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



**End Semester Examination – April / May – 2022**

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| **Code :** | **18AE2001** | **Duration :** | **3hrs** |
| **Sub. Name :** | **INTRODUCTION TO AEROSPACE ENGINEERING** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Pattern** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Name 3 centres of ISRO. | CO1 | R | 1 |
| 2. | Name the city in which Gas Turbine Research Establishment (GTRE) is located. | CO1 | R | 1 |
| 3. | State the four forces acting on an airplane. | CO2 | R | 1 |
| 4. | Explain the difference between centre of pressure and aerodynamic centre. | CO2 | R | 1 |
| 5. | State three wing positions in an airplane. | CO3 | R | 1 |
| 6. | State three wing shapes in an airplane. | CO3 | R | 1 |
| 7. | List the engines that power most the flying machines. | CO4 | R | 1 |
| 8. | An aircraft piston engine, also commonly referred to as a reciprocating engine, is an internal combustion engine that uses one or more reciprocating pistons to convert \_\_\_\_\_\_ into a rotational motion. | CO4 | R | 1 |
| 9. | If weight ([newton](https://en.wikipedia.org/wiki/Newton_(unit))) is used, then specific impulse has units of \_\_\_\_. | CO5 | R | 1 |
| 10. | Specific impulse of cryogenic propellants is \_\_\_\_\_ than liquid propellants. | CO5 | R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Explain the functions of horizontal and vertical stabilizers in an airplane. | CO1 | R | 3 |
| 12. | A sample of gas occupies 12 L under a pressure of 1.2 atm. Calculate its volume if the pressure increases to 3.6 atm. Temperature is assumed constant. | CO2 | A | 3 |
| 13. | State different types of landing gears in an airplane. | CO3 | R | 3 |
| 14. | Explain the working principle of jet propulsion. | CO4 | R | 3 |
| 15. | Explain briefly PSLV launch vehicle. | CO5 | R | 3 |
| 16. | Write three Kepler’s laws of motion. | CO6 | R | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | |
| 17. | a. | Describe the functions of slats, spoiler, aileron and rudder in an airplane. | CO1 | R | 4 |
| b. | State the values of density, pressure and temperature at sea level of the standard atmosphere. | CO1 | R | 2 |
| c. | State the five important layers of the upper atmosphere with increase in altitude. | CO1 | R | 4 |
| d. | Calculate the value of air temperature at 11 km altitude. | CO1 | A | 2 |
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| 18. | a. | With the help of neat figure of an airfoil, explain the different terms used in it. | CO2 | R | 5 |
| b. | A 100 cm meter rule is pivoted at its middle point (at 50 cm point). If weight of 2 N is hanged from the 20 cm point, Calculate the amount of weight required to be applied at the 80 cm mark to keep it in a balanced position. | CO2 | A | 4 |
| c. | Explain NACA2421. | CO2 | R | 3 |
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| 19. | a. | Explain the terms ‘dead load’ and ‘live load’ used in an aircraft. | CO3 | R | 3 |
| b. | State the five major units of the airframe of a fixed-wing aircraft. | CO3 | R | 3 |
| c. | Describe briefly the wing construction of a fixed wing aircraft. | CO3 | R | 4 |
| d. | List some of the materials used in an aircraft. | CO3 | R | 2 |
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| 20. | a. | Explain briefly ramjet engines, turboprop engines and turbofan engines. | CO4 | R | 12 |
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| 21. | a. | From the first principles, derive the rocket equation  Vb = g0 Isp ln(Mi/Mf),  Where Vb is the burnout velocity, g0 is the acceleration due to gravity at sea level, Isp is specific impulse and Mi/Mf is the mass ratio. | CO5 | E | 8 |
|  | b. | If the Isp of a rocket using liquid hydrogen and oxygen as fuel and oxidizer is 430 s, and Vb is 10000 metres/s, calculate its mass ratio (g0= 9.8 m/s2). | CO5 | A | 4 |
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| 22. | a. | Calculate the values of pressure, density and temperature for the standard atmosphere at an altitude of 14km. | CO1 | A | 12 |
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| 23. | a. | A two-stage rocket has the following design characteristics.  First stage: propellant mass = 30000 kg, structural mass = 12000 kg. Second stage: propellant mass = 15000 kg, structural mass = 4500 kg. The pay load mass is 100 kg. The specific impulse for first stage is 300 s and for the second stage is 400 s. Calculate the final burnout velocity (g0=9.8 m/s2). | CO5 | A | 8 |
|  | b. | The burnout velocity Vb of a single stage rocket is 9800 m/s. Its mass ratio (Mi/Mf)is 9. Find the specific impulse Isp of the rocket (g0=9.8 m/s2). | CO5 | A | 4 |
|  |  | **Compulsory:** | | | |
| 24. | a. | The asteroid belt is the region of the [Solar System](http://en.wikipedia.org/wiki/Solar_System) located roughly between the orbits of the [planets](http://en.wikipedia.org/wiki/Planet) \_\_\_\_ and \_\_\_\_\_. | CO6 | R | 1 |
| b. | The observed average separation of Pluto from Sun is 39.44 astronomical units. From Kepler's 3rd Law, find the orbital period of Pluto. | CO6 | A | 3 |
| c. | Find the orbital period of an Earth satellite if its semi-major axis (a) is 8000 km. Earth’s gravitational constant (µ) is 398600 km3/s2. | CO6 | A | 4 |
| d. | Using Keplerꞌs equation M = E – e sin E, calculate the mean anomaly M in degrees if the eccentric anomaly E and eccentricity e are 30 degrees and 0.15, respectively. | CO6 | A | 4 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the nature of aerospace technologies. |
| CO2 | Identify the different types of Aircraft components and their functions. |
| CO3 | Assess the forces and moments due to flow over the aircraft components. |
| CO4 | Apply the principles of aerodynamics to different parts of an aeroplane. |
| CO5 | Evaluate the performance of propulsion system. |
| CO6 | Apply the knowledge of gravitational law, Kepler’s law and Newton’s law to the space vehicle. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 15 | - | 14 | - | - | - | 29 |
| CO2 | 10 | - | 7 | - |  |  | 17 |
| CO3 | 17 | - | - | - | - | - | 17 |
| CO4 | 17 | - | - | - |  |  | 17 |
| CO5 | 5 | - | 16 | - | 8 | - | 29 |
| CO6 | 4 | - | 11 | - | - | - | 15 |
|  | | | | | | | **124** |