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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **17AE3022** | **Duration** | **3hrs** |
| **Course Title** | **ELEMENTS OF AEROSPACE ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | State the International Standard Atmosphere (ISA) at sea level values for temperature, pressure, density, and viscosity as per ICAO. | CO1 | R | 6 |
|  | b. | Identify the different types of drag experienced by an aircraft during flight and explain the reasons behind each type. Additionally, describe the factors that influence the magnitude of drag. | CO1 | R | 10 |
|  |  |  |  |  |  |
| 2. | a. | Identify different types of flight vehicles under the 'heavier-than-air' category and explain the primary characteristics and applications of each type. | CO2 | R | 8 |
|  | b. | Explain the working principle of a hot air balloon and discuss the factors affecting its lift and altitude control. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 3. | a. | Explain the basic principle behind the generation of lift by a cambered airfoil. Describe how its shape influences airflow and creates a pressure difference that contributes to lift. | CO3 | U | 8 |
|  | b. | Describe the flow parameters that directly affect the magnitude of lift generated by an airfoil. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Distinguish between monocoque and semi-monocoque aircraft structures, based on the characteristics and structural differences. | CO4 | U | 8 |
|  | b. | Compare and contrast steel alloys with composites used in aircraft construction, highlighting the applications and advantages. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain the typical control actuation systems used in aircraft for primary flight control surfaces. Describe how these systems assist in maneuvering and stabilizing the aircraft during flight. | CO5 | U | 8 |
|  | b. | Describe the basic flight instruments by classifying them into categories based on the type of information they provide and how they assist the pilot in maintaining control of the aircraft. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain the principle of operation of a rocket, focusing on the conservation of momentum and how the exhaust velocity relates to the thrust generated. | CO6 | U | 8 |
|  | b. | Distinguish between piston type rotary engine and turbofan engines used in aircrafts based on the key characteristics, advantages, and typical applications. | CO6 | U | 8 |
|  |  |  |  |  |  |
| 7. | a. | Examine the control surfaces of an airplane, including ailerons, elevators, and rudders. Explain how each control surface contributes to maneuvering the airplane along different axes of flight. | CO4 | R | 8 |
|  | b. | Classify the major components of an aircraft, including the fuselage, wings, empennage, and engines based on the functionality. | CO4 | U | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Illustrate the nomenclature and flow characteristics of an airfoil with a neat sketch. Label key parts, such as the leading edge, trailing edge, chord line, and camber, and describe how airflow interacts with these features. | CO3 | A | 10 |
|  | b. | Illustrate the concept of a Mach cone and provide a neat sketch showing sound wave propagation at different flow regimes based on Mach number. | CO3 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand standard atmosphere and properties. |
| CO2 | Understand Principles of flight. |
| CO3 | Get Knowledge in aerodynamic shapes. |
| CO4 | Understand Aerospace materials and aircraft structural component. |
| CO5 | Classify the Aircraft instrumentation systems. |
| CO6 | Categorize the Power plants used in various aircraft. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 16 |  |  |  |  |  | 16 |
| CO2 | 8 | 8 |  |  |  |  | 16 |
| CO3 |  | 26 | 10 |  |  |  | 36 |
| CO4 |  | 16 |  |  |  |  | 16 |
| CO5 |  | 32 |  |  |  |  | 32 |
| CO6 |  | 16 |  |  |  |  | 16 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18AE2018** | **Duration** | **3hrs** |
| **Course Title** | **PROPULSION-II** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define thrust coefficient. | | CO1 | R | 1 |
| 2. | A rocket engine produces a thrust of 100 kN. If the exhaust velocity is 3500 m/s, what is the mass flow rate of the propellant? | | CO1 | R | 1 |
| 3. | Mention the purpose of thrust vectoring in rocket engines. | | CO2 | R | 1 |
| 4. | State the types of thrust vectoring using in aircraft and rockets. | | CO2 | R | 1 |
| 5. | Draw the schematic diagram of solid rocket motor. | | CO3 | R | 1 |
| 6. | If the stoichiometric air-fuel ratio for a gasoline engine is 14.7:1, calculate how much air is required to completely burn 1 kg of gasoline? | | CO4 | A | 1 |
| 7. | State the advantages and disadvantages of integral ram rocket. | | CO4 | U | 1 |
| 8. | List earth storable propellants. | | CO5 | R | 1 |
| 9. | State the need for solar sail. | | CO5 | U | 1 |
| 10. | State the advantage of electric propulsion systems. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between subsonic diffuser and subsonic nozzles. | | CO1 | An | 3 |
| 12. | Define specific impulse and explain the significance of specific impulse in rocket propulsion. | | CO2 | U | 3 |
| 13. | List any six criteria for selection of liquid propellants. | | CO3 | R | 3 |
| 14. | Illustrate the purpose of binders in solid propellant rocket motors. | | CO4 | A | 3 |
| 15. | State the application of integral ram rocket engine. | | CO5 | R | 3 |
| 16. | State the classification of electric propulsion. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Write short notes on   1. Convergent Nozzle 2. Convergent Divergent Nozzle 3. Aerospike Nozzle | CO1 | A | 4  4  4 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the purpose of staging and explain the various types of staging used in a rocket engine with neat sketch. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Mention the purpose of additives for solid rocket propellants | CO3 | A | 2 |
|  | b. | Draw and explain the manufacturing process flow diagram of solid rocket motor | CO3 | A | 10 |
|  |  |  |  |  |  |
| 20. |  | Explain the working principle of liquid rocket engine with a neat sketch. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the heat transfer mechanism for liquid rocket engine. | CO5 | A | 4 |
|  | b. | Explain any two methods used in cooling the liquid rocket engine. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 22. |  | Draw the schematic diagram of turbo-pump feed system and explain each sub-system. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the valid assumption made for an ideal rocket. | CO3 | A | 4 |
|  | b. | Compare the characteristics of double based propellant with composite propellants of solid propellant. | CO3 | E | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the working principle of magneto plasma dynamic MPD thrusters. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understand and evaluate the performance of chemical propellant |
| **CO2** | Select and design a suitable air inlets and nozzles |
| **CO3** | Select and design a suitable solid rocket motor |
| **CO4** | Select and design a suitable liquid rocket motor |
| **CO5** | Understand the working of sub-systems of the propulsion system. |
| **CO6** | Assess the performance of electric propulsion systems |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 |  | 12 | 3 |  |  | 17 |
| **CO2** | 2 | 3 | 12 |  |  |  | 17 |
| **CO3** | 4 |  | 16 |  | 8 |  | 28 |
| **CO4** |  | 1 | 16 | 12 |  |  | 29 |
| **CO5** | 4 | 1 | 12 |  |  |  | 17 |
| **CO6** | 4 |  |  | 12 |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV/DEC – 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18AE2025** | **Duration** | **3hrs** |
| **Course Title** | **NAVIGATION, GUIDANCE AND CONTROL OF AEROSPACE VEHICLES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the frequency at which radio detection and ranging system operates. | | CO1 | R | 1 |
| 2. | Recall the use of radar in remote sensing. | | CO1 | R | 1 |
| 3. | Identify the navigation that is based on the position of celestial bodies in space. | | CO2 | U | 1 |
| 4. | Recite the frequency range of VOR. | | CO2 | R | 1 |
| 5. | Represent the sensor that uses earth’s gravity to determine orientation. | | CO3 | U | 1 |
| 6. | State Coriolis Force. | | CO3 | R | 1 |
| 7. | Identify the system, which is employed to control the path of the aircraft without human intervention. | | CO4 | R | 1 |
| 8. | Define the purpose of electronic unit in missile guidance. | | CO4 | R | 1 |
| 9. | State an example for closed loop control system. | | CO5 | R | 1 |
| 10. | Describe Absolutely stable system. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Classify polarization. | | CO1 | U | 3 |
| 12. | Extend the use of marker beacons in ILS. | | CO2 | U | 3 |
| 13. | Label the types of accelerometers. | | CO3 | R | 3 |
| 14. | Rewrite Terrain matching navigation. | | CO4 | R | 3 |
| 15. | Give examples of closed loop transfer function. | | CO5 | U | 3 |
| 16. | Define corner frequency. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the RADAR EQUATION to describe the performance of practical radar. | CO1 | R | 6 |
|  | b. | List the applications of RADAR. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. |  | State hyperbolic navigation methods. And distinguish LORAN –A and LORAN-C. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Identify the use of Newton’s second law in accelerometers and explain the different types of accelerometers. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate Yaw orientational Control system. | CO3 | U | 6 |
|  | b. | Show the displacement Autopilot with pitch rate feedback. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Articulate on the classical guidance laws with applications. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the ground equipment and receiver of VOR. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Determine the overall transfer function of the control system whose signal flow graph is given below. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Summarize the applications of Bode plot in the controller design. | CO6 | U | 6 |
|  | b. | Explain the concept of stability and Routh’s stability criterion. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the radar concepts and their operation. |
| CO2 | Identify fundamental navigation concepts and their working. |
| CO3 | Exemplify various inertial sensors and their applications in IMU. |
| CO4 | Compute guidance commands with the knowledge of the guidance laws. |
| CO5 | Illustrate control system concepts. |
| CO6 | Integrate and validate control systems in aerospace applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 14 | 3 | - | - | - | - | 17 |
| CO2 | 1 | 16 | - | - | - | - | 17 |
| CO3 | 4 | 25 | - | - | - | - | 29 |
| CO4 | 5 | - | 12 | - | - | - | 17 |
| CO5 | 13 | 3 | 12 | - | - | - | 28 |
| CO6 | 4 | 6 | 6 | - | - | - | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **18AE2027** | **Duration** | **3hrs** |
| **Course Title** | **HEAT AND MASS TRANSFER** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State Fourier’s law of heat conduction. | | CO1 | R | 1 |
| 2. | Identify the unit of thermal diffusivity. | | CO1 | R | 1 |
| 3. | Name the modes of condensation. | | CO2 | R | 1 |
| 4. | State Fick’s law of diffusion. | | CO2 | R | 1 |
| 5. | Define Biot number. | | CO3 | R | 1 |
| 6. | Give examples of transient heat conduction. | | CO3 | U | 1 |
| 7. | Define Grashof number. | | CO4 | R | 1 |
| 8. | Define the momentum thickness. | | CO4 | R | 1 |
| 9. | Define the effectiveness of the heat exchanger. | | CO5 | R | 1 |
| 10. | Define ablative heat transfer. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the critical thickness of insulation. | | CO1 | U | 3 |
| 12. | Define film boiling. | | CO2 | R | 3 |
| 13. | Explain lumped heat analysis. | | CO3 | U | 3 |
| 14. | Sketch the boundary layer inside a pipe. | | CO4 | A | 3 |
| 15. | Classify the heat exchanger. | | CO5 | U | 3 |
| 16. | Explain aerodynamic heating. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Hot air at 40ºC is flowing through a steel pipe of 10 cm diameter. The pipe is covered with two layers of insulating materials of thickness 4 cm and 3 cm and their corresponding thermal conductivities are 0.1 and 0.32 W/mK. The inside and outside convective heat transfer coefficients are 50 W/m²K and 15 W/m²K respectively. The outer temperature is 10ºC. Determine the heat loss per meter length of the steam pipe. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A nickel wire carrying an electric current of 1.5 mm diameter and 50 cm long, is submerged in a water bath that is open to atmospheric pressure. Calculate the voltage at the burn out point, if at this point the wire carries a current of 200 A. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the types of fins and indicate their applications. | CO3 | U | 6 |
|  | b. | An aluminum sphere weighing 7 kg and initially at a temperature of 320ºC is suddenly immersed in a liquid at 25ºC. The convective heat transfer coefficient is 50 W/m²K. Determine the time required for the sphere to reach 100ºC. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | Air at 0ºC flows over a flat plate at a speed of 90 m/s and is heated to 100ºC. The plate is 60 cm long and 75 cm wide. Assuming the transition of boundary layer take place at Re= 5x105. Calculate the following:   1. Average friction coefficient 2. Average heat transfer coefficient 3. Rate of energy dissipation | CO4 | A | 4  4  4 |
|  |  |  |  |  |  |
| 21. |  | A parallel flow heat exchanger is used to cool 4.2 kg/min of hot liquid of specific heat 3.5 kJ/kg K at 130˚C. A cooling water of specific heat 4.18 kJ/kg K is used for cooling purposes at a temperature of 15 ˚C. The mass flow rate of cooling water is 17 kg/min. Calculate the following.   1. Outlet temperature of liquid 2. Outlet temperature of water 3. Effectiveness of heat exchanger   Take overall heat transfer coefficient is 1100 W/m²K. The heat exchanger area is 0.3 m². | CO5 | A | 4  4  4 |
|  |  |  |  |  |  |
| 22. |  | The molecular weights of the two components A and B of a gas mixture are 24 and 48 respectively. The molecular weight of a gas mixture is found to be 30. If the mass concentration of the mixture is 1.2 kg/m³, determine the following:   1. Density of components A and B 2. Molar fractions 3. Mass fractions | CO2 | A | 4  4  4 |
|  |  |  |  |  |  |
| 23. |  | Explain in detail the heat transfer in rocket thrust chambers with a neat sketch. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A horizontal plate of 800 mm long and 70 mm wide is maintained at a temperature of 140ºC in a large tank that is full of water at 60ºC. Determine the total heat loss from the plate. | CO4 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the fundamental modes of heat transfer. |
| **CO2** | Understand the phase change heat transfer. |
| **CO3** | Use the heat transfer correlation for different heat transfer applications. |
| **CO4** | Understand the concept of hydrodynamic and thermal boundary layers. |
| **CO5** | Analyse and design the different types of heat exchangers. |
| **CO6** | Apply heat transfer principles of different applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 3 | 12 | - | - | - | 17 |
| **CO2** | 5 | - | 24 | - | - | - | 29 |
| **CO3** | 1 | 16 | - | - | - | - | 17 |
| **CO4** | 2 | - | 27 | - | - | - | 29 |
| **CO5** | 1 | 3 | 12 | - | - | - | 16 |
| **CO6** | 1 | 15 | - | - | - | - | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **18AE2032** | **Duration** | **3hrs** |
| **Course Title** | **FINITE ELEMENT ANALYSIS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define discrete element. | | CO1 | R | 1 |
| 2. | Define boundary value problem. | | CO1 | R | 1 |
| 3. | Define shape function. | | CO2 | R | 1 |
| 4. | List the stages of FEA. | | CO2 | R | 1 |
| 5. | Write the equation of the stiffness matrix for a 2D truss element. | | CO3 | A | 1 |
| 6. | Define degrees of freedom. | | CO3 | R | 1 |
| 7. | Name any two FEA software. | | CO4 | R | 1 |
| 8. | List the methods to analyze fluid flow. | | CO4 | R | 1 |
| 9. | Explain the Linear Strain Triangular (LST) element. | | CO5 | U | 1 |
| 10. | List the stresses of a typical axisymmetric element. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State the principle of the Rayleigh-Ritz method. | | CO1 | R | 3 |
| 12. | Compare and contrast local and natural coordinate systems. | | CO2 | U | 3 |
| 13. | Identify the properties of the global stiffness matrix. | | CO3 | R | 3 |
| 14. | Explain plane strain condition. | | CO4 | U | 3 |
| 15. | State the significance of the subparametric element. | | CO5 | R | 3 |
| 16. | Write the expression of the strain-displacement matrix for an axisymmetric element. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | The differential equation of a physical phenomenon is given by  Trial function, y= a1(x-x4) and boundary conditions are y(0) = 0 and y(1)=0. Calculate the value of the parameter a1 by the following methods:   1. Point collocation method 2. Subdomain collocation method 3. Least squares method 4. Galerkin method | CO1 | A | 3  3  3  3 |
|  |  |  |  |  |  |
| 18. |  | A thin steel plate of uniform thickness 25 mm is subjected to a point load of 420 N at mid-depth as shown in the figure below. The plate is also subjected to self-weight. If young`s modulus E= 2 x 105 N/mm2 and unit weight density,  ρ = 0.8 x 10-4 N/mm3, calculate the following:   1. Displacement at each nodal point 2. Stresses in each element | CO2 | A | 6  6 |
|  |  |  |  |  |  |
| 19. |  | For the two bar truss shown in Fig. below, determine the stiffness matrix of elements 1 and 2. Take Young’s modulus E= 70 GPa and Area A= 200 mm². | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | A pump pumping fluid at Q=6500 m³/hr is located at coordinates (5,2) in the element as shown in Fig. below. Determine the amount of Q allotted to each node. All nodal coordinates are in m. Assume unit thickness of t= 1mm. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Determine the stiffness matrix for the constant strain triangular (CST) element shown in Fig. below. The coordinates are given units of millimeters. Assume plane stress conditions. Take E= 210 GPa, ʋ= 0.25 and t= 10 mm. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | A beam, fixed at one end and supported by a roller at the other end, has a 20kN concentrated load applied at the center of the span, as shown in Fig. below. Calculate the deflection under the load and construct the shear force and bending moment diagrams for the beam.      Take E= 20X106 N/cm² and I = 2500 cm4 | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | A wall of 0.6 m thickness has a thermal conductivity of 1.2 W/mK. The wall is to be insulated with a material of thickness 0.06 m having an average thermal conductivity of 0.3 W/mK. The inner surface is 1000ºC and the outside of the insulation is exposed to atmospheric air at 30ºC with a heat transfer coefficient of 35 W/m²K. Calculate the nodal temperatures. | CO4 | A | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | The nodal coordinates for an axisymmetric triangular element are given below:  r1= 20 mm; z1= 40 mm, r2= 40 mm, z2= 40 mm, r3= 30 mm and z3=60 mm  Determine the strain-displacement matrix [B] for that element. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Analyze the discrete and continuum problem using finite element method. |
| **CO2** | Understand the different Numerical solution to the FEA Problems. |
| **CO3** | Identify mathematical model for solution of common engineering problems. |
| **CO4** | Describe the usage of professional-level finite element software to solve engineering problems  in Solid mechanics, fluid mechanics and heat transfer. |
| **CO5** | Analyze the functions of different elements and Stiffness Matrix. |
| **CO6** | Perform the Axisymmetric problems. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 5 | - | 12 | - | - | - | 17 |
| **CO2** | 2 | 3 | 24 | - | - | - | 29 |
| **CO3** | 4 | - | 13 | - | - | - | 17 |
| **CO4** | 2 | 3 | 24 | - | - | - | 29 |
| **CO5** | 3 | 1 | 12 | - | - | - | 16 |
| **CO6** | 1 | - | 15 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18AE2036** | **Duration** | **3hrs** |
| **Course Title** | **INTRODUCTION TO NON DESTRUCTIVE TESTING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the various scopes of non-destructive testing. | | CO1 | R | 1 |
| 2. | Name any two NDT techniques used to detect internal defects. | | CO1 | R | 1 |
| 3. | Distinguish between liquid penetrant testing & visual inspection. | | CO2 | U | 1 |
| 4. | List any two properties of a good developer. | | CO2 | A | 1 |
| 5. | Write the merits of Eddy current testing. | | CO3 | A | 1 |
| 6. | Define the principle behind magnetic particle testing. | | CO3 | U | 1 |
| 7. | Indicate the limitations of radiography test. | | CO4 | A | 1 |
| 8. | State the normal beam location technique used in Acoustic emission testing. | | CO5 | R | 1 |
| 9. | Differentiate between Acoustic Emission & Ultrasonic testing. | | CO5 | U | 1 |
| 10. | Define the basic principle of Thermography. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Outline the history of Non-Destructive Testing. | | CO1 | A | 3 |
| 12. | Discuss the reason why liquid penetrant testing cannot be used to detect internal defects. | | CO2 | U | 3 |
| 13. | List the essential properties required to increase sensitivity of the MPT test. | | CO3 | A | 3 |
| 14. | Evaluate the influencing factors affecting radiographic testing. | | CO4 | E | 3 |
| 15. | Differentiate between Ultrasonic testing and other NDT methods. | | CO5 | U | 3 |
| 16. | Describe the applications of thermography test in electronics industry. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the differences between the NDT and destructive test. | CO1 | U | 6 |
|  | b. | Discuss the various features of NDT techniques. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Explain the physical principle of liquid penetrant test procedure with neat sketches. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | In detail, explain the working of magnetic particle testing with neat sketch and state its applications, merits and limitations. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe with neat sketch the radiographic techniques. | CO4 | R | 12 |
|  |  |  |  |  |  |
| 21. |  | Enumerate the working principle of Ultrasonic technique with a block diagram and state its limitations. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the principle of Eddy current testing and its limitations with neat sketch. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the principle of acoustic emission technique and the various parameters involved in AET. | CO5 | U | 9 |
|  | b. | Write short note about modes of displays used in radiography test. | CO5 | A | 3 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Write the history and development of thermography test with its advantages and limitations. | CO6 | R | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understanding various types of discontinuities. |
| **CO2** | Knowledge in non – destructive testing, its scope and purpose. |
| **CO3** | Understand the different NDT processes. |
| **CO4** | Evaluate the properties of material without causing damage. |
| **CO5** | Learn dynamic behavior of defect with NDT tools. |
| **CO6** | Choose the best NDT method for different application. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 12 | 3 |  |  |  | 17 |
| **CO2** |  | 16 | 1 |  |  |  | 17 |
| **CO3** | 12 | 13 | 4 |  |  |  | 29 |
| **CO4** | 12 |  | 1 |  | 3 |  | 16 |
| **CO5** | 13 | 13 | 3 |  |  |  | 29 |
| **CO6** | 12 | 1 | 3 |  |  |  | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18AE2039** | **Duration** | **3hrs** |
| **Course Title** | **CRYOGENIC PROPULSION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the suitable material for handling cryogenic fluids. | | CO1 | R | 1 |
| 2. | Observe the properties of helium 3. | | CO1 | U | 1 |
| 3. | Identify the boiling point of liquid hydrogen in Kelvin. | | CO2 | U | 1 |
| 4. | Describe the function of expander in liquefaction systems. | | CO2 | R | 1 |
| 5. | Write the equation of energy added isothermally in an ideal refrigeration system. | | CO3 | A | 1 |
| 6. | State the purpose of surge volume in Solvays refrigerator. | | CO3 | R | 1 |
| 7. | State the purpose of outer vessel in the storage vessel of cryogens. | | CO4 | R | 1 |
| 8. | Write the minimum thickness of the inner shell for a cylindrical vessel. | | CO4 | A | 1 |
| 9. | List the types of reflective insulation used for insulation of cryogenic containers. | | CO5 | R | 1 |
| 10. | Explain the need of liquid nitrogen in liquid rocket engine. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the importance of magnetic properties in material section for cryogenic applications. | | CO1 | U | 3 |
| 12. | Differentiate – Kapitza system and Heylandt system. | | CO2 | U | 3 |
| 13. | List the advantages of cryogen-free dilution refrigerators. | | CO3 | R | 3 |
| 14. | Explain the importance of draining the vessels in the cryogenic refrigeration system. | | CO4 | U | 3 |
| 15. | State and explain apparent thermal conductivity in cryogenic insulation. | | CO5 | R | 3 |
| 16. | Discuss the applications of liquid helium as a cryogen. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Discuss the historical background of cryogenics with a timeline. | CO1 | R | 6 |
|  | b. | State the significance of thermal expansion between different materials. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain Joule-Thompson effect with a neat sketch also derive the equation for Joule-Thompson coefficient. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Differentiate – Solvay refrigerator and Gifford – Mc-Mohan refrigerator. | CO3 | U | 4 |
|  | b. | Explain Vuilleumier refrigerator with necessary equations and sketches. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the design procedure of inner and outer vessel for a cryogenic vessel. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain in detail the gas filled powders and fibrous insulation method used for insulating cryogenic containers. | CO5 | U | 8 |
|  | b. | Explain in detail the necessary precaution to be taken for transporting cryogens through lift. | CO5 | A | 4 |
|  |  |  |  |  |  |
| 22. |  | Describe the Claude system with necessary sketch and equations. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain magnetic refrigeration system with neat sketch. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the working principle of liquid oxygen –liquid hydrogen rocket engine. | CO6 | U | 8 |
|  | b. | State the advantage of cryogenic engine over semi cryogenic rocket engine. | CO6 | R | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the thermal, physical and flow properties of cryogenic fluids. |
| **CO2** | Understand the liquefaction systems to produce cryogenic fluids |
| **CO3** | Know the various method of cryogenic refrigeration systems |
| **CO4** | Explain the various cryogenic fluid storage and transfer lines |
| **CO5** | Design of various insulations for cryogenic propellant tanks |
| **CO6** | Know the various applications of cryogenics in propulsion systems |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 7 | 10 | - | - | - | - | 17 |
| **CO2** | 13 | 16 | - | - | - | - | 29 |
| **CO3** | 4 | 24 | 1 | - | - | - | 29 |
| **CO4** | 1 | 15 | 1 | - | - | - | 17 |
| **CO5** | 4 | 8 | 4 | - | - | - | 16 |
| **CO6** | 4 | 12 | - | - | - | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **18AE2041** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED SPACE DYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define two body problem. | | CO1 | R | 1 |
| 2. | Define Orbital mechanics. | | CO1 | R | 1 |
| 3. | State Lambert's Theorem. | | CO2 | R | 1 |
| 4. | List the significance of Lambert’s theorem in orbital mechanics. | | CO2 | R | 1 |
| 5. | Define Lagrangian and express it mathematically. | | CO3 | R | 1 |
| 6. | Define synodic coordinate system. | | CO3 | R | 1 |
| 7. | Define Lagrangian point. | | CO4 | R | 1 |
| 8. | Define equilateral points. | | CO4 | R | 1 |
| 9. | Define radiation pressure. | | CO5 | R | 1 |
| 10. | Define Earth oblateness. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain singular differential equations. | | CO1 | U | 3 |
| 12. | Explain the applications of Lambert’s theorem. | | CO2 | A | 3 |
| 13. | Explain Lagrangian frame in celestial mechanics. | | CO3 | A | 3 |
| 14. | Explain the motion around collinear and equilateral points. | | CO4 | U | 3 |
| 15. | Explain Tisserand's criterion used for identifying comets. | | CO5 | A | 3 |
| 16. | Explain Lissajous orbits. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the concept of one-dimensional motion in orbital mechanics and derive the regularized equations using first and second step regularization techniques. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Derive the differential equation for the motion of a spacecraft relative to a planet in a two-body system. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Derive Lambert’s Theorem and explain the steps involved in determining the time of flight between two points in an orbit. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Derive Jacobi Integral and explain its importance in describing the motion of a particle in a rotating coordinate system | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the motion of a particle near an equilibrium point in a dynamical system. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the complexities and dynamics of the three-dimensional restricted three-body problem. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe Halo orbits and explain its complex dynamics. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the perturbed restricted three-dimensional three-body problem considering Earth's oblateness and solar radiation pressure. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Ability to understand two-body orbital motion and regularization. |
| CO2 | Gain knowledge of orbital transfer technique |
| CO3 | Understand planar restricted three-body problem. |
| CO4 | Understand orbital motion in planar restricted three-body problem. |
| CO5 | Attain knowledge of 3-dimensional restricted three-body problem and identification of comets. |
| CO6 | Gain knowledge of halo orbits and perturbed 3 body problem. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 | 12 | - | - | - | 29 |
| CO2 | 2 | - | 15 | - | - | - | 17 |
| CO3 | 2 | - | 15 | - | - | - | 17 |
| CO4 | 2 | 3 | 12 | - | - | - | 17 |
| CO5 | 1 | 12 | 3 | - | - | - | 16 |
| CO6 | 1 | 27 | - | - | - | - | 28 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **18AE3026** | **Duration** | **3hrs** |
| **Course Title** | **FUNDAMENTAL OF COMBUSTION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Determine the stoichiometric air to fuel ratio for propane by mass. | CO1 | A | 7 |
|  | b. | Butane C4H10 burns with air with an equivalence ratio of 0.75. Determine the number of moles of air required for per mole the fuel. | CO1 | A | 7 |
|  | c. | Differentiate between detonation and explosion. | CO1 | An | 6 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | The lower heating value of Methane is 50,016 kJ/kg. Determine the heating value of Methane:   1. Per mass of mixture. 2. Per mole of air-fuel mixture. 3. Per cubic meter of air-fuel mixture. | CO2 | A | 14 |
|  | b. | Differentiate between premixed flame and diffusion flame. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 3. | a. | Explain Rankine - Hugoniot relations with neat sketch. | CO3 | U | 8 |
|  | b. | Estimate the detonation velocity for a stoichiometric C2H2 – air mixture initially at 298 K and 1 atm. Neglect dissociation in the products. The molar specific heat of C2H2 at 298 K is 43.96 kJ/k mol-K. | CO3 | An | 12 |
|  |  | **(OR)** |  |  |  |
| 4. |  | A combustion wave propagates with mass flux of 3500 kg/s-m2 through a mixture initially at 298K and 1 Atm. The molecular weight and specific heat ratio of the mixture (burned and unburned) are 29.0 kg/k mol and 1.30, respectively, and the heat release is 3.40\*106 J/kg. Determine the state (p2, v2) of the burned gas and determine in which region this state lies on the Rankine-Hugoniot curve. Also, determine the Mach number of the burned gases. | CO3 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | In mass-diffusion-controlled evaporation of a fuel droplet, the droplet surface temperature is an important parameter. Evaluate the droplet lifetime of a 100-μm-diameter n- dodecane droplet evaporating in dry nitrogen at 1 atm if the droplet temperature is 10 K below the dodecane boiling point. Repeat the calculation for a temperature 20 K below the boiling point, and compare the results. For simplicity, assume that, in both cases, the mean gas density is that of nitrogen at a mean temperature of 800 K. Use this same temperature to estimate the fuel vapor diffusivity. The density of liquid dodecane is 749 kg/m3. | CO4 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain four factors affecting combustion efficiency in gas turbine engine. | CO4 | A | 5 |
|  | b. | State three types of the fuels used in airbreathing engines and explain the significance of each. | CO4 | R | 15 |
|  |  |  |  |  |  |
| 7. | a. | Differentiate between double base propellant and composite propellant. | CO5 | An | 8 |
|  | b. | Explain the process involved in the manufacturing of a solid rocket motor with neat sketch. | CO5 | A | 12 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Illustrate the single fuel droplet combustion model with neat sketch. | CO6 | A | 10 |
|  | b. | Explain the working principle of hybrid rockets. | CO6 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Evaluate the initial nitrate oxide formation rate in ppm/s and the amount of nitric oxide formed in 0.25 ms, for the shock heating of air to 2500 K and 3 atm. where m=1, n=1/2. | CO6 | E | 12 |
|  | b. | Explain the process of supersonic combustion in scramjet. | CO6 | A | 8 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the system by applying laws of combustion. |
| CO2 | Ability to evaluate the process involved in premixed and non-premixed combustion. |
| CO3 | Measure burning velocity and their effects on combustion. |
| CO4 | Design the combustor for engines. |
| CO5 | Analysis of reaction and mixing processes. |
| CO6 | Evaluate performance of rocket fuels. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  |  | 14 | 6 |  |  | 20 |
| CO2 |  |  | 14 | 6 |  |  | 20 |
| CO3 |  | 8 | 20 | 12 |  |  | 40 |
| CO4 | 15 |  | 5 |  | 20 |  | 40 |
| CO5 |  |  | 12 | 8 |  |  | 20 |
| CO6 |  |  | 28 |  | 12 |  | 40 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **18AE3027** | **Duration** | **3hrs** |
| **Course Title** | **UNMANNED AIRCRAFT SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Classify the various elements of Unmanned Aircraft Systems. | CO1 | An | 16 |
|  |  |  |  |  |  |
| 2. |  | Explain the various airframe configurations of: |  |  |  |
|  |  | 1. Horizontal Take Off and Landing UAV. | CO2 | A | 8 |
|  |  | 1. Vertical Take Off and Landing UAV. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. |  | Describe the design standards and regulatory aspects of military and civilian applications of UAV. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 4. | a. | Discuss various types of electro-optic payloads based on their applications and functioning. | CO4 | U | 10 |
|  | b. | Explain the two basic methods of maintaining a stabilized sight-line for the sensors and payloads. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 5. |  | Explain briefly about the various steps involved in the UAV system ground testing. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Classify the army roles of UAVs into distinct categories based on their operational objectives and capabilities. | CO6 | U | 16 |
|  |  |  |  |  |  |
| 7. |  | Distinguish the various categories of unmanned aircraft systems based on their intended use, range, and endurance. | CO1 | An | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Categorize the navy roles of UAVs based on their operational objectives and capabilities. | CO6 | An | 10 |
|  | b. | Classify the civilian roles of UAVs based on their operational objectives and capabilities. | CO6 | An | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basic terminologies and classification of UAS. |
