**Graphical user interface, application

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| **Course Code** | **14AE2030 / 18AE2045** | **Duration** | **3hrs** |
| **Course Name** | **BASICS OF AEROSPACE ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | Who is referred to as the father of aerial navigation? | | | CO1 | R | | 1 |
| 2. | The first human to be photographed in a flight was \_\_\_\_\_\_\_\_\_. | | | CO1 | R | | 1 |
| 3. | Name the three principal motion associated with an aircraft while flying. | | | CO2 | R | | 1 |
| 4. | Write the use of Slats and Flaps on a wing. | | | CO2 | R | | 1 |
| 5. | The 3 predominant types of fuselage structure are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | | CO3 | R | | 1 |
| 6. | Empennage is a term used to denote the \_\_\_\_\_\_\_\_\_\_\_\_\_ portion of an aircraft | | | CO3 | R | | 1 |
| 7. | \_\_\_\_\_\_\_\_ alloy is generally used in hypersonic aircraft structures. | | | CO4 | R | | 1 |
| 8. | Gas turbines engine work on \_\_\_\_\_\_\_\_\_\_\_ cycle. | | | CO4 | R | | 1 |
| 9. | TSFC stands for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | | CO5 | R | | 1 |
| 10. | Newton’s \_\_\_\_\_\_\_\_\_\_\_ law is applied in generation of thrust in jet engines. | | | CO5 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Explain the features of aerial steam carriage. | | | CO1 | | R | 3 |
| 12. | State the use of Whirling arm apparatus. | | | CO2 | | U | 3 |
| 13. | Explain how lift is generated in an aero foil based on equal transit theory. | | | CO3 | | U | 3 |
| 14. | Explain 3 instruments used in the aircrafts to measure the performance of engine parameters. | | | CO4 | | R | 3 |
| 15. | Draw the 4 basic forces acting on an aircraft. | | | CO5 | | U | 3 |
| 16. | Why is the efficiency of a turbojet engine less than a propeller engine? | | | 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. | |  | Elucidate the contributions of Sir George Cayley to the development of Aeronautics. | CO1 | | R | 12 |
|  | |  |  |  | |  |  |
| 18. | |  | Explain the function and working of basic flight instruments used in aircrafts. | CO2 | | R | 12 |
|  | |  |  |  | |  |  |
| 19. | |  | Explain the principal axes of an aircraft and its related maneuvers with a neat sketch. | CO3 | | U | 12 |
|  | |  |  |  | |  |  |
| 20. | |  | Explain the different fuselage types with its merits and demerits. | CO3 | | R | 12 |
|  | |  |  |  | |  |  |
| 21. | |  | Explain the use of metallic materials used for the construction of aircraft structures over the years. | CO4 | | U | 12 |
|  | |  |  |  | |  |  |
| 22. | |  | Explain the working, types and disadvantages of a solidpropellant rocket engine? | CO5 | | U | 12 |
|  | |  |  |  | |  |  |
| 23. | |  | Explain the working of a turbofan engine with a neat sketch. | CO6 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | |  | Draw the outline of a typical aircraft and detail its parts and functions. | CO2 | | U | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the evolution of aircrafts and flying vehicles. |
| CO2 | Understand the parts and function of aircrafts. |
| CO3 | Obtain knowledge on principles of flight. |
| CO4 | Understand the fundamentals of structures and materials used. |
| CO5 | Understand the principles of aircraft and rocket propulsion. |
| CO6 | Obtain knowledge on the engines used in aircraft propulsion. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 17 | - | - | - | - | - | 17 |
| CO2 | 14 | 15 | - | - | - | - | 29 |
| CO3 | 14 | 15 | - | - | - | - | 29 |
| CO4 | 5 | 12 | - | - | - | - | 17 |
| CO5 | 2 | 15 | - | - | - | - | 17 |
| CO6 | - | 15 | - | - | - | - | 15 |
|  | | | | | | | **124** |

**Graphical user interface, application

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| **Course Code** | **17AE2006** | **Duration** | **3hrs** |
| **Course Name** | **AIRCRAFT INSTRUMENTATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | One form of energy is converted into another form in a \_\_\_\_\_\_\_\_\_ system. | | CO1 | R | | 1 |
| 2. | Measurand refer to \_\_\_\_\_\_ variable. | | CO2 | U | | 1 |
| 3. | Loudspeaker is an example of a \_\_\_\_\_\_. | | CO3 | U | | 1 |
| 4. | \_\_\_\_\_\_is measured by accelerometer. | | CO3 | R | | 1 |
| 5. | Gyroscope is used to measure\_\_\_\_\_\_ velocity. | | CO4 | U | | 1 |
| 6. | Altimeter is an example of \_\_\_\_\_\_ instruments. | | CO4 | U | | 1 |
| 7. | Thermoelectric thermometer also known as \_\_\_\_\_\_. | | CO5 | R | | 1 |
| 8. | \_\_\_\_\_\_is measured by bellows tube gauge. | | CO5 | R | | 1 |
| 9. | Speed is expressed in \_\_\_\_\_\_. | | CO6 | U | | 1 |
| 10. | \_\_\_\_\_\_is the S.I. unit of torque. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Define calibration. | | CO1 | | R | 3 |
| 12. | Classify the measurement errors. | | CO2 | | U | 3 |
| 13. | Explain the need for instrumentation in aircraft. | | CO3 | | R | 3 |
| 14. | List some aircraft instruments. | | CO4 | | R | 3 |
| 15. | Identify the sensors used to measure temperature. | | CO5 | | U | 3 |
| 16. | Enumerate the advantages of pressure switches. | | 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. |  | List the various elements of a generalized measurement system and explain with the aid of a neat schematic. | CO1 | | R | 12 |
|  |  |  |  | |  |  |
| 18. |  | Explain the construction and working principle of a recorder, indicator and integrator. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 19. |  | Summarize the salient features of the cockpit instruments used in civil and military aircraft system. | CO3 | | U | 12 |
|  |  |  |  | |  |  |
| 20. |  | Describe the construction and working of heading instruments employed in aircrafts. | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 21. |  | Enumerate any two types of pressure measuring devices for aircraft applications. | CO5 | | R | 12 |
|  |  |  |  | |  |  |
| 22. |  | Examine the construction of a rotating vane type indicator. List out its merits and demerits. | CO6 | | A | 12 |
|  |  |  |  | |  |  |
| 23. |  | Illustrate any two types of fuel flow rate measuring devices used in an aircraft and explain their advantages and disadvantages. | CO6 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Sketch any two types of airdata instruments and articulate about them. | CO4 | | A | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the basics of measurements and different parameters. |
| CO2 | Appreciate the need for general measurements in aviation industry. |
| CO3 | Identify the fundamental cockpit instruments and their working principles. |
| CO4 | Select proper instrumentation requirements for aerospace vehicles. |
| CO5 | Differentiate various sensors and transducers used in aerospace vehicles. |
| CO6 | Apprehend the principles behind temperature, pressure, fuel flow and engine measurements. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 16 | - | - | - | - | - | 16 |
| CO2 | - | 16 | - | - | - | - | 16 |
| CO3 | 4 | 13 | - | - | - | - | 17 |
| CO4 | 3 | 14 | 12 | - | - | - | 29 |
| CO5 | 14 | 3 | - | - | - | - | 17 |
| CO6 | 3 | 2 | 24 | - | - | - | 29 |
|  | | | | | | | **124** |

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| **Course Code** | **17AE2030/ 18AE2030** | **Duration :** | **3hrs** |
| **Course Name** | **WIND TUNNEL TECHNIQUES** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |  |
| 1. | Name the component that has converging passage upstream of the test section. | CO1 | R | 1 |
| 2. | The power to drive low speed tunnel is proportional to \_\_\_\_\_\_\_\_\_\_\_. | CO1 | R | 1 |
| 3. | The starting load is \_\_\_\_\_\_\_\_\_\_ in blowdown tunnel. | CO2 | U | 1 |
| 4. | Model is flown under \_\_\_\_\_\_\_\_\_\_\_in free flight tunnel. | CO2 | R | 1 |
| 5. | Flow is assumed to be \_\_\_\_\_\_ from downstream of normal shock to second throat. | CO3 | U | 1 |
| 6. | The most frequently used type of compressor in storage tank of blowdown wind tunnel is \_\_\_\_\_\_\_\_\_\_\_\_\_. | CO3 | U | 1 |
| 7. | Lateral moment about the longitudinal axis is \_\_\_\_\_\_\_. | CO4 | R | 1 |
| 8. | Static loads are measured by \_\_\_\_\_\_. | CO4 | R | 1 |
| 9. | LDA measures \_\_\_\_\_\_\_\_\_ at a point in flow using light beams. | CO5 | R | 1 |
| 10. | A streamline shows the direction of \_\_\_\_\_\_\_\_\_\_. | CO6 | R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | List out the demerits of open circuit wind tunnel. | CO1 | U | 3 |
| 12. | Define Froude number. | CO2 | R | 3 |
| 13. | Explain runtime. | CO3 | U | 3 |
| 14. | Explain dynamic stability rig. | CO4 | U | 3 |
| 15. | Highlight the significance of barometer. | CO5 | U | 3 |
| 16. | Distinguish between optical and non-optical visualization techniques. | CO6 | R | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is Compulsory)** | | | | | |
| 17. |  | Discuss the salient features of spin tunnel with a neat sketch. | CO1 | U | 12 |
|  |  |  |  | |  |
| 18. |  | Explain in detail the components of high speed wind tunnel. | CO2 | U | 12 |
|  |  |  |  | |  |
| 19. |  | Describe the construction of shock tube and its notable performance with neat sketches. | CO3 | U | 12 |
|  |  |  |  | |  |
| 20. |  | Explain the balances used in wind tunnel to measure force and moments. | CO4 | U | 12 |
|  |  |  |  | |  |
| 21. |  | Discuss the function of strain gauge with a neat sketch. | CO4 | U | 12 |
|  |  |  |  | |  |
| 22. |  | Explain the manometers used in wind tunnel. | CO5 | U | 12 |
|  |  |  |  | |  |
| 23. |  | Discuss the various temperature measurement devices in wind tunnel. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the features of outputs from shadowgraph technique. | CO6 | U | 12 |

