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| **Name:**<br><br>**Enrolment No:** | |

**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**
**End Semester Examination, December 2022**

**Course: Flight Mechanics I** **Semester: V**
**Program: B.Tech ASE/ASE+AVE** **Time : 03 hrs.**
**Course Code: ASEG3001** **Max. Marks: 100**

**Instructions: Assume any missing DATA appropriately.**

**SECTION A**
**5Qx4M=20Marks**

| S. No. | | **Marks** | **CO** |
|---|---|---|---|
| Q 1 | Differentiate between geopotential and geometric altitudes. | **4** | **CO1** |
| Q 2 | How Induced Drag of aircraft can be minimized? | **4** | **CO2** |
| Q 3 | An aircraft of mass 2500 kg in straight and level flight at a constant speed of 100 m/s has available excess power of $1.0 \times 10^6$ Watt, Calculate the steady rate of climb, it can attain at that speed. | **4** | **CO3** |
| Q 4 | An aircraft is performing a coordinated turn at a bank angle of 30 deg and forward speed of 100 m/s. Assume g=9.81 m/s$^2$. Calculate *load factor* and *turn radius* of turn. | **4** | **CO4** |
| Q 5 | Compare effect of altitude on Power available and Power required vs velocity graphs in steady level flight for *jet engine* and *propeller driven* aircrafts. | **4** | **CO5** |

**SECTION B**
**4Qx10M= 40 Marks**

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| Q1 | Derive expressions for P, T and $\rho$ in gradient layer of atmosphere. | **10** | **CO1** |
| Q2 | The altimeter on a low-speed airplane reads 2 km. The airspeed indicator reads 50 m/s. If the outside air temperature is 280 K and pressure is 79480 Pa, what is the true velocity of the airplane? | **10** | **CO2** |
| Q3 | Compare *radius* (R) and *rate* ($\omega$) during **pull-up** with **pull-down** maneuvers for civil and military aircrafts. | **10** | **CO3** |
| Q4 | In steady level turning flight of an aircraft at a load factor n, show that the ratio of the horizontal component of lift and aircraft weight is given by $\sqrt{n^2 - 1}$ | **10** | **CO4** |

**SECTION-C**
**2Qx20M=40 Marks**

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| Q 1 | Consider our executive jet, W = 45000 N, S = 20 m$^2$, T = 9000 N and the parabolic drag polar is, $C_D=0.02+0.05\ C_L^2$<br>Calculate the max angle of climb, and the climb rate under that condition, and find the max rate of climb, and the angle of climb under that flight condition. | **20** | **CO4** |

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|---|---|---|---|
| Q2 | Derive *Brequet Range and Endurance* formula for Propeller driven aircraft.<br>OR<br>An airplane weighing 13250 N is powered by piston engine delivering 230 HP. Its SFC is 7.3 x$10^{-7}$ N/w.s. Other parameters are wing span 11m, wing area 16 $m^2$ $C_{D0}$=0.025, e=0.8, prof eff. 0.85. Determine the fuel required to fly non-stop over a distance of 1850 km. | **20** | **CO5** |