| **CO2** | Relate the design parameters of UAV systems. |
| **CO3** | Obtain knowledge on the application of UAV standards to design UAS . |
| **CO4** | Obtain knowledge on payloads and launch systems for UAS. |
| **CO5** | Understand the basic principles of UAV Testings. |
| **CO6** | Apply the principles to design UAS for specific applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  |  |  | 32 |  | - | 32 |
| CO2 |  |  | 16 |  |  | - | 16 |
| CO3 |  | 16 |  |  |  | - | 16 |
| CO4 |  | 16 |  |  |  | - | 16 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  | 16 |  | 20 |  | - | 36 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **19AE2004** | **Duration** | **3hrs** |
| **Course Title** | **ENGINEERING DESIGN AND COST ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define product development. | | CO1 | R | 1 |
| 2. | What is requirement analysis? | | CO1 | U | 1 |
| 3. | List the key steps involved in selecting products for Value Engineering actions. | | CO2 | R | 1 |
| 4. | Define risk analysis in product development. | | CO2 | U | 1 |
| 5. | Define value of a product. | | CO3 | R | 1 |
| 6. | Interpret Value Engineering. | | CO3 | U | 1 |
| 7. | Illustrate the primary purpose of measuring profits in a business. | | CO4 | U | 1 |
| 8. | Define Queuing theory in value engineering. | | CO4 | U | 1 |
| 9. | Explain the role of the designer in a Value engineering team. | | CO5 | U | 1 |
| 10. | Mention the role of Additive manufacturing in aircraft industry. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain Requirement Engineering and its importance in the product development process. | | CO1 | A | 3 |
| 12. | Describe the importance of assigning rupee equivalents to functions in Value Engineering. | | CO2 | U | 3 |
| 13. | Describe the key components of a Value Engineering program and explain their role in achieving cost efficiency. | | CO3 | U | 3 |
| 14. | Explain the Monte Carlo method and its application in decision-making. | | CO4 | A | 3 |
| 15. | Describe the different services provided by a value engineering team. | | CO5 | U | 3 |
| 16. | Explain the concept of Digital Twin technology and its role in enhancing product lifecycle management. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Analyze the PESTEL factors and explain their influence on the various stages of the product life cycle. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Apply the TRIZ methodology to solve engineering problems and explain how TRIZ tools and principles can be utilized to address engineering challenges. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the steps involved in implementing a Value Engineering program and analyze how each step contributes to improving product value and reducing costs. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Articulate the decision matrix method to a real-world decision-making scenario and explain how it can be used to select the optimum alternative. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze the process of developing alternative methods to achieve required functions and explain their impact on cost, performance and value enhancement. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Describe the key roles and responsibilities of a value engineering team in optimizing processes within the aircraft manufacturing industry. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain how recent advancements in engineering design can be applied to enhance the efficiency and innovation in aircraft industry. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Examine the concepts of Concurrent Engineering, Lean Design, and Rapid Prototyping and explain how these methodologies can be integrated to enhance product development efficiency and innovation. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Define and explain the concept of Product Life Cycle. |
| **CO2** | Conduct requirement analysis. |
| **CO3** | Generate ideas, evaluate and select engineering techniques. |
| **CO4** | Apply and perform FMEA, Fault Tree Analysis etc. |
| **CO5** | Conduct and interpret functional analysis. |
| **CO6** | Apply the basics of Value Engineering. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 3 | 12 |  |  | 17 |
| **CO2** | 1 | 4 | 12 | - | - | - | 17 |
| **CO3** | 1 | 4 | 12 | - | - | - | 17 |
| **CO4** | - | 2 | 15 | 12 | - | - | 29 |
| **CO5** | - | 16 | - | - | - | - | 16 |
| **CO6** | - | 1 | 24 | 3 | - | - | 28 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2002** | **Duration** | **3hrs** |
| **Course Title** | **BASICS OF FLUID MECHANICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the term Viscosity. | | CO1 | R | 1 |
| 2. | State Newton’s Law of Viscosity. | | CO1 | U | 1 |
| 3. | Give the final expression of potential function for a uniform flow. | | CO2 | U | 1 |
| 4. | Give the expression of stream function for source flow. | | CO2 | U | 1 |
| 5. | Name two applications of Bernoulli’s principle. | | CO3 | R | 1 |
| 6. | The floating body is considered to be in unstable equilibrium if the metacenter is \_\_\_\_\_\_the centre of gravity. | | CO3 | R | 1 |
| 7. | Define the term “D’ Alembert’s Paradox”. | | CO4 | R | 1 |
| 8. | Explain the relation between head loss and velocity in Darcy Weisbach Equation for a laminar flow through pipe. | | CO4 | U | 1 |
| 9. | List one advantage of dimensional anlysis. | | CO5 | U | 1 |
| 10. | Write the mathematical expression of normal force exerted by a fluid jet on fixed vertical plate. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe different types of manometers. | | CO1 | R | 3 |
| 12. | Compare and contrast streaklines and pathlines in fluid flow. | | CO2 | U | 3 |
| 13. | Describe the relationship between Euler and Bernoulli’s equation. | | CO3 | U | 3 |
| 14. | Write a brief explanation of frictional loss due sudden expansion and contraction in pipes with neat sketch. | | CO4 | A | 3 |
| 15. | Distinguish between the Froude Number, Reynolds Number, and Euler Number in terms of their definitions. | | CO5 | U | 3 |
| 16. | Establish the relationship between the dynamic forces exerted by a fluid jet on a fixed and moving, inclined plate (Jet velocity is “V”, plate velocity is “u”, plate inclination angle is “ϴ” to horizontal). | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Classify the different types of stability of floating bodies based on the relative positions of the center of gravity, center of buoyancy, and metacenter. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18 |  | Given a control volume and fluid flow scenario, describe and derive the momentum equation in the integral form using the principles of momentum conservation, divergence theorem and Gradient theorem. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Establish the expression for Bernaulli’s equation of motion in fluid dynamics. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Water is flowing through a horizontal pipe with a diameter of 150 mm and a length of 80 m at a velocity of 3 m/s. Calculate the head lost due to friction using:   1. Darcy's formula 2. Chezy’s formula, for which C=65. Given the kinematic viscosity of water is ν=0.01stoke. | CO4  CO4 | An  An | 7  5 |
|  |  |  |  |  |  |
| 21. |  | Explain Buckingham pi theorem to obtain the equation of lift. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | A jet of oil with a density of 850 kg/m3 strikes a stationary plate inclined at an angle of 450 to the horizontal. The jet has a velocity of 8m/s and a cross-sectional area of 0.04 m2. Compute the dynamic normal force exerted by the fluid jet on the vertical plate. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | An orifice meter with an orifice diameter of 10 cm is installed in a pipe with a diameter of 20 cm. The pressure difference across the orifice meter is recorded as 12 N/cm². The coefficient of discharge is 0.60. Estimate the discharge of oil through the pipe, assuming the density of the oil is 850kg/m3. | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | In the figure, an inverted differential manometer is connected to two pipes A and B which convey water. The fluid in the manometer is oil of Sp. Gr. 0.8 for the monomeric readings is shown in figure. Calculate the pressure difference between A and B.  C:\Users\Master\Downloads\Open Pressure PPT 2 manometers.jpeg | CO1 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Know the properties of different fluids and pressure measurements. |
| **CO2** | Apply mathematical knowledge to predict the properties and characteristics of a fluid. |
| **CO3** | Understand the nature of buoyancy of submerged and floating bodies. |
| **CO4** | Attain the Knowledge of flow measurement systems. |
| **CO5** | Estimate the friction factor of pipe flow and losses associated with it. |
| **CO6** | Understand the non-dimensional parameters used in airflow. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 4 | 13 | 12 | - |  |  | 29 |
| **CO2** | - | 17 | - | - |  |  | 17 |
| **CO3** | 2 | 3 | 12 | 12 |  |  | 29 |
| **CO4** | 1 | 1 | 3 | 12 |  |  | 17 |
| **CO5** | - | 4 | 12 | - |  |  | 16 |
| **CO6** | - | 1 | 15 | - |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2005** | **Duration** | **3hrs** |
| **Course Title** | **STRENGTH OF MATERIALS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define factor of safety. | | CO1 | R | 1 |
| 2. | Identify the factors affecting thermal stress. | | CO1 | U | 1 |
| 3. | Define hogging moment. | | CO2 | R | 1 |
| 4. | Identify the type of beam if the shear force diagram is a triangle with the length of the beam as its base. | | CO2 | U | 1 |
| 5. | Define pure bending. | | CO3 | R | 1 |
| 6. | Indicate anyone assumption of simple bending. | | CO3 | U | 1 |
| 7. | Express shearing force in terms of slope. | | CO4 | U | 1 |
| 8. | Relate maximum deflection and slope for a loaded beam. | | CO4 | U | 1 |
| 9. | Express power transmitted by a shaft. | | CO5 | U | 1 |
| 10. | Define principal plane. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between lateral and longitudinal strains. | | CO1 | U | 3 |
| 12. | Explain point of contraflexure. | | CO2 | U | 3 |
| 13. | Explain section modulus. | | CO3 | U | 3 |
| 14. | List the methods to determine slope and deflection in a loaded beam. | | CO4 | R | 3 |
| 15. | Indicate the type of stress in a shaft under torsion. | | CO5 | U | 3 |
| 16. | Define the term obliquity. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C. Take E for steel and copper as 2.1 X 105 N/mm² and 1 X 105 N/mm² respectively. The value of coefficient of linear expansion for steel and copper is given as 11 X 10-6 per °C and 18 X 10-6 per °C respectively. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A cantilever of length 5 m is loaded as shown in fig. below. Sketch the shear force and bending moment diagrams for the cantilever. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Derive the expression of simple bending with a neat sketch. | CO3 | A | 8 |
|  | b. | A cantilever of length 2 m fails when a load of 2 kN is applied at the free end. If the section of the beam is 40 mm X 60 mm, calculate the stress at the failure. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. |  | Consider a simply supported beam of length 5 m, which is carrying a point load of 5 kN at a distance of 3 m from the left end. Determine the following:   1. Slope at the left support 2. Deflection under the load 3. Maximum deflection | CO4 | A | 4  4  4 |
|  |  |  |  |  |  |
| 21. |  | A hollow shaft, having an inside diameter 60% of its outer diameter, is to replace a solid shaft transmitting the same power at the same speed. Calculate the percentage saving in material, if the material to be used is also the same. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Compare laminated spring with helical spring. | CO5 | U | 4 |
|  | b. | A closely coiled helical spring of mean diameter 20 cm is made of 3 cm diameter rod and has 16 turns. A weight of 3 kN is dropped on this spring. Calculate the height by which the weight should be dropped before striking the spring so that the spring may be compressed by 18 cm. Take C= 8 X 104 N/mm². | CO5 | A | 8 |
|  |  |  |  |  |  |
| 23. |  | The stresses at a point in a bar are 200 N/mm² (tensile) and 100 N/mm² (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major stress. Also determine the maximum intensity of shear stress in the material at the point. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | The tensile stresses at a point across two mutually perpendicular planes are 120 N/mm² and 60 N/mm². Determine the normal, tangential and resultant stresses on a plane inclined at 30° to the axis of the minor stress using Mohr’s circle method. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Describe the characteristics of conventional metals. |
| **CO2** | Understand the effect loads acting at different sections of the beam. |
| **CO3** | Calculate the stresses developed in beams. |
| **CO4** | Compare different methods of beam deflection. |
| **CO5** | Analyze the stresses developed in the shaft and spring. |
| **CO6** | Analyze the states of stress in a 2D oblique plane. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 4 | 12 | - | - | - | 17 |
| **CO2** | 1 | 4 | 12 | - | - | - | 17 |
| **CO3** | 1 | 4 | 12 | - | - | - | 17 |
| **CO4** | 3 | 2 | 12 | - | - | - | 17 |
| **CO5** | - | 8 | 20 | - | - | - | 28 |
| **CO6** | 4 | - | 24 | - | - | - | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2007** | **Duration** | **3hrs** |
| **Course Title** | **ENGINEERING THERMODYNAMICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | A tank is filled with oil whose density is 850 kg/m3. If the volume of the tank is V = 2 m3, determine the amount of mass m of oil in the tank. | | CO1 | R | 1 |
| 2. | State intensive and extensive properties. | | CO1 | R | 1 |
| 3. | During a heating process, the temperature of a system rises by 23°C. Express this rise in temperature in K, °F, and R. | | CO1 | R | 1 |
| 4. | In 1 kg mixture of gas at 1.013 bar and 300 k the various constituent’s gases are as follows 75% nitrogen, 18 % oxygen and remaining carbon dioxide. Determine gas constants for each gas constituents. Take universal gas constant as 8314 J/kg K. | | CO2 | R | 1 |
| 5. | Explain an ideal gas. | | CO2 | U | 1 |
| 6. | State the limitation of first law of thermodynamics. | | CO3 | R | 1 |
| 7. | Define thermal reservoir. | | CO4 | R | 1 |
| 8. | A fluid at 200 kPa and 300 ֯C has a volume of 0.8 m3. In a frictionless process at constant volume the pressure is 100 kPa, find the final temperature of the air. | | CO5 | U | 1 |
| 9. | Draw the PV and TS diagram of an otto cycle. | | CO6 | R | 1 |
| 10. | State the various types of gas power cycles. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between the terms change of state, path, and process· | | CO1 | U | 3 |
| 12. | A rigid tank contains a hot fluid that is cooled while being stirred by a paddle wheel. Initially, the internal energy of the fluid is 800 kJ. During the cooling process, the fluid loses 500 kJ of heat, and the paddle wheel does 100 kJ of work on the fluid. Determine the final internal energy of the fluid. Neglect the energy stored in the paddle wheel. | | CO2 | A | 3 |
| 13. | The table given below shows the values of heat transfer and work done during aa cyclic process. Determine work interaction for the process 4-1and state whether it is done upon the system or by the system.   |  |  |  | | --- | --- | --- | | Process | Q (kJ) | W (kJ) | | 1-2 | 850 | 75 | | 2-3 | -80 | -65 | | 3-4 | -700 | 70 | | 4-1 | 210 | ? | | | CO3 | A | 3 |
| 14. | Explain Daltons law of partial pressure. | | CO4 | U | 3 |
| 15. | State Avogadro law. | | CO5 | R | 3 |
| 16. | Differentiate between vapor compression refrigeration and vapor absorption refrigeration cycle. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | A mixture of 18 kg of nitrogen and 2 kg of carbon dioxide is put into a vessel at atmospheric condition. Determine the capacity of the vessel and the pressure in vessel, if it is heated up to twice of initial temperature. Take ambient temperature as 27 ֯C. | CO1 | A | 6 |
|  | b. | A rigid tank contains a hot fluid that is cooled while being stirred by a paddle wheel. Initially, the internal energy of the fluid is 800 kJ. During the cooling process, the fluid loses 500 kJ of heat, and the paddle wheel does 100 kJ of work on the fluid. Determine the final internal energy of the fluid. Neglect the energy stored in the paddle wheel. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Apply steady flow energy equation to a compressor and determine the exit pressure. | CO2 | A | 6 |
|  | b. | Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7 m/s velocity, 100 kPa pressure and 0.95 m3/kg volume, and leaving at 5 m/s, 700 kPa and 0.19 m3/kg. The internal energy of the air leaving is 90 kJ/kg greater than the air entering. Cooling water in the compressor jacket absorbs heat from the air at the rate of 58 kW. Compute the rate of shaft work input to the air in kW. Also find the ratio of the inlet pipe diameter to outlet pipe diameter. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | State the causes of irreversibility of a process. | CO3 | R | 4 |
|  | b. | Illustrate using the second law how friction makes a process irreversible. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 20. | a. | A cyclic heat engine operates between a source temperature of 800 ֯C and a sink temperature of 30 ֯C. What is the least rate of heat rejection per kW net output of the engine? | CO3 | A | 6 |
|  | b. | Derive transfer of heat through a finite temperature difference is ΔS univ = | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Write down the first and second TdS equations, and derive the expression for the difference in heat capacities, CP and cV . What does the expression signify? | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Derive Maxwell's equations. | CO5 | U | 6 |
|  | b. | Derive Clausius-Clapeyron equation. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | An engine working on the Otto cycle is supplied with air at 0.1 MPa, 35°C. The compression ratio is 8. Heat supplied is 2100 kI/kg. Calculate the maximum pressure and temperature of the cycle, the cycle efficiency, and the mean effective pressure. (For air, cP = l.005, Cv = 0.718, and R = 0.287 kJ/kg K). | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write short note on two stroke diesel cycle with P-V and T-S diagram. | CO6 | A | 8 |
|  | b. | Differentiate between otto cycle and diesel cycle. | CO6 | U | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basic concepts of thermodynamics, laws of thermodynamics and types of work and heat interactions. |
| **CO2** | Evaluate the properties of pure substances, ideal gases and real gases from property tables or state equations. |
| **CO3** | Apply the first law of thermodynamics for closed and open systems undergoing different thermodynamic processes and cycles. |
| **CO4** | Understand the concept of entropy and properties of pure substances and real gases |
| **CO5** | Perform energy calculations of engineering systems and analyze the feasibility of the processes undergone by the systems. |
| **CO6** | Evaluate the efficiency and co-efficient of performance of thermal systems and vapor power cycles. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 9 | 3 | 6 |  |  |  | 18 |
| **CO2** | 1 | 1 | 9 |  |  |  | 11 |
| **CO3** | 4 |  | 23 |  |  |  | 27 |
| **CO4** | 1 | 9 |  |  |  |  | 10 |
| **CO5** | 3 | 13 | 13 |  |  |  | 29 |
| **CO6** | 2 | 7 | 8 | 12 |  |  | 29 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE2009** | **Duration** | **3hrs** |
| **Course Title** | **AERODYNAMICS** | **Max. Marks** | **100** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO/BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Define centre of pressure. | | CO1/U | 1 |
| 2. | Define lift and drag. | | CO1/U | 1 |
| 3. | What are ideal/elementary flows? | | CO2/U | 1 |
| 4. | What is a streamline? | | CO2/U | 1 |
| 5. | What is the value of thickness for NACA0012 aerofoil? | | CO3/U | 1 |
| 6. | What is chord? | | CO3/U | 1 |
| 7. | What is a vortex filament? | | CO4/U | 1 |
| 8. | What is circulation? | | CO4/U | 1 |
| 9. | What kind of solution we can get by using panel methods? | | CO5/U | 1 |
| 10. | Panel method is developed based on what type of analysis of flow? | | CO5/U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Obtain equation for lift and drag in terms of normal and axial forces. | | CO1/U | 3 |
| 12. | What is stream function and velocity potential? | | CO2/U | 3 |
| 13. | Say .such that and = dF/dz. Show that | | CO3/U | 3 |
| 14. | What is the form of governing equations in panel methods? What would be the velocity normal to the surface? | | CO5/U | 3 |
| 15. | Write two inferences from Helmholtz theorem? | | CO4/U | 3 |
| 16. | What is displacement thickness? Derive an appropriate expression for it. | | CO6/U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23. Q.No 24 is Compulsory)** | | | | |
| 17. | a. | What is gradient of a scalar field? Explain with an appropriate scalar field variable. | CO1/U | 4 |
| b. | What is Curl of a vector? | CO1/U | 4 |
|  | c. | Say, if Curl of a vector (V = ui+vj+wk) is zero. Show that dy/dx = u/v | CO1/A | 4 |
|  |  |  |  |  |
| 18. | a. | Obtain Laplace equation for an irrotational flow. | CO2/A | 5 |
| b. | With a neat sketch explain working of Pitot static tube. | CO2/U | 7 |
|  |  |  |  |  |
| 19. | a. | Define source and sink and obtain stream function and velocity potential | CO2/A | 6 |
|  | b | Obtain stream function and velocity potential for a combination of uniform flow and source. | CO2/A | 6 |
|  |  |  |  |  |
| 20. | a. | Explain nomenclature for NACA 5 series aerofoils. | CO3/U | 6 |
| b. | Using Kutta condition show that circulation around a closed curve is zero. | CO3/U | 6 |
|  |  |  |  |  |
| 21. | a. | Define induced drag with a neat sketch. | CO4/U | 5 |
| b. | What is Biot savart law? Using the same find induced velocity by a vortex filament. | CO4/U | 7 |
| 22. | a. | Outline general procedure of panel methods. | CO5/A | 6 |
| b. | Consider two vortices on a panel and explain the solution methodology. | CO5/U | 6 |
|  |  |  |  |  |
| 23. | a. | What is divergence of a vector? | CO1/U | 5 |
| b. | The subsonic compressible flow over a cosine shaped (wavy) wall is illustrated in Figure. The wavelength and amplitude of the wall are ”*l*” and “*h*”, respectively, as shown in Figure. The streamlines exhibit the same qualitative shape as the wall, but with diminishing amplitude as  distance above the wall increases    and  where  Consider the particular flow that exists for the case where *l* = 1 0 m,  *h* = 0.01 m, *V∞* = 240 m/s, and *M∞* = 0 7. Also, consider a fluid element of fixed mass moving along a streamline in the flow field. The fluid element passes through the point (*x/l, y/l*) = (1/4, 1). At this point, calculate the time rate of change of the volume of the fluid element, per unit volume. | CO1/A | 7 |
|  |  | **COMPULSORY** | | |
| 24. | a. | From order of magnitude analysis applied to boundary layer over a flat plate show that y- momentum equation reduces to | CO6/U | 6 |
| b. | Obtain appropriate expression for momentum thickness. | CO6/U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the aerodynamic variable connected with airflow. |
| CO2 | Understand the concept of basics flows and its characteristics. |
| CO3 | Develop the knowledge of incompressible flow over airfoil. |
| CO4 | Assess the flow field over the finite wing span. |
| CO5 | Estimate the flow over aircraft wings and Fuselage |
| CO6 | Understand the concept of the boundary layer and its characteristics. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 18 | 11 |  | - | - | 29 |
| CO2 |  | 12 | 17 |  |  |  | 29 |
| CO3 |  | 17 | 0 | 0 | - | - | 17 |
| CO4 |  | 17 |  |  |  |  | 17 |
| CO5 |  | 11 | 06 |  | - | - | 17 |
| CO6 |  | 15 |  |  | - | - | 15 |
|  | | | | | | | 124 |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2011** | **Duration** | **3hrs** |
| **Course Title** | **AEROSPACE STRUCTURES-I** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the primary assumptions in the method of joints for analyzing a plane truss. | | CO1 | R | 1 |
| 2. | List the equilibrium equations that are used at each joint in the method of joints. | | CO1 | R | 1 |
| 3. | What makes a beam statically indeterminate? | | CO2 | R | 1 |
| 4. | State the methods used for determining the shear force and bending moment diagrams for a statically indeterminate beam. | | CO2 | R | 1 |
| 5. | For a circular shaft subjected to torsion, the strain energy is proportional to the \_\_\_\_\_\_of the applied torque. | | CO3 | R | 1 |
| 6. | For a material undergoing axial loading, an increase in the length of the member will \_\_\_\_\_\_\_\_\_ (increase/decrease) strain energy. | | CO3 | R | 1 |
| 7. | State main application of the unit load method in structural analysis. | | CO4 | R | 1 |
| 8. | What is compatibility in the context of indeterminate truss analysis? | | CO4 | U | 1 |
| 9. | In the context of column buckling, define the term "slenderness ratio". | | CO5 | U | 1 |
| 10. | For which type of material is the Maximum Shear Stress Theory (Tresca) most applicable? | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the steps involved in the method of joints for analyzing a plane truss. | | CO1 | U | 3 |
| 12. | Describe the process of drawing the shear force and bending moment diagrams for a fixed-fixed beam subjected to a uniformly distributed load (UDL) using the moment distribution method. | | CO2 | U | 3 |
| 13. | Explain the concept of strain energy due to axial loads and derive the formula for calculating the strain energy stored in a member subjected to axial loading. | | CO3 | U | 3 |
| 14. | Explain an indeterminate truss with an example. | | CO4 | U | 3 |
| 15. | Describe the factors affecting the critical buckling load of a column and explain how each factor influences the buckling behavior. | | CO5 | U | 3 |
| 16. | Explain **Maximum Principal Stress Theory** (Rankine’s Theory) and its suitability for brittle materials. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Determine the force in members AB, BD, and CD of the truss shown in Fig. Also solve for the force on members FH, DF, and DG. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A continuous ABD 10 m long rest on three beam supports A, B and C at the same level and is loaded as shown in Fig. Determine the moment over the beam and draw the shear force and bending moment diagram using Clapeyron’s three moment equation. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | A beam of length L is subjected to a concentrated load P at a distance ‘a’ from the left support. The right end is clamped. Determine the support reaction at the left support using Castigliano's theorem. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Find horizontal deflection of joint C of truss ABCD loaded as shown in Figure using unit load method. Assume that, all members have the same axial rigidity. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Derive the Euler’s buckling load for a column with fixed-free end conditions. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Discuss the Maximum Principal Stress Theory, Maximum Principal Strain Theory, Maximum Shear Stress Theory (Tresca), and Distortion Energy Theory (Von Mises) in detail. For each theory, explain the assumptions, the underlying physical mechanism of failure, and the conditions where each theory is most appropriate. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | A solid column of diameter 50 mm is required to be replaced by hollow column whose external diameter is 1.25 times internal diameter. The column is long enough to fail by buckling only. Compute percent saving in material. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Determine the forces in the members of the truss shown in Fig. | CO1 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Determine the forces of each member in a truss. |
| **CO2** | Analyze statically indeterminate beam under different support/ loading conditions. |
| **CO3** | Find the deflection of an elastic structure based on strain energy of the structure. |
| **CO4** | Analyze the indeterminate trusses using energy method. |
| **CO5** | Compare the buckling of columns with different support conditions. |
| **CO6** | Predict failure of the structures made of conventional metals. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 3 | 24 |  |  |  | 29 |
| **CO2** | 2 | 3 | 12 |  |  |  | 17 |
| **CO3** | 2 | 3 | 12 |  |  |  | 17 |
| **CO4** | 1 | 4 | 12 |  |  |  | 17 |
| **CO5** |  | 4 | 24 |  |  |  | 28 |
| **CO6** | 1 | 15 |  |  |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **20AE2014** | **Duration** | **3hrs** |
| **Course Title** | **AIRPLANE PERFORMANCE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Differentiate between cruise and loiter in the normal operation of an airplane. | | CO1 | U | 1 |
| 2. | Define Aerodynamic center. | | CO1 | U | 1 |
| 3. | Write the unit for thrust specific fuel consumption of a turbojet engine. | | CO2 | A | 1 |
| 4. | Write the equation for in terms of coefficient of zero lift drag and K. | | CO3 | A | 1 |
| 5. | Write the governing equations of motion for steady, level flight with a help of a neat sketch. | | CO3 | A | 1 |
| 6. | Draw the power available and the power required curve vs free stream velocity (V∞) for a turboprop airplane and indicate the excess power available, | | CO4 | R | 1 |
| 7. | State the typical effect of high altitude on rate of climb of a turbojet aircraft. | | CO4 | R | 1 |
| 8. | State the constraint on free stream velocity () to achieve minimum turn radius and maximum turn rate in an unaccelerated level turn of an airplane. | | CO5 | R | 1 |
| 9. | State the variation of load factor (increase/ decrease) with incrase in banking angle () with reason. | | CO5 | R | 1 |
| 10. | State the reason for lesser value of induced drag coefficient with in-ground effect as compared to induced drag coefficient with out-of-ground effect. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the difference between curve for symmetrical and cambered airfoils with a neat sketch. | | CO1 | U | 3 |
| 12. | Sketch the variation in the pressure of incoming air when it passes through the various components of a jet engine. | | CO2 | R | 3 |
| 13. | Explain using graphical approach to plot thrust requires curve for a steady level flight. | | CO3 | U | 3 |
| 14. | Lift produced in a steady, climbing flight is less than that of a study, level flight. Justify the statement with a neat sketch. | | CO4 | U | 3 |
| 15. | Explain how the available thrust become the constraint on maximum load factor (nmax) to achieve minimum turn radius and maximum turn rate in an unaccelerated level turn of an airplane. | | CO5 | U | 3 |
| 16. | Explain the total landing distance with the help of a neat sketch. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain wing tip vertices and lift induced drag with the help of neat sketches. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain about the dependency of propeller efficiency on the free stream velocity with a neat sketch and draw the propeller efficiency curve as a function of advance ratio. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | For steady level flight, derive the expression for velocity as shown at which thrust required is minimum using analytical approach and a plot between thrust required and free steam velocity. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Obtain the expression for velocity as shown for maximum rate of climb of a steady, unaccelerated climbing flight. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Elaborately explain the V-n diagram with a neat sketch indicating the limit load factor and ultimate load factor. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Derive the expression for minimum turn radius from and . (Note that n is a function of ) | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the various phases of take-off flight and derive the expression to estimate the take-off ground roll distance of an airplane. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Derive the maximum climb angle and the corresponding velocity at from and . Also write equation for rate of climb that corresponds to the maximum climb angle. | CO4 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the preliminary design of aircraft based on the performance. |
| **CO2** | Differentiate performance characteristics of jet engine from propeller engine. |
| **CO3** | Estimate the performance characteristics in level flight. |
| **CO4** | Assess the climbing performance characteristics of aircraft. |
| **CO5** | Estimate the turning performance characteristics of aircraft. |
| **CO6** | Realize the ground effects on performance. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | - | 17 | - | - | - | - | 17 |
| **CO2** | 3 | - | 13 | - | - | - | 16 |
| **CO3** | - | 3 | 14 | - | - | - | 17 |
| **CO4** | 2 | 3 | 24 | - | - | - | 29 |
| **CO5** | 2 | 15 | 12 | - | - | - | 29 |
| **CO6** | 1 | 15 | 1 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE2016** | **Duration** | **3hrs** |
| **Course Title** | **INTRODUCTION TO AEROSPACE MATERIALS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Give an example of a metallic bond and define it. | | CO1 | U | 1 |
| 2. | Indicate the use of “Alclad” material in aerospace engineering. | | CO3 | R | 1 |
| 3. | Define the term “Solid solution”. | | CO1 | R | 1 |
| 4. | State the compositions and application of “Babbitt” material. | | CO2 | R | 1 |
| 5. | Indicate the reasons for fatigue failure on aircraft components. | | CO4 | U | 1 |
| 6. | List out the types of high temperature materials. | | CO5 | R | 1 |
| 7. | Indicate the importance of creep strength of a materials which will be used in aerospace applications. | | CO2 | U | 1 |
| 8. | Define the term “Gob” in glass manufacturing. | | CO6 | R | 1 |
| 9. | Show how the annealing is done on materials. | | CO5 | U | 1 |
| 10. | Name the types of steels used in aerospace applications. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate the “Alloy” and “Metal” with suitable example. | | CO3 | U | 3 |
| 12. | Write the classifications of alloys. | | CO4 | A | 3 |
| 13. | Indicate few ultra-high temperature (UHT) materials and its applications. | | CO2 | U | 3 |
| 14. | Write about the “Nickel-chromium Steel” and its applications. | | CO5 | U | 3 |
| 15. | Review the compositions and applications of “Molybdenum Steel”. | | CO1 | U | 3 |
| 16. | Distinguish between the extrusion and forging used for making aluminum alloys. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the various phases of the Iron Carbon Equilibrium diagram. | CO1 | A | 6 |
|  | b. | Illustrate the hardness test procedure for materials with suitable sketch. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Compare the applications of Alclad Aluminum Alloy with steel and mention the major properties of Alclad. | CO5 | An | 6 |
|  | b. | Analyze the Binary phase diagram for binary alloy and explain its various phases. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Appraise in detail on Three-point bending test . | CO4 | An | 6 |
|  | b. | Explain with help of a neat sketch, the test set -up used for conducting “torsional test” on materials. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Sketch the experimental set-up used for carrying out the fatigue test on aluminium materials and explain in detail. | CO4 | A | 6 |
|  | b. | Illustrate the Impact test conducted on materials with help of a suitable sketch. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Analyze the characteristics of high temperature materials. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Differentiate the “thermoplastics” and “thermoset plastic” with suitable example. | CO2 | An | 6 |
|  | b. | With help of a schematic diagram explain the process of an injection moulding machine used for manufacturing of polymer matrix composite. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Sketch the arrangement used for forging of materials and explain the process in details. | CO3 | A | 6 |
|  | b. | Draw an arrangement of a “solvent dip process” used for developing Pre-peg composite and explain the process in detail. | CO3 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the materials used for storage of cryogenic solid and liquid propellant used in rockets. | CO6 | A | 6 |