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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 | Arrive the pressure, velocity and temperature using measurement techniques |
| CO6 | Choose the proper flow visualization techniques |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 15 | **-** | **-** | **-** | **-** | 17 |
| CO2 | 4 | 13 | **-** | **-** | **-** | **-** | 17 |
| CO3 | - | 17 | **-** | **-** | **-** | **-** | 17 |
| CO4 | 2 | 27 | **-** | **-** | **-** | **-** | 29 |
| CO5 | 1 | 27 | **-** | **-** | **-** | **-** | 28 |
| CO6 | 4 | 12 | **-** | **-** | **-** | **-** | 16 |
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| **Course Code** | **17AE2043** | **Duration** | **3hrs** |
| **Course Name** | **NON DESTRUCTIVE TESTING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | List the various casting defects that influence the performance of materials. | | CO1 | R | | 1 |
| 2. | Name any two NDT techniques used to detect external defects. | | CO1 | R | | 1 |
| 3. | Distinguish Visual inspection and Liquid penetrant testing. | | CO2 | U | | 1 |
| 4. | List out any two properties of a good developer. | | CO2 | A | | 1 |
| 5. | Write the limitation of Magnetic particle testing. | | CO3 | A | | 1 |
| 6. | Define the term ‘Rise time’ in Acoustic Emission Testing. | | CO3 | U | | 1 |
| 7. | Indicate the advantages of Radiography Test. | | CO4 | A | | 1 |
| 8. | State the linear location technique used in AE. | | CO5 | An | | 1 |
| 9. | Distinguish Ultrasonic and Acoustic Emission Testing. | | CO5 | E | | 1 |
| 10. | Define Thermography. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Outline the advantages and disadvantages of Visual inspection. | | CO1 | | A | 3 |
| 12. | Discuss why Magnetic Particles inspection cannot be used to detect internal defects. | | CO2 | | E | 3 |
| 13. | List out the essential properties required to increase sensitivity of the MPT test. | | CO3 | | A | 3 |
| 14. | Differentiate acoustic emission test and other NDT methods. | | CO5 | | U | 3 |
| 15. | Evaluate the influencing factors affecting Radiographic testing. | | CO5 | | E | 3 |
| 16. | Describe the advantages and limitations of Thermography test. | | 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. | Briefly inscribe the comparison between NDT and destructive test. | CO1 | | E | 6 |
|  | b. | Discuss the various optical aids used in visual inspection techniques. | CO1 | | An | 6 |
|  |  |  |  | |  |  |
| 18. |  | Explain the working of Magnetic particle testing with neat sketch and state its applications, merits and limitations. | CO2 | | U | 12 |
| 19. | a. | In detail explain the principle of Magnetic particle test procedure with neat sketch. | CO3 | | R | 8 |
|  | b. | Write down the advantages and disadvantages of MPT. | CO3 | | A | 4 |
| 20. | a. | Explain the principle of Eddy current testing with neat sketch. | CO4 | | R | 9 |
|  | b. | Discuss the various applications and limitations of Eddy current testing. | CO4 | | A | 3 |
| 21. |  | Describe with neat sketch the Radiographic techniques and its limitations. | CO5 | | U | 12 |
| 22. |  | Enumerate the working principle of Ultrasonic technique with a block diagram and state its limitations. | CO5 | | R | 12 |
| 23. | a. | Explain the principle of Acoustic Emission technique and the various parameters involved in AET. | CO5 | | U | 8 |
|  | b. | Write short notes on safety aspects related to Radiography test. | CO5 | | E | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Write the principle of Thermography test with a neat block diagram. | CO6 | | R | 8 |
|  | b. | Discuss the application of Thermography testing in Aerospace industry. | CO6 | | A | 4 |

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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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | - | 3 | 6 | 6 | - | 17 |
| CO2 | - | 13 | 1 | - | 3 | - | 17 |
| CO3 | 8 | 1 | 5 | - | - | - | 14 |
| CO4 | 9 | 1 | 6 | - | - | - | 16 |
| CO5 | 12 | 23 | - | 1 | 4 | - | 40 |
| CO6 | 8 | 1 | 7 | - | 4 | - | 20 |
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| **Course Code** | **17AE3022** | **Duration** | **3hrs** |
| **Course Name** | **ELEMENTS OF AEROSPACE ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the structure of atmosphere by dividing into different layers. | CO1 | Remember | 8 |
|  | b. | Explain how temperature, pressure, density vary with altitude with help of graph. | CO1 | Understand | 8 |
|  |  |  |  |  |  |
| 2. | a. | Explain the classification of heavier than air aircraft, with necessary diagrams. | CO2 | Understand | 8 |
|  | b. | Compare different speed types of flow used in identifying Mach number. | CO2 | Understand | 8 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the pressure distribution over an airfoil. | CO3 | Understand | 8 |
|  | b. | Explain the criteria used to decide the variation of coefficient of lift Vs angle of attack for different AR. | CO3 | Understand | 8 |
|  |  |  |  |  |  |
| 4. | a. | List the types, characteristics, uses of aluminium and its alloys. | CO4 | Remember | 8 |
|  | b. | Explain the types of fuselage structure with necessary diagrams. | CO4 | Understand | 8 |
|  |  |  |  |  |  |
| 5. | a. | Discuss the working of Auto pilot system. | CO5 | Understand | 8 |
|  | b. | Classify the basic instrumentation in aircraft and explain any one with neat sketch. | CO5 | Understand | 8 |
|  |  |  |  |  |  |
| 6. | a. | Illustrate the airfoil terminology and types of camber with neat sketch. | CO3 | Understand | 8 |
|  | b. | Discover the characteristics of an airfoil, when subjected to different angle of attacks. | CO3 | Understand | 8 |
|  |  |  |  |  |  |
| 7. | a. | State the advantage and disadvantage of liquid propellant rocket. | CO6 | Remember | 8 |
|  | b. | Classify the merits and limitations of piston engine. | CO6 | Understand | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Describe the challenges of space exploration. | CO6 | Understand | 10 |
|  | b. | With neat illustrations, explain in detail the working of a turbojet engine. | CO6 | Understand | 10 |

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|  | **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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 8 | 8 |  |  |  |  | 16 |
| CO2 |  | 16 |  |  |  |  | 16 |
| CO3 |  | 32 |  |  |  |  | 32 |
| CO4 | 8 | 8 |  |  |  |  | 16 |
| CO5 |  | 16 |  |  |  |  | 16 |
| CO6 | 8 | 28 |  |  |  |  | 36 |
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**Graphical user interface, application

