |
|  | ii) Aileron power | 6 |
|  | iii) Aileron reversal. | 10 |
|  | | **Compulsory:** |  |  |
| 9. |  | Explain the following terms in detail.   1. Spin 2. Spiral Instability. | CO3 | 20 |