|  | b. | Analyze the high temperature insulation materials used for various space vehicles. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Explain the influenced of microstructure on mechanical properties of metals and alloys |
| CO2 | Understand the material properties |
| CO3 | Classify different materials |
| CO4 | Identify the testing method of materials |
| CO5 | Select the right material for particular applications. |
| CO6 | Develop new material combinations based on requirement. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 4 | 6 | 6 | - | - | 17 |
| CO2 | 1 | 4 | - | 6 | - | - | 11 |
| CO3 | 1 | 3 | 12 | 12 | - | - | 28 |
| CO4 | - | 1 | 21 | 12 | - | - | 34 |
| CO5 | 1 | 4 | - | 6 | - | - | 11 |
| CO6 | 2 | 3 | 12 | 6 | - | - | 23 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE2017** | **Duration** | **3 hrs** |
| **Course Title** | **GAS DYNAMICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define compressibility. | | CO1 | R | 1 |
| 2. | Illustrate the importance of bell shape in nozzle efficiency. | | CO1 | U | 1 |
| 3. | Sketch an over expanded nozzle. | | CO2 | A | 1 |
| 4. | State the principle change in flow parameters across a normal shock. | | CO2 | R | 1 |
| 5. | Draw hodograph with a neat sketch. | | CO3 | R | 1 |
| 6. | Write the equations of motion of a flow across a centered expansion wave. | | CO3 | A | 1 |
| 7. | Sketch the shock diamond produced by a biconvex airfoil in a supersonic wind tunnel test section. | | CO4 | U | 1 |
| 8. | Predict the change in parameters for a flow with heat addition. | | CO4 | A | 1 |
| 9. | List the types of wind tunnel balances. | | CO5 | R | 1 |
| 10. | Classify wind tunnels based on test section. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Indicate the effect of entropy in flow properties. | | CO1 | U | 3 |
| 12. | Compare and contrast nozzles and diffusers. | | CO2 | U | 3 |
| 13. | Write the expression for equations of motion across a moving normal shock. | | CO3 | A | 3 |
| 14. | State the expression for prandtl Meyer relation. | | CO4 | R | 3 |
| 15. | Interpret the isothermal flow through constant area duct with friction. | | CO5 | U | 3 |
| 16. | Categorize wind tunnels based on various factors. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | A pressure vessel has a volume of 10 m3 is used to store high-pressure air for operating a supersonic wind tunnel. If the air pressure and temperature inside the vessel are 20 atm and 288 K, respectively. Determine the mass and internal energy of air stored in the vessel. Also calculate the change in entropy if the temperature of air inside the vessel is increased to 400 K. | CO1 | A | 8 |
|  | b. | Articulate the expressions for compressibility. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. | a. | A nozzle in a wind tunnel gives a test-section Mach number of 2.0. Air enters the nozzle from a large reservoir at 0.69 bar and 310 K. The cross-sectional area of the throat is 1000sq.cm. Determine the pressures, temperatures and velocity at the throat and test sections, area of cross-section of the test section, mass flow rate and power required to drive the compressor. | CO2 | A | 6 |
|  | b. | Develop the expression for Area - Velocity – Mach number relation. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | The ratio of the exit to entry area in a subsonic diffuser is 4.0. The Mach number of a jet of air approaching the diffuser at a stagnation pressure of 1.01325 bar and static temperature of 290 K is 2.2. There is a standing normal shock wave just outside the diffuser entry. The flow in the diffuser is isentropic. Calculate the Mach number, Temperature, and pressure at the exit of the diffuser. Also compute the stagnation pressure loss between initial and final states of the flow. | | CO3 | An | 12 |
|  |  | |  |  |  |
| 20. | a. | Consider a double wedge airfoil placed in a supersonic flow field at 00 AOA. The half angle of the wedge is 200, Free stream Mach number is 2.5 and static pressure and temperature are 1 atm and 300 K respectively. Take γ=1.4. Compute Mach number, Static pressure, and temperature across the entire flow field. | CO5 | A | 8 |
|  | b. | Summarize the expressions for θ-β-M relation. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 21. | A combustion chamber in a gas turbine plant receives air at 350 K, 0.55 bar and 75 m/s. The air-fuel ratio is 29 and the calorific value of the fuel is 41.87 MJ/kg. Taking γ=1.4 and R=287 J/kg K for the gas predict the initial and final Mach numbers, final pressure, temperature and velocity of the gas, percent stagnation pressure loss in the combustion chamber and the maximum stagnation temperature attainable. | | CO4 | U | 12 |
|  |  | |  |  |  |
| 22. | A long pipe of 25.4 mm diameter has a mean coefficient of friction of 0.003. Air enters the pipe at a Mach number of 2.5, Stagnation temperature 310 K and static pressure 0.507 bar. Show for a section at which M=1.2, Static pressure and temperature, Stagnation pressure and temperature, velocity of air, distance of this section from the inlet and mass flow rate of air. | | CO4 | U | 12 |
|  |  | |  |  |  |
| 23. | Describe in detail the different types of balances used in wind tunnels | | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | Deduce the expressions relating flow parameters with heat addition. | | CO4 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the influence of compressibility to distinguish between the flow regimes. |
| **CO2** | Apply compressibility corrections for flow in converging-diverging passages and instruments like Pitot static tube. |
| **CO3** | Estimate the sudden changes in the flow field due to normal shocks. |
| **CO4** | Estimate the influence of friction and heat transfer in the flow field. |
| **CO5** | Understand oblique shocks and its effect on supersonic flow fields. |
| **CO6** | Choose proper flow visualization techniques for any given situation. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 4 | 12 |  |  |  | 17 |
| **CO2** | 1 | 3 | 13 |  |  |  | 17 |
| **CO3** | 1 |  | 4 | 12 |  |  | 17 |
| **CO4** | 3 | 25 | 1 | 12 |  |  | 41 |
| **CO5** | 1 | 7 | 8 |  |  |  | 16 |
| **CO6** |  | 13 |  | 3 |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2018** | **Duration** | **3hrs** |
| **Course Title** | **AIRCRAFT INSTRUMENTATION AND AVIONICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the system used to measure the quantity or parameter in avionics. | | CO1 | R | 1 |
| 2. | Indicate the term, which refers to the degree of closeness between a measured, and its true value. | | CO1 | R | 1 |
| 3. | Convert 20.6 meter of water column into bar. | | CO2 | U | 1 |
| 4. | Give an example of a gyroscopic instrument. | | CO2 | U | 1 |
| 5. | Select a temperature indicating system employed in the aircraft. | | CO3 | R | 1 |
| 6. | Indicate the system that is also referred to as boost gauge. | | CO3 | U | 1 |
| 7. | Choose a system that depends on electronics for its operation although it contains electromechanical elements. | | CO4 | U | 1 |
| 8. | Cite the parameter on which the maximum altitude an aircraft can fly depends on. | | CO4 | U | 1 |
| 9. | Name the data bus that was developed at Wright Patterson Air Force base in 1970. | | CO5 | R | 1 |
| 10. | Give an example of a cockpit system. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List out the stages of a generalized measurement system. | | CO1 | R | 3 |
| 12. | Classify the instruments employed in aircraft. | | CO2 | U | 3 |
| 13. | State the functions of an accelerometer. | | CO3 | R | 3 |
| 14. | Summarize the role of avionics in civil and military aircraft system. | | CO4 | U | 3 |
| 15. | Group the commercial and military data buses in avionics. | | CO5 | U | 3 |
| 16. | Enumerate the features of an alphanumeric display used in avionics. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Describe the functions of an indicator, recorder and integrator with the help of a neat schematic. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. |  | Discuss the construction and operation of a pitot static system. Summarize its merits and demerits. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the salient features of an accelerometer highlighting its advantages and disadvantages. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Write short notes on any two pressure measuring instruments employed in avionics system. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Sketch the cabin pressure control system and explain its construction. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Construct the architecture of military standard (MIL STD) 1553B and summarize its salient features. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Examine the trends in display technology in avionics. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write about synthetic and enhanced vision system with neat sketches. | CO6 | A | 6 |
|  | b. | Explain the working principle of multi-function keyboard system. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basics of measurements and different parameters. |
| **CO2** | Identify the fundamental cockpit instruments and their working principles. |
| **CO3** | Differentiate various sensors and transducers used in aerospace vehicles. |
| **CO4** | Comprehend the principles behind temperature, pressure, fuel flow and engine measurements. |
| **CO5** | Analyze the functioning of military/civil aircraft data buses and communication process between them. |
| **CO6** | Identify display technologies and their working principles. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 17 | - | - | - | - | - | 17 |
| **CO2** | - | 17 | - | - | - | - | 17 |
| **CO3** | 4 | 13 | 12 | - | - | - | 29 |
| **CO4** | - | 5 | 12 | - | - | - | 17 |
| **CO5** | 1 | 3 | 12 | - | - | - | 16 |
| **CO6** | 3 | 1 | 24 | - | - | - | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2019** | **Duration** | **3hrs** |
| **Course Title** | **SPACE DYNAMICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State the thrust equation of rocket. | | CO1 | R | 1 |
| 2. | Define specific impulse. | | CO1 | R | 1 |
| 3. | Describe universal time. | | CO2 | R | 1 |
| 4. | Define Solar day. | | CO2 | R | 1 |
| 5. | Sate the Kepler’s equation representing eccentric and mean anomaly. | | CO3 | R | 1 |
| 6. | Define eccentric anomaly. | | CO3 | R | 1 |
| 7. | State the eccentricity values for circular, elliptical and parabolic orbits. | | CO4 | R | 1 |
| 8. | Define earth’s oblateness. | | CO4 | R | 1 |
| 9. | Define station keeping of satellites. | | CO5 | R | 1 |
| 10. | Define orbit transfer. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain static margin. | | CO1 | A | 3 |
| 12. | The mean distance between the earth and the sun is 1.5 x1011m. The mean distance between the sun and the mars is 2.287 x 1011m. Calculate the period of mars around the sun in earth days. | | CO2 | An | 3 |
| 13. | Explain conservation of angular momentum with respect to a satellite on space. | | CO3 | A | 3 |
| 14. | Explain the J2 effects on a satellite. | | CO4 | A | 3 |
| 15. | Describe different scenarios in which orbital maneuvers are executed in space missions. | | CO5 | U | 3 |
| 16. | Explain planetary departure in space mechanics. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe and derive the Tsiolkovsky equation to find the incremental velocity of a rocket. | CO1 | U | 10 |
|  | b. | Explain in detail about stability of rockets. | CO1 | An | 2 |
|  |  |  |  |  |  |
| 18. |  | A four stage rocket is used to put up a satellite of 40kg mass in Low Earth Orbit (LEO). The approximate values of mass of the propellant, structure mass and jet velocity for each stage are given below:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Stage** | **I** | **II** | **III** | **IV** | | Propellant Mass(kg) | 9000 | 3500 | 1700 | 260 | | Structure Mass(kg) | 1500 | 550 | 250 | 40 | | VJ (m/s) | 2200 | 2400 | 2500 | 2750 |   Determine:  i. Payload mass fraction of the total rocket.  ii. Structural mass fraction of each stage  iii. The ideal incremental velocity provided by each stage and total ΔV.  iv. If the first stage fires for a period of 50sec and the rate of mass depletion can be assumed to be constant, calculate the acceleration of the rocket at takeoff. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain about the planets, asteroids, comets and meteoroids in the solar system with pictorial representation. | CO2 | An | 6 |
|  | b. | State Kepler's three laws of planetary motion and explain these laws with suitable diagrams. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Calculate the orbital elements of a geocentric satellite whose inertial position and velocity vectors in a geocentric equatorial frame are  r = 2615**I**^+ 15881**J**^ + 3980**K**^ (km)  v = -2.767**I**^ **-** 0.7905**J**^ **+** 4.980**K**^ (km/s) | CO3 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the general and restricted two-body problems and derive the differential equation that characterizes the motion of a satellite with respect to a planet. | CO3 | U | 6 |
|  | b. | Explain the applications of orbital perturbations in satellites. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the different types of forces that cause orbital perturbations. | CO4 | An | 6 |
|  | b. | Explain Cowell’s method to solve equation of motion with perturbations. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Describe Hohmann transfer from low circular to a higher circular orbits. | CO5 | U | 6 |
|  | b. | Calculate the total ∆V requirement for a bi-elliptic Hohmann transfer from a geocentric circular orbit of 700km radius to one of 105000km radius. Let apogee of the first ellipse be 210000km. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the concept of an interplanetary Hohmann transfer for moving between different celestial bodies in the solar system. | CO6 | A | 6 |
|  | b. | Explain the rendezvous opportunities in interplanetary trajectories. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Estimate performance and stability of rockets. |
| CO2 | Attain a general knowledge of laws governing orbital motion. |
| CO3 | Compute orbits of satellites. |
| CO4 | Study the effects of perturbations on orbital motion. |
| CO5 | Study orbital maneuvers useful for the study of inter-planetary trajectories. |
| CO6 | Generate preliminary design of inter-planetary trajectories |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 10 | 15 | 2 | - | - | 29 |
| CO2 | 2 | - | 6 | 9 | - | - | 17 |
| CO3 | 2 | 6 | 3 | 12 | - | - | 23 |
| CO4 | 2 | 6 | 9 | 6 | - | - | 23 |
| CO5 | 1 | 9 | - | 6 | - | - | 16 |
| CO6 | 1 | 3 | 6 | 6 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2020** | **Duration** | **3hrs** |
| **Course Title** | **AEROSPACE STRUCTURES-II** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Indicate any one cross-section of the beam such that the beam will never undergo unsymmetrical bending. | | CO1 | U | 1 |
| 2. | Draw neutral axis in unsymmetrical bending of beam. | | CO1 | U | 1 |
| 3. | Indicate the region of an I-beam where the shear flow is typically the highest. | | CO2 | U | 1 |
| 4. | Indicate the shear center of a thin-walled box beam of square cross-section with the help of a neat sketch. | | CO2 | U | 1 |
| 5. | State the advantage of adding booms to a thin-walled closed-section beam. | | CO3 | R | 1 |
| 6. | State the effect of a boom on a closed thin wall structure subjected to a torque. | | CO3 | U | 1 |
| 7. | Write the equation for the flexural rigidity of the plate. | | CO4 | A | 1 |
| 8. | What is the effect of increasing plate thickness on its buckling strength? | | CO4 | U | 1 |
| 9. | State the type of stress that causes diagonal waves to form in thin plates. | | CO5 | R | 1 |
| 10. | State the term used to refer to the distance between the centers of the two rivets in a riveted joint. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain unsymmetrical bending with the help of a neat sketch. | | CO1 | U | 3 |
| 12. | Locate the shear center for a symmetrical ‘C’ section and explain the reason for its location. | | CO2 | R | 3 |
| 13. | A thin-walled closed section beam of rectangular shape (height = 100 mm, width = 50 mm, wall thickness = 2 mm) is subjected to a torque of 500 Nm. Determine the shear flow and shear stress in the walls due to the applied torque. | | CO3 | A | 3 |
| 14. | An extruded aluminum section has a plate of width 300 mm and thickness 6 mm, subjected to uniform compressive stress. The plate is simply supported along its longitudinal edges. Determine the critical buckling stress using | | CO4 | A | 3 |
| 15. | With the help of a neat sketch, explain the structural advantages of providing lips in the extruded thin-walled structures. | | CO5 | U | 3 |
| 16. | Explain any two types of failure in riveted joints with the help of a neat sketch. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | A cantilever beam of rectangular section is subjected to a load of 1000 N which is inclined at an angle of 30° to the vertical as shown in Figure. Determine the normal stress due to bending at points A, B, C and D using the equation  . | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Determine the shear flow and horizontal location of the shear center for the shear resistant beam shown in Figure using . Assume a vertical shear load = 60 kN and area (A) = 2.5 cm2. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Determine the shear flow, shear stress and twist per unit length of the two-cell structure shown in Figure. Assume G = 25x105 N/cm2 and thickness = 0.1 cm. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Determine the crippling stress for the formed section shown in Figure using angle method, if material is aluminium alloy 2024-T3.  Fcy = 2.75x108 N/m2. Ec = 70x109 N/m2. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Determine the shear flow and twist per unit length of the structure shown in Fig. Assume G = 25x105 N/cm2 and radius R = 10 cm. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Determine the efficiency of the following riveted joints:  1. Single riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 50 mm.  2. Double riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 65 mm. Assume  Permissible tensile stress in plate = 120 MPa  Permissible shearing stress in rivets = 90 MPa  Permissible crushing stress in rivets = 180 MPa. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | The Figure shows a single cell beam with four flanges, Determine the internal shear flow when the beam carries an external load of 2000 N as shown using .. Consider the thickness of the cell is uniform and is equal to 0.1 cm. | CO3 | A | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A cantilever beam carries concentrated loads as shown in Figure. Determine the distribution of stiffener loads and the shear flow distribution in the web panels assuming that the latter are effective only in shear. | CO5 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the stresses due to unsymmetrical bending of beams. |
| **CO2** | Predict the shear flow and shear center in thin-walled open section beams. |
| **CO3** | Calculate the shear stress in thin-walled closed section beams. |
| **CO4** | Analyze the buckling characteristics of plates. |
| **CO5** | Assess the load and stress distribution of wing and fuselage sections. |
| **CO6** | Analyze the stresses in structural joints of aircraft components. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 0 | 5 | 12 |  |  |  | 17 |
| **CO2** | 3 | 2 | 12 |  |  |  | 17 |
| **CO3** | 1 | 1 | 27 |  |  |  | 29 |
| **CO4** | 0 | 1 | 16 |  |  |  | 17 |
| **CO5** | 1 | 3 | 24 |  |  |  | 28 |
| **CO6** | 1 | 3 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2022** | **Duration** | **3hrs** |
| **Course Title** | **PROPULSION-II** | **Max. Marks** | **100** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | | **BL** | | **M** | |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | |
| 1. | A rocket motor has a specific impulse of 250 seconds. If the propellant mass is 1000 kg, what is the total impulse produced by the motor? | | CO1 | | U | | 1 | |
| 2. | A rocket engine produces a thrust of 500 kN. If the mass flow rate of the propellant is 100 kg/s, what is the specific impulse of the engine? | | CO1 | | U | | 1 | |
| 3. | State the significance of mixed compression intake. | | CO2 | | R | | 1 | |
| 4. | Describe jet-avators with neat sketch. | | CO2 | | R | | 1 | |
| 5. | Determine the exit velocity if the thrust produced is 62250 N and the mass flow rate is 24.9 kg/s. | | CO3 | | A | | 1 | |
| 6. | State the purpose of burn rate modifiers in the solid propellant motor. | | CO3 | | R | | 1 | |
| 7. | List the various types of pyrogen igniter. | | CO4 | | R | | 1 | |
| 8. | State the purpose of gas generator in a liquid rocket engine. | | CO5 | | R | | 1 | |
| 9. | State the chalenges in electro thermal propulsion system. | | CO6 | | R | | 1 | |
| 10. | Explain the need for ion electrostatic accelerator in an ion propulsion system. | | CO6 | | U | | 1 | |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | |
| 11. | A liquid rocket engine uses a propellant combination of RP-1 and liquid oxygen. The engine's mass flow rate is 40 kg/s, and the exhaust velocity is 3,500 m/s. The combustion chamber pressure is 2 MPa and the throat area is 10 cm2. Calculate the thrust coefficient and the thrust produced by the engine. | | CO1 | | An | | 3 | |
| 12. | State the types of thrust reversal mechanism used in advanced aircrafts. | | CO2 | | R | | 3 | |
| 13. | Explain the Saint Robert’s law. | | CO3 | | U | | 3 | |
| 14. | Illustrate the purpose of binders in solid propellant rocket motors. | | CO4 | | A | | 3 | |
| 15. | Describe how thrust can be varied in liquid rocket engine. | | CO5 | | U | | 3 | |
| 16. | State the application of integral ram rocket engine. | | CO6 | | R | | 3 | |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | | | | |
| 17. |  | Design a nozzle for an ideal rocket that has to operate at sea level having a combustion chamber pressure of P1 = 3 MPa and a chamber temperature of T1= 3571 K, oxygen to fuel ratio is 2.35. Assuming that k = 1.24 and R = 355.4 J/kg-K, determine the throat area, throat dia, exit area, exit dia, throat velocity, throat temp and exit temperature, exit velocity. Take divergent angle as 15 degrees. Sea level pressure is equals to exit pressure of the nozzle P2 = P3 = 0.101325 MPa. The Thrust produced by the rocket is 5000 N. | | CO1 | | C | | 12 | |
|  |  |  | |  | |  | |  | |
| 18. | a. | Differentiate between supersonic diffuser and supersonic nozzles. | | CO2 | | An | | 4 | |
|  | b. | Explain the function of exhaust nozzles their types and applications in an aircraft. | | CO2 | | A | | 8 | |
|  |  |  | |  | |  | |  | |
| 19. | a. | State the purpose of supersonic intakes, explain their types and their performance. | | CO2 | | R | | 8 | |
|  | b. | State any four factors influencing the burn rate in solid propellant rocket motor. | | CO2 | | R | | 4 | |
|  |  |  | |  | |  | |  | |
| 20. | a. | Classify solid rocket motor based on their application. | | CO3 | | An | | 6 | |
|  | b. | Analyze the combustion flame structure of a double base propellant strand burner in a inert atmosphere. | | CO3 | | An | | 6 | |
|  |  |  | |  | |  | |  | |
| 21. | a. | Explain the cooling techniques used in liquid rocket engine. | | CO4 | | A | | 6 | |
|  | b. | Illustrate the atomization and combustion process in a liquid rocket engine with neat sketch. | | CO4 | | An | | 6 | |
|  |  |  | |  | |  | |  | |
| 22. | a. | Explain the monopropellant gas generator with necessary sketch. | | CO5 | | A | | 6 | |
|  | b. | Explain the need of electric propulsion systems and state the significance of arc jet propulsion system. | | CO6 | | A | | 6 | |
|  |  |  | |  | |  | |  | |
| 23. |  | Write short notes on the following nozzles   1. Convergent Nozzles. 2. Convergent Divergent Nozzles. 3. Aerospike Nozzles. | | CO2 | | A | | 4  4  4 | |
| **COMPULSORY QUESTION** | | | | | | | | |
| 24. | a. | Explain the purpose of scramjet engine. | | CO6 | | U | | 4 | |
|  | b. | Explain the strut based supersonic combustion process in a scramjet combustor. | | CO6 | | A | | 8 | |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand and evaluate the performance of chemical propellant. |
| **CO2** | Select and design a suitable air inlets and nozzles. |
| **CO3** | Select and design a suitable solid rocket motor. |
| **CO4** | Select and design a suitable liquid rocket engine. |
| **CO5** | Understand the working of sub-systems of the propulsion system. |
| **CO6** | Assess the performance of advance propulsion systems. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** |  | 2 |  | 3 |  | 12 | 17 |
| **CO2** | 17 |  | 8 | 4 |  |  | 29 |
| **CO3** | 1 | 3 | 13 | 12 |  |  | 29 |
| **CO4** | 1 |  | 9 | 6 |  |  | 16 |
| **CO5** | 1 | 3 | 6 |  |  |  | 10 |
| **CO6** | 4 | 5 | 14 |  |  |  | 23 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **20AE2023** | **Duration** | **3 hrs** |
| **Course Title** | **COMPUTATIONAL FLUID DYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the assumptions of energy equation. | | CO1 | R | 1 |
| 2. | List the types of boundary conditions in steady flow. | | CO1 | R | 1 |
| 3. | Define unstructured grid for steady state problems. | | CO2 | R | 1 |
| 4. | Differentiate between implicit and explicit forms. | | CO2 | U | 1 |
| 5. | Give two examples of first order finite differencing schemes. | | CO3 | U | 1 |
| 6. | Identify whether the upwind differencing scheme is second order accurate. | | CO3 | R | 1 |
| 7. | Summarize the steps involved in solving problems using Gauss seidel method. | | CO4 | U | 1 |
| 8. | Illustrate staggered grid for solving momentum equation with a neat sketch. | | CO4 | U | 1 |
| 9. | Describe inflexion point related to turbulance. | | CO5 | U | 1 |
| 10. | Illustrate energy cascade with a neat sketch. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the two types of approaches used in solving fluid flow problems. | | CO1 | R | 3 |
| 12. | Sketch two 2D and 3D elements for unstructured grid generation. | | CO2 | A | 3 |
| 13. | Describe the transportive nature of upwind differencing scheme. | | CO3 | U | 3 |
| 14. | Write short notes on SIMPLER algorithm. | | CO5 | A | 3 |
| 15. | Differentiate between translational and rotational interfaces based on boundary condition accuracy. | | CO5 | U | 3 |
| 16. | Distinguish between Zero equation and One equation turbulence models. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. |  | Articulate the continuity equation for steady, compressible flow through a control volume fixed in space. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain in detail the hyperbolic equation for a fluid flow problem. | CO2 | U | 8 |
|  | b. | State the applications of Time Averaged Navier Stokes equations for compressible flows. | CO2 | R | 4 |
|  |  |  |  |  |  |
| 19. |  | Deduce the steps involved in solving steady state diffusion problems. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | A thin plate is initially at a uniform temperature of 200°C. At a certain time t = 0 the temperature of the east side of the plate is suddenly reduced to 0°C. The other surface is insulated. Use the explicit finite volume method in conjunction with a suitable time step size to calculate the transient temperature distribution of the slab and compare it with the analytical solution at time, t = 4 s, The datas are: plate thickness, L = 2 cm, thermal conductivity k = 10 W/m.K and ρc = 10 × 106 J/m3.K. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain in detail the hybrid differencing scheme and assess its properties. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Classify the types of boundary conditions used in transient analysis. | CO5 | U | 9 |
|  | b. | Describe the steps involved in SIMPLE algorithm with a block diagram. | CO5 | U | 3 |
|  |  |  |  |  |  |
| 23. |  | Articulate the expressions involved in K Epsilon turbulence model. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Consider a large plate of thickness L = 2 cm with constant thermal conductivity k = 0.5 W/m.K and uniform heat generation q = 1000 kW/m3. The ends are maintained at temperatures of 100°C and 200°C. Assuming that the dimensions in the y- and z-directions are so large that temperature gradients are significant in the x-direction only, calculate the steady state temperature distribution. The governing equation is: | CO2 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the governing equations for fluid flow and its classification. |
| **CO2** | Choose proper turbulent models for given flow situations. |
| **CO3** | Apply proper solution methodologies for PDE. |
| **CO4** | Arrive at proper domain for the numerical simulation for given flow situations. |
| **CO5** | Define the boundary conditions and generate grids. |
| **CO6** | Solve real life fluid dynamic problems. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 5 | - | 12 |  |  |  | 17 |
| **CO2** | 7 | 7 | 3 | 12 |  |  | 29 |
| **CO3** | 1 | 4 | - | 12 |  |  | 17 |
| **CO4** | - | 14 |  | 12 |  |  | 29 |
| **CO5** |  | 16 | 3 |  |  |  | 16 |
| **CO6** |  | 4 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2025** | **Duration** | **3hrs** |
| **Course Title** | **AIRCRAFT STABILITY AND CONTROL** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define degrees of freedom. | | CO1 | R | 1 |
| 2. | Illustrate the importance of neutral point in static longitudinal stability. | | CO1 | U | 1 |
| 3. | Write the expression for the contribution of elevator hinge moment towards stability. | | CO2 | A | 1 |
| 4. | Sketch trim tabs. | | CO2 | A | 1 |
| 5. | Interpret the expression for contribution of wing towards static directional stability. | | CO3 | U | 1 |
| 6. | Illustrate dorsal fins with a neat sketch. | | CO3 | U | 1 |
| 7. | State the significance of aerodynamic balancing. | | CO4 | R | 1 |
| 8. | Describe the effects of coupling of static lateral and directional stability. | | CO4 | R | 1 |
| 9. | Compare and contrast the static and dynamic stability. | | CO5 | U | 1 |
| 10. | Give some examples of dynamic instabilities. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Name the 6 degrees of freedom of an airplane. | | CO1 | R | 3 |
| 12. | Represent stick force gradients with a neat sketch. | | CO2 | U | 3 |
| 13. | Explain in short the principle of rudder lock. | | CO3 | U | 3 |
| 14. | Briefly, describe the effects of propeller in static lateral stability. | | CO4 | R | 3 |
| 15. | Compare and contrast stick fixed and stick free stability. | | CO5 | U | 3 |
| 16. | Write the expression for Rouths discriminant. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Articulate the expression for wing and horizontal tail towards static longitudinal stability. | CO1 | A | 8 |
|  | b. | Write short notes on elevator requirements. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. | a. | Deduce the steps involved in estimation of hinge moment parameters. | CO2 | An | 7 |
|  | b. | Estimate the factors influencing the aft most position of center of gravity for stable configuration. | CO2 | U | 5 |
|  |  |  |  |  |  |
| 19. |  | Establish the expression for fuselage and propeller effects on static directional stability. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Associate yawing moment with its conventions. | CO4 | U | 6 |
|  | b. | Enumerate the aileron control force requirements for lateral control. | CO4 | R | 6 |
|  |  |  |  |  |  |
| 21. |  | Interpret the equations of motion for stick fixed and stick free condition of dynamic longitudinal stability. | CO5 | U | 12 |
| 22. | a. | Devise the steps involved in determining the aileron control reversal speed. | CO5 | An | 9 |
|  | b. | Illustrate Dutch roll with a neat sketch. | CO5 | U | 3 |
|  |  |  |  |  |  |
| 23. |  | Classify the effects of coupling of static directional and lateral motion in dynamic stability | CO5 | U | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Write short notes on   1. Spiral Divergence 2. Directional Divergence 3. Aileron control effectiveness 4. Autorotation | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the static stability behavior of an aircraft |
| **CO2** | Analyze the effects of Elevator on static longitudinal stability. |
| **CO3** | Assess the motion of aircraft and related modes of directional stability. |
| **CO4** | Estimate the static lateral stability of aircraft. |
| **CO5** | Understand the dynamic longitudinal stability of aircraft. |
| **CO6** | Perform the dynamic analysis to determine stability of aircraft. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 4 | 1 | 12 |  |  |  | 17 |
| **CO2** |  | 8 | 9 |  |  |  | 17 |
| **CO3** |  | 5 | 12 |  |  |  | 17 |
| **CO4** | 11 | 6 |  |  |  |  | 17 |
| **CO5** |  | 21 | 9 |  |  |  | 40 |
| **CO6** |  | 1 | 15 |  |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE2027** | **Duration** | **3hrs** |
| **Course Title** | **FINITE ELEMENT ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List different numerical methods in FEA. | | CO1 | R | 1 |
| 2. | List the classification of FEA problems. | | CO1 | R | 1 |
| 3. | Define shape function. | | CO2 | R | 1 |
| 4. | List the advantage of FEA. | | CO2 | R | 1 |
| 5. | Define natural coordinates. | | CO3 | U | 1 |
| 6. | State general FEA equation. | | CO3 | R | 1 |
| 7. | Write the equation of stiffness matrix for a beam element. | | CO4 | A | 1 |
| 8. | List any two sign conversions for beam elements. | | CO4 | R | 1 |
| 9. | State the stiffness matrix for a CST. | | CO5 | U | 1 |
| 10. | List different types of heat transfer. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Verify the condition to satisfy the numbering of nodes and elements, for the given diagram. | | CO1 | U | 3 |
| 12. | State the importance of location of nodes in detail with neat sketch. | | CO2 | R | 3 |
| 13. | Calculate the stress in bar elements and determine the type of stress when the deflection is 0.445mm and E = 83\*10^3 MN /m2 and length of the 3 elements are 400mm, 800mm and 600mm. | | CO3 | An | 3 |
| 14. | State the difference between boundary value problem and initial value problem. | | CO4 | R | 3 |
| 15. | Calculate Stress-Strain relationship Matrix [D] where E = 2.1\*10^5 MN /m2 and the poison’s ratio is 0.3. | | CO5 | An | 3 |
| 16. | Define convection, conduction, and radiation heat transfer. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Find the solution for the following differential equation. | CO1 | An | 12 |
| 18. |  | Calculate the nodal displacement, Element stress and Support reaction, E = 2\*105 MN/m2. The bar is subjected to a point load P = 40 kN at its center. Also determine the reaction force at the support. | CO2 | An | 12 |
| 19. |  | Determine the element stiffness matrix for each element, for the given 4 bar truss and assemble the structural stiffness matrix K for the entire truss.  E = 2\*105 N/mm2, Ae = 652 mm2 for all elements. | CO3 | An | 12 |
| 20. |  | Establish the expression for the shape function for beam element in 4th order beam Equation. | CO4 | An | 12 |
| 21. |  | Determine the stiffness matrix for CST element. The coordinates are given in units of millimeters. Assume plane stress Condition. E = 210GPa, v =0.25 & t =10mm | CO4 | An | 12 |
| 22. |  | Explain and derive Stress-Strain relationship matrix for 2D element. | CO5 | An | 12 |
| 23. |  | Explain and derive the shape function for the constant strain triangular Asymmetry element. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain and derive 1-D heat conduction with free end convection. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | |  | | --- | | Understand the approximate methods applied to structural problems. | |
| **CO2** | |  | | --- | | Understand the discretization of bar elements. | |
| **CO3** | |  | | --- | | Develop mathematical models for truss problems. | |
| **CO4** | |  | | --- | | Derive the finite element equations for beam elements. | |
| **CO5** | |  | | --- | | Assemble finite element equation for 2D plane elements. | |
| **CO6** | |  | | --- | | Solve filed problems for finding the unknowns in heat and fluid flow problems. | |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 3 | 12 | - | - | - | 17 |
| **CO2** | 5 | - | 12 | - | - | - | 17 |
| **CO3** | 1 | 1 |  | 15 | - | - | 17 |
| **CO4** | 4 |  | 1 | 24 | - | - | 29 |
| **CO5** | - | 1 | - | 27 | - | - | 28 |
| **CO6** | 3 | 1 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **20AE2030** | **Maximum Marks: 100** |
| **Course Title** | **TECHNICAL APTITUDE** | **Time: 3 Hours** |