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| **Course Code** | **18AE2011** | **Duration** | **3hrs** |
| **Course Name** | **PROPULSION - I** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Pattern** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | State the various types of power plant. | CO1 | R | 1 |
| 2. | Define ram pressure. | CO1 | R | 1 |
| 3. | State the advantages of free turbine. | CO2 | R | 1 |
| 4. | State the advantage of gas turbine engine over piston engine. | CO2 | R | 1 |
| 5. | List at least two functions of a convergent nozzle. | CO3 | R | 1 |
| 6. | State the factors to be considered in the selection of materials for turbine blades. | CO4 | R | 1 |
| 7. | Draw the velocity diagram of turbine blade. | CO4 | R | 1 |
| 8. | Mention the function of liners in combustion chamber. | CO5 | R | 1 |
| 9. | Define auto ignition temperature. | CO5 | R | 1 |
| 10. | List the assumptions made in matching of components. | CO6 | R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Recall how air breathing engines are classified. | CO1 | R | 3 |
| 12. | Mention the influence of pressure thrust on the overall thrust of an aircraft. | CO2 | R | 3 |
| 13. | State the secondary function of the compressor in a jet engine. | CO4 | R | 3 |
| 14. | With the help of neat sketches, explain the variation of pressure and velocity in an axial compressor. | CO4 | U | 3 |
| 15. | Mention the purpose of stator, rotor, shroud and case of an axial flow turbine. | CO4 | R | 3 |
| 16. | Mention the various requirements of combustion chamber for a gas turbine engine. | CO5 | R | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. |  | Write a short note on   1. Operating envelope. 2. Standard atmosphere. 3. Working cycle of gas turbine engine. | CO1 | U | 4  4  4 |
|  |  |  |  |  |  |
| 18. | a. | With a neat sketch explain the working principle of a turbo jet engine. | CO2 | U | 8 |
|  | b. | State the merits and demerits of turbojet engine over ramjet engine. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | List the requirements of a good atomizer. | CO3 | R | 6 |
|  | b. | With the help of a neat sketch explain the breakup mechanism for a swirl injector. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | A centrifugal compressor has a pressure ratio of 4:1 with an isentropic efficiency of 80% when running at 15000rpm and inducing air at 293 k. Curved vanes at inlet give the air a prewhirl of 25° to axial direction at all radii and the mean dia of eye is 250 mm. The absolute air velocity at inlet is 150 m/s. Impeller tip dia is 600 mm. calculate the slip factor. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Discuss the behavior of turboprop engine for fuel flow rate as function of true air speed with the help of a neat sketch. | CO1 | A | 8 |
| b. | Mention the advantage and disadvantage of a turboprop engine. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | State the requirements of a good after burner. | CO5 | R | 4 |
| b. | Explain the working principle of an afterburner with neat sketch. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 23. |  | Air at a temperature of 273 K enters a ten stage axial flow compressor at the rate of 7 kg/s. The pressure ratio is 6.5 and the isentropic efficiency is 92%, the compression process being adiabatic. The compressor has symmetrical blades. The axial velocity of 110 m/s is uniform across the stage and the mean blade speed of each stage is 190 m/s. Determine the direction of the air at the entry to the exit from the rotor and the stator blades and also the power given to the air. Assume Cp = 1.005 kJ/kg K and ϒ= 1.4. | CO6 | A | 12 |
|  |  | **Compulsory:** | | | |
| 24. | a. | Discuss in details the need for turbine blade cooling. | CO5 | A | 4 |
| b. | Describe the matching procedure for a turbofan engine. | CO5 | A | 8 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the performance of air breathing engines. |
| CO2 | Analyse the performance of different propulsion cycles. |
| CO3 | Understand the working of sub-systems of the propulsion system. |
| CO4 | Assess the performance of compressor and turbine. |
| CO5 | Evaluate the performance of combustion chamber, cooling and afterburner. |
| CO6 | Find the causes of under-performance and remedial measures. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 16 | 8 |  |  |  | 29 |
| CO2 | 5 | 12 |  |  |  |  | 17 |
| CO3 | 7 | 6 |  |  |  |  | 13 |
| CO4 | 8 | 3 |  | 12 |  |  | 23 |
| CO5 | 9 | 8 | 12 |  |  |  | 29 |
| CO6 | 1 | - | 12 | -- | - | - | 13 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **18AE2014/14AE2021/17AE2016** | **Duration** | **3hrs** |
| **Course Name** | **GAS DYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |  | |
| 1. | Isentropic flow contains \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_. | CO1 | R | | 1 |
| 2. | Estimate the speed of sound wave in air at 20°C and 1 atm. | CO1 | U | | 1 |
| 3. | A pitot probe facing a supersonic flow measures the \_\_\_\_\_\_\_\_\_ behind a normal shock. | CO2 | R | | 1 |
| 4. | The converging nozzle can produce \_\_\_\_\_\_\_\_\_ flow. | CO2 | U | | 1 |
| 5. | Static pressure ratio across the normal shock is given by \_\_\_\_\_\_\_\_\_. | CO3 | R | | 1 |
| 6. | Shock polar is a \_\_\_\_\_\_\_\_\_ at M\*=2.45. | CO3 | R | | 1 |
| 7. | Wing sweep beneficial in that it decreases drag-divergences Mach number. (True/ False) | CO4 | U | | 1 |
| 8. | Perturbation theory is valid for \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_ flows. | CO4 | R | | 1 |
| 9. | High-speed wings usually design with \_\_\_\_\_\_\_\_\_airfoils. | CO5 | R | | 1 |
| 10. | Indraft wind tunnels do not use \_\_\_\_\_\_\_\_\_\_ chamber. | CO6 | R | | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Estimate the stagnation temperature and stagnation pressure of air that is flowing at 44 kPa, 245.9 K, and 470 m/s. | CO1 | U | 3 |
| 12. | Explain choking condition in a nozzle. | CO2 | U | 3 |
| 13. | List out the changes across an expansion wave. | CO3 | R | 3 |
| 14. | At a given point on the surface of an airfoil, the pressure co-efficient is -0.3 at very low speeds. If the free stream Mach number is 0.6, find the Cp at this point. | CO4 | R | 3 |
| 15. | Sketch fanno curve. | CO5 | R | 3 |
| 16. | Name the non-optical methods of flow visualization. | CO6 | R | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | **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 steps to obtain the expression of speed of sound. | CO1 | U | 12 | |
|  |  |  |  |  |  | |
| 18. |  | Air flows isentropically through a convergent –divergent nozzle of inlet area 12 cm² at a rate of 0.7 kg/s. The conditions at the inlet and exit of the nozzle are 8 kg/m3 and 400K and 4 kg/m3 and 300K respectively.Estimate the cross-sectional area, pressure and Mach number at the nozzle exit. | CO2 | U | 12 | |
|  |  |  |  |  |  | |
| 19. | a. | Explain the salient features of expansion hodograph. | CO3 | U | 8 | |
|  | b. | Discuss Prandtl relation for normal shock. | CO3 | U | 4 | |
|  |  |  |  |  |  | |
| 20. |  | Explain about the performance of C-D nozzle for various pressure ratios. | CO3 | U | 12 | |
|  |  |  |  |  |  | |
| 21. |  | Explain the Prandtl-Glauert transformation for subsonic flow with a suitable example. | CO4 | U | 12 | |
|  |  |  |  |  |  | |
| 22. |  | Discuss the following   1. Swept back wing. 2. Tip effect. | CO4 | U | 6  6 | |
|  |  |  |  |  |  | |
| 23. |  | Explain the notable flow conditions of rayleigh flow. | CO5 | U | 12 | |
|  |  | **COMPULSORY QUESTION** | | | | | | **COMPULSORY:** |
| 24. |  | Illustrate the working principle of schileren technique with a neat sketch. | CO6 | R | 12 | |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the influence of compressibility to distinguish between the flow regime. |
| CO2 | Apply compressibility corrections for flow in C-D passages and instrument like Pitot static tube. |
| CO3 | Estimate the sudden changes in the flow field. |
| CO4 | Analyse the compressible flow field over an airfoil and finite wings. |
| CO5 | Estimate the influence of friction and heat transfer in the flow field. |
| CO6 | Choose proper flow visualisation techniques for the given situation. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 16 | - | - | - | - | 17 |
| CO2 | 1 | 16 | - | - | - | - | 17 |
| CO3 | 5 | 24 | - | - | - | - | 29 |
| CO4 | 4 | 25 | - | - | - | - | 29 |
| CO5 | 4 | 12 | - | - | - | - | 16 |
| CO6 | 4 | 12 | - | - | - | - | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Define thrust coefficient. | | | CO1 | R | 1 |
| 2. | State the advantages of multi-staging in rocket. | | | CO1 | R | 1 |
| 3. | Mention the purpose of thrust vectoring in rocket engines. | | | CO2 | R | 1 |
| 4. | Briefly describe radial outflow nozzle. | | | CO2 | U | 1 |
| 5. | Define velocity correction factor. | | | CO3 | R | 1 |
| 6. | Draw the schematic diagram of solid rocket motor. | | | CO3 | R | 1 |
| 7. | Illustrate the various method to control the thurst in liquid rocket motor. | | | CO4 | U | 1 |
| 8. | List the requirement of a good atomizer. | | | CO5 | R | 1 |
| 9. | Mention the need for gel propellants. | | | CO5 | U | 1 |
| 10. | State the reason for the azimuthal swirl of gas injected near base of cathode in the arc jet thruster. | | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | List the various propellant used in hypergolic engine. | | | CO1 | R | 3 |
| 12. | Write short note on the performance of subsonic intake based on  a. High Speed low mass flow b. Low speed high mass flow | | | CO2 | U | 3 |
| 13. | Group the following based on the propellant combination  1. Double base a. P,Al,polybutadieneacrylicacid  acrylonitrile  2. Composite propellant b. NC,NG  3. Composite propellant PBAN c. AP,Al,HTPB | | | CO3 | A | 3 |
| 14. | List any six criteria for selection of liquid propellants. | | | CO4 | R | 3 |
| 15. | Mention the influence of spray angle, Weber number and Reynolds number on injector’s performance. | | | CO5 | An | 3 |
| 16. | Differentiate photon sail and electrical propulsion. | | | 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 rocket projectile has the following characteristics:  Initial mass 200 kg  Mass after rocket operation 130 kg  Payload, non-propulsive structure, etc. 110 kg  Rocket operating duration 3.0 sec  Average specific impulse of propellant 240 sec  Determine the propellant flow rate, thrust, thrust-to-weight ratio, acceleration of vehicle, effective exhaust velocity, total impulse, and the impulse-to-weight ratio. | CO1 | An | 12 |
|  | |  |  |  |  |  |
| 18. | |  | Discuss the various modes of inlet operation for supersonic nozzle.  a. Subcritical b. Critical c. Supercritical | CO2 | An | 4  4  4 |
|  | |  |  |  |  |  |
| 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 | | a. | Explain the process of heat transfer in the combustion chamber of a liquid rocket engine. | CO4 | U | 4 |
|  | | b. | Explain the regenerative cooling and transpiration cooling with neat sketch. | CO4 | U | 8 |
|  | |  |  |  |  |  |
| 21. | |  | Explain the working principle of hybrid rocket motor and also mention the hazards associated with hybrids rocket motors. | CO5 | A | 12 |
|  | |  |  |  |  |  |
| 22. | | a. | Draw the schematic diagram of turbo-pump feed system with fuel rich stage combustion. | CO4 | An | 4 |
|  | | b. | Explain the fuel rich stage combustion and mention their advantages over pressure feed system. | CO4 | A | 8 |
|  | |  |  |  |  |  |
| 23. | |  | For an ideal rocket with a characteristic velocity c\* of 1220 m/sec, a mass flow rate of 73.0 kg/sec, a thrust coefficient of 1.50, and a nozzle throat area of 0.0248 m2, compute the effective exhaust velocity, the thrust, the chamber pressure, and the specific impulse. | CO1 | An | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | | a. | Write down the function of inlet and isolators in the scramjet engine. | CO6 | R | 4 |
|  | | b. | Explain supersonic combustion with neat sketch. | CO6 | U | 8 |

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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 engine. |
| 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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 |  |  | 24 |  |  | 29 |
| CO2 | 1 | 4 |  | 12 |  |  | 17 |
| CO3 | 2 |  | 15 | - |  |  | 17 |
| CO4 | 3 | 13 | 8 | 4 |  |  | 28 |
| CO5 | 1 | 1 | 12 | 3 |  |  | 17 |
| CO6 | 4 | 12 |  | - |  |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