1. The parameter which measures the efficiency of an aircraft engine is \_\_\_\_\_.

a. Specific power output b. Specific heat capacity

c. Specific energy consumption d. Specific fuel consumption

1. The increase in \_\_\_\_\_ does not contribute to the increase in power produced by the piston engine.

a. Size of the fly wheel b. Size of the engine c. RPM of the engine d. Mean effective pressure

1. The force exerted by the weight of the atmosphere on an object in the atmosphere is called as \_\_\_\_\_.

a. Mass b. Weight c. Pressure d. Stress

1. Instruments used to measure pressure in aviation is \_\_\_\_\_.

a. Barometer b. Altimeter c. Anemometer d. Pitot tube

1. The primary factor that affects the advance ratio is \_\_\_\_\_.

a. Aircraft's weight b. Aircraft's speed c. Aircraft's altitude d. Aircraft's fuel consumption

1. At higher altitudes, the thrust produced by the turbojet engine \_\_\_\_\_.

a. Increases b. Decreases c. Remains constant d. Cannot be defined

1. The thrust produced by the turboprop engine is due to \_\_\_\_\_ mass flow rate and \_\_\_\_\_ change in velocity.

a. More, less b. Less, more c. More, more d. Less, less

1. The thrust produced by the turbojet engine is due to \_\_\_\_\_ mass flow rate and \_\_\_\_\_ change in velocity.

a. Less, more b. More, less c. More, more d. Less, less

1. The type of drag that occurs due to the friction between the aircraft's surface and the air is \_\_\_\_\_.

a. Wave drag b. Induced drag c. Parasite drag d. Form drag

1. The type of drag that occurs due to the generation of lift is \_\_\_\_\_.

a. Induced drag b. Parasite drag c. Wave drag d. Form drag

1. The type of drag caused by the creation of shock waves around the aircraft is \_\_\_\_\_.

a. Induced drag b. Parasite drag c. Wave drag d. Form drag

1. The center of pressure in an aerofoil is the point where the \_\_\_\_\_.

a. Resultant aerodynamic force acts b. Total pressure in a fluid is zero

c. Aerodynamic forces on an aerofoil are balanced d. Pressure distribution on a body is uniform

1. When the center of pressure is located behind the center of gravity, then the aircraft become \_\_\_\_\_.

a. More stable b. Unstable c. Either stable or unstable d. Neither stable nor unstable

1. The relationship between the center of pressure and the center of gravity in an unstable aircraft is \_\_\_\_\_.

a. The center of pressure is ahead the center of gravity b. They are at the same location

c. The center of pressure is behind the center of gravity d. There is no relationship

1. The benefit of using spoilers during landing is to \_\_\_\_\_.

a. Increase lift for a softer touchdown b. Improve visibility during landing

c. Reduce noise during landing d. Decrease lift for a shorter landing distance

1. For static longitudinal stability the value of dCm/dCl should be

a. 0 b. 1 c. Positive d. Negative

1. Weather cock effect is related to

a. Longitudinal Stability b. Lateral stability c. Directional stability d. Dynamic stability

1. Adverse yaw is due to

a. Coupling of lateral and directional stability b. Coupling of lateral and longitudinal stability

c. Lateral stability alone d. Longitudinal stability alone

1. The ability of the body to continue in its disturbed position is called

a. Statically stable b. Statically unstable c. Statically Neutral d. Dynamically stable

1. If C.G. is behind the aerodynamic centre in a wing alone configuration. The plane is

a. Stable b. Unstable c. Neutral d. Unconditionally stable

1. \_\_\_\_\_\_\_ of the following configuration has slip stream effects.

a. Tractor Propeller b. Jet engine driven

c. Multiple Jet engines d. Pusher Propeller

1. Increase in number of blades

a. Increases the normal force b. Decreases the normal force

c. Neither increase nor decrease the normal force d. Results in propeller windmilling

1. During crosswind landing which of the following should be effective

a. Rudder b. Elevator c. Aileron d. Both Rudder and Aileron

1. Aerodynamic balancing is used for

a. Increasing Static longitudinal stability b. Increasing Static lateral stability

c. Reducing the stick force d. Balancing the airplane

1. Trim tabs are used for

a. Trimming the aircraft during flight b. Aerodynamic balancing of control surfaces

c. Reducing the stick forced d. All the above.

1. Determine the work done by the turbine if the combustion chamber exit temperature is 2600 K and turbine exit temperature is 1250 K. Take cp =1.005 kJ/kg K.

a. 1250 kJ/kg b. 2542.25 kJ/kg c. 1356.75 kJ/kg d. 1005 kJ/kg

1. Determine the work input to the compressor if the compressor inlet and exit temperature is 310 K and 420 K. Take cp =1.005 kJ/ kg K

a. 110.55 kJ/ kg b. 180 kJ/kg c. 145 kJ/kg d. 92 kJ/kg

1. A gas compressor operates on a pressure ratio of 5.5. The inlet air temperature to the compressor is 270 K. find the temperature of air at the compressor exit.  Take k = 1.4

a. 439.4 K b. 364.2 K c.400 K d.462.2 K

1. In a gas turbine plant air enters the compressor at 1 bar and 27⁰C. It is compressed to 6.5 bar with an isentropic efficiency of 82%. Find the actual temperature rise at the exit of the compressor.  Take k = 1.4

a. 485.69 K b. 365.69 K c. 558.69 K d. 600.69 K

1. In a gas turbine plant air enters the compressor at 1 bar and 30 ̊C. The compression ratio is 4.5 and the isentropic efficiency of the turbine is 84%. Find the actual temperature at the exit of the turbine, if the inlet to the turbine is at a temperature of 2100 K. Take k = 1.146

a. 1792.3 K b. 1920 K c. 2543.2 K d. 1650 K

1. Determine the work done by the turbine if the combustion chamber exit temperature is 2450 K and turbine exit temperature is 920 K. Take cp =1.116 kJ/kg K.

a. 1707.48 kJ/kg b. 2542.25 kJ/kg c. 2860 kJ/kg d. 1285.2 kJ/kg

1. A gas compressor operates on a pressure ratio of 5. The inlet air temperature to the compressor is 300 K. find the temperature of air at the compressor exit.  Take k = 1.4

a. 364.2 K b. 475.14 K c. 400 K d. 462.21 K

1. In a gas turbine plant air enters the compressor at 1 bar and 25 ̊C. The compression ratio is 6.5 and the isentropic efficiency of the turbine is 84%. Find the actual temperature at the exit of the turbine, if the inlet to the turbine is at a temperature of 1900 K. Take k = 1.146

a. 1561.38 K b. 1286.65 K c. 1682.65 K d. 1222.65 K

1. Jet engines works on \_\_\_\_\_\_ cycle.

a. Otto b. Dual c. Diesel d. Brayton

1. Gas turbines are suitable for aircraft propulsion because

a. gas turbines are light weight b. gas turbines are compact in size

c. gas turbines have a high power-to-weight ratio d. all of the above

1. In working condition of turbojet engine, velocity of air entering the engine is

a. higher than the velocity of exhaust gases leaving the engine

b. lower than the velocity of exhaust gases leaving the engine

c. equal to the velocity of exhaust gases leaving the engine

d. cannot say

1. Jet engines have \_\_\_\_\_\_\_\_ shafts.

a. single b. multiple

c. single or multiple d. none of the above mentioned

1. Internal energy in the fuel is converted into \_\_\_\_\_\_\_\_\_\_ of the exhaust in turbojets.

a. kinetic energy b. pressure energy

c. kinetic & pressure energy d. none of the above

1. In turbofan engine, the bypass ratio is the ratio of

a. total mass flow rate of exhaust stream to the mass flow rate of stream from turbine exhaust  
b. total mass flow rate of exhaust stream to the mass flow rate of stream from fan exhaust  
c. the mass flow rate of stream from turbine exhaust to the mass flow rate of stream from fan exhaust  
d. the mass flow rate of stream from fan exhaust to the mass flow rate of stream from turbine exhaust

1. What is the effect of increasing bypass ratio of a turbofan engine on its trust?

a. trust increases with increase in bypass ratio of turbofan engine  
b. trust decreases with increase in bypass ratio of turbofan engine  
c. trust of the turbofan engine only depends upon the fuel rate, so no change of thrust with increase

in bypass ratio  
d. cannot say

1. \_\_\_\_\_\_\_\_\_\_ bypass turbo fan engines are used in sub sonic flights.

a. Medium b. Low c. High d. None of the mentioned

1. Among the choices given the specific impulse is highest for the

a. Cryogenic rocket engine b. Liquid rocket engine

c. Solid propellant d. Ramjet engine

1. A rocket moves forward when \_\_\_\_\_\_\_ are expelled from the rear of the rocket,

a. Gases b. Forces c. Fuels d. water

1. The heat flux of liquid rocket engine is maximum at the

a. Chamber b. convergent portion c. Throat d. Divergent portion

1. The temperature of liquid oxygen is

a. -8.3 ºC b. -283 ºC c. -83 ºC d. -183 ºC

1. The exhaust velocity of a ion thruster is

a. 0.3 km/s b. 3 km/s c. 30 km/s d. 300 km/s

1. If the flow of air through the compressor is perpendicular to its axis, then it is a

a. Reciprocating compressor b. Axial flow compressor

c. Centrifugal compressor d. Turbo compressor

1. Gas turbines use following type of air compressor

a. Rotary type b. Reciprocating type

c. Lobe type d. Axial flow type

1. The gas in cooling chamber of a closed cycle gas turbine is cooled at

a. Constant Temperature b. constant Pressure

c. Constant volume d. None of these.

1. In a jet propulsion unit, the products of combustion after passing through the gas turbine are discharged into

a. Atmosphere b. Vacuum c. Discharge nozzle d. Back to the compressor

1. For a linearly elastic, isotropic and homogeneous material, the number of elastic constants required to relate stress and strain is:
2. Two b) Three c) Four d) Six
3. For an isotropic, homogeneous and linearly elastic material, which obeys Hooke's law, the number of independent elastic constant is:

a) 1 b) 2 c) 3 d) 6

1. In a simple tension test, Hooke's law is valid up to the [IAS-1998]

a) Elastic limit b) Limit of proportionality

c) Ultimate stress d) Breaking point

1. The materials which show direction dependent properties are called

a) Homogeneous materials b) Viscoelastic materials

c) Isotropic materials d) Anisotropic materials

1. In the case of an engineering material under unidirectional stress in the x-direction, the Poisson's ratio is equal to
2. b) c) d)
3. Which one of the following is correct in respect of Poisson’s ratio (ν) limits for an isotropic elastic solid?
4. -∞ ≤ ν ≤∞ b) 1/4 ≤ ν ≤1/3 c) -1 ≤ ν ≤1/2 d) -1/2 ≤ ν ≤1/2
5. The ratio of Young's modulus of Elasticity E and Bulk modulus K for a material is given by

a) 2 (1 – 2 ν) b) 3 (1- 2 ν) c) 3 (1 - ν) d) 2(1 + 2 ν)

1. If a piece of material neither expands nor contracts in volume when subjected to stress, then the Poisson’s ratio must be
2. Zero b) 0.25 c) 0.33 d) 0.5
3. Young's modulus of elasticity and Poisson's ratio of a material are 1.25 × 105 MPa and 0.34 respectively. The modulus of rigidity of the material is:

a) 0.4025 ×105 MPa b) 0.4664 × 105 MPa

c) 0.8375 × 105 MPa d) 0.9469 × 105 MPa

1. For a composite consisting of a bar enclosed inside a tube of another material when compressed under a load ‘P’ as a whole through rigid collars at the end of the bar. The equation of compatibility is given by (suffixes 1 and 2 refer to bar and tube respectively).

a) b) c) d)

1. A 100 mm×5 mm×5 mm steel bar free to expand is heated from 15°C to 40°C. Then the bar is subjected to

a) Tensile stress b) Compressive stress

c) Tensile strain d) Compressive strain

1. If a material expands freely due to heating, it will develop

a) Thermal stress b) Tensile stress

c) Compressive stress d) No stress

1. A copper rod 400 mm long is pulled in tension to a length of 401.2 mm by applying a tensile load of 330 MPa. If the deformation is entirely elastic, the Young’s modulus of copper is

a) 110 GPa b) 110 MPa c) 11 GPa d) 11 MPa

1. The Young's modulus of elasticity of a material is 2.5 times its modulus of rigidity. The Poisson’s ratio for the material will be

a) 0.25 b) 0.33 c) 0.50 d) 0.75

1. The moduli of elasticity and rigidity of a material are 200 GPa and 80 GPa, respectively. the value of the Poisson's ratio of the material is

a) 0·30 b) 0·26 c) 0·25 d) 0·24

1. The elastic constants Young’s modulus (E) and bulk modulus (K) are related as (ν is the Poisson’s ratio)

a) E = 2K (1 – 2 ν) b) E = 3K (1- 2 ν) c) E = 3K (1 + ν) d) E = 2K(1 + 2 ν)

1. The condition for Mohr’s circle to be tangent to the y-axis

a) σx ≠ 0, σy = 0, τxy = 0 b) σx = σy, τxy = 0

c) σx ≠ 0, σy ≠ 0, τxy ≠ 0 d) σx ≠ 0, σy ≠ 0, τxy = 0

1. A two-dimensional fluid element rotates like a rigid body. At a point within the element, the pressure is 1 unit. Radius of the Mohr's circle, characterizing the state of stress at that point, is

a) 0.5 unit b) 0 unit c) 1 unit d) 2 units

1. The condition for Mohr’s circle to be a circle having center at the intersection of the x and y axes

a) σx ≠ 0, σy = 0, τxy = 0 b) σx = σy, τxy = 0

c) σx ≠ 0, σy ≠ 0, τxy ≠ 0 d) σx = 0, σy = 0, τxy ≠ 0

1. The condition for Mohr’s circle to degenerate into a point

a) σx ≠ 0, σy = 0, τxy = 0 b) σx = σy, τxy = 0

c) σx ≠ 0, σy ≠ 0, τxy ≠ 0 d) σx ≠ 0, σy ≠ 0, τxy = 0

1. The maximum shear stress (τmax) acting on a plane of an element is obtained by (σ1 and σ2­ are the principal stresses)
2. (σ1 + σ2)/2 b) (σ1 - σ2)/2

c) 2 (σ1 + σ2) d) 2(σ1 - σ2)

1. If two principal stresses at a point are 1000 MPa & -600 MPa, then the maximum shear stress is

a) 800 MPa b) 500 MPa c) 1600 MPa d) 200 MPa

1. Principal stresses at a point in plane stressed element are σx = σy = 500 MPa. Normal stress on the plane inclined at 45o to x-axis will be

a) 0 b) 500 MPa c) 707 MPa d) 1000 MPa

1. A body is subjected to a pure tensile stress of 100 units. The maximum shear produced in the body at some oblique plane due to the above is

a) 100 units b) 75 units c) 50 units d) 0 unit

1. In a strained material one of the principal stresses is twice the other. The maximum shear stress in the same case is τmax. Then, the value of the maximum principle stress is

a) τmax b) 2τmax c) 4τmax d) 8τmax

1. In a strained material, normal stresses on two mutually perpendicular planes are σx and σy (both alike) accompanied by a shear stress τxy. One of the principal stresses will be zero, only if

a) b) c) d)

1. The ratio of the area under the bending moment diagram to the flexural rigidity between any two points along a beam gives the change in

a) Deflection b) Slope c) Shear force d) Bending moment

1. A structural member in which loads applied at right angles to the axis is called

a) Beam b) Bar c) Column d) Shaft

1. A plane element is subjected to the state of stress given by σx = τxy = 100 MPa and σy = 0. Maximum shear stress in the element is equal to

a) b) c) d) 15

1. Normal stresses of equal magnitude p, but of opposite signs, act at a point of a strained material in perpendicular direction. The magnitude of the resultant normal stress on a plane inclined at 45° to the applied stresses is

a) 2p b) p/2 c) p/4 d) Zero

1. Consider a simply supported two-dimensional beam. If the beam is converted into a fixed-fixed beam, then the degree of static indeterminacy will

a) Increase by 3 b) Increase by 2

c) Increase by 1 d) Decreases by 2

1. A cantilever 5 m long, carries a point load of 5 N at its free end and a uniformly distributed load of 2 N/meter run throughout its length, the maximum bending moment on the cantilever is

a) 100 N-meters b) 50 N-meters c) 25 N-meters d) 75 N-meters

1. A cantilever 10 meters long carries a uniformly distributed load of 10 kN/meter run starting from free end up to the middle of its length. The BM at the fixed end of the cantilever is

a) 25 kNm b) 75 kNm c) 50 kNm d) 100 kNm.