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| --- | --- | --- | --- |
| **Course Code** | **18AE2019/17AE2020** | **Duration** | **3hrs** |
| **Course Name** | **AIRCRAFT STABILITY AND CONTROL** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | State the condition for static stability of an aircraft. | | CO1 | R | | 1 |
| 2. | Explain longitudinal stability of an aircraft. | | CO1 | U | | 1 |
| 3. | During a flight due to passenger’s movement the CG of airplane moves away from neutral point, due to this the elevator angle required to trim the airplane will \_\_\_\_\_\_\_\_\_ (increase/ decrease) | | CO2 | R | | 1 |
| 4. | For an aircraft, the value of pitching moment coefficient (Cmα) is zero. Comment on its stability. | | CO2 | R | | 1 |
| 5. | Stability about yawing axis is called as \_\_\_\_\_\_\_\_\_\_. | | CO3 | R | | 1 |
| 6. | Indicate the sign of dCm∕dCL for statically stable aircraft. | | CO3 | R | | 1 |
| 7. | Explain the effect of dihedral on stability, | | CO4 | U | | 1 |
| 8. | Indicate three kinds of static stability of an aircraft. | | CO4 | R | | 1 |
| 9. | Stick fixed and stick free are similar. (True/ False) | | CO5 | R | | 1 |
| 10. | Dynamic stability is a time dependent criterion. (True/ False) | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Explain about the degrees of freedom of a system. | | CO1 | | Ap | 3 |
| 12. | Differentiate Stick fixed and Stick free longitudinal stability. | | CO2 | | U | 3 |
| 13. | Explain rudder lock. | | CO3 | | Ap | 3 |
| 14. | Distinguish between aerodynamic balancing and mass balancing. | | CO4 | | U | 3 |
| 15. | The contribution of horizontal tail to pitching moment coefficient with respect to centre of gravity of an air vehicle is given by , where α is an angle of attack of air vehicle. State whether the aircraft is longitudinally stable/ unstable. | | CO5 | | Ap | 3 |
| 16. | List the functions of trim tab. | | 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. |  | Derive an expression for the wing contribution to the pitching moment of an aircraft about center of gravity. | CO1 | | A | 12 |
| 18. |  | Derive the required Rudder angle for Equilibrium condition. | CO2 | | A | 12 |
| 19. |  | Derive the Equation of motion for dynamic longitudinal stability. | CO3 | | A | 12 |
| 20. |  | A light airplane has a wing of rectangular plan form 12.8 m span,  2.14 m chord and CLmax of 1.5. The wing loading is 850 N/m2. The airplane is rolled through 450 in one second when flying at three times its stalling speed. Estimate the rolling moment created by the ailerons assuming steady motion. | CO4 | | A | 12 |
| 21. |  | Discuss in detail the contribution of various components of the airplane on static directional stability. | CO3 | | A | 12 |
| 22. |  | For an airplane the pitching moment co-efficient is given by the following expression when c.g. lies at 0.25 c.  Cmcg = 0.05 - 0.10CL - 0.01δe where δe is in degrees.  Answer the following:   1. Is the airplane statically stable? Justify. 2. What is the static margin in this case? 3. What is the location of neutral point stick fixed? 4. What is the value of CL for which equilibrium is achieved with zero elevator deflection? 5. What is the value of elevator effectiveness (Cmδ)? 6. If the elevator deflection is limited to ± 250, locate the most forward c.g.   location for which trim is obtained at CL=1.5 | CO4 | | A | 12 |
| 23. |  | Derive the neutral point equation for stick free longitudinal stability. | CO5 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Discuss in detail the phenomena of autorotation and spin and explain how the pilot can recover from that situation. | CO6 | | A | 10 |
|  | b. | Explain the stability derivatives in longitudinal dynamics. | CO6 | | A | 2 |

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|  | **COURSE OUTCOMES** | | | | | | | |
| CO1 | Understand the degree of freedom of aircraft system. | | | | | | | |
| CO2 | Analyse the static stability behaviour of the aircraft. | | | | | | | |
| CO3 | Understand the dynamic longitudinal stability of aircraft. | | | | | | | |
| CO4 | Perform the dynamic analysis to determine stability of aircraft. | | | | | | | |
| CO5 | Estimate the requirement of control force and power plant. | | | | | | | |
| CO6 | Assess the motion of unstable aircraft and related modes of instability. | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | | |
| CO / P | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | | 1 | 1 | 15 |  |  |  | 17 |
| CO2 | | 2 | 3 | 12 |  |  |  | 17 |
| CO3 | | 2 |  | 27 |  |  |  | 29 |
| CO4 | | 1 | 4 | 24 |  |  |  | 29 |
| CO5 | | 1 |  | 15 |  |  |  | 16 |
| CO6 | | 1 | 3 | 12 |  |  |  | 16 |
|  | | | | | | | | **124** |

Graphical user interface, application

Description automatically generated with medium confidence

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

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| **Q. No.** | **Questions** | | | **Course Outcome / Pattern** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | What is the principle of operation of radar? | | | CO1 / R | | 1 |
| 2. | What is minimum detectable signal for radar? | | | CO1 / R | | 1 |
| 3. | What is the information provided by Doppler radar in aircrafts? | | | CO2 / R | | 1 |
| 4. | Name the three components of instrument landing system. | | | CO2 / R | | 1 |
| 5. | Mention any two coordinate systems used for airborne vehicle navigation. | | | CO3 / R | | 1 |
| 6. | Name the inertial sensors used in inertial navigation. | | | CO3 / R | | 1 |
| 7. | Mention the two basic guidance systems used in missiles. | | | CO4 / R | | 1 |
| 8. | What is LOS for a missile tracking a target? | | | CO4 / R | | 1 |
| 9. | What are the two major types of control system? | | | CO5 / R | | 1 |
| 10. | Define transfer function. | | | CO5 / R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Mention any three civilian applications of radar. | | CO1 / R | | 3 | |
| 12. | What is the principle of TRSB-MLS? | | CO2 / U | | 3 | |
| 13. | What is the principle of operation of inertial navigation system in aircrafts? | | CO3 / U | | 3 | |
| 14. | Draw the block diagram of a roll stabilization control system for missile. | | CO4 / U | | 3 | |
| 15. | What is the need for reducing the block diagram of a given control system? | | CO5 / U | | 3 | |
| 16. | Name the five time domain specifications of control system. | | 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. | Derive the radar range equation. | CO1 / U | | 6 | |
| b. | With the help of a block diagram, explain the operation of a typical pulse radar. | CO1 / U | | 6 | |
|  |  |  |  | |  | |
| 18. |  | Explain the basic principle and operation of VOR/DME navigation system. | CO2 / U | | 12 | |
| 19. |  | Explain the complete algorithm used in strap down inertial navigation to compute the position of a vehicle in NED coordinate frame. | CO3 / An | | 12 | |
|  |  |  |  | |  | |
| 20. | a. | With the help of a block diagram, explain the displacement autopilot system in aircraft. | CO4 / A | | 6 | |
| b. | With the help of a block diagram, explain the basic lateral autopilot in aircraft. | CO4 / A | | 6 | |
|  |  |  |  | |  | |
| 21. |  | Determine the closed-loop transfer function *C*(*s*)/*R*(*s*) of the system shown in Figure 1 by using block diagram reduction technique.    **Figure 1.** | CO5 / A | | 12 | |
|  |  |  |  | |  | |
| 22. |  | Obtain the closed loop transfer function of the system whose signal flow graph is shown in Figure 2 using Mason’s gain formula.    **Figure 2.** | CO5 / A | | 12 | |
|  |  |  |  | |  | |
| 23. | a. | Mention the components of GPS satellite signals and explain the basic principle of position determination in GPS. | CO2 / U | | 6 | |
| b. | Explain the principle of operation of differential GPS in detail. | CO2 / U | | 6 | |
|  |  | **Compulsory:** | | | | |
| 24. |  | Using Routh-Hurwitz method, determine the stability and find the number of poles in the left half-plane, the right half-plane, and on the j-axis for the system shown in Figure 3.    **Figure 3.** | CO6 /An | | 12 | |

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|  | **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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 12 | - | - | - | - | 17 |
| CO2 | 2 | 27 | - | - |  |  | 29 |
| CO3 | 2 | 3 | - | 12 | - | - | 17 |
| CO4 | 2 | 3 | 12 | - |  |  | 17 |
| CO5 | 2 | 3 | 12 | 12 | - | - | 29 |
| CO6 | 3 | - | - | 12 | - | - | 15 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Recall Fourier’s law of conduction. | | CO1 | R | 1 |
| 2 | Adiabatic process means \_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | Fins are used to increase heat transfer by increasing \_\_\_\_\_\_\_\_\_. | | CO2 | R | 1 |
| 4. | Highlight an application of boiling process. | | CO2 | R | 1 |
| 5. | Maximum emissive power (Ebλ)max is \_\_\_\_\_\_\_\_\_. | | CO3 | U | 1 |
| 6. | Define absorptivity (α). | | CO3 | R | 1 |
| 7. | Thermal boundary layer is due to \_\_\_\_\_\_\_\_\_. | | CO4 | U | 1 |
| 8. | Reynolds number equation is \_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 9. | Define Biot number. | | CO5 | R | 1 |
| 10. | The heating of a body produced by passage of air or other gases over the body is known as \_\_\_\_\_\_\_\_\_. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List two examples of heat conduction. | | CO1 | R | 3 |
| 12. | Define condensation. | | CO2 | R | 3 |
| 13. | Outline gray body. | | CO3 | R | 3 |
| 14. | State Newton’s law of cooling. | | CO4 | R | 3 |
| 15. | Explain cross-flow heat exchanger. | | CO5 | U | 3 |
| 16. | Define ablative heat transfer. | | 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 wire of 6 mm diameter with 2 mm thick insulation(k=o.11 W/mK). If the convective heat transfer coefficient between the insulating surface and air is 25 W/m²K, find the critical thickness of insulation and also find the percentage of change in the heat transfer rate if the critical radius is used. | CO1 | R | 12 |
| 18. |  | A vessel contains a binary mixture of O2 and N2 with partial pressures in the ratio 0.21 and 0.79 at 20°C. If the total pressure of the mixture is 1.1 bar, estimate the following   1. Molar concentrations b) Mass densities c) Mass fractions   d) Molar fractions of each species | CO2 | U | 12 |
| 19. |  | Estimate the heat exchange by radiation between the surfaces of two long cylinders having radii 120 mm and 60 mm respectively. The axis of the cylinders are parallel to each other. The inner cylinder is maintained at a temperature of 130°C and emissivity of 0.6. Outer cylinder is maintained at a temperature of 30°C and emissivity of 0.5. | CO3 | U | 12 |
| 20. |  | A black body at 300 K emits radiation. Estimate 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   Total emissive power of the furnace if it is assumed as a real surface having emissivity equal to 0.85. | CO3 | U | 12 |
| 21. |  | Air at 30°C flows over a flat plate at a velocity of 2 m/s. The plate is 2 m long and 1.5 m wide. Estimate the following   1. Hydrodynamic and thermal boundary layer thickness st the trailing edge of the plate 2. Total drag force 3. Total mass flow rate through the boundary layer between x= 40 cm and x=85 cm | CO4 | U | 12 |
| 22. |  | A vertical plate of 0.75 m height is at 170°C and is exposed to air at a temperature of 105°C and one atmosphere. Estimate the following   1. Mean heat transfer coefficient 2. Rate of heat transfer per unit width of the plate | CO4 | R | 12 |
| 23. |  | A 5cm thick copper slab is at 200°C initially and it is suddenly immersed in water. So its surface is lowered to 90°C. In one test run, the initial temperature is decreased by 40°C and the time taken is 6 minutes. Estimate the heat transfer coefficient by using lumped capacity method of analysis. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A counter flow single pass heat exchanger is used to cool the engine oil from 150°C to 55°C with water that is available at 23°C as the cooling medium. The specific heat of oil is 2125 J/kgK. The flow rate of cooling water through the inner tube of 0.4 m diameter is 2.2 kg/s. The flow rate of oil through the outer tube of 0.75 m diameter is 2.4 kg/s. If the value of the overall heat transfer coefficient is 240 W/m2K, estimate the length of heat exchanger to meet its cooling requirement. | CO5 | U | 12 |