1. The maximum shear force of a cantilever beam of length ‘L’ loaded with uniform distributed load ‘w’ throughout is

a) wL b) wL/2 c) 2wL d) wL/4

1. The maximum bending moment of a simply supported beam of length ‘L’ loaded with mid- point load ‘P’ is

a) PL b) PL/2 c) PL/4 d) PL/8

1. At the point of contraflexure, the value of bending moment is

a) Zero b) Maximum c) Minimum d) Can’t be determined

1. A spring mass damper system with a mass of 1 kg is found to have a damping ratio of 0.2 and a natural frequency of 5 rad/s. The damping of the system is given by
   1. 2 Ns/m b. 2 N/s c. 0.2 kg/s d. 0.2 N/s
2. In a spring mass damper single degree of freedom system, the mass is 2 kg and the undamped natural frequency is 20 Hz. The critical damping constant of the system is

a. 160π Ns/m b. 80π Ns/m c. 1 Ns/m d. 0 Ns/m

1. A 1 kg mass attached to a spring elongates it by 16 mm. This mass is then pulled from its equilibrium position by 10 mm and released from rest. Assuming the acceleration due to gravity of 9.81 m/s2, the response of the mass in mm is given by

a. x=10 sin24.76t b. x=10 cos24.76t c. x=sin16t d. x=10 cos16t

1. For a critically damped single degree of freedom, spring mass damper with a damping constant of 4 Ns/m and spring constant of 16 N/m, the system mass m is

a. 0.5 kg b. 0.25 kg c. 2 kg d. 4 kg

1. During an under-damped oscillation of a single degree of freedom system, in the time-displacement plot the third peak is of magnitude 100 and the tenth peak is of magnitude 10. The damping ratio is approximately

a. 0.052 b. 0.023 c. 0.366 d. 0.159

1. A single degree of freedom system is vibrating with initial (first cycle) amplitude of 5 cm. The viscous damping factor associated with the vibrating system is 2%. Vibration amplitude of the fifth cycle (in cm) is

a. 1.65 b. c. 2.67 d. 3.02

1. A 0.5 kg mass is suspended vertically from the point fixed on the earth by a spring having a stiffness of 5 N/mm. The static displacement (in mm) of the mass is \_\_\_\_\_\_.

a. 0.981 b. c. 2.67 d. 4.41

1. A linear mass-spring dashpot is over-damped. In free vibration, this system undergoes

a. non-oscillatory motion b. random motion

c. oscillatory and periodic motion d. oscillatory and non-periodic motion

1. An aircraft landing gear can be idealized as a single degree of freedom spring-mass-damper system. The desirable damping characteristics of such a system is:

a. Under damped b. Over damped c. Critically damped d. Undamped

1. The angle between the wing's chord line and the oncoming free stream airflow is called as \_\_\_\_\_.

a. Angle of pitch b. Angle of twist c. Angle of attack d. Pitching moment

1. Winglets reduce drag by \_\_\_\_\_.

a. Decreasing the weight of the aircraft b. Decreasing the lift generated by the wings

c. Decreasing the vortices at the wingtips d. Increasing the lift generated by the wings

1. The full form of NACA is \_\_\_\_\_.

a. National Advisory Committee for Aeronautics b. National Aeronautical Control Agency

c. National Association of Civil Aviation d. National Aeronautics and Space Administration

1. The lift coefficient is defined as \_\_\_\_\_.

a. The ratio of lift force to dynamic pressure b. The ratio of lift force to wing area

c. The ratio of lift force to weight d. The ratio of lift force to drag force

1. The critical angle of attack is defined as\_\_\_\_\_.

a. The angle at which the aircraft takes off b. The angle at which drag becomes zero

c. The angle at which lift becomes zero d. The angle at which the aircraft stalls

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2033** | **Duration** | **3hrs** |
| **Course Title** | **DESIGN AND ANALYSIS OF COMPOSITE STRUCTURES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name the matrix phase in E-Glass Fiber/Epoxy Composite. | | CO1 | R | 1 |
| 2. | List few advantages of composite materials over metals. | | CO1 | R | 1 |
| 3. | State the assumptions followed in plane stress condition. | | CO2 | R | 1 |
| 4. | Define Young’s Modulus. | | CO2 | R | 1 |
| 5. | Distinguish between local coordinate system and global coordinate system. | | CO3 | U | 1 |
| 6. | State transformed stiffness matrix. | | CO3 | R | 1 |
| 7. | Define density of composites. | | CO4 | R | 1 |
| 8. | Define fiber volume fraction. | | CO4 | R | 1 |
| 9. | Define laminate code. | | CO5 | R | 1 |
| 10. | Define chopped fibers. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Distinguish between composite and alloy. | | CO1 | U | 3 |
| 12. | Explain plane strain condition. | | CO2 | A | 3 |
| 13. | Describe  i. Transformation matrix [T]  ii. Reuter matrix [R] | | CO3 | U | 3 |
| 14. | Explain voids in composites. | | CO4 | U | 3 |
| 15. | Represent the composite layers for the laminate codes:  i. [0/-45/902/60/0]  ii. [0/-45/60]S | | CO5 | U | 3 |
| 16. | Explain plain weave fibers. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the different types of composite materials in detail. | CO1 | U | 6 |
|  | b. | Explain Hooke’s law for different types of materials. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | Develop a generalized Hooke’s law for unidirectional lamina and reduce to two dimension. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the relationship between the compliance and stiffness matrices and determine the engineering elastic constants of a lamina. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Develop Hooke’s law for a two dimensional angle lamina. | CO3 | A | 6 |
|  | b. | Calculate the engineering elastic constants for unidirectional angle lamina. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Describe maximum stress failure theory and maximum strain failure theories for an angle lamina. | CO3 | U | 6 |
|  | b. | Describe micromechanical analysis composite lamina and explain volume fractions and mass fractions. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Determine longitudinal Young’s modulus E1 and transverse Young’s modulus E2 using strength of materials approach. | CO4 | A | 6 |
|  | b. | A glass/epoxy lamina consists of 70% fiber volume fraction. The density of glass fiber and epoxy are given as ρf = 2500kg/m3 and ρm = 1200kg/m3  Determine:  i. Density of lamina  ii. Mass fraction of glass & epoxy  iii. Volume of composite lamina if the mass of lamina is 4kg | CO4 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Develop stress strain relation for a composite laminate using classical laminate theory. | CO5 | A | 9 |
|  | b. | Define classical laminate theory and state the assumptions made in this theory. | CO5 | R | 3 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Describe in detail, the production methods for various composite fibers that find application in manufacturing of composite materials. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Describe the various types of composite materials. |
| CO2 | Understand the structural behavior of lamina. |
| CO3 | Compare the various failure theories of composite materials. |
| CO4 | Assess various properties of lamina. |
| CO5 | Analyze the stresses developed in a laminate. |
| CO6 | Describe the manufacturing techniques of fibers. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 9 | 6 | - | - | - | 17 |
| CO2 | 2 | 12 | 15 | - | - | - | 29 |
| CO3 | 1 | 10 | 6 | 6 | - | - | 23 |
| CO4 | 2 | 9 | 6 | 6 | - | - | 23 |
| CO5 | 4 | 3 | 9 | - | - | - | 16 |
| CO6 | 1 | 12 | 3 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **20AE2035** | **Duration** | **3hrs** |
| **Course Title** | **STRUCTURAL VIBRATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | If a simple pendulum completes 50 oscillations in 10 seconds, determine the period in seconds. | | CO1 | A | 1 |
| 2. | If a spring-mass system completes 50 oscillations in 10 seconds, determine the frequency of oscillation in rad/s. | | CO1 | A | 1 |
| 3. | Write the equation of motion for the simple pendulum with a spring attached as shown in figure. | | CO2 | A | 1 |
| 4. | In a simple harmonic oscillator, at the mean position state whether velocity is maximum or minimum. | | CO2 | R | 1 |
| 5. | Write the geometric boundary conditions used in the vibration of a simply supported string. | | CO3 | A | 1 |
| 6. | State the advantage of studying matrix iteration method in determining the mode shape and frequency of a given system. | | CO4 | R | 1 |
| 7. | Verify whether the given masses and Eigen vectors satisfy the orthogonality condition. | | CO4 | R | 1 |
| 8. | Define buffeting in aero elasticity. | | CO5 | R | 1 |
| 9. | State the function of a seismometer. | | CO5 | R | 1 |
| 10. | State the condition on the ratio for measuring acceleration using an accelerometer. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | The length of a simple pendulum executing a simple harmonic motion is increased by 21%. Determine the percentage increase in the time period of the pendulum of increased length. | | CO1 | A | 3 |
| 12. | State whether the given systems as shown in figure belong to either a single degree of freedom system or a two-degree freedom system.  a) b) | | CO2 | R | 3 |
| 13. | Write the possible boundary conditions in the longitudinal vibration of a bar. | | CO3 | A | 3 |
| 14. | Write the mass matrix [m] and flexibility matrix [] for the spring-mass system shown in Figure. | | CO4 | A | 3 |
| 15. | Explain wing divergence speed. | | CO5 | U | 3 |
| 16. | The size of the accelerometer is small compared to that of the vibrometer. Justify the statement. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Prove that in an under damping oscillation of a spring mass system, the logarithmic decrement is given by  where n is the number of cycles, and are the amplitudes of mass at 0th and nth cycles respectively. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Determine the natural frequencies and the corresponding mode shape for the two degrees of freedom system shown in figure. Derive the equation of motion from the condition of force equilibrium. Consider  . | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Derive the natural frequencies for a fixed-free bar under longitudinal vibration. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Determine the fundamental natural frequency and the corresponding mode shapes for the system shown in figure by matrix iteration method. Also, obtain higher mode shape and natural frequency by applying the orthogonality condition. Consider m = 2 kg and k = 100 N/m. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the control reversal speed and determine the critical speed at which aileron becomes completely ineffective. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the working principle of a vibrometer, a vibration measuring instrument, by deriving the required equation and with the help of a neat sketch. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Determine the natural frequencies and the corresponding mode shape for the two degrees of freedom system shown in figure. Derive the equation of motion from the Lagrangian principle. Consider m = 5 kg and k = 200 N/m. | CO2 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Derive the natural frequency of a simple spring-mass system as shown in figure. | CO1 | A | 6 |
|  | b. | Derive the natural frequency of a simple pendulum as shown in figure. | CO1 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe various types of vibration systems. |
| **CO2** | Understand multi degree freedom systems. |
| **CO3** | Calculate frequency of free vibration of simple structures. |
| **CO4** | Compare the different methods of vibration analysis. |
| **CO5** | Understand the vibration of various components in aircraft. |
| **CO6** | Identify techniques used in vibration measurement. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | - | - | 29 | - | - | - | 29 |
| **CO2** | 4 | - | 25 | - | - | - | 29 |
| **CO3** | - | - | 16 | - | - | - | 16 |
| **CO4** | 2 | - | 15 | - | - | - | 17 |
| **CO5** | 2 | 15 | - | - | - | - | 17 |
| **CO6** | 1 | 15 | - | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE2037** | **Duration** | **3hrs** |
| **Course Title** | **CRYOGENIC PROPULSION** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the three Isotopes of hydrogen. | | CO1 | R | 1 |
| 2. | Observe the properties of liquid hydrogen. | | CO1 | U | 1 |
| 3. | Identify the boiling point of Liquid oxygen in Kelvin. | | CO2 | U | 1 |
| 4. | Write the function of expander in liquefaction systems. | | CO2 | R | 1 |
| 5. | Write the equation of energy added isothermally in an ideal refrigeration system. | | CO3 | A | 1 |
| 6. | State the purpose of displacer in Solvays refrigerator. | | CO3 | R | 1 |
| 7. | State the purpose of diffuser in a Dewar vessel. | | CO4 | R | 1 |
| 8. | Write the minimum thickness of the inner shell for a cylindrical vessel. | | CO4 | A | 1 |
| 9. | List the types of reflective insulation used for insulation of cryogenic containers. | | CO5 | R | 1 |
| 10. | Explain the need of cryogenics in liquid rocket engine. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the importance of electrical resistivity in material section for cryogenic applications. | | CO1 | U | 3 |
| 12. | Differentiate – Kapitza system and Heylandt system. | | CO2 | U | 3 |
| 13. | List the advantages of dilution refrigerators. | | CO3 | R | 3 |
| 14. | Explain the types of safety devices installed in the cryogenic containers. | | CO4 | U | 3 |
| 15. | State the need of insulation requirement for a cryogenic container. | | CO5 | R | 3 |
| 16. | Discuss the applications of liquid nitrogen as a cryogen. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | State the significance of slip planes between different materials. | CO1 | R | 6 |
|  | b. | Discuss the historical background of cryogenics with a timeline. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Explain Joule-Thompson effect with a neat sketch also derive the equation for Joule-Thompson coefficient. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain Philips refrigerator with necessary equations and sketches. | CO3 | U | 8 |
|  | b. | Differentiate – Solvay refrigerator and Gifford – Mc-Mohan refrigerator. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the design procedure of inner and outer vessel for a cryogenic vessel. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain in detail the necessary precaution to be taken for transporting cryogens through lift. | CO5 | A | 4 |
|  | b. | Explain in detail the vacuum insulation method used for insulating cryogenic containers. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 22. |  | Describe the Linde Hampson system with necessary sketch and equations. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain dilution refrigeration system with neat sketch. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the working principle of liquid oxygen –liquid hydrogen rocket engine. | CO6 | U | 8 |
|  | b. | State the advantage of cryogenic engine over semi cryogenic rocket engine. | CO6 | R | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Remember the thermal, physical and flow properties of cryogenic fluids. |
| **CO2** | Understand the liquefaction systems to produce cryogenic fluids. |
| **CO3** | Know various methods of cryogenic refrigeration systems. |
| **CO4** | Know the various cryogenic fluid storage and transfer lines. |
| **CO5** | Understand various insulations for cryogenic propellant tanks. |
| **CO6** | Know the various applications of cryogenics in propulsion systems. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 7 | 10 |  |  |  |  | 17 |
| **CO2** | 13 | 16 |  |  |  |  | 29 |
| **CO3** | 4 | 24 | 1 |  |  |  | 29 |
| **CO4** | 1 | 15 | 1 |  |  |  | 17 |
| **CO5** | 4 | 8 | 4 |  |  |  | 16 |
| **CO6** | 4 | 12 |  |  |  |  | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE2038** | **Duration** | **3 hrs** |
| **Course Title** | **ROCKETS AND MISSILES** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Classify the types of Missiles based on range. | | CO1 | U | 1 |
| 2. | State the full form of ISS. | | CO1 | R | 1 |
| 3. | List the airframe components of a surface to Air Missiles. | | CO2 | R | 1 |
| 4. | Give an example of guidance system in missiles. | | CO2 | U | 1 |
| 5. | Classify the types of igniters used in rocket engines. | | CO3 | U | 1 |
| 6. | State the importance of igniters in missiles. | | CO3 | R | 1 |
| 7. | List the types of jet control methods. | | CO4 | U | 1 |
| 8. | Define lateral separation of stages in a rocket body. | | CO4 | R | 1 |
| 9. | Define ICBMs. | | CO5 | R | 1 |
| 10. | State the importance of ceramic coatings in rocket engines. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Name any two International Rockets industries. | | CO1 | R | 3 |
| 12. | Describe the forces and moments acting on a missile passing through the atmosphere. | | CO2 | U | 3 |
| 13. | Define stage separation in rockets. | | CO3 | R | 3 |
| 14. | List any two methods of aerodynamic controls used in Rockets. | | CO4 | R | 3 |
| 15. | State Newton’s laws of gravity. | | CO5 | R | 3 |
| 16. | Define ablation cooling for rocket engines. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain in detail the current scenario of rocket launches happened internationally in past 5 years. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe the Airframe components of a missile based on structural integrity. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Classify the different types of igniters used in solid propellant rocket motors. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe the thrust vector controls on a missile passing through the atmosphere. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Articulate in detail the electrostatic and electro-dynamic propulsion system. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | The mass ratio and specific impulse of a rocket are given by 5.6 and 28 s respectively. The rocket is tracking an inclined trajectory with a constant pitch angle of 38º. The burn out time is 128s. Calculate the angle of attack at a time of 12s afterburner. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Compute the separation velocity imparted by the helical compression spring during stage separation of a space launch vehicle in space with the following data at a particular time.  Upper stage mass=1200 kg.  Lower stage mass=2700 kg.  Separation between Lower stage and separation datum=1.4 m.  Separation between Upper stage and separation datum=1.94 m.  Spring force=2004 N. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Classify the different types of propulsion systems used in rockets. | CO4 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Discuss types of rockets and missiles with respect to Indian & International scenario. |
| **CO2** | Analyze the Aerodynamics of rockets &amp; missiles. |
| **CO3** | Understand the performance of rocket and missiles within the atmosphere. |
| **CO4** | Estimate the rocket performance in free space and gravitational field. |
| **CO5** | Design the basic staging of rockets and missiles. |
| **CO6** | Identify the control methods of rockets and missiles. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 15 |  |  |  |  | 17 |
| **CO2** | 1 | 16 |  |  |  |  | 17 |
| **CO3** | 4 | 1 | 12 |  |  |  | 17 |
| **CO4** | 6 | 11 | 12 |  |  |  | 29 |
| **CO5** | 2 | 2 | 12 |  |  |  | 16 |
| **CO6** | 4 | - | 24 |  |  |  | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **20AE2044** | **Duration** | **3hrs** |
| **Course Title** | **BOUNDARY LAYER THEORY** | **Max. Marks** | **100** |

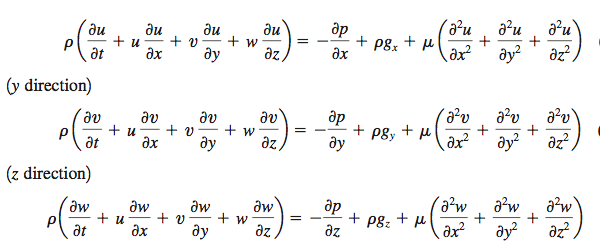
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | When we consider natural convection, what additional complication arises to the type of differential equation that the hydrodynamic and thermal boundary layer equations are for steady, incompressible, 2D, constant property and laminar flow over a flat plate. | | CO1 | U | 1 |
| 2. | Compare the relative sizes of the thermal and hydrodynamic boundary layer in forced convection. | | CO1 | U | 1 |
| 3. | State the expression to calculate the hydrodynamic and thermal entrance length number for internal flows. | | CO1 | R | 1 |
| 4. | State the criterion used to determine the importance of natural convection in a given flow field. | | CO2 | R | 1 |
| 5. | Specify the type of flow that can be analyzed by the Bernoulli equation. | | CO2 | U | 1 |
| 6. | Express the most general law of conservation of mass in differential form. | | CO2 | R | 1 |
| 7. | If the divergence of velocity is zero, comment on the nature of the flow with reference to the continuity equation. | | CO2 | U | 1 |
| 8. | Express in one sentence, the meaning of thermally fully developed flow. | | CO3 | U | 1 |
| 9. | State the non-dimensional numbers that are analogous to each other in hydrodynamic and thermal and concentration boundary layers. | | CO4 | R | 1 |
| 10. | A liquid metal to water heat exchanger used in a nuclear reactor has liquid sodium flowing through the tubes. For analyzing the flow in the tubes, assess the treatment of the flow, with regard to the state of development of the thermal and hydrodynamic boundary layers. | | CO4 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain Reynolds Analogy. | | CO1 | U | 3 |
| 12. | Evaluate the qualitative difference between the definitions of hydrodynamically and thermally developed flow considering the boundary conditions for velocity and temperature that are typical in a convective heat transfer situation. | | CO2 | E | 3 |
| 13. | Define the stress tensor and the definition of pressure and explain how the definition is appropriate. | | CO2 | U | 3 |
| 14. | Briefly explain the appropriateness of the diagonal components of the symmetric component of the gradient tensor. | | CO2 | U | 3 |
| 15. | In flow over a surface the velocity and temperature profile are given by *u(y) = Ay + By2 – Cy3* and *T(y) = D+ Ey + Fy2 – Gy3*, where the profile coefficients *A* through *G* are constants. Obtain expressions for the friction coefficient *Cf*, and the convection coefficient *h* in terms of *u∞*, *T∞* and the appropriate profile coefficients and fluid properties. | | CO4 | A | 3 |
| 16. | Comment on the advantages of the Karman-Pohlhausen momentum integral method in solving the Navier Stokes equations, compared to Blasius solution. | | CO1 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | A thin steel flat plate of thermal conductivity of 25 *W/(mK)*, that is 0.2 *m* x 0.2 *m* on a side is oriented parallel to an atmospheric airstream having a velocity of *u∞ =* 40 *m/s.* The plate is coated on both sides with a thick layer of naphthalene. The boundary layer temperature profile on both sides of the plate is given by where *y* is the distance normal to the surface and *Pr=0.*7 and ** is the kinematic viscosity of air. The Schmidt Number for air is *Sc* = 0.7 The air is at a temperature of *T∞ = 1*20*oC* while the plate is maintained at a temperature of *Tw =* 20*oC*, calculate the surface heat flux, drag force and the mass transfer coefficient on the plate. Note that both sides of the plate are actively interacting with the flow. Assuming a diffusion coefficient of | CO2 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | With a neat sketch write a note on boundary layer separation and list few methods to control it? | CO5 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | From the continuity and Navier-Stokes equations, show that the velocity profile for steady, laminar, fully developed flow of an incompressible fluid between two infinite parallel plates, one of which is stationary and the other moving with a constant velocity *U* (Couette Flow) is given by | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Determine a fourth order velocity profile for the hydrodynamic boundary layer on a flat plate with appropriate boundary conditions. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Determine a fourth temperature profile for the thermal boundary layer on a flat plate (no viscous dissipation) with appropriate boundary conditions. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Consider the steady, laminar flow of an incompressible fluid past a flat plate. The boundary layer velocity profile is approximated as for and for . Determine the hydrodynamic boundary layer thickness and the shear stress and skin friction coefficient using the Integral Momentum Boundary Layer equation, in terms of the local Reynolds number. Start from the Karman Pohlhausen Integral Equation and definition of Momentum Thickness for the given conditions | CO3 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | (a) Describe the boundary layer effects in hypersonic flows.  (b) Evaluate the differences between the analysis of hypersonic boundary layers compared to incompressible boundary layers.  (c) Explain the differences between 2D and 3D boundary layers. | CO6 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Consider the steady, laminar flow of a liquid metal past a flat plate. Determine the thermal boundary layer thickness and the surface heat flux and the Nusselt number using the Integral Thermal Boundary Layer equation for a cubic temperature profile, in terms of the local Reynolds number and Prandtl No. Hint - Considering the value of the Prandtl number for the given fluid, assume and justify a velocity profile inside the thermal boundary layer. Start from thermal integral equation for the given conditions. | CO3 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

Some useful information required

**Properties Required –Density of air = 1.16 kg/m3, Pr for air = 0.7, Cp of air = 1.005 kJ/(kg/K), Conductivity of air = 26.3 x 10-3 W/(mK), Thermal Diffusivity = 22.5 x 10-6m2/s**

**Dynamic Viscosity of air = 184.6 x 10-7N.s/m2**



For a thin flat plate

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the relationship between different boundary layer transport phenomena |
| CO2 | Solve the flat plate boundary layer equations by analytical and semi-analytical methods |
| CO3 | Solve the boundary layer equations of flat plate and bluff bodies by approximate integral method |
| CO4 | Estimate the boundary layer thickness and calculate skin friction drag |
| CO5 | Understand separation of boundary layer and how it affects the form drag and total drag |
| CO6 | Analyse the different kinds of boundary layer control |