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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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 17 | - | - | - | - | - | 17 |
| CO2 | 5 | 12 | - | - | - | - | 17 |
| CO3 | 4 | 25 | - | - | - | - | 29 |
| CO4 | 16 | 13 | - | - | - | - | 29 |
| CO5 | 1 | 15 | - | - | - | - | 16 |
| CO6 | 1 | 15 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | When 𝑥 is the independent variable and 𝑖’s are the locations where the residue is equated to zero. Then the choice of weight function for collocation method is \_\_\_\_\_\_\_\_\_\_\_. | | CO1 | U | | 1 |
| 2. | (𝑤𝑣)’= \_\_\_\_\_\_\_\_\_\_\_ . | | CO1 | R | | 1 |
| 3. | If the structure is divided into discrete areas or volumes then it is called \_\_\_\_\_\_\_. | | CO2 | R | | 1 |
| 4. | The number of nodes in a domain when it is discretized into N linear 1-D elements is \_\_\_\_\_\_\_\_. | | CO2 | R | | 1 |
| 5. | The number of DoF of a frame element is \_\_\_\_\_\_\_\_\_\_. | | CO3 | U | | 1 |
| 6. | The displacement function for 1-D, two node linear element in terms of shape function will be \_\_\_\_\_\_\_\_\_. | | CO3 | R | | 1 |
| 7. | Write down the finite element equation for 1D heat conduction with free end convection. | | CO4 | R | | 1 |
| 8. | A three noded triangular element is called as\_\_\_\_\_\_\_\_\_. | | CO4 | R | | 1 |
| 9. | The determinant of an element stiffness matrix is always \_\_\_\_\_\_\_\_\_. | | CO5 | R | | 1 |
| 10. | The ring is produced by revolving \_\_\_\_\_\_\_\_ about an axis of rotation. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | State the principle of Galerkin’s method. | | CO1 | | R | 3 |
| 12. | Comment on the characteristics of global stiffness matrix. | | CO2 | | U | 3 |
| 13. | Write the rules of discretization. | | CO3 | | R | 3 |
| 14. | Define pathline. | | CO4 | | R | 3 |
| 15. | Outline natural coordinate system. | | CO5 | | R | 3 |
| 16. | State the conditions of a problem to be axisymmetric. | | 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 differential equation of a physical phenomenon is given by, d²y/dx² + 500x² =0, 0≤x≤1  Trial function, y= a1(x-x4),  Boundary conditions are, y(0)=0, y(1)=0  Estimate the value of the parameter a1 by the following methods:   1. Point collocation. 2. Subdomain collocation. 3. Least squares. 4. Galerkin. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. |  | A steel bar of length 800 mm is subjected to an axial load of 3kN as shown in fig. below. Find the elongation of the bar, neglecting self weight.    Take E = 2×105 N/mm² , A = 300 mm² | CO2 | | R | 12 |
|  |  |  |  | |  |  |
| 19. |  | For the two bar truss shown in fig below, estimate the stiffness matrix of element 1 and 2. Take Young’s modulus E= 70 GPa, Area A= 200 mm² | CO3 | | U | 12 |
|  |  |  |  | |  |  |
| 20. |  | A beam, fixed at one end and supported by a roller at the other end, has a 20kN concentrated load applied at the centre of the span, as shown in fig below. Estimate the deflection under the load and construct the shear force and bending moment diagrams for the beam.  Take E= 20×106 N/cm² and I = 2500 cm4 | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 21. |  | For the bar as shown in fig. below with length 2L, modulus of elasticity E, mass density ρ and cross sectional area A, estimate the first two natural frequencies. | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 22. |  | Find the expression of shape function for the eight-noded quadrilateral element. | CO5 | | R | 12 |
|  |  |  |  | |  |  |
| 23. |  | Estimate the stiffness matrix for the elements shown in fig.    The coordinates are given in mm. Assume plane stress conditions. Take E= 2.1×105 N/mm2, ν=0.25 and t= 10 mm | CO5 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | For the axisymmetric elements shown in fig. below, estimate the element stresses. Let E= 210 GPa and ν=0.25. The co-ordinates (in millimeters) are shown in fig. below.    The nodal displacements are : u1=0.05 mm,u2= 0.02 mm,  u3=0 mm, w1=0.03 mm, w2=0.02 mm and w3=0mm | CO6 | | U | 12 |

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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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 13 | - | - | - | - | 17 |
| CO2 | 14 | 3 | - | - | - | - | 17 |
| CO3 | 4 | 13 | - | - | - | - | 17 |
| CO4 | 5 | 24 | - | - | - | - | 29 |
| CO5 | 16 | 12 | - | - | - | - | 28 |
| CO6 | - | 16 | - | - | - | - | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | List the various casting defects that affect the performance of materials. | | CO1 | R | | 1 |
| 2. | Name any two NDT techniques used to detect internal defects. | | CO1 | R | | 1 |
| 3. | Differentiate Visual inspection & Liquid penetrant testing. | | CO2 | U | | 1 |
| 4. | Mention merits of dry developers applied during LPT. | | CO2 | A | | 1 |
| 5. | Write the limitation of Magnetic particle testing. | | CO3 | A | | 1 |
| 6. | Define the term ‘Peak Amplitude’ in Acoustic Emission Testing. | | CO3 | U | | 1 |
| 7. | Indicate the limitation of Radiography Test. | | CO4 | A | | 1 |
| 8. | State the linear location technique used in AE. | | CO5 | An | | 1 |
| 9. | Differentiate Ultrasonic and Acoustic Emission Testing. | | CO5 | E | | 1 |
| 10. | Define Thermography. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Outline the advantages and disadvantages of Visual inspection. | | CO1 | | A | 3 |
| 12. | Discuss why Magnetic Particles inspection cannot be used to detect internal defects? | | CO2 | | E | 3 |
| 13. | List out the various functions of developers used in LPT. | | CO3 | | A | 3 |
| 14. | Differentiate Ultrasonic test and other NDT Methods. | | CO5 | | U | 3 |
| 15. | Evaluate the factors affecting Radiographic testing. | | CO5 | | E | 3 |
| 16. | Describe the advantages and limitations of Thermography test. | | 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. | Briefly inscribe the differences between the NDT and destructive test. | CO1 | | E | 6 |
|  | b. | Discuss the various optical aids used in visual inspection techniques. | CO1 | | An | 6 |
| 18. |  | Explain the working of Liquid Penetrant testing with neat sketch and state its applications, merits and limitations. | CO2 | | U | 12 |
| 19. | a. | Explain in detail the principle of Magnetic particle test procedure with neat sketch. | CO3 | | R | 8 |
|  | b. | Write down the advantages and disadvantages of MPT. | CO3 | | A | 4 |
| 20. | a. | Explain the principle of Eddy current testing with neat sketch. | CO4 | | R | 9 |
|  | b. | Discuss the various applications and limitations of Eddy current testing. | CO4 | | A | 3 |
| 21. |  | Describe with neat sketch the Radiographic techniques and its limitations. | CO5 | | U | 12 |
| 22. |  | Enumerate the working principle of Ultrasonic technique with a block diagram and state its limitations. | CO5 | | R | 12 |
| 23. | a. | Explain the principle of Acoustic Emission technique and the various parameters involved in AET. | CO5 | | U | 8 |
|  | b. | Write short notes on safety aspects related to Radiography test. | CO5 | | E | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Write the principle of Thermography test with a neat block diagram. | CO6 | | R | 8 |
|  | b. | Discuss the application of Thermography testing in Aerospace industry. | CO6 | | A | 4 |

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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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | - | 3 | 6 | 6 | - | 17 |
| CO2 | - | 13 | 1 | - | 3 | - | 17 |
| CO3 | 8 | 1 | 5 | - | - | - | 14 |
| CO4 | 9 | 1 | 6 | - | - | - | 16 |
| CO5 | 12 | 23 | - | 1 | 4 | - | 40 |
| CO6 | 8 | 1 | 7 | - | 4 | - | 20 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
|  | | **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | In pure copper the increase in thermal conductivity below 100 K is due to the predominant motion of \_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 2. | \_\_\_\_\_\_\_\_\_\_crystal structures are most preferred in cryogenic applications. | | CO1 | R | 1 |
| 3. | Define coefficient of performance. | | CO2 | R | 1 |
| 4. | Illustrate the importance of pre-cooling in a L-H system. | | CO2 | U | 1 |
| 5. | List the various types of refrigeration system. | | CO3 | R | 1 |
| 6. | State the purpose of vent line in a dewar vessel. | | CO4 | U | 1 |
| 7. | Mention the various modes of heat transfer from a cryogenic container. | | CO5 | R | 1 |
| 8. | State the advantage of expanded foam type of insulator. | | CO5 | R | 1 |
| 9. | List the various physical quantities measured during the static testing of a cryogenic rocket engine. | | CO6 | R | 1 |
| 10. | Mention the importance of a test cell. | | CO6 | U | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Differentiate between ortho and para hydrogen with necessary sketch. | CO1 | A | 3 |
| 12. | State the purpose of regenerator in a liquefaction system. | CO2 | A | 3 |
| 13. | Briefly explain magneto caloric effect. | CO3 | U | 3 |
| 14. | List the various types of vacuum pumps with their operating range. | CO4 | U | 3 |
| 15. | State the purpose of spacer in multi-layer insulation. | CO5 | U | 3 |
| 16. | Mention the advantage of oxidizer rich stage combustor. | CO6 | R | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23. Q.No 24 is Compulsory)** | | | | | |
| 17. |  | With the help of neat sketch and T-S diagram explain thermodynamically ideal liquefaction system | CO1 | U | 12 |
| 18. |  | Explain Linde-Hampson Liquefaction system with a neat sketch. Derive the expressions for Liquid yield and work requirement. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the process in magnetic refrigeration system   1. Adiabatic Magnetization 2. Isomagnetic enthalpy transfer 3. Adiabatic demagnetization 4. Isomagnetic entropy transfer | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain in detail the necessary precaution to be taken in the transport of a cryogen. | CO4 | R | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain vacuum insulation with neat sketch. | CO5 | R | 8 |
| b. | Compare the advantages and disadvantages of Vacuum insulation with multi-layer insulations. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 22. |  | In short explain the following hazards while handling cryogen.  a. Extreme cold hazard.  b. Oxygen deficiency hazard.  c. Oxygen enrichment hazard. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Briefly explain the change in the following mechanical properties of metal when it is exposed to cryogenic temperature  a. Yield strength.  b Ultimate strength.  c. Fatigue strength. | CO1 | R | 12 |
|  |  | **COMPULSORY QUESTION** | | | |
| 24. |  | Discuss the applications of cryogenics for space vehicles. | CO6 | A | 12 |

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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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 14 | 12 | 3 |  | - | - | 29 |
| CO2 | 1 | 1 | 15 |  |  |  | 17 |
| CO3 | 1 | 3 | 12 |  | - | - | 16 |
| CO4 | 12 | 20 |  |  |  |  | 32 |
| CO5 | 10 | 3 |  |  | - | - | 13 |
| CO6 | 4 | 1 | 12 |  | - | - | 17 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Recall newton’s law of gravity. | | CO1 | R | | 1 |
| 2. | ﻿Sketch the conical section with different orbital shapes. | | CO1 | U | | 1 |
| 3. | Write the velocity formula of any position vectors using Gibbs method of orbit determination. | | CO2 | U | | 1 |
| 4. | Recall the expression for change in true anomaly as a function of position vectors. | | CO2 | R | | 1 |
| 5. | Define the restricted problem of three bodies. | | CO3 | U | | 1 |
| 6. | Sketch the equilibrium points of a restricted body problem. | | CO3 | U | | 1 |
| 7. | There are \_\_\_\_\_\_\_\_ pure imaginary roots at the collinear points L1,2,3  of the characteristic equation in the planar restricted three-body problem. | | CO4 | R | | 1 |
| 8. | At the Lagrangian points of the planar restricted three-body problem, the partial derivatives w.r.t. x and y are:Ωx=\_\_\_\_, Ωy=\_\_\_\_. | | CO4 | U | | 1 |
| 9. | At the collinear points Li (i =1, 2, 3) in the three-dimensional restricted three-body problem, the angular frequency sz \_\_\_\_\_\_si (i =1, 2, 3). | | CO5 | R | | 1 |
| 10. | If in two-body problem, the angular momentum h = 50000 km2/s, hz = 5000 km2/s, find the value of the orbital inclination i in degrees. | | CO5 | A | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | State Kepler’s laws of orbital motion. | | CO1 | | An | 3 |
| 12. | Explain Lambert’s theorem with the help of a figure. | | CO2 | | U | 3 |
| 13. | Explain Tisserand's criterion for the identification of comets. | | CO3 | | U | 3 |
| 14. | Construct the principal system of co-ordinates at the equilateral point L4 to show the angle α, which the major-axis of the elliptic orbit makes with the ξ-axis for mass ratio μ = 0.2 in the planar restricted three-body problem. | | CO4 | | A | 3 |
| 15. | Write equations of motion for three-dimensional restricted three-body problem. | | CO5 | | R | 3 |
| 16. | Write the equations of motion for planar restricted three-body problem when more massive primary is an oblate spheroid with its equatorial plane coincident with the plane of motion. | | 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. |  | ﻿Deduce the solution for Kepler’s first law of orbital motion. | CO1 | | An | 12 |
| 18. |  | ﻿A meteoroid is sighted at an altitude of 267,000 km. After 13.5 hours and a change in true anomaly of 5o, the altitude is observed to be 140,000 km. Calculate the perigee altitude and the time to perigee after the second sighting | CO2 | | R | 12 |
| 19. |  | Derive an equation of motion in a Jacobian Integral. | CO3 | | An | 12 |
| 20. |  | To study the motion near the equilibrium points in the planar restricted three-body problem, expand the force function Ω up to second-order terms around a Lagrangian point. Find the linearized variational equation of motion in two dimensions in the planar restricted three-body problem. Derive the fourth-degree characteristic equation  λ4 + (4 - Ωxx- Ωyy)λ2 + {ΩxxΩyy- (Ωxy)2}= 0,  at the Lagrangian points in the planar restricted three-body problem. | CO4 | | E | 12 |
| 21. | a. | Derive Tisserand criterion 1/2a + [a (1 – e2)]1/2 cos I = constant, for identification of comets, where a, e and I are initial semi-major axis, eccentricity and orbital inclination of a comet with respect to Sun-Jupiter orbital plane. | CO5 | | E | 8 |
|  | b. | If a = 4.81 AU, e = 0.763 and I = 7.47 degrees are the orbital elements of a comet before having close encounter with Jupiter, and aꞌ =10.8 AU, eꞌ = 0.731 are its orbital parameter after the encounter with Jupiter, find the value of orbital inclination Iꞌ in degrees of the comet after the encounter. The distance between Sun and Jupiter is 5.2 AU. | CO5 | | A | 4 |
| 22. |  | Derive Lambert’s theorem analytically. | CO2 | | An | 12 |
| 23. |  | Prove that the second-order derivatives at the equilateral point L4are Ωxx= 3/4, Ωxy = 3.31/2 (μ - 1/2)/2, Ωyy = 9/4.Using these values of partial derivatives, prove that thecharacteristic equation is λ4 + λ2 + 27μ (1 - μ)/4 = 0. Find the value of the critical mass μ0 = 0. 03852 at the equilateral equilibrium points. | CO4 | | E | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Write the equations of motion for planar photogravitational restricted three-body problem. Obtain the two equations to find locations of the five Lagrangian points. Prove that the locations of the triangular Lagrangian points is given by r1=q1/3, r2 = 1. Derive the fifth-degree algebraic equations to find the location of the collinear Lagrangian point L1. | CO6 | | E | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | ﻿Understand two-body orbital motion. |
| CO2 | ﻿Gain knowledge of preliminary orbit determination and orbital transfer technique. |
| CO3 | ﻿Understand the concept of dynamical systems. |
| CO4 | ﻿Understand orbital motion in restricted three-body problem (RTBP). |
| CO5 | ﻿Attain knowledge of equilibrium points and its uses in RTBP. |
| CO6 | ﻿Gain knowledge of orbits in 3-dimensional RTBP. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 | - | 15 | - | - | 17 |
| CO2 | 13 | 4 | - | 12 | - | - | 29 |
| CO3 | - | 5 | - | 12 | - | - | 17 |
| CO4 | 1 | 1 | 3 | - | 24 | - | 29 |
| CO5 | 4 | - | 5 | - | 8 | - | 17 |
| CO6 | 3 | - | - | - | 12 | - | 15 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | | |
| 1. | | a. | Compare and contrast the specifications and features of HALE, MALE, TUAV and MUAV. | CO1 | U | 12 |
|  | | b. | Explain the classification of airspace as per the FAA regulations. | CO1 | U | 4 |
|  | |  |  |  |  |  |
| 2. | | a. | Briefly explain the different elements of a typical unmanned Aircraft system. | CO2 | R | 12 |
|  | | b. | Differentiate center of gravity and center of pressure in an aircraft. | CO2 | R | 4 |
|  | |  |  |  |  |  |
| 3. | | a. | Explain the various aircraft configurations used in horizontal take-off, vertical take-off and hybrid unmanned aircrafts. | CO3 | R | 12 |
|  | | b. | Write a short note on the maintenance needs to be considered in selection of UAS. | CO3 | R | 4 |
|  | |  |  |  |  |  |
| 4. | | a. | Explain the features and working of  i) Yagi-Uda antenna.  ii) Parabolic dish antenna. | CO4 | U | 12 |
|  | | b. | Enumerate the personnel requirement and their qualifications for the operation of Unmanned Systems as per FAA requirements. | CO4 | U | 4 |
|  | |  |  |  |  |  |
| 5. | | a. | Write a brief note on the dispensable and non-dispensable payloads used in UAS. | CO5 | U | 12 |
|  | | b. | Discuss the resolution of electro optic payloads based on Johnson’s criteria. | CO5 | U | 4 |
|  | |  |  |  |  |  |
| 6. | | a. | List the use of unmanned aircraft systems in day-to-day applications and explain the advantages and limitations. | CO6 | R | 12 |
|  | | b. | Explain the features of Catapault launch system used for UAVs. | CO4 | U | 4 |
|  | |  |  |  |  |  |
| 7. | |  | Describe the launch mechanisms used for horizontal take-off and vertical take-off unmanned aircraft systems with their advantages. | CO3 | U | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | | |
| 8. | |  | Describe the roles of unmanned aircrafts in naval, paramedical, civilian, army and commercial applications. | CO6 | U | 20 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the basic terminologies and classification of UAS. |
| CO2 | Relate the design parameters of UAS 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 testing. |
| CO6 | Apply the principles to design UAS for specific applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 16 | - | - | - | - | 16 |
| CO2 | 16 | - | -- | -- | -- | -- | 16 |
| CO3 | 16 | 16 | - | - | - | - | 32 |
| CO4 | - | 20 | - | - | - | - | 20 |
| CO5 | - | 16 | - | - | - | - | 16 |
| CO6 | 12 | 20 | - | - | - | - | 32 |
|  | | | | | | | **132** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | List out the factors to be considered in product design. | | CO1 | U | | 1 |
| 2. | Define the “maturity stage” in Product life cycle. | | CO1 | R | | 1 |
| 3. | State the “theory of inventive problem solving”. | | CO2 | R | | 1 |
| 4. | Enumerate the “Segmentation” in TRIZ. | | CO2 | R | | 1 |
| 5. | Indicate how to evaluate the value of a product. | | CO3 | U | | 1 |
| 6. | Express the reasons for “developing alternates” concept. | | CO3 | R | | 1 |
| 7. | Identify any one of the method of measuring the profit. | | CO5 | U | | 1 |
| 8. | Show a decision matrix with help of a block diagram. | | CO4 | U | | 1 |
| 9. | List out the various “different services” required for a value engineering team. | | CO6 | R | | 1 |
| 10. | Express the use of Design For Manufacturing (DFM). | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Mention the various stages of Product life cycle. | | CO1 | | A | 3 |
| 12. | Document any two new products that can be developed by you. | | CO2 | | U | 3 |
| 13. | Write the effect of decrease in “function” and decrease in “cost” in value engineering process. | | CO3 | | A | 3 |
| 14. | Differentiate “Net profit” and “Gross profit”. | | CO4 | | U | 3 |
| 15. | Summarize the fundamental changes to be carried out in the engineering culture by the industries. | | CO5 | | U | 3 |
| 16. | Express the five principles of DFM briefly. | | 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. |  | With suitable examples Illustrate how Political,  Economic,  Social,  Technological, Environmental and Legal factors would influence the product development and sale. | CO1 | | An | 12 |
|  |  |  |  | |  |  |
| 18. |  | Sketch a block diagram which shows the idea evaluation process and explain in detail. | CO3 | | A | 12 |
|  |  |  |  | |  |  |
| 19. |  | Write the steps involved in idea generation process and explain in detail. | CO3 | | A | 12 |
|  |  |  |  | |  |  |
| 20. |  | Outline the various steps or phases in “Value Engineering” Process. | CO4 | | A | 12 |
|  |  |  |  | |  |  |
| 21. |  | Explain the steps involved in generating decision matrix with suitable example. | CO5 | | An | 12 |
|  |  |  |  | |  |  |
| 22. |  | Develop a Function Analysis System Technique for a product or process to be developed. | CO5 | | An | 12 |
|  |  |  |  | |  |  |
| 23. |  | Mention the various types of construction management contracts and illustrate about each. | CO6 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | With help of a block diagram illustrate the Concurrent Engineering process in detail. | CO6 | | An | 12 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 | 3 | 12 | - | - | 17 |
| CO2 | 2 | 3 | - | - | - | - | 5 |
| CO3 | 1 | 1 | 27 | - | - | - | 29 |
| CO4 | - | 4 | 12 | - | - | - | 16 |
| CO5 | - | 4 | - | 24 | - | - | 28 |
| CO6 | 1 | 4 | 12 | 12 | - | - | 29 |
|  | | | | | | | **124** |