|  |  |  |  |  |  |  |  |
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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO /BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 5 |  |  |  |  | **5** |
| CO2 | 2 | 8 | 12 | 12 | 3 |  | **37** |
| CO3 |  | 4 | 24 | 24 |  |  | **52** |
| CO4 | 1 | 1 | 3 |  |  |  | **5** |
| CO5 |  | 12 |  |  |  |  | **12** |
| CO6 |  |  |  |  | 12 |  | **12** |
| **Total** | **4** | **30** | **39** | **36** | **15** |  | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20AE2048** | **Duration** | **3hrs** |
| **Course Title** | **UNMANNED AIRCRAFT SYSTEMS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Explain the advantages of Unmanned Aircraft Vehicle (UAV) over drone aircraft. | | CO1 | U | 1 |
| 2. | Write any two factors that makes UAV environment friendly. | | CO1 | A | 1 |
| 3. | Define the term aspect ratio from the perspective of aircraft wing. | | CO2 | R | 1 |
| 4. | State the significance of ducted fan arrangement in aircraft. | | CO2 | R | 1 |
| 5. | State the full form of FAA and EASA. | | CO3 | R | 1 |
| 6. | Name the authority which monitors the safe operation of civilian UAV in India. | | CO3 | R | 1 |
| 7. | Compare and contrast the role of rudder and elevator from the viewpoint of aircraft stability. | | CO4 | U | 1 |
| 8. | State the significance of global positioning system in navigation. | | CO4 | R | 1 |
| 9. | Explain the importance of documentation from the perspective of ground-flight testing. | | CO5 | U | 1 |
| 10. | Name any two future developments happening in the field of UAS power generation. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare and contrast the dull roles and covert roles of UAV from military contexts. | | CO1 | U | 3 |
| 12. | Differentiate the various stages involved in the design process of Unmanned Aircraft Systems (UAS). | | CO2 | An | 3 |
| 13. | Explain the factors to be considered for reducing the radar signature in the design of UAV stealth technology. | | CO3 | A | 3 |
| 14. | Describe the relevance of inertial navigation system from the context of unmanned aircraft maneuverability. | | CO4 | U | 3 |
| 15. | Write a shot explanation on human factors in unmanned aircraft systems. | | CO5 | A | 3 |
| 16. | Compare and contrast different methods of recovering aircrafts launched using catapult technique. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Classify the various categories of unmanned aircraft systems based on their intended use, range and endurance. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the parameters to be considered in the selection of Unmanned Aircraft Systems (UAS). | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Compare the different aspects of airframe design to be considered while designing an unmanned aircraft vehicle. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Categorize electro-optical non-dispensable payloads into distinct types based on their functionalities and applications. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Generalize the various procedures to be followed for in-flight testing of an unmanned aircraft vehicle. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Classify the naval roles of UAVs into distinct categories based on their operational objectives and capabilities. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Differentiate between the essential elements of a UAS based on the functions and operational significance. | CO1 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Compare and contrast the various methods of launch and recovery of both HTOL and VTOL UAV. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basic terminologies and classification of UAS. |
| **CO2** | Relate the design parameters of UAV systems. |
| **CO3** | Obtain knowledge on the application of aerodynamic principles to design UAS. |
| **CO4** | Obtain knowledge on payloads and launch systems for UAS. |
| **CO5** | Understand the basic principles of UAV Testing. |
| **CO6** | Apply the principles to design UAS for specific applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** |  | 16 | 1 | 12 |  |  | 29 |
| **CO2** | 2 | 12 |  |  |  |  | 14 |
| **CO3** | 2 | 12 | 3 |  |  |  | 17 |
| **CO4** | 1 | 4 |  | 15 |  |  | 20 |
| **CO5** |  | 13 | 3 |  |  |  | 16 |
| **CO6** | 1 | 27 |  |  |  |  | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE2052** | **Duration** | **3hrs** |
| **Course Title** | **WIND TUNNEL TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Distinguish between open circuit and closed circuit wind tunnels. | | CO1 | U | 1 |
| 2. | Identify the lowest Mach number of high speed wind tunnel. | | CO1 | U | 1 |
| 3. | Define pumping time of supersonic tunnel. | | CO2 | R | 1 |
| 4. | State the significance of wide angle diffuser. | | CO2 | R | 1 |
| 5. | List the types of Transonic wind tunnel with Mach numbers. | | CO3 | U | 1 |
| 6. | Classify hypersonic wind tunnel. | | CO3 | U | 1 |
| 7. | List the types of wind tunnel balances. | | CO4 | U | 1 |
| 8. | State the significance of wire type balance method. | | CO4 | R | 1 |
| 9. | Enumerate the instruments used to measure pressure in wind tunnels. | | CO5 | R | 1 |
| 10. | List the non-optical flow visualization methods in low speed wind tunnel. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain purging in closed circuit wind tunnel. | | CO1 | U | 3 |
| 12. | List the types of valves used in supersonic wind tunnel. | | CO2 | R | 3 |
| 13. | State the principle of hotshot wind tunnel. | | CO3 | R | 3 |
| 14. | Classify the different types of balances used in supersonic wind tunnels. | | CO4 | U | 3 |
| 15. | Explain the operating principle of pressure sensitive paints. | | CO5 | U | 3 |
| 16. | Identify the components of shadowgraph technique. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Sketch the schematic diagram of a subsonic wind tunnel and explain the function of its components. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the components and operation of supersonic blowdown wind tunnel with a neat sketch. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the working principle of plasma arc wind tunnel with a neat sketch. | CO3 | U | 6 |
|  | b. | Sketch the shock tube and explain the components in detail. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Compare the features, benefits, and drawbacks of various strut-type balance types. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the operating principle and different modes of operation of constant temperature hot wire anemometer with neat sketches. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the capacity of air drier in supersonic wind tunnels. | CO2 | U | 6 |
|  | b. | Explain the characteristics of aftercooler in wind tunnel operations. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Write the basic concept, essential elements and configuration of the Planar Laser Fluorescence (PLIF) technology in wind tunnels. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the advantages and disadvantages of non-optical flow visualisation techniques. | CO6 | U | 4 |
|  | b. | Explain the working principle and construction of the schlieren technique with a neat sketch. | CO6 | A | 8 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the various types of wind tunnels and test techniques. |
| **CO2** | Choose proper high speed wind tunnel for required test. |
| **CO3** | Choose correct model for wind tunnel testing. |
| **CO4** | Estimate the forces and moments for given model. |
| **CO5** | Estimate pressure, velocity and temperature using measurement techniques. |
| **CO6** | Choose the proper flow visualization techniques. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | - | 5 | 12 | - | - | - | 17 |
| **CO2** | 5 | 24 | - | - |  |  | 29 |
| **CO3** | 3 | 8 | 6 | - | - | - | 17 |
| **CO4** | 1 | 4 | - | 12 | - | - | 17 |
| **CO5** | 1 | 15 | 12 | - | - | - | 28 |
| **CO6** | 1 | 7 | 8 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE2056** | **Duration** | **3hrs** |
| **Course Title** | **BASICS OF AEROSPACE ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Who successfully performed the first trans-Atlantic flight? | | CO1 | R | 1 |
| 2. | \_\_\_\_\_\_\_\_\_\_\_\_ built a 50 feet high artificial hill to launch gliders. | | CO1 | R | 1 |
| 3. | Name three gyroscope-based instruments used in aircrafts. | | CO2 | R | 1 |
| 4. | State the importance of safety in primary structures of aircrafts. | | CO2 | R | 1 |
| 5. | Define chord length in an aerofoil. | | CO3 | R | 1 |
| 6. | Write two limitations of composite structures. | | CO4 | R | 1 |
| 7. | In a turboprop engine approximately \_\_\_\_\_\_ % of the thrust comes from the propeller. | | CO5 | R | 1 |
| 8. | Define escape velocity. | | CO5 | R | 1 |
| 9. | State the reason for the high earth orbits to be called as geo-synchronous orbits. | | CO6 | R | 1 |
| 10. | \_\_\_\_\_\_\_\_\_\_\_\_\_ is India’s first experimental communication satellite. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | State the principle of Ornithopters. | | CO1 | R | 3 |
| 12. | What is meant by aerodynamic interference in Biplanes? | | CO2 | U | 3 |
| 13. | Write five stresses acting on an aircraft. | | CO3 | U | 3 |
| 14. | State the use of nickel alloys in high temperature applications in aircrafts. | | CO4 | R | 3 |
| 15. | Name five launch vehicles developed by India. | | CO5 | U | 3 |
| 16. | Write the use of BLDC motors in multi-copter drones. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Otto Lilienthal was referred to as the ‘Glider man”. Justify the claim by explaining the contributions of Otto Lilienthal to flying. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe the five major components of an aircraft with a line sketch. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the parts of an aircraft wing with a neat sketch. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe the use of non-metallic materials used in the construction of aircraft structures. | CO4 | R | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the principle and working of a solid propulsion system and its advantages. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. |  | Describe the principle and working of a turbofan engine with a sketch. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the major components of a multi-copter drone. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the function and use of the basic instruments used for flying. | CO2 | R | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Understand the evolution of aircrafts and flying vehicles. |
| CO2 | Understand the parts and functions of aircrafts. |
| CO3 | Obtain knowledge on principles of flight. |
| CO4 | Understand the fundamentals of structures and materials used in Aerospace applications. |
| CO5 | Understand the principles of aircraft and rocket propulsion. |
| CO6 | Obtain knowledge on the components and function of Multi-copter drones. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 17 | - | - | - | - | - | 17 |
| CO2 | 14 | 3 | - | - | - | - | 17 |
| CO3 | 13 | 3 | - | - | - | - | 16 |
| CO4 | 16 | - | - | - | - | - | 16 |
| CO5 | 14 | 15 | - | - | - | - | 29 |
| CO6 | 13 | 16 | - | - | - | - | 29 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE2062** | **Duration** | **3hrs** |
| **Course Title** | **HEAT AND MASS TRANSFER** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the term advection in heat transfer. | | CO1 | R | 1 |
| 2. | State the significance of heat transfer. | | CO1 | R | 1 |
| 3. | Identify the unit of thermal diffusivity. | | CO2 | U | 1 |
| 4. | Write Laplace’s equation in Cartesian form. | | CO2 | A | 1 |
| 5. | State Newton’s law of cooling. | | CO3 | R | 1 |
| 6. | Define boundary layer. | | CO3 | R | 1 |
| 7. | Give an example of free convection. | | CO4 | U | 1 |
| 8. | Write the expression of maximum emissive power. | | CO5 | A | 1 |
| 9. | State the significance of radiation shield. | | CO5 | R | 1 |
| 10. | State the function of condenser. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain thermal conductivity and its role in heat transfer. | | CO1 | U | 3 |
| 12. | List the types of fins. | | CO2 | R | 3 |
| 13. | Differentiate between forced convection and free convection. | | CO3 | U | 3 |
| 14. | Define Grashof number. | | CO4 | R | 3 |
| 15. | Define irradiation. | | CO5 | R | 3 |
| 16. | Distinguish between cross flow and counter flow heat exchanger. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the mechanisms involved in convection mode of heat transfer with an example. | CO1 | U | 8 |
|  | b. | Write Fourier’s law of heat conduction and examine the role of parameters in it. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. |  | A wall of a cold room is composed of three layers. The outer layer is brick 20 cm thick, the middle layer is cork 10 cm thick and the inside layer is cement 5 cm thick. The temperature of the outside air is 25°C and that on the inside air is -20°C. The film co-efficient for outside air and brick is 45.4 W/m²K and for inside air and cement is 17 W/ m²K. Determine the following   1. Thermal resistance 2. The heat flow rate   Brick, cork and cement have respective thermal conductivities of 3.45 W/mK, 0.043 W/mK and 0.294 W/mK. | CO2 | A | 6  6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the development of thermal boundary layer over a plate with a neat sketch. | CO3 | U | 6 |
|  | b. | A flat plate measuring 0.8 m x 0.25 m placed longitudinally in a stream of crude oil which flows with a velocity of 4 m/s. Calculate the following:   1. Boundary layer thickness at the middle of plate 2. Shear stress at the middle of plate   kinematic viscosity = 1 stroke | CO3 | A | 3  3 |
|  |  |  |  |  |  |
| 20. |  | A horizontal pipe of 15 cm diameter is maintained at wall temperature of 200°C and is exposed to air at 37°C. Calculate the heat loss per meter length if emissivity of pipe is 0.92. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Liquid oxygen is stored in double walled spherical vessel. Inner wall temperature -160°C and outer wall temperature is 30°C. Inner diameter of sphere is 20 cm and outer diameter is 32 cm. Calculate the following:   1. Heat transfer if emissivity of spherical surface is 0.05. 2. Rate of evaporation of liquid oxygen if its rate of vapourization of latent heat is 200 kJ/kg. | CO5 | A | 6  6 |
|  |  |  |  |  |  |
| 22. | a. | Explain lumped heat analysis. | CO2 | U | 6 |
|  | b. | A 12 cm diameter long bar initially at a uniform temperature of 40°C is placed in a medium at 650°C with a convective coefficient of 22 W/m²K. Determine the time required for the center to reach 255°C. For the material of the bar, thermal conductivity k= 20 W/mK, density ρ = 580 kg/m³ and specific heat Cp= 1050 J/kgK. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | A black body at 3000 K emits radiation. Calculate the following:   1. Monochromatic emissive power at 1 µm wave length 2. Wave length at which emission is maximum 3. Maximum emissive power 4. Total emissive power | CO5 | A | 3  3  3  3 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Derive the expression of logarithmic mean temperature difference for parallel flow heat exchanger with the suitable assumptions. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the various modes of heat transfer and the factors affecting it |
| **CO2** | Solve steady state and transient heat conduction problems |
| **CO3** | Understand the physical phenomena associated with convective transport processes |
| **CO4** | Understand the role of non- dimensional parameters and use them to solve practical convective heat transfer problems |
| **CO5** | Understand the physical mechanisms involved in radiation heat transfer |
| **CO6** | Select and design heat exchangers for a given application and heat load |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 11 | 4 | - | - | - | 17 |
| **CO2** | 3 | 7 | 19 | - | - | - | 29 |
| **CO3** | 2 | 9 | 6 | - | - | - | 17 |
| **CO4** | 3 | 1 | 12 | - | - | - | 16 |
| **CO5** | 4 | - | 25 | - | - | - | 29 |
| **CO6** | - | 4 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20AE3001** | **Duration** | **3hrs** |
| **Course Title** | **HIGH SPEED JET FLOWS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | State the limitations on air as a perfect gas. | CO1 | R | 6 |
|  | b. | The noise of an aircraft in level flight flown overhead is only heard by an observer at sea level altitude when the aircraft has travelled 1 km from the location of the observer. Ignoring the temperature variation with altitude, estimate the flight altitude if the aircraft is flying at Mach 3.0. | CO1 | E | 14 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Differentiate between nozzles and diffusers for subsonic flows. | CO2 | U | 6 |
|  | b. | Air enters a nozzle at a pressure of 3 MPa with a temperature of 400 ֯C. At the nozzle exit, *A*2 = 5000mm2 and *p*2 =0.5MPa. Expansion through the nozzle is isentropic according to the law *p*V*𝛾*=constant. Calculate (a) the Mach number at nozzle exit, (b) the throat area, and (c) the mass flow through the nozzle. | CO2 | An | 14 |
|  |  |  |  |  |  |
| 3. | a. | Explain turbulence characteristics of free jets and mixing length. | CO3 | A | 6 |
|  | b. | A Mach 2 uniform air flow passes over a wedge. An oblique shock, making an angle of 40֯ with the flow direction, is attached to the wedge. If the static pressure and temperature in the freestream are 50 kPa and 0 ֯C, Calculate the static pressure and temperature behind the wave, the Mach number of the flow passing over the wedge, and the wedge angle. | CO3 | An | 14 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain the various classification of control methods for jets. Explain any two control methods in detail. | CO3 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Explain under expanded, correctly expanded and overexpanded jets with neat sketch. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Evaluate the mass flow rate of air, the nozzle throat area, and the reservoir pressure and temperature required for a supersonic wind tunnel operation with test-section conditions of Mach 3, static pressure of 0.2 atm, and static temperature 300K. The test-section area is 0.05m2; assume the flow to be isentropic. | CO5 | E | 20 |
|  |  |  |  |  |  |
| 7. | a. | Explain turbulence characteristics of free jets. | CO4 | A | 10 |
|  | b. | Estimate the temperature rise at the nose of an aircraft flying with Mach number 2 at an altitude of 10,000 m. | CO4 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the Couette flow and Poiseuille flow in detail. | CO5 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Illustrate four types of noise and the source of noise generation in a jet. | CO6 | A | 10 |
|  | b. | Explain any two noise suppression techniques in jets. | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the nature of high-speed flow characteristics. |
| CO2 | Apply the concepts of nozzles and diffusers for various applications |
| CO3 | Understand the various jet control methods. |
| CO4 | Evaluate the performance jet acoustics and free shear layer. |
| CO5 | Apply the concepts for turbulent jets in free stream. |
| CO6 | Analyze problems associate with jet acoustics |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 |  |  |  | 14 |  | 20 |
| CO2 |  | 6 |  | 14 |  |  | 20 |
| CO3 |  |  | 26 | 14 |  |  | 40 |
| CO4 |  |  | 10 |  | 10 |  | 20 |
| CO5 |  |  | 40 |  | 20 |  | 60 |
| CO6 |  |  | 20 |  |  |  | 20 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21AE3001** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED AERODYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Using a control volume and fluid flow scenario, explain and derive the momentum equation in its integral form by applying the principles of momentum conservation, the divergence theorem, and the gradient theorem. Provide a detailed, step-by-step explanation for each part of the derivation. | CO1 | U | 12 |
|  | b. | Describe the mathematical expressions of the 3D Navier-Stokes equations in the x direction, detailing each term and its significance in fluid dynamics. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 2. | a. | Articulate the derivation of the velocity profile for Couette flow, clearly explaining each step in the process. Additionally, illustrate the setup with a diagram that shows the boundary conditions and velocity distribution across the flow | CO2 | A | 12 |
|  | b. | Consider a steady, incompressible Couette flow between two parallel plates. The lower plate is stationary, and the upper plate is moving with a constant velocity of U=5 m/s. The distance between the plates is h=0.1 m. Assume the fluid has a dynamic viscosity of μ=0.001 Pa⋅s. Calculate the velocity of the fluid at a point y=0.05 m from the lower stationary plate. | CO2 | An | 4 |
|  |  |  |  |  |  |
| 3. |  | Examine the concepts of displacement thickness and momentum thickness in boundary layer theory. Interpret the derivations of both thicknesses, explaining their significance in fluid dynamics and their impact on flow behavior. | CO3 | A | 16 |
|  |  |  |  |  |  |
| 4. |  | Classify the various types of shock waves, including normal shocks, oblique shocks, and expansion waves. Explain the influence of back pressure on shock wave formation, detailing how changes in back pressure affect the characteristics and behavior of the shock formations within a CD nozzle. | CO4 | U | 16 |
|  |  |  |  |  |  |
| 5. |  | An aircraft is flying at a Mach number of 𝑀1=2.0 at an altitude where the ambient air pressure is 𝑃1=50 kPa and the temperature is 𝑇1=250K. A normal shock wave forms in front of the jet due to its high speed, causing a sudden change in the flow properties. Assume air as an ideal gas with γ=1.4 and R=287 J/kg⋅K. Determine the   1. Mach number M2​ after the shock. 2. Temperature T2​ and pressure P2​ immediately after the shock wave. 3. Stagnation pressure ratio across the shock wave, P02/P01 ​​​. 4. Density ratio ρ2/ρ1 across the shock wave. 5. Strength of the shock wave. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Describe the governing equations for Rayleigh flow and explain how they characterize the behavior of gases under different conditions. | CO6 | U | 16 |
|  |  |  |  |  |  |
| 7. |  | Air flows steadily from a large pressurized tank at pressure Po into a converging duct that is open to another tank at back pressure Pb. The duct is insulated. The given conditions are: Po=158.0 kPa, To=520.0 K, Pb=101.3 KPa, Ae=0.0130 m2. Evaluate:   1. Is the flow at the exit subsonic, sonic or supersonic? Provide justification for the conclusion. 2. At what value of Pb does the nozzle exit reaches critical condition? 3. Calculate Mach number and Temperature at the exit of the duct for this case. 4. Calculate the static to total density ratio across the converging nozzle. | CO4 | An | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Air flows from a pressurized tank with a stagnation pressure 𝑃0=250kPa and a stagnation temperature 𝑇0=500K through a converging-diverging nozzle. The back pressure is low enough such that the flow is subsonic upstream of the throat, sonic at the throat, and supersonic downstream of the throat. The throat area is 0.15 m2. Calculate the following:  a) The area at a location where the Mach numbers are 𝑀=0.35 and 𝑀=2.1. Provide justification for the conclusions.  b) The static temperature and pressure at the throat.  c) The mass flow rate at the choked condition. | CO5 | An | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Assess the forces and moments due to flow. |
| CO2 | Understand the flow behavior over various body shapes. |
| CO3 | Apply compressibility corrections for flow in C-D passages and instruments like Pitot static tube. |
| CO4 | Assess the nature of compressible flow over airfoils and finite wings. |
| CO5 | Use the computational tools to evaluate hypersonic flows. |
| CO6 | Understand the basic principles of expansion waves. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 16 |  |  |  |  | 16 |
| CO2 |  |  | 12 | 4 |  |  | 16 |
| CO3 |  |  | 16 |  |  |  | 16 |
| CO4 |  | 16 |  | 16 |  |  | 32 |
| CO5 |  |  | 16 | 20 |  |  | 36 |
| CO6 |  | 16 |  |  |  |  | 16 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21AE3002** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED STRUCTURAL ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Explain the concept of principal stresses and principal planes. Derive expressions for principal stresses in a 2D stress system using Mohr’s circle. For a given stress state (σx=100 MPa, σy=40 MPa and τxy=30 MPa), determine the principal stresses, principal planes, and maximum shear stress. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 2. |  | For an orthotropic lamina, explain how engineering elastic constants (such as ​) are transformed when the lamina is oriented at an angle θ with respect to the global coordinate system. Derive the transformed stiffness matrix [Q′] for a lamina rotated by an angle θ from its principal material axes. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. |  | A 4-m long cantilever I beam with cross section as shown in Figure is constructed from an IPN section. A load acts in the vertical direction at the end of the beam.  (a) Determine the maximum bending stresses in the beam if the y axis of the cross section is vertical and therefore aligned with the load P.  (b) Determine the maximum bending stresses if the beam is inclined at a small angle to the load P.  Use . | CO3 | A | 16 |
|  |  |  |  |  |  |
| 4. |  | The cross section of a channel beam with double flanges and constant thickness throughout the section is shown in the figure. Derive the following formula for the distance e from the centerline of the web to the shear center S: | CO4 | A | 16 |
|  |  |  |  |  |  |
| 5. |  | The sheet-stringer panel shown in Figure is loaded in compression. The sheet is assumed to be simply-supported at the loaded ends and along the rivet lines, but free at the sides. Each-stringer has an area of 0.7 cm2. E = 70 GPa for the sheet and stringer material. Panel-length is 1m. Find the total compressive load carried under the following  conditions:  (i) when the sheet first buckles.  (ii) when the stringer stress is 200 MPa. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Determine the shear flows in the web panels and direct load in the flanges and stiffeners of the beam shown in Figure. if the web panels resist shear stresses only. | CO6 | A | 16 |
|  |  |  |  |  |  |
| 7. |  | The cross section of a slit circular tube of constant thickness is shown in the Figure. Show that the distance e from the center of the circle to the shear center S is equal to 2r. | CO4 | A | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Determine the direct stress distribution in a thin-walled Z-section produced by a positive bending moment Mx. Height of the section = h and the flange width = h/2.  Use . | CO3 | A | 20 |
|  |  |  |  |  |  |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Understand stress and strain compatibility conditions. |
| CO2 | Derive Stress-strain relationship of a lamina. |
| CO3 | Differentiate the symmetrical and unsymmetrical bending. |
| CO4 | Determine the shear center in various open and closed section of aircraft structures. |
| CO5 | Analyze the buckling of plates to predict the critical stress. |
| CO6 | Design aircraft composite panel for aerospace applications. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  |  | 16 |  |  |  | 16 |
| CO2 |  |  | 16 |  |  |  | 16 |
| CO3 |  |  | 36 |  |  |  | 36 |
| CO4 |  |  | 32 |  |  |  | 32 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 16 |  |  |  | 16 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **21AE3005** | **Duration** | **3hrs** |
| **Course Title** | **ELEMENTS OF DATA ANALYTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Briefly discuss the characteristics of big data. Also explain the NOIR scales of measurement for different types of data. | CO1 | U | 8 |
|  | b. | The vertical distance (in meters) travelled by a rocket in a test are given below. Find the mean, median and mode.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Distance Range | 0 -10 | 10 -20 | 20 -30 | 30-40 | 40 -50 | 50-60 | 60-70 | | Frequency | 6 | 5 | 8 | 15 | 7 | 6 | 3 | | CO1 | A | 8 |
|  |  |  |  |  |  |
| 2. | a. | The chances of A, B and C becoming a general manager of a certain company are in the ratio 4: 2: 3. The probability that the bonus scheme will be introduced in the company if A, B and C become general manager are 0.3, 0.7 and 0.8 respectively. (i) What is the probability for bonus scheme to be introduced ? (ii) If bonus scheme has been introduced, then what is the probability that B has been appointed as general manager? | CO2 | A | 8 |
|  | b. | Determine the system reliability of the following series-parallel configurations. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | In a large consignment of electric bulbs, 5% are defective. A random sample of 15 is taken for inspection. Use Poisson Distribution to find the probability that   1. All are good bulbs. 2. Exactly 3 are defective bulbs 3. At most 3 are defective bulbs. | CO2 | An | 8 |
|  | b. | The life time of a battery is known to be exponentially distributed with a mean of 3 years. Find the probability that (i) the life time of a battery is greater than 4 years (ii) the battery fails before 2 years of use. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 4. | a. | 1000 families were selected at random in a city to test the belief that high income families send their children to public schools and the low income families send their children to government schools. The following results were obtained.   |  |  |  | | --- | --- | --- | |  | Public schools | Government Schools | | Low income | 370 | 430 | | High income | 130 | 70 |   Test whether income and the type of schooling are independent. | CO3 | An | 8 |
|  | b. | A random sample of 25 tyres from a large consignment gave the average life of the tyres as 38000 km with a standard deviation of 5000 km. Could the sample come from a population with mean life of 40000 km? Use the level of significance at 5%. | CO3 | An | 8 |
|  |  |  |  |  |  |
| 5. |  | The data below represent blood pressure measurements from a Randomized Block Design experiment involving three age groups, each with 3 persons. The three persons within each age group were randomly assigned to drugs A, B, and C, with one person per drug. Test whether there is significant difference between the drug effects, and between the age groups.   |  |  |  |  | | --- | --- | --- | --- | | Age \ Drugs | A | B | C | | 20-30 | 69 | 80 | 40 | | 30-40 | 91 | 92 | 47 | | 40-50 | 65 | 63 | 44 | | CO3 | An | 16 |
|  |  |  |  |  |  |
| 6. |  | The following data relate to advertisement expenditure (in lakhs of rupees) and their corresponding sales (in crores of rupees).   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | advertisement expenditure | 10 | 12 | 15 | 23 | 20 | | sales | 14 | 17 | 23 | 25 | 21 |   (i)Find the two lines of Regression. (ii) Predict the sales corresponding to the advertisement expenditure of 30 lakhs and estimate the advertisement expenditure corresponding to a sales target of 35 crores. | CO4 | An | 16 |
|  |  |  |  |  |  |
| 7. | a. | By the method of least square fit a straight line to the following data. Also estimate the value of y when x = 6.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | X | 1 | 2 | 3 | 4 | 5 | | Y | 14 | 27 | 40 | 55 | 68 | | CO5 | An | 8 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  | b. | Monthly sales revenue data were collected for a company and given below:   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Months | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | sales | 125 | 145 | 186 | 131 | 151 | 192 | 137 | 157 | 198 | 143 | 163 | 204 |   (i) Calculate the three point moving averages. (ii) Plot the actual and trend values on a graph. (iii) Comment on the trend. | | CO5 | | An | | 8 |
|  |  |  | |  | |  | |  |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | | | | |
| 8. | a. | (i) In a trivariate distribution, it is found that R12 = 0.98, R13 = 0.44, and R23 = 0.54. Find the partial correlation coefficients, and multiple correlation coefficient R1.23.  (ii) A nutritionist wants to predict a patient's cholesterol level (Y) based on the daily intake of fats ( X1 gm.), exercise time (X2 min), and age(X3 years). Based on the past data he developed a multiple linear regression model; Y= 2.69X1 - 0.07X2 + 0.33X3 + 115.119. Predict the cholesterol level of a 48-year-old person who consumes 28 grams of fats, and exercises for 25 minutes per day using the MLR model. | CO6 | | An | | 10 | |
|  | b. | Find the maximum likelihood estimator for when is the Poisson distribution. | CO6 | | An | | 10 | |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand nature of data, and measurements. |
| CO2 | Relate predictive analysis using probability distributions. |
| CO3 | Construct the comparative analysis using testing of hypothesis |
| CO4 | Measure the relationship between variables. |
| CO5 | Analyze data trends using graphical method |
| CO6 | Estimate using multiple correlation models |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 8 | 8 |  |  |  | 16 |
| CO2 |  |  | 16 | 16 |  |  | 32 |
| CO3 |  |  |  | 32 |  |  | 32 |
| CO4 |  |  |  | 16 |  |  | 16 |
| CO5 |  |  |  | 16 |  |  | 16 |
| CO6 |  |  |  | 20 |  |  | 20 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21AE3007** | **Duration** | **3hrs** |
| **Course Title** | **MODELING AND SIMULATION OF AEROSPACE VEHICLES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the principles employed in modeling techniques for carrying out simulation. | CO1 | U | 8 |
|  | b. | Compare the techniques employed in numerical computation for models with the help of neat sketches. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Examine the continuous system simulation languages emphasizing the importance of CSMP III. | CO2 | A | 8 |
|  | b. | Develop an autopilot system for a ballistic vanguard missile based on the lead compensation technique. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. |  | Explain the linear and non-linear models employed in an aircraft. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 4. |  | Articulate on the Design Assurance Level (IDAL) mentioned in ARP4754 with respect to risk and explain each of the levels with its failure rate. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 5. | a. | Summarize the four governing axioms of classical mechanics. | CO5 | U | 8 |
|  | b. | Identify the elements of mathematical models in classical mechanics with the Euclidean space-time equations. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain in detail on the utilization of flight simulator as a training device and research tool. | CO6 | U | 8 |
|  | b. | Discuss about the merits and demerits of simulators. | CO6 | U | 8 |
|  |  |  |  |  |  |
| 7. |  | Examine the simulation computational technique of a discrete model, considering the example of a clerk who begins his work with pile of documents to be processed. | CO1 | R | 16 |
|  |  |  |  |  |  |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Examine the effectiveness of a flight simulator and highlight its advantages. | CO6 | R | 10 |
|  | b. | Describe the simulator certification procedures, in detail. | CO6 | R | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Analyze the concepts of system models. |
| CO2 | Practice system simulation for cockpit systems. |
| CO3 | Model and design aircraft elements. |
| CO4 | Comprehend the principles behind system assessment, validation and certification. |
| CO5 | Relate system dynamics and mathematical models for flight simulation. |
| CO6 | Relate to the usage of flight simulator for various aircrafts. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 16 | 16 | - | - | - | - | 32 |
| CO2 | - | - | 16 | - | - | - | 16 |
| CO3 | - | 16 | - | - | - | - | 16 |
| CO4 | - | - | 16 | - | - | - | 16 |
| CO5 | - | 16 | - | - | - | - | 16 |
| CO6 | 20 | 16 | - | - | - | - | 36 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **21AE3009** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED AVIONICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Identify and enumerate on the standard that defines the electrical and protocol specifications (IEEE 802.3 and ARINC 664, Part 7) for the exchange of data between avionics subsystems. | CO1 | R | 16 |
|  |  |  |  |  |  |
| 2. |  | Explain the salient features of an aircraft system that utilizes MCDU, MFD, HUD which works in conjunction with flight management system. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate uplink and downlink. Explain their advantages and disadvantages. | CO3 | A | 8 |
|  | b. | Construct the aircraft communication system for which the protocol was designed by ARINC. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 4. |  | Choose the system that can guide the aircraft along the flight plan and explain with suitable diagrams. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 5. |  | Describe the salient features of an autopilot flight detector system and derive the same. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 6. | a. | Write in detail the wireless communication system based on IEEE 802.16 standard. | CO6 | A | 6 |
|  | b. | Construct an avionic system that is employed for sending and receiving the messages. | CO6 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the salient features of an aircraft system that utilizes a colour graphical display. | CO2 | A | 8 |
|  | b. | Construct the flight system, which can be used to enhance HOTAS. | CO2 | A | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Illustrate the advanced form of ACARS MU, which acts as a router to encode the messages from the CDU. | CO6 | U | 10 |
|  | b. | Explain the hardware architecture of a communication management function. | CO6 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Evaluate various aircraft avionics architectures and bus systems. |
| CO2 | Identify various flight display system elements. |
| CO3 | Comprehend the principles behind flight communication protocols. |
| CO4 | Examine flight management system and their working principles. |
| CO5 | Assess various elements of flight control systems. |
| CO6 | Analyze the functioning of on flight communication system. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 16 |  |  |  |  |  | 16 |
| CO2 |  |  | 32 |  |  |  | 32 |
| CO3 |  |  | 16 |  |  |  | 16 |
| CO4 |  |  | 16 |  |  |  | 16 |
| CO5 |  | 16 |  |  |  |  | 16 |
| CO6 |  | 20 | 16 |  |  |  | 36 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21AE3010** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED AIRCRAFT MATERIALS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Describe the engineering properties and applications of wood in aircraft components. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. |  | Distinguish between nickel-based superalloys and iron-based superalloys. | CO2 | An | 16 |
|  |  |  |  |  |  |
| 3. | a. | Explain the importance of interfaces in metal matrix composites. | CO3 | A | 10 |
|  | b. | Examine the properties of magnesium and its alloys with its significances. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 4. |  | Summarize the applications of high temperature materials in aircraft components. | CO4 | E | 16 |
|  |  |  |  |  |  |
| 5. | a. | Explain the polymers used for Radar-Absorbing Materials (RAMs). | CO5 | An | 10 |
|  | b. | Differentiate between elastomers and thermoplastic polymers. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 6. |  | Explain the process of composites manufacturing by resin infusion with necessary diagram. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Summarize the background and history of smart materials. | CO6 | E | 10 |
|  | b. | Write the properties of piezoelectric materials related to aerospace applications. | CO6 | A | 6 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Explain the properties and applications of magnetic smart materials. | CO6 | A | 10 |
|  | b. | Describe the properties and applications of electrostrictive ceramics with necessary points. | CO6 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Explore the use of conventional materials for aircraft structures. |
| CO2 | Learn the properties and composition of alloys for aerospace application. |
| CO3 | Design and analyse light weight metals and composite structures. |
| CO4 | Understand the definition and classification of aerospace composites. |
| CO5 | Choose suitable manufacturing method for composite materials. |
| CO6 | Examine smart and intelligent material characteristics and engineering effect. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 16 |  |  |  |  | 16 |
| CO2 |  |  |  | 16 |  |  | 16 |
| CO3 |  |  | 16 |  |  |  | 16 |
| CO4 |  |  |  |  | 16 |  | 16 |
| CO5 |  |  | 16 | 16 |  |  | 32 |
| CO6 |  | 10 | 16 |  | 10 |  | 36 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **21AE3011** | **Duration** | **3hrs** |
| **Course Title** | **SIMULATION AND MODEL BASED SYSTEM ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain system engineer and give an overview of system engineering. | CO1 | U | 8 |
|  | b. | Describe the terms systems, boundary, process domains and communication of system engineering. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 2. | a. | State the importance of language in model-based system engineering. | CO2 | A | 8 |
|  | b. | Explain architectural design and state the significance of verification and validation. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the need for pattern-based system engineering. | CO3 | A | 8 |
|  | b. | Explain description pattern view point, rules and element description viewpoint. | CO3 | An | 8 |
|  |  |  |  |  |  |
| 4. | a. | Differentiate between system architecture model and analytical model. | CO3 | An | 8 |
|  | b. | Explain the specific SysML modeling techniques for representing and analyzing functional and physical architectures? | CO4 | An | 8 |
|  |  |  |  |  |  |
| 5. | a. | Differentiate between enabling patterns and test pattern. | CO4 | An | 8 |
|  | b. | Explain aim, concept, viewpoint and overview of traceability pattern. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain evidence pattern and state the need for evidence pattern. | CO5 | A | 8 |
|  | b. | Articulate the role of digital engineering in MBSE and its impact on the aerospace industry. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 7. | a. | Analyze the implications of retrofitting a complex system model due to changes in requirements or design modifications. Propose strategies to minimize the risks associated with model retrofitting to ensure the integrity of the overall process. | CO5 | An | 8 |
|  | b. | Distinguish between competence modelling and life cycle modelling. | CO6 | E | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | TTC is the customer for a Royal wheel company. The Royal wheel company needs to supply the aircraft wheel, based on the TTC’s requirement. Considering the principles of system engineering, create the entire set up for the sequential operation to fulfill the customer’s demand. | CO6 | C | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Understand system engineering and its usage. |
| CO2 | Understand how model based engineering used in development of systems. |
| CO3 | Understand the concepts of Modelling Patterns. |
| CO4 | Articulate the usage of modelling patterns. |
| CO5 | Understand the concepts of Modelling Patterns. |
| CO6 | Examine applications and case studies of Modelling Patterns. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 8 | 8 |  |  |  |  | 16 |
| CO2 |  |  | 16 |  |  |  | 16 |
| CO3 |  |  | 8 | 16 |  |  | 24 |
| CO4 |  |  |  | 16 |  |  | 16 |
| CO5 |  | 8 | 16 | 8 |  |  | 32 |
| CO6 |  |  |  |  | 8 | 20 | 28 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **21AE3012** | **Duration** | **3hrs** |
| **Course Title** | **AVIATION 4.0** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Explain how Digital Supply Chain Management and synchronized planning enhance efficiency and support better decision-making in operations. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 2. |  | Analyze the role of Aviation 4.0 in transforming search and rescue services and explain how technologies like IoT, AI, and real-time data monitoring enhance the effectiveness and in search and rescue operations in the aviation industry. | CO1 | An | 16 |
|  |  |  |  |  |  |
| 3. |  | Explain the concept of the extended five-dimensional digital twin technology and explain its significance. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 4. |  | Explain Additive Manufacturing Systems and analyze how they contribute to the advancement of modern manufacturing processes. | CO3 | An | 16 |
|  |  |  |  |  |  |
| 5. |  | Explain the integration of Digital Twin technology with Cyber-Physical Systems (CPS) and the Internet of Things (IoT) | CO4 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Explain Digital Fly-By-Wire (DFBW) systems, describing their main elements, types and their impact on aircraft performance and safety. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 7. |  | Analyze how Augmented Reality (AR) and Virtual Reality (VR) contribute to improving design, manufacturing and maintenance processes in aerospace applications. | CO6 | An | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Analyze the characteristics and implementation of Digital Twin technology in Aviation 4.0, and explain its impact on aviation operations. | CO2 | An | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the concepts of Aviation 4.0 |
| CO2 | Articulate the usage of Digital Twin in Aviation. |
| CO3 | Understand use of digital technologies in smart manufacturing. |
| CO4 | Articulate the usage of the CPS, IOT and Big data in Avionics. |
| CO5 | Illustrate the concepts of Digital Fly-By-Wire. |
| CO6 | Examine applications and case studies of AR, VR & MR in Manufacturing. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 16 | 16 | - | - | 32 |
| CO2 | - | - | 16 | 20 | - | - | 36 |
| CO3 | - | - | - | 16 | - | - | 16 |
| CO4 | - | - | 16 | - | - | - | 16 |
| CO5 | - | - | 16 | - | - | - | 16 |
| CO6 | - | - |  | 16 | - | - | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **DATA ANALYTICS AND VISUALIZATION** | **Duration** | **3hrs** |
| **Course Title** | **21AE3013** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Compare different types of data analytics. | CO1 | An | 8 |
|  | b. | Suppose you are planning to utilize a visualization technique for aerospace application, how will you evaluate its value using profitability? | CO1 | C | 8 |
|  |  |  |  |  |  |
| 2. |  | Explain different language modelling techniques with examples. | CO2 | An | 16 |
|  |  |  |  |  |  |
| 3. |  | You have obtained the feedback from various customers regarding your recently launched product. Design a system which adapts NLP and machine learning to understand the sentiments expressed through the feedback. | CO2 | An | 16 |
|  |  |  |  |  |  |
| 4. |  | How task abstraction supports data visualization? Explain with examples. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 5. |  | Define dashboard in power BI. How will you create a bubble chart in the dashboard and format it? Mention the conclusions you can draw from a bubble chart. | CO5 | An | 16 |
|  |  |  |  |  |  |
| 6. |  | When will you use scatter plot for data visualization? List the steps involved in creating a scatter plot using power BI with an example data. Also, mention the interactive methods we can utilize to get the insight from the visual. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Compare excel with power BI. | CO6 | An | 6 |
|  | b. | How will you analyze the given data with sun burst chart and waterfalls chart using excel? | CO6 | An | 10 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Summarize the methods to manipulate the view of a data visual by changing the viewpoints. | CO4 | A | 5 |
|  | b. | The data provides 10 measurements from NASA Airfoil Self-Noise Dataset. f is the frequency in Hz and SSPL is scaled sound pressure level in dB. f is used to predict SSPL.   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | f | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 | 4000 | | SSPL | 126.42 | 127.69 | 128.09 | 126.97 | 126.09 | 126.99 | 126.62 | 124.11 | 123.24 | 121.12 |  1. Construct a scatter plot 2. Verify all the properties of the fitted Regression Line. 3. Diagnose the LR model with residual plot and write the inference | CO3 | An | 15 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Examine the concepts of data and visualization. |
| CO2 | Perform data analysis and categorize data. |
| CO3 | Perform statistical analysis and abstraction of data. |
| CO4 | Evaluate various representation of spatial data. |
| CO5 | Represent data in various charts in Power BI. |
| CO6 | Plot and analyze data in various charts in excel. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  |  |  | 8 |  | 8 | 16 |
| CO2 |  |  |  | 32 |  |  | 32 |
| CO3 |  |  |  | 15 |  |  | 15 |
| CO4 |  |  | 21 |  |  |  | 21 |
| CO5 |  |  | 16 | 16 |  |  | 32 |
| CO6 |  |  |  | 16 |  |  | 16 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **21AE3014** | **Duration** | **3hrs** |
| **Course Title** | **ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN AEROSPACE APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Mention the criteria to be adapted in designing rational agents. | CO1 | U | 6 |
|  | b. | With the help of a block diagram, explain how a simple reflex agent and a learning agent are deciding action on the environment. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 2. | a. | Draw the architecture of knowledge-based agent. | CO2 | U | 6 |
|  | b. | For the search problem represented by the tree diagram, find the optimal value using alpha-beta pruning algorithm. Clearly indicate the steps followed. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. |  | Discuss the design aspects of AI based flight management expert system. | CO3 | A | 16 |
|  |  |  |  |  |  |
| 4. | a. | Analyze the effect of complexity of the machine learning models on the model performance. | CO4 | An | 6 |
|  | b. | Draw the functional block diagram of Perceptron. With the help of pseudocode explain Perceptron learning algorithm. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Applying vector concepts, explain the SVM classifier model. | CO4 | A | 6 |
|  | b. | How will you apply logistic regression to classify hard-to-position and loss-of-effectiveness control surface fault in a flight simulator test? Assume that the simulation data is acquired from six sensors. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 6. | a. | A classifier has been trained to classify the images of two fighter air crafts. The actual and predicted class are as follows.  Actual= [‘Interceptor’, ‘Escort’, ‘Interceptor’, ‘Escort’, ‘Interceptor’, ‘Interceptor’,‘Escort’,‘Interceptor’,‘Escort’,‘Interceptor’] Predicted= [‘Interceptor’, ‘Interceptor’, ‘Interceptor’, ‘Escort’, ‘Interceptor’, ‘Interceptor’, ‘Escort’, ‘Escort’, ‘Escort’, ‘Escort’].  Construct the confusion matrix and calculate all the performance metrics. | CO5 | An | 6 |
|  | b. | Outline the data collection methods for machine learning based aerospace applications. | CO6 | U | 10 |
|  |  |  |  |  |  |
| 7. |  | Apply the random forest concept for unmanned aircraft configuration selection. Clearly indicate the feature selection measures. | CO5 | A | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | The classification dataset of aircraft types based on remote sensing images has a total of 4,854 valid aircrafts, which is divided into 6 classes : 1. Swept-back wing aircraft, 2. Swept-back aircraft with leading edge, 3. Forward-swept wing aircraft with trailing edge, 4. Delta-wing aircraft, 5. Propeller aircraft, 6. Helicopter. Design an ANN based classifier. Select the proper architecture. Each image is a grey image with size 512×512. | CO6 | C | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Comprehend the concept of artificial intelligent systems.. |
| CO2 | Execute suitable strategy for solving real world problems. |
| CO3 | Design expert systems for specific applications. |
| CO4 | Select and evaluate linear algorithms. |
| CO5 | Compare and contrast nonlinear and ensemble algorithms. |
| CO6 | Implement machine learning techniques. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 16 |  |  |  |  | 16 |
| CO2 |  | 6 |  | 10 |  |  | 16 |
| CO3 |  |  | 16 |  |  |  | 16 |
| CO4 |  |  | 26 | 6 |  |  | 32 |
| CO5 |  |  | 16 | 6 |  |  | 22 |
| CO6 |  | 10 |  |  |  | 20 | 30 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **22AE3001** | **Duration** | **3hrs** |
| **Course Title** | **ARTIFICIAL INTELLIGENCE SYSTEMS FOR UNMANNED AERIAL VEHICLES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the process of training neural network models for the application of object tracking by drones with night-vision or thermal cameras in detail, with an example. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain any of the Artificial Neural Network (ANN) model architectures. | CO1 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Explain the implementation of IoT in crop health monitoring with a detailed equipment list and its functions. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain the application of IoT for the operation of unmanned traffic management in the case of drone delivery. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Detail the list of components and their functions for a typical Hybrid drone. | CO3 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the mandatory sensors to be used on an autonomous drone and explain the integration process. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | List the communication methods used in a simple quadcopter and sketch the signal flow diagram with the flow directions. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the process of using stealth technology to swarm the airplane drones for homeland security applications. | CO6 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Evaluate the suitable model for urban development and planning among the Digital Elevation Model (DEM), Digital Surface Model (DSM), and Digital Terrain Model (DTM). | CO4 | E | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Discuss the principles of training methodologies of neural networks |
| CO2 | Discuss the use of IoT and AI systems in Unmanned Aerial Vehicles |
| CO3 | Illustrate the communication systems and its applications in UAVs |
| CO4 | Analyze the image and data captured using UAVs with contours and graphs |
| CO5 | Summarize the use of different sensors in UAVs |
| CO6 | Develop novel artificial neural networks |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 40 | - | - | - | - | 40 |
| CO2 | - | 40 | - | - | - | - | 40 |
| CO3 | 20 | 20 | - | - | - | - | 40 |
| CO4 | - | - | - | - | 20 | - | 20 |
| CO5 | - | - | 20 | - | - | - | 20 |
| CO6 | - | 20 | - | - | - | - | 20 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23AE1001** | **Duration** | **3hrs** |
| **Course Title** | **PROFESSIONAL ETHICS IN ENGINEERING AND AVIATION INDUSTRY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Give an example of the term “Profession” and define. | | CO1 | U | 1 |
| 2. | Mention an example for an Industrial Ethics. | | CO1 | R | 1 |
| 3. | List out the ethics expected by the industries. | | CO2 | R | 1 |
| 4. | State the factors which are affecting the Self - confidence. | | CO2 | R | 1 |
| 5. | Give an example of a “Moral Issue” in an industry. | | CO3 | R | 1 |
| 6. | Clarify the term “conscientious commitment”. | | CO3 | U | 1 |
| 7. | List out the various social responsibilities expected from an Engineer. | | CO4 | U | 1 |
| 8. | Define the term “Stress” on human being. | | CO5 | U | 1 |
| 9. | Indicate the major three Professional Rights. | | CO5 | R | 1 |
| 10. | Indicate the various fraud awareness training aspects for employees. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List all the theories on leadership. | | CO2 | A | 3 |
| 12. | Differentiate between the democratic and bureaucratic leadership style. | | CO3 | U | 3 |
| 13. | Write how the risk can be analyzed by using a “Risk table”. | | CO4 | A | 3 |
| 14. | Write about the “Conflict Management Techniques” briefly. | | CO1 | U | 3 |
| 15. | Differentiate between “Occupational Crime” and “Common Crime” | | CO5 | A | 3 |
| 16. | Explain the serious hazards associated with working in airports. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. |  | Draw a neat sketch or block diagram which indicates the leadership styles and explain the various leadership styles in detail. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Draw a block diagram which shows the various leadership qualities and explain in detail. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Indicate the various “Engineers Responsibilities” in detail. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain why “Engineers” are called as “responsible Experimenters”. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | With help of a block diagram, illustrate the Signs of stress on human being and write the causes for stresses in details. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Illustrate the “Risk Analysis” in details with help of a block diagram and an example. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | **Describe the most important rights applicable to all employees in detail.** | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Summarize the Code of ethics in airport and air travel in detail. | CO6 | An | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Identify the potential value of the approaches in the organization (strategic, managerial and operational/tactical) relating to Ethical values. |
| CO2 | Appraise the role of leaders in ethically managing society |
| CO3 | Apply the professional ethics with a demonstrated commitment to leadership practice and interpersonal skill |
| CO4 | Assess the effectiveness of own capability and performance in meeting organizational values and goals. |
| CO5 | Evaluate the impact of failure due to non-compliance of ethical consideration in organizations |
| CO6 | Examine the Ethics followed in the aviation industry. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 4 | 12 | - | - | - | 17 |
| CO2 | 2 | - | 15 | 12 | - | - | 29 |
| CO3 | 1 | 4 | - | 12 | - | - | 17 |
| CO4 | - | 1 | 3 | - | - | - | 4 |
| CO5 | 1 | 1 | 3 | 24 | - | - | 29 |
| CO6 | 1 | 3 | - | 24 | - | - | 28 |
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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23AE2001** | **Duration** | **3hrs** |
| **Course Title** | **INTRODUCTION TO AEROSPACE ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write the full form of “SPRE”. | | CO1 | A | 1 |
| 2. | List the types of Chemical Rocket Engines. | | CO1 | R | 1 |
| 3. | List the components of HPRE. | | CO2 | R | 1 |
| 4. | Define Mach Number. | | CO2 | R | 1 |
| 5. | Differentiate between HPRE and LPRE. | | CO3 | U | 1 |
| 6. | What is “Heavier-than-Air” flight? | | CO3 | R | 1 |
| 7. | Define Reynold’s Number. | | CO4 | U | 1 |
| 8. | State the Newton’s First Law. | | CO4 | R | 1 |
| 9. | List the components of Scramjet engine. | | CO5 | U | 1 |
| 10. | List two uses of aileron. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe the generation of lift using a graph between Pressure co-efficient and Chord length along an airfoil of a wing. | | CO1 | R | 3 |
| 12. | Describe the advantages of Hybrid Propellant Rocket Engines. | | CO2 | U | 3 |
| 13. | List the three inner components of Aircraft Wing structures with a sketch. | | CO3 | An | 3 |
| 14. | Explain flow separation with stall in a symmetrical airfoil. Draw graph between Coefficient of Lift and angle of attack. | | CO4 | U | 3 |
| 15. | Explain the forces acting upon an aircraft during level flight in the powered cord. | | CO5 | An | 3 |
| 16. | With a neat sketch, classify aircrafts based on position of its wings. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the principle of operation of Turbojet Engine. | CO1 | A | 6 |
|  | b. | Illustrate the processes of operation of Turbojet Engine on a temperature and entropy diagram. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the six components of an airplane and their functions with sketches. | CO2 | A | 6 |
|  | b. | Explain the International Standard Atmospheric conditions based on the altitude from the earth according to ICAO. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the structural components of aircraft wing with a neat sketch. | CO3 | U | 6 |
|  | b. | Explain the structural components of fuselage with a neat sketch. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the functioning of Diffuser, Combustion Chamber and Nozzle. | CO4 | A | 6 |
|  | b. | Distinguish between the functions of the components of Ramjet and Scramjet. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. |  | List any six types of materials used for aircraft construction and their advantages in the aircraft components. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the parts of passenger aircraft and identify the Primary and Secondary control surfaces with the help of neat sketch. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Describe the construction of Balloons and its application in measurements. | CO6 | U | 6 |
|  | b. | Explain the construction of Dirigibles. | CO6 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the requirement of Propulsion units based on the flying altitude and Speed. | CO6 | An | 6 |
|  | b. | Explain three assumptions in deriving the Euler’s equation and Bernoulli’s equation. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Relate the fundamentals of aerospace technologies to Aircrafts & Space-crafts |
| **CO2** | Demonstrate proficiency in basic principles of aerodynamic |
| **CO3** | Identify and describe different types of fuselage and wing construction |
| **CO4** | Compare and contrast the different types of propulsion system |
| **CO5** | Interpret the concepts of rocket and missile dynamics |
| **CO6** | Summarize the laws of interplanetary physics |