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| **Course Code** | **14AE2027/17AE2035** | **Duration** | **3hrs** |
| **Course Name** | **NAVIGATION, GUIDANCE AND CONTROL OF AEROSPACE VEHICLES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Mathematical function that theoretically models the system’s output is termed as \_\_\_\_\_\_ function. | | CO1 | R | | 1 |
| 2. | A system is said to be \_\_\_\_\_\_ if its output is under control. | | CO1 | U | | 1 |
| 3. | Example for a second order system is \_\_\_\_\_\_. | | CO2 | U | | 1 |
| 4. | The change of state of a dynamic system with respect to time is termed as\_\_\_\_\_\_. | | CO2 | R | | 1 |
| 5. | Abbreviate the term GPS \_\_\_\_\_\_. | | CO4 | U | | 1 |
| 6. | Instrument that determines the vehicle position is known as \_\_\_\_\_\_. | | CO4 | U | | 1 |
| 7. | AFCS stands for \_\_\_\_\_\_. | | CO5 | R | | 1 |
| 8. | \_\_\_\_\_\_ refers to the rotation of the aircraft around a side-to-side axis. | | CO5 | R | | 1 |
| 9. | \_\_\_\_\_\_ system provides automatic stabilization to the aircraft. | | CO6 | U | | 1 |
| 10. | Radars are used to \_\_\_\_\_\_control the air traffic. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Classify the types of control systems. | | CO1 | | R | 3 |
| 12. | Compare the transient and steady state response time. | | CO2 | | R | 3 |
| 13. | List the parameters to be considered to design the controls for aircraft. | | CO3 | | R | 3 |
| 14. | Identify the coordinate systems employed for navigation. | | CO4 | | U | 3 |
| 15. | Enumerate the importance of pitch orientation. | | CO5 | | U | 3 |
| 16. | Define microwave landing system. | | 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. |  | An aircraft cruising at 150 kmph on autopilot mode is given a reference pitch angle of 20 degrees. The autopilot control system has a transfer function as follows. Determine the stability of the system with a neat sketch of root locus. | CO1 | | A | 12 |
|  |  |  |  | |  |  |
| 18. |  | Establish a mathematical expression for Mason’s gain formula. | CO1 | | A | 12 |
|  |  |  |  | |  |  |
| 19. |  | Sketch the bode plot for the following transfer function and determine phase margin and gain margin. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 20 |  | Explain the Nyquist stability criteria with an example. | CO3 | | U | 12 |
|  |  |  |  | |  |  |
| 21. |  | Enumerate the different types of radio navigation systems. | CO4 | | R | 12 |
|  |  |  |  | |  |  |
| 22. |  | Examine the longitudinal and lateral autopilot system with a neat schematic. | CO5 | | U | 12 |
|  |  |  |  | |  |  |
| 23. |  | Explain the construction of a fly-by-wire control system with a neat diagram. | CO6 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Discuss the principle of a GPS and explain how it is used to determine the position and velocity of an object. | CO3 | | U | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the control system and assess its performance and stability using routh Hurwitz criterion and root locus. |
| CO2 | Analyse time and frequency domain specifications and perform analysis using bode plot, polar plot and Nyquist stability criteria. |
| CO3 | Deploy the skills effectively in design of control for aerospace vehicle systems. |
| CO4 | Understand the working principles and specifications of navigation methods. |
| CO5 | Simulate and assess the performance of autopilots, augmentation systems and missile guidance systems. |
| CO6 | Apprehend the functionality of advanced navigation and guidance systems. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 1 | 24 | - | - | - | 29 |
| CO2 | 4 | 13 | - | - | - | - | 17 |
| CO3 | 3 | 24 | - | - | - | - | 27 |
| CO4 | 12 | 5 | - | - | - | - | 17 |
| CO5 | 2 | 15 | - | - | - | - | 17 |
| CO6 | 3 | 14 | - | - | - | - | 17 |
|  | | | | | | | **124** |

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| --- | --- | --- | --- |
| **Course Code** | **20AE2001** | **Duration** | **3hrs** |
| **Course Name** | **INTRODUCTION TO AEROSPACE ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | Label the glider name. | | | CO1 | U | | 1 |
| 2. | Discuss TATA airways. | | | CO1 | R | | 1 |
| 3. | Describe the functions of rudder. | | | CO2 | R | | 1 |
| 4. | Cite the type of airfoil | | | CO2 | R | | 1 |
| 5. | Discuss truss fuselage structure. | | | CO3 | U | | 1 |
| 6. | https://www.engineeringcivil.com/wp-content/uploads/2010/08/Howe-Truss-Warren-Truss-and-Pratt-Truss.JPG  Label the structure type | | | CO3 | R | | 1 |
| 7. | How a Car Engine Works | Engine Components and Engine Parts  Cite the stroke of piston engine | | | CO4 | U | | 1 |
| 8. | Describe the functions of propeller. | | | CO4 | R | | 1 |
| 9. | Classify the types of rocket engines. | | | CO5 | U | | 1 |
| 10. | Describe newton’s 3rd law. | | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Differentiate – commercial jets&war crafts. | | | CO1 | | An | 3 |
| 12. | Describe Reynolds number with equation. | | | CO2 | | U | 3 |
| 13. | Differentiate – monocoque and truss fuselage structure. | | | CO3 | | An | 3 |
| 14. | Describe the wing structural members. | | | CO4 | | U | 3 |
| 15. | Compare hybrid rocket engine with liquid rocket engine. | | | CO5 | | An | 3 |
| 16. | Explain Kepler’s law of motion. | | | 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. |  | | Describe in detail the history of Indian aviation with necessary timelines. | CO1 | | U | 12 |
| 18. |  | | Describe the aircraft components and its functions with necessary sketches. | CO2 | | R | 12 |
| 19. |  | | Elaborate the types of wing construction with necessary sketches. | CO3 | | U | 12 |
| 20. |  | | Discuss in detail the working principle of turbofan engine with neat diagram. | CO4 | | U | 12 |
| 21. |  | | Classify the types of rockets based on their propellants used with necessary diagrams. | CO5 | | U | 12 |
| 22. | a. | | Discuss in detail the features of HAL with necessary timelines. | CO1 | | U | 8 |
|  | b. | | Discuss in detail the features of GTRE with necessary timelines. | CO1 | | U | 4 |
| 23. |  | | Explain about the materials used in Aircraft structures with necessary points. | CO3 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | |  | Deduce the Vis-viva equation for orbiting bodies. | CO6 | | An | 12 |