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| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 5 | 1 | 11 |  |  |  | 17 |
| **CO2** | 2 | 3 | 12 |  |  |  | 17 |
| **CO3** | 1 | 7 | 6 | 3 |  |  | 17 |
| **CO4** | 1 | 4 | 6 | 6 |  |  | 17 |
| **CO5** | 1 |  | 24 | 3 |  |  | 28 |
| **CO6** |  | 10 | 12 | 6 |  |  | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **23AE2002** | **Duration** | **3hrs** |
| **Course Title** | **ENGINEERING MECHANICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Two concurrent forces of 12 N and 18 N are acting at an angle of 60°. The resultant force is \_\_\_\_\_\_\_. | | CO1 | U | 1 |
| 2. | The ability of a force to produce a twist effect about an axis is called as \_\_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | Determine the resultant of the parallel forces shown in Figure. | | CO2 | U | 1 |
| 4. | The algebraic sum of moments due to all forces acting on the object about any point is equal to the moment of their \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ about the same point. | | CO2 | R | 1 |
| 5. | The unit of linear acceleration is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | CO3 | R | 1 |
| 6. | Define inelastic collision. | | CO4 | R | 1 |
| 7. | Define velocity of separation. | | CO4 | R | 1 |
| 8. | Write the formula for the rebounding height (h) of a ball if it is dropped from a height (H). | | CO5 | R | 1 |
| 9. | State the Impulse-Momentum energy principle. | | CO5 | R | 1 |
| 10. | The maximum value of the frictional force is called \_\_\_\_\_\_\_\_\_ . | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State Lami’s theorem and write the expression for the same with a sketch. | | CO1 | R | 3 |
| 12. | Convert the force system shown to a single force and a couple at A. | | CO2 | U | 3 |
| 13. | State and illustrate parallel axis theorem with a diagram. | | CO3 | An | 3 |
| 14. | A stone dropped from the top of a tower reaches the ground in 8 seconds. Find the velocity of the stone when it reaches the ground. | | CO4 | U | 3 |
| 15. | A particle is projected with an initial velocity of 60 m/s at an angle of 75º with the horizontal. Determine the maximum height reached by the particle. | | CO5 | U | 3 |
| 16. | A body of weight 100 N is placed on a rough horizontal plane and pushed by a force of 45N as shown in Figure to just cause sliding over the horizontal plane. Determine the coefficient of friction. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | A string ABCD attached to two fixed points A and D has two equal weights of 1000 N attached to it at B and C. The weights rests with the portions AB and CD inclined at angles of 30º and 60º respectively to the vertical as shown in Figure. Find the tensions in the portions AB, BC and CD of the string, if the inclination of BC with the vertical is 120º. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A beam AB of span 10 m is loaded as shown in Figure. Determine the reactions at A and B. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Determine the Moment of Inertia of the I Section shown in Figure. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | A particle is projected with an initial velocity of 60 m/s at an angle of 75º with the horizontal. Determine a) maximum height attained by the particle b) horizontal range of the particle c) time taken by the particle to reach the highest point d) time of flight. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | A ball is dropped from a height of 10 m on a fixed steel platform. Determine the height to which the ball rebounds on the first, second and third bounces. The coefficient of restitution between the ball and the plate is 0.9. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Two weights 100 N and 50 N are connected by a thread and move along a rough horizontal plane under the action of a force 60 N, applied to the first weight of 100 N as shown in figure. The coefficient of friction between the sliding surfaces of the weight and the plane is 0.25. Determine the acceleration of the weights and the tension in the thread using work-energy method. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | A body of weight 200 N kept on a horizontal plane is pulled by a force of 150 N applied at an angle of 60º to the horizontal. The block moves with an instant velocity of 2 m/s while the coefficient of friction between the body and the surface is 0.25. Find the velocity of the body after 15 sec using impulse-momentum method. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Block 2 rests on block 1 and is attached by a horizontal rope AB to the wall as shown in the Figure. What force P is necessary to cause motion of block 1 to impend? The coefficient of friction between the blocks is 1/4 and between the floor and block 1 is 1/3. Mass of blocks 1 and 2 are 14 and 9 respectively. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Determine the resultant force and moment for a given system of forces. |
| **CO2** | Apply physical concepts to verify the equilibrium condition of rigid bodies. |
| **CO3** | Estimate the second moment of Inertia for simple solids. |
| **CO4** | Derive the relationship between displacement, velocity and acceleration of a body in motion. |
| **CO5** | Identify the cause of motion imparted on a particle. |
| **CO6** | Distinguish between static and kinetic Friction. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 4 | 1 | 12 | - | - | - | 17 |
| **CO2** | 1 | 4 | 12 | - | - | - | 17 |
| **CO3** | 1 | - | 15 | - | - | - | 16 |
| **CO4** | 2 | 3 | 24 | - | - | - | 29 |
| **CO5** | 2 | 3 | 24 | - | - | - | 29 |
| **CO6** | 1 | - | 15 | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23AE2004** | **Duration** | **3hrs** |
| **Course Title** | **BASICS OF FLUID MECHANICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Explain the assumptions made when treating a fluid as incompressible. | | CO1 | U | 1 |
| 2. | State the formula used to calculate the hydrostatic pressure. | | CO1 | R | 1 |
| 3. | **Write** one real-world application of Bernoulli’s equation in aerodynamics. | | CO2 | U | 1 |
| 4. | Illustrate the concept of a path line using with neat sketch. | | CO2 | U | 1 |
| 5. | Explain hydrodynamically fully developed flow in circular pipes. | | CO3 | U | 1 |
| 6. | Illustrate the angular deformation of a fluid element subjected to shear flow. | | CO3 | U | 1 |
| 7. | **Explain** the significance of Knudsen number in fluid mechanics. | | CO4 | U | 1 |
| 8. | **Express** the Peclet number formula involving Characteristic length, velocity, and thermal diffusivity. | | CO4 | U | 1 |
| 9. | Distinguish between the characteristics of velocity profiles in laminar and turbulent flow within a circular pipe. | | CO5 | U | 1 |
| 10. | **Illustrate** the formation of wing tip vortices using a diagram of airflow over a wing. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | **Express** the relationship between absolute pressure, gauge pressure, vacuum pressure with atmospheric pressure mathematically. | | CO1 | U | 3 |
| 12. | Write the mathematical expression of material derivative of velocity in all three Cartesian coordinates. | | CO2 | A | 3 |
| 13. | Express the mathematical formula of the Navier-Stokes equation in the y-direction and explain the physical significance of each term. | | CO3 | U | 3 |
| 14. | **Distinguish** between laminar, transition and turbulent flow regimes based on Reynolds number for a pipe flow. | | CO4 | U | 3 |
| 15. | **Illustrate** the development of flow in the entrance region of a circular pipe in terms of boundary layer region and velocity profile. | | CO5 | U | 3 |
| 16. | Explain the concept of induced drag in airfoil aerodynamics. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | An inclined single column manometer (ϴ 60 degree) is connected to a pipe containing a liquid of sp.gr. 0.9 as shown in Figure (h1=30cm, L=40cm, ∆h=1cm). The area of the reservoir is 100 times the area of the tube. Compute pressure in the pipe. The manometric liquid is mercury of sp. gr :13.6. | CO1 | A | 8 |
|  | b. | Write the mathematical expression of specific volume, mass flow rate and volume flow rate in terms of density, cross sectional area and velocity. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 18. |  | Given a control volume and fluid flow scenario, describe and derive the momentum equation in the integral form using the principles of momentum conservation, divergence theorem and gradient theorem. Provide a step-by step  explanation of the derivation. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Establish the general mathematical expression for the velocity profile and maximum velocity of a fully developed, steady, laminar flow between two fixed parallel plates. Include all necessary assumptions and steps in the derivation. | CO3 | A | 6 |
|  | b. | Consider a steady, incompressible flow of water between two large, parallel fixed plates separated by a distance of 0.02 m. The width of the channel is 0.3 m. The dynamic viscosity of water is 0.002Pa⋅s. The pressure gradient driving the flow is dP/dx =−1500Pa/m. Calculate the maximum velocity and discharge (volumetric flow rate) between the plates. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Explain Buckingham pi theorem to obtain the equation of drag force on a smooth sphere. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Air at 25°C flows through a 200 m long smooth pipe with a diameter of 0.06 m at a velocity of 10 m/s. The kinematic viscosity of air at this temperature is 1.8×10−5 m2/s. Determine the head loss due to friction. | CO5 | A | 6 |
|  | b. | Oil at 20°C flows through a 50 m long smooth pipe with a diameter of 0.04 m at a velocity of 0.5 m/s. The kinematic viscosity of the oil is 1.2×10−4 m2/s. Calculate the head loss due to friction. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Derive and deduce the expression for displacement thickness for over a flat plate. | CO6 | An | 6 |
|  | b. | A fluid of density 1.125 kg/m3 and dynamic viscosity 1.9x10-5 Pa.s flows over a flat plate. The free stream velocity is 5 m/s. Compute the boundary layer thickness, displacement thickness and momentum thickness at a point located 0.5 m from the plate leading edge. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | A horizontal venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Calculate the actual discharge through the pipe. | CO2 | An | 8 |
|  | b. | Explain material derivative of temperature with appropriate expression. | CO2 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A differential manometer is connected between two points, A and B, on separate pipelines as shown in figure. Point A and B are located 4 meters above the level of manometric fluid in the right limb. The fluid in pipe A has a specific gravity of 1.4, while the fluid in pipe B has a specific gravity of 0.8. The pressures at points A and B are given as 1.2 kgf/cm² and 2 kgf/cm², respectively. Calculate the difference in mercury levels in the differential manometer. Manometric fluid specific gravity is 13.6. | CO1 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| **CO1** | Calculate hydrostatic forces and determine stability requirements for submerged and floating bodies and on structures like locks, dams and gates. |
| **CO2** | Describe fluid flow and kinematics using streamlines, streak lines and path lines. |
| **CO3** | Analyze simple fluid flow systems using Bernoulli’s equation appropriately for analysis of with an understanding of its limitations. |
| **CO4** | Employ the principles of conservation of mass and momentum, potential flow and boundary layer theory for completely solving a flow field, using a combination of exact solutions and approximate solutions. |
| **CO5** | Calculate form drag and friction drag over bodies, estimate friction losses and determine pumping power required to push fluid through a system. |
| **CO6** | Deduce the non-dimensional numbers that affect fluid flow, and design appropriate physical and numerical experiments for analysis. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 4 | 12 | 12 |  |  | 29 |
| **CO2** |  | 18 | 3 | 8 |  |  | 29 |
| **CO3** |  | 5 | 12 |  |  |  | 17 |
| **CO4** |  | 5 | 12 |  |  |  | 17 |
| **CO5** |  | 4 | 6 | 6 |  |  | 16 |
| **CO6** |  | 4 |  | 12 |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| **Course Code** | **23AE2006** | **Duration** | **3hrs** |
| **Course Title** | **STRENGTH OF MATERIALS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write the type of stress a rope experiences, when it is used to pull a load. | | CO1 | A | 1 |
| 2. | Give an example of a case wherein the structure is subjected to strain without stress. | | CO1 | U | 1 |
| 3. | Draw the shear force diagram for a cantilever beam of length ‘L’ subjected to a point load ‘P’ at its free end. | | CO2 | U | 1 |
| 4. | Write the value of the bending moment at the supports of a simply supported beam with no overhangs. | | CO2 | A | 1 |
| 5. | Define 'neutral axis' in bending of beams. | | CO3 | R | 1 |
| 6. | If the bending stress in a beam is compressive at the top of the neutral axis, indicate the kind of stress occurs at the bottom of the neutral axis. | | CO3 | U | 1 |
| 7. | Indicate the locations at which maximum rotation occurs in a simply supported beam with a uniformly distributed load over the entire span. | | CO4 | U | 1 |
| 8. | Indicate the boundary conditions used for a cantilever beam subjected to a uniformly distributed load over the entire span. | | CO4 | U | 1 |
| 9. | Write the expression for the torsional rigidity of the shaft. | | CO5 | A | 1 |
| 10. | Write the significance of the radius of Mohr’s Circle. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the difference between ductility and brittleness with examples. | | CO1 | U | 3 |
| 12. | Explain what is meant by a pure bending moment. | | CO2 | U | 3 |
| 13. | Draw the variation of normal stress due to bending across the cross-section of a rectangular beam. | | CO3 | U | 3 |
| 14. | For a given material, if the depth of a rectangular beam is doubled, determine the increase in bending rigidity as compared to that of original beam. | | CO4 | U | 3 |
| 15. | Define shear strain with the help of a neat sketch. | | CO5 | R | 3 |
| 16. | Determine the maximum shear stress if two principal stresses at a point are 1000 MPa and -600 MPa. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | The bar shown in Figure is tested in a universal testing machine. It is observed that at a load of 40 kN, the total extension of the bar is 0.280 mm. Determine the Young’s modulus of the material. (d1, d2 and d3 are the diameters of sections 1, 2 and 3 respectively).  dl = 25 mm  d2 = 20 mm  250 mm  d3 = 25 mm  150 mm | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Sketch the shear force and bending moment diagram for the beam shown in Figure. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | A cast iron beam of an ‘I’ section shown in Figure is freely supported on a span of 5 m. If the tensile stress does not exceed 20 N/mm2, determine the safe uniformly distributed load the beam can carry and the maximum compressive stress. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Determine the maximum deflection of the square beam with side length 20 cm made of steel material with Young’s modulus 210 GPa. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | A solid shaft ABCD as shown in Figure having diameter = 3 cm turns freely in a bearing at D and is loaded at B and C by torques T1 = 20 Nm and T2 = 12 Nm. The shaft is connected in the gear box at A to gears that are temporarily locked in position. Determine the maximum shear stress in each part of the shaft and the angle of twist at the end D.  (Assume L1 = 20 cm, L2 = 30 cm, L3 = 20 cm and G = 11.5 kN/cm2. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | The state of plane stress at a point is represented by the stress element below. Determine the stresses on an inclined element with θ = 30°. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | A 400 mm long bar has rectangular cross-section 10 mm × 30 mm. This bar is subjected to  (i) 15 kN tensile force on 10 mm × 30 mm face,  (ii) 80 kN compressive force on 10 mm × 400 mm face, and  (iii) 180 kN tensile force on 30 mm × 400 mm face. Determine the change in volume if Young’s modulus E = 2 × 105 N/mm2 and Poisson’s ratio ν = 0.3. | CO1 | A | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Determine the maximum deflection and slope at the ends of a rectangular beam having width = 25 cm, depth = 15 cm and made of aluminium material with Young’s modulus 70 GPa. | CO4 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the characteristics of conventional metals. |
| **CO2** | Realize the effect loads acting at different sections of the beam. |
| **CO3** | Determine the stresses developed in beams. |
| **CO4** | Compute the deflection of beam under various loading condition. |
| **CO5** | Evaluate the stresses developed in the shaft due to torque. |
| **CO6** | Analyze the states of stress in a 2D oblique plane. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** |  | 4 | 25 |  |  |  | 29 |
| **CO2** |  | 4 | 13 |  |  |  | 17 |
| **CO3** | 1 | 4 | 12 |  |  |  | 17 |
| **CO4** |  | 5 | 24 |  |  |  | 29 |
| **CO5** | 3 |  | 13 |  |  |  | 16 |
| **CO6** |  | 3 | 13 |  |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23AE2008** | **Duration** | **3hrs** |
| **Course Title** | **ENGINEERING THERMODYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define thermodynamic equilibrium. | | CO1 | R | 1 |
| 2. | Differentiate between Macroscopic and Microscopic approach. | | CO1 | R | 1 |
| 3. | Define Specific heat at constant volume (Cv). | | CO2 | R | 1 |
| 4. | State the limitation of first law of thermodynamics. | | CO2 | U | 1 |
| 5. | Define heat pump. | | CO3 | R | 1 |
| 6. | Explain Carnot theorem. | | CO3 | U | 1 |
| 7. | Define Ideal gas in thermodynamics. | | CO4 | R | 1 |
| 8. | State Dalton’s Law of partial pressures. | | CO4 | U | 1 |
| 9. | What is regenerative cycle in refrigeration cycles? | | CO5 | U | 1 |
| 10. | Define flash point and fire point. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between path function and point function. | | CO1 | U | 3 |
| 12. | Recall the different forms of stored energy in thermodynamics. | | CO2 | R | 3 |
| 13. | Describe the conditions of reversibility. | | CO3 | U | 3 |
| 14. | Explain the Compressibility factor for real gases. | | CO4 | U | 3 |
| 15. | Describe the processes of Rankine cycle with necessary P-V diagram. | | CO5 | R | 3 |
| 16. | Summarize the reasons for using a spherical cavity on a piston head instead of a flat surface. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | A certain gas of volume 0.6 m3, pressure of 5 bar and temperature of 140°C is heated in a cylinder to 10 bar when the volume remains constant. Calculate (i) Temperature at end of process, (ii) The heat transfer, (iii) Change in internal energy (iv) Work done by the gas Cp=1.005 KJ/Kg.K & Cv=0.71 KJ/KgK. | CO1 | A | 6 |
|  | b. | Explain the Concept of continuum with relevant diagram. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | 0.35kg of air at a pressure of 1bar occupies a volume of 0.4m3. If this air expands isothermally to a volume of 0.8m3, Estimate; (i) The initial temperature, (ii) The final temperature, (iii) External work done, (iv)Heat absorbed by the air. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the irreversibility due to the Transfer of Electricity through a Resistor dissipative effect. | CO3 | U | 9 |
|  | b. | Summarize the deduction of third law of thermodynamics. | CO3 | U | 3 |
|  |  |  |  |  |  |
| 20. |  | Explain the Joule Kelvin effect (or) Joule Thomson effect with necessary equations. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Illustrate regenerative cycle in vapour power cycle with necessary diagrams and its efficiency. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Describe the working principle of Diesel cycle with relevant diagrams and equations. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Steam at 20 bar, 360°C is expanded in a steam turbine to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. (a) Assuming ideal processes, find per kg of steam the network and the cycle efficiency. (b) If the turbine and the pump have each 80% efficiency, find the percentage reduction in the network and cycle efficiency. (Steam table can be used). | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the working principle of Dual cycle with relevant diagrams and equations. | CO6 | A | 9 |
|  | b. | Explain the purpose of air standard cycles in thermodynamics. | CO6 | U | 3 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate a deep understanding of the fundamental principles and concepts of thermodynamics, including the laws of thermodynamics, properties of pure substances. |
| **CO2** | Apply the First Law of Thermodynamics to analyze and solve engineering problems involving energy conservation. |
| **CO3** | Analyze and interpret the implications of the Second Law of Thermodynamics in relation to the direction of natural processes and entropy changes. |
| **CO4** | Derive and apply various thermodynamic relations, including Maxwell's equations and the relationships between thermodynamic properties |
| **CO5** | Evaluate and compare different vapour power cycles, identify key components and enhance the performance of refrigeration processes. |
| **CO6** | Evaluate and enhance the efficiency of gas-powered systems, by applying principles of thermodynamics. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 9 | 6 |  |  |  | 17 |
| **CO2** | 4 | 1 |  | 12 |  |  | 17 |
| **CO3** | 1 | 16 |  |  |  |  | 17 |
| **CO4** | 1 | 4 | 12 |  |  |  | 17 |
| **CO5** | 3 | 13 | 12 |  |  |  | 28 |
| **CO6** |  | 19 | 9 |  |  |  | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **23AE2010** | **Duration** | **3hrs** |
| **Course Title** | **INTRODUCTION TO AEROSPACE MATERIALS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the term used to describe the collective sharing of a sea of valence electrons between several positively charged metal ions. | | CO1 | R | 1 |
| 2. | Name the the fundamental property of materials which is closely related to tensile strength. | | CO1 | R | 1 |
| 3. | Write one application area of impact testing in industries. | | CO2 | A | 1 |
| 4. | State the formula to calculate the flexural strength in a standard three point bending flexural test. | | CO2 | R | 1 |
| 5. | Indicate the working temperature of graphite as a refractory material which has the composition of carbon particles. | | CO3 | U | 1 |
| 6. | Indicate the tempering and creep resistance of iron base alloys. | | CO3 | U | 1 |
| 7. | Write the reinforcement phase in E-Glass Fiber/ Composite. | | CO4 | A | 1 |
| 8. | Write the Matrix phase in a Carbon Fiber-Epoxy Composite. | | CO4 | A | 1 |
| 9. | Give the Composition of Silicon in Silicon-chromium Steel material. | | CO5 | U | 1 |
| 10. | Name the space vehicle that lifted off with Astronauts Neil A. Armstrong, Michael Collins and Edwin E. Aldrin Jr. at 9:32 a.m on July 16, 1969**.** | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Represent the Substitutional solid solutions in the form of a schematic diagram. | | CO1 | U | 3 |
| 12. | Write the formula to find the minimum flattened height during flattening test of materials. | | CO2 | A | 3 |
| 13. | List the eenvironmental resistance requirements of high temperature materials. | | CO3 | R | 3 |
| 14. | State the applications of composite materials in Aerospace industry. | | CO4 | R | 3 |
| 15. | Indicate the atomic number and atomic weight values of Molybdenum. | | CO5 | U | 3 |
| 16. | Give the two types of steels used in solid and liquid propellant rocket motors. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain how alloys are classified in general based on the atomic arrangement that forms the alloy. | CO1 | A | 6 |
|  | b. | Explain the Iron Carbon Equilibrium/phase diagram with a graphical representation. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | Enumerate the salient features of an impact testing used to determine the behaviour of materials subjected to shock loading in bending with the help of a simple sketch. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the three main groups of ablative materials based on working principles. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe briefly the different types of Composite materials and its applications. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Determine the methods, benefits, and best Practices in Aluminum Heat Treatment Process. | CO5 | A | 6 |
|  | b. | Determine the methods, benefits, and best Practices in Steel Heat Treatment Process. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Enumerate the salient features of fatigue testing with the help of a simple sketch of the S-N curve. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | ~~Sketch the Iron Carbon Equilibrium/phase diagram with a graphical representation and comment on the same.~~  Sketch the Equilibrium phase diagram of water with a graphical representation and comment on the same with Gibbs Phase Rule. | CO1 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write briefly on the wonder material graphene which can be made from a layer of carbon one-atom thick. | CO6 | A | 6 |
|  | b. | Explain briefly on the high temperature insulation used for Nose cone of Launch Vehicles and Re-entry Vehicles. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Realize the influence of microstructure on mechanical properties of metals and alloys. |
| **CO2** | Recommend appropriate testing method of materials as per international standards. |
| **CO3** | Classify different materials based on degradation mechanisms. |
| **CO4** | Identify appropriate materials for specific applications. |
| **CO5** | Select the advanced materials for various aerospace and aircraft applications. |
| **CO6** | Develop new material combinations based on requirement. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 3 | 24 |  |  |  | 29 |
| **CO2** | 24 | 1 | 4 |  |  |  | 29 |
| **CO3** | 4 | 13 | 0 |  |  |  | 17 |
| **CO4** | 3 | 12 | 2 |  |  |  | 17 |
| **CO5** | 0 | 4 | 12 |  |  |  | 16 |
| **CO6** | 1 | 3 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

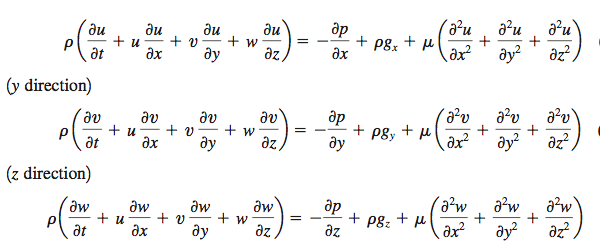
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| --- | --- | --- | --- |
| Course Code | 23AE2046 | Duration | 3hrs |
| Course Title | BOUNDARY LAYER THEORY | Max. Marks | 100 |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | | **Questions** | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | | Sketch the hydrodynamic and thermal boundary layers for steady incompressible laminar flow of a constant property fluid over a thin flat plate, showing the relative size for *Pr <* 1*, Pr =*1and *Pr >* 1. | CO3 | A | 1 |
| 2. | | Comment on the velocity profiles in laminar and turbulent hydrodynamic boundary layers for steady incompressible laminar flow of a constant property fluid over a thin flat plate, **with a sketch showing shape and relative sizes** | CO3 | U | 1 |
| 3. | | Compare the relative sizes of the thermal and hydrodynamic boundary layer in natural convection | CO3 | U | 1 |
| 4. | | State the Laminar to Turbulent Transition Reynolds number for internal flow and external flow | CO1 | R | 1 |
| 5. | | Specify the type of flow that can be analyzed by the Euler momentum equations | CO1 | U | 1 |
| 6. | | State the two main observations by Prandtl based on which the boundary layer equations are developed | CO4 | R | 1 |
| 7. | | Express in one sentence, the meaning of hydrodynamically fully developed flow | CO6 | U | 1 |
| 8. | | Differentiate the Darcy-Weisbach friction factor from the Fanning friction coefficient | CO6 | U | 1 |
| 9. | | State the non dimensional numbers that are analogous to each other in hydrodynamic, thermal and concentration boundary layers | CO3 | R | 1 |
| 10. | | A liquid metal to water heat exchanger used in a nuclear reactor has liquid sodium flowing through the tubes. For analyzing the flow in the tubes, assess the treatment of the flow, with regard to the state of development of the thermal and hydrodynamic boundary layers. | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the principle of similarity of hydrodynamic boundary layer profiles at various locations along the length of a flat plate exposed to a uniform flow, from a physical viewpoint, and explain briefly how it helps in solving the boundary layer equations. | | CO4 | E | 3 |
|  |  | |  |  |  |
| 12. | After order of magnitude analysis on the y momentum equation (y being the direction perpendicular to the main flow, and the only body force is gravity in the negative y direction) we obtain . Evaluate how this helps in analyzing the x-momentum equation and therefore the entire flow field. | | CO4 | E | 3 |
|  |  | |  |  |  |
| 13 | Define the stress tensor and the definition of pressure and explain the appropriateness of the definition. | | CO1 | U | 3 |
|  |  | |  |  |  |
| 14. | Briefly explain the appropriateness and physical significance of the diagonal components of the symmetric component of the gradient tensor. | | CO1 | U | 3 |
|  |  | |  |  |  |
| 15. | A Newtonian fluid having a specific gravity of 0.92 and a kinematic viscosity of 5 x 10-4*m2/s* flows past a flat plate. The velocity profile is given by . The boundary layer thickness is given by , where is the local Reynolds number and *x* is the distance along the plate. (1) Express the skin friction coefficient as a function of *Rex*. (2) Calculate the shear stress at the plate surface at a point where the boundary layer thickness, ** is 1 *mm* and free stream velocity *U=10 m/s.*. | | CO3 | A | 3 |
|  |  | |  |  |  |
| 16. | Comment on the advantages of the Karman-Pohlhausen momentum integral method in solving the Navier Stokes equations, compared to Blasius solution? | | CO5 | U | 3 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | |
| 17. | A plate of 0.4*m* widthand length 2*m (length dimension in the direction of flow)* is exposed to an atmospheric airstream having a velocity of *u∞ =* 40 *m/s.* The air is at a temperature of *T∞ =* 20*oC* while there is sufficient supply to the plate to maintain a surface temperature of *Ts =* 120*oC*. The plate experiences a drag force of 0.75 *N*. Calculate the rate of heat transfer from the plate? Assume that the viscous drag is uniformly distributed over the entire surface of the plate | | CO3 | An | 12 |
|  |  | |  |  |  |
| 18. | With a neat sketch write a note on boundary layer separation and list few methods to control it? | | CO5 | U | 12 |
|  |  | |  |  |  |
| 19. | Two immiscible, incompressible, viscous fluids having the same density but different viscosities are contained between two horizontal infinite parallel plates at a distance *2h* between them as shown. The bottom plate is fixed and the upper plate moves with a constant velocity *U*. Use the Navier Stokes equations to determine the velocity at the interface. Express your answer in terms of *U*, *1* and *2*. The pressure gradient in the *x* direction is zero and the only body force is due to the fluid weight and the motion of the fluid is caused entirely by the movement of the upper plate. | | CO2 | A | 12 |
|  |  | |  |  |  |
| 20. | Determine a fourth order velocity profile for the hydrodynamic boundary layer on a flat plate with appropriate boundary conditions. | | CO5 | A | 12 |
|  |  | |  |  |  |
| 21. | Determine a cubic temperature profile for the thermal boundary layer on a flat plate ( no viscous dissipation) with appropriate boundary conditions. | | CO5 | A | 12 |
|  |  | |  |  |  |
| 22. | For steady, incompressible, inviscid, laminar, axisymmetric flow without viscous dissipation in a pipe,  (a) Describe in detail, the qualitative differences between hydrodynamic and thermal boundary layers.  (b) Derive an expression for the variation of mean temperature for constant wall heat flux boundary conditions.  b) Sketch the variation of wall temperature and mean temperature for constant wall heat flux and constant wall temperature boundary conditions and briefly explain the reason for the nature of the variation. | | CO6 | E | 12 |
|  |  | |  |  |  |
| 23. | Consider the steady, laminar flow of an incompressible fluid past a flat plate. The boundary layer velocity profile is approximated as for and for . Determine the hydrodynamic boundary layer thickness and the shear stress and skin friction coefficient using the Integral Momentum Boundary Layer equation, in terms of the local Reynolds number. Start from the Karman Pohlhausen Integral Equation and definition of Momentum Thickness for the given conditions | | CO5 | An | 12 |
| **COMPULSORY:** | | | | | |
| 24. | Consider the steady, laminar flow of an incompressible fluid past a flat plate. Determine the thermal boundary layer thickness and the surface heat flux and the Nusselt number using the Integral Boundary Layer equation, in terms of the local Reynolds number and Prandtl No, for *Pr* > 1. Assume a cubic temperature profile in the thermal boundary layer and a linear velocity profile in the momentum boundary layer. | CO5 | | An | 12 |

Some useful information required

**Properties Required –Density of air = 1.16 kg/m3, Pr for air = 0.7, Cp of air = 1.005 kJ/(kg/K), Conductivity of air = 26.3 x 10-3 W/(mK), Thermal Diffusivity = 22.5 x 10-6m2/s**, **Dynamic Viscosity of air = 184.6 x 10-7N.s/m2**



For a thin flat plate

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
| **CO1** | Apply basic conservation laws and comprehend the various principles in mechanics and mathematics used in the derivation of the Navier-Stokes Equations |
| **CO2** | Solve problems for which exact solutions of the Navier-Stokes equations exist |
| **CO3** | Comprehend the relationship between different boundary layer transport phenomena |
| **CO4** | Solve the boundary layer equations of flat plate by similarity variable method |
| **CO5** | Solve the boundary layer equations by the approximate integral method over bluff bodies and flat plate |
| **CO6** | Analyze hydrodynamic and thermal boundary layers of internal flows for various boundary conditions |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 7 |  |  |  |  | **8** |
| CO2 |  |  | 12 |  |  |  | **12** |
| CO3 | 1 | 2 | 4 | 12 |  |  | **19** |
| CO4 | 1 |  |  |  | 6 |  | **7** |
| CO5 |  | 15 | 24 | 24 |  |  | **63** |
| CO6 |  | 3 |  |  | 12 |  | **15** |
| **Total** | **3** | **27** | **40** | **36** | **18** |  | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

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| --- | --- | --- | --- |
| **Course Code** | **23AE2060** | **Duration** | **3hrs** |
| **Course Title** | **BASICS OF AEROSPACE ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the significance of hot air balloons in the history of aviation. | | CO1 | U | 1 |
| 2. | Name four important components of an aircraft. | | CO1 | R | 1 |
| 3. | State the primary function of the main wing in an aircraft. | | CO2 | U | 1 |
| 4. | Draw the 5 series NACA airfoil. | | CO2 | U | 1 |
| 5. | Name two composite materials used for aircraft construction. | | CO3 | R | 1 |
| 6. | Define a composite material. | | CO3 | R | 1 |
| 7. | Name two types of propellants used in rocket engine. | | CO4 | R | 1 |
| 8. | Define an air breathing engine. | | CO4 | U | 1 |
| 9. | Name the Indian agency involved in space research. | | CO5 | R | 1 |
| 10. | Define the payloads in an Unmanned Aircraft System. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the developments in aircraft propulsion systems over the years. | | CO1 | A | 3 |
| 12. | Describe how pressure and temperature vary with altitude in the standard atmosphere. | | CO2 | U | 3 |
| 13. | Distinguish between metallic and non-metallic materials. | | CO3 | U | 3 |
| 14. | Explain the working principle of a rocket engine. | | CO4 | A | 3 |
| 15. | Explain the role of launch vehicles in space exploration. | | CO5 | A | 3 |
| 16. | Explain the role of autopilot systems in drones, and how do they enhance flight operations. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the classification of flight vehicles based on their design and purpose. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe the nomenclature and classification system of NACA airfoils and explain the significance of each digit in the NACA 4-digit series. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the structure and function of wing and fuselage construction, with neat sketches. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the different types of materials used in aerospace engineering and their application in the design of aircraft and spacecraft. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the operating principle of Air Breathing engines used in aircraft, with a neat sketch. Also describe the different types of jet engines and their applications. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain our solar system including the Sun, the planets, and the Moon with a neat sketch | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the different parts of an Unmanned aircraft system and also analyze the societal applications of drones. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the principle of operation of rockets with a neat sketch and describe the different types of rockets with their applications. | CO4 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the evolution of aircrafts and flying vehicles. |
| **CO2** | Explain the parts and functions of aircrafts. |
| **CO3** | Obtain knowledge on principles of flight. |
| **CO4** | Identify structures and materials used in Aerospace applications. |
| **CO5** | Explain the principles of aircraft and rocket propulsion. |
| **CO6** | Obtain knowledge on the components and function of Multicopter drones. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 13 | 3 | - |  |  | 17 |
| **CO2** | - | 5 | 12 | - | - | - | 17 |
| **CO3** | 2 | 3 | 12 | 12 | - | - | 29 |
| **CO4** | 1 | 1 | 15 | 12 | - | - | 29 |
| **CO5** | 1 | - | 3 | 12 | - | - | 16 |
| **CO6** | - | 1 | 3 | 12 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – NOV / DEC 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **24AE3001** | **Duration** | **3hrs** |
| **Course Title** | **AUTONOMOUS NAVIGATION AND FLIGHT CONTROL IN UAV** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the software associated with the drone and its operation. Classify it into open-source and commercial versions with their pros and cons. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | List six flight controllers for various categories of drones as per the DGCA Drone Rule 2021. Explain the necessary flight modes to meet DGCA requirements and specify any application-specific flight modes. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | List the mandatory sensors for drones. Explain the mandatory sensor calibration process for rotorcraft and airplane-category drones. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain the application of the Kalman filter and Extended Kalman filter in drones. Specify the segment where EKF is used and its importance. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | How to extract attitude data from the data flash log (.bin file) and explain how to plot and analyze it? | CO4 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | What attitude, terrain, location, and IMU data are embedded in the data flash log? How effectively can it be used for drone testing? | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Define the requirements for executing an autonomous mission and explain how to test the autonomous flight of a simple quadcopter. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the procedure to execute an AUTO mission using QGCS and Mission Planner. Highlight the differences between the two. | CO5 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Consider a drone that crashed by hitting an obstacle in the field. Explain the troubleshooting procedure and evaluate the variables used to identify the cause of the problem. | CO6 | E | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Identify and describe various UAV software platforms (e.g., ArduPilot, PX4) and their basic setup and configuration. |
| CO2 | Configure and operate different flight modes (manual, auto, semi-autonomous, and autonomous) for rotorcraft, aeroplanes and hybrid VTOLs using relevant UAV software. |
| CO3 | Analyze the performance of inertial measurement unit (IMU) sensors and implement sensor fusion algorithms (e.g., Kalman filter) for accurate attitude estimation under various motion conditions. |
| CO4 | Integrate and calibrate altitude sensors (barometer, ultrasonic sensor) with UAV systems to implement and test altitude control algorithms for terrain following and obstacle avoidance. |
| CO5 | Evaluate the effectiveness of autonomous navigation and waypoint systems, including the use of ground control stations, telemetry, and radar communication systems for UAV operations. |
| CO6 | Design, implement, and test fault detection algorithms and recovery strategies to ensure UAV operational safety in the presence of sensor failures and anomalies. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | - | - | - | - | 20 |
| CO2 | - | 20 | - | - | - | - | 20 |
| CO3 | - | - | 20 | - | - | - | 20 |
| CO4 | - | 40 | 20 | - | - | - | 60 |
| CO5 | - | 20 | 20 | - | - | - | 40 |
| CO6 | - | - | - | - | 20 | - | 20 |
|  | | | | | | | **180** |