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|  | **COURSE OUTCOMES** | | | | | | | |
| CO1 | Understand the nature of aerospace technologies. | | | | | | | |
| CO2 | Identify the different types of Aircraft components and their functions. | | | | | | | |
| CO3 | Assess the forces and moments due to flow over the aircraft components. | | | | | | | |
| CO4 | Apply the principles of aerodynamics to different parts of an aeroplane. | | | | | | | |
| CO5 | Evaluate the performance of propulsion system. | | | | | | | |
| CO6 | Apply the knowledge of gravitational law, Kepler’s law and Newton’s law to the space vehicle | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | | |
| CO / P | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | | 1 | 25 |  | 3 |  |  | 29 |
| CO2 | | 13 | 4 |  |  |  |  | 17 |
| CO3 | | 1 | 25 |  | 3 |  |  | 29 |
| CO4 | | 1 | 16 |  |  |  |  | 17 |
| CO5 | |  | 13 |  | 3 |  |  | 16 |
| CO6 | | 1 | 3 |  | 12 |  |  | 16 |
|  | | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | The compressibility is the reciprocal of \_\_\_\_\_\_. | | | CO1 | U | | 1 |
| 2. | Name the fluid in which same pressure is seen at a point in all directions when fluid is in motion. | | | CO1 | R | | 1 |
| 3. | A soap bubble 62.5 mm diameter has an internal pressure in excess of the outside pressure of 20N/m2. Find tension in the soap film. | | | CO2 | R | | 1 |
| 4. | SI unit of kinetic viscosity is \_\_\_\_\_\_. | | | CO2 | R | | 1 |
| 5. | In stable equilibrium for completely submerged bodies, Buoyancy force=Weight of body, the centre of buoyancy is above the centre of gravity. | | | CO3 | U | | 1 |
| 6. | The floating body is considered to be in unstable equilibrium if the metacenter is \_\_\_\_\_\_the centre of gravity. | | | CO3 | R | | 1 |
| 7. | The energy loss in venturimeter is not \_\_\_\_\_\_\_ than orifice meter. | | | CO4 | U | | 1 |
| 8. | The pitot tube is used for measurement of \_\_\_\_\_\_\_\_\_\_. | | | CO4 | R | | 1 |
| 9. | Define Chezy’s formula. | | | CO5 | R | | 1 |
| 10. | Rewrite force in terms of M,L and T. | | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Define surface tension. | | | CO1 | | R | 3 |
| 12. | Identify the condition of flow to be an irrotational. | | | CO2 | | U | 3 |
| 13. | Distinguish between cohesion and adhesion. | | | CO3 | | R | 3 |
| 14. | Recite the significance of Venturimeter. | | | CO4 | | R | 3 |
| 15. | Recall the expression of loss of head in various pipe fittings. | | | CO5 | | R | 3 |
| 16. | Define kinematic similarity. | | | 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 simple manometer is used to measure the pressure of oil (sp. Gravity=0.8) flowing in a pipe line. Its right limb is open to the atmosphere and left limb is connected to the pipe. The centre of the pipe is 9 cm below the level of mercury (sp. gravity=13.6) in the right limb (hand). If the difference of mercury level in the  two limbs is 15 cm, determine the absolute pressure of the oil in the pipe in N/cm². | CO1 | | U | 12 |
|  | |  |  |  | |  |  |
| 18. | |  | Explain the following   1. Vortex flow. 2. Doublet flow. | CO2 | | U | 12 |
|  | |  |  |  | |  |  |
| 19. | | a. | Explain the procedures to obtain the expression of force exerted by the jet on the plate in the direction of force. | CO3 | | U | 6 |
|  | | b. | Estimate the force exerted by a jet of water of diameter 75 mm on a stationary flat plate, when the jet strikes the plate normally with velocity of 20 m/s. | CO3 | | U | 6 |
|  | |  |  |  | |  |  |
| 20. | |  | An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 25 cm. Estimate the discharge of oil through the horizontal venturimeter. Take Cd=0.98. | CO4 | | U | 12 |
|  | |  |  |  | |  |  |
| 21. | |  | An orifice meter with orifice diameter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter gives readings of 19.62 N/cm² and 9.81 N/cm² respectively. Coefficient of discharge for the orifice meter is given as 0.6.Estimate the discharge of water through pipe. | CO4 | | U | 12 |
|  | |  |  |  | |  |  |
| 22. | |  | A 150 mm diameter pipe reduces in diameter abruptly to 100 mm diameter. If the pipe carries water at 30 litres per second, estimate the pressure loss across the contraction. Take the coefficient of contraction as 0.6. | CO5 | | R | 12 |
|  | |  |  |  | |  |  |
| 23. | |  | Estimate the diameter of a pipe of length 2000 m when the rate of flow of water through the pipe is 200 litres per second and the head lost due to friction is 4 m. Take the value of C=50 in Chezy’s formula. | CO5 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | |  | The pressure difference ∆P in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity µ and density ρ. Using Buckingham’s Π theorem, find an expression for ∆P. | CO6 | | R | 12 |

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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 it. |
| CO6 | Get knowledge of the non-dimensional parameters used in airflow. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 13 | - | - | - | - | 17 |
| CO2 | 2 | 15 | - | - | - | - | 17 |
| CO3 | 4 | 13 | - | - | - | - | 17 |
| CO4 | 1 | 28 | - | - | - | - | 29 |
| CO5 | 16 | 12 | - | - | - | - | 28 |
| CO6 | 12 | 4 | - | - | - | - | 16 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Ceramic is a ductile material. (True/ False). | CO1 | R | | 1 |
| 2. | Define Poisson‘s ratio. | CO1 | R | | 1 |
| 3. | List the types of beam supports. | CO2 | R | | 1 |
| 4. | The moment at the supported end of a simply supported beam is \_\_\_\_\_\_\_\_\_. | CO2 | U | | 1 |
| 5. | Pure bending applied on the beam causes the beam to bend in the form of an arc of a circle. (True/ False). | CO3 | U | | 1 |
| 6. | A cantilever beam is loaded with uniformly distributed load over the whole span. The bottom fibre is subjected to \_\_\_\_\_\_\_\_ stress. | CO3 | U | | 1 |
| 7. | Write the boundary condition for a cantilever beam subjected to a point load at the free end. | CO4 | Ap | | 1 |
| 8. | Indicate the boundary condition for a cantilever beam subjected to uniform distributed load over the entire length. | CO4 | U | | 1 |
| 9. | Write the expression for the torsional rigidity of the shaft. | CO5 | Ap | | 1 |
| 10. | The radius of Mohr’s circle is equal to\_\_\_\_\_\_\_\_. | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Sketch the stress-strain curve for steel material and indicate the salient points. | CO1 | | Ap | 3 |
| 12. | Explain pure bending in a beam. | CO2 | | Ap | 3 |
| 13. | Sketch the bending stress distribution along the depth of a rectangular beam and indicate the location of neutral axis and the maximum normal stress. | CO3 | | Ap | 3 |
| 14. | If the length of the simply supported beam subjected to a central point load is doubled, determine the increase in the maximum deflection of the beam. | CO4 | | Ap | 3 |
| 15. | Explain polar moment of Inertia and write its expression for a hollow shaft with outer diameter D and inner diameter d. | CO5 | | Ap | 3 |
| 16. | The two non-zero principal stresses at a point in a thin plate are 𝜎n1 = 50 MPa and 𝜎n2 = 25 MPa. The maximum shear stress at this point is \_\_\_\_\_ 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. | Determine the change in length, width and thickness of a steel bar which is 4 m long, 30 mm wide and 20 mm thick when it is subjected to an axial pull of 30 kN in the direction of length. Young’s modulus E = 2x105 N/mm2 and Poisson’s ratio = 0.3. Also find the volumetric strain. | CO1 | | Ap | 12 |
|  |  |  | |  |  |
| 18. | Sketch the shear force and bending moment diagram for the beam shown in figure. | CO2 | | Ap | 12 |
|  |  |  | |  |  |
| 19. | Two wooden planks 150 x 50 mm each are connected to form a beam of ‘T’ section. If a moment of 3.4 kNm is applied around the horizontal neutral axis, inducing tension below the neutral axis. Find the stress at the extreme fibers of the cross-section. Also calculate the tensile force on the cross section. | CO3 | | Ap | 12 |
|  |  |  | |  |  |
| 20. | Calculate the maximum deflection and slope of the beam shown in the Figure. | CO4 | | Ap | 12 |
|  |  |  | |  |  |
| 21. | A solid steel shaft of diameter 60 mm is to be designed using allowable shear stress τallow = 40 MPa and an allowable angle of twist per unit length is 1o per m. Determine the maximum permissible torque T that may be applied to the shaft, assuming G = 80 GPa. | CO5 | | Ap | 12 |
|  |  |  | |  |  |
| 22. | A copper bar shown in the figure is subjected to a tensile load of 30 KN. Determine elongation of the bar if E=100GPa. Also find maximum stress induced. | CO1 | | Ap | 12 |
|  |  |  | |  |  |
| 23. | Sketch the shear force and bending moment diagram for the beam shown in figure. | CO2 | | Ap | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | At a point in a strained material, the state of stress is as shown in figure. Determine both theoretically and graphically (Mohr’s circle) (i) principal stresses, (ii) location of principal planes and  (iii) maximum shear stress and its location. | CO6 | | Ap | 12 |

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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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 |  | 17 |  |  |  | 19 |
| CO2 | 1 | 1 | 17 |  |  |  | 19 |
| CO3 |  | 2 | 15 |  |  |  | 17 |
| CO4 |  | 1 | 16 |  |  |  | 17 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 16 |  |  |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the Non-cyclic Process. | | CO1 | R | 1 |
| 2. | Define Path Function in Thermodynamics. | | CO1 | R | 1 |
| 3. | Triple point appeared as line on P-T diagram (True/False). | | CO2 | U | 1 |
| 4. | Write the expression for the basis of H-S diagram. | | CO2 | A | 1 |
| 5. | Write the expression for First Law of Thermodynamics for a cyclic process. | | CO3 | A | 1 |
| 6. | Define adiabatic process with the help of First law of thermodynamics. | | CO3 | R | 1 |
| 7. | State PMM of type II. | | CO4 | R | 1 |
| 8. | Write the significance of the Heat Engine. | | CO4 | U | 1 |
| 9. | Write the importance of dryness fraction. | | CO5 | U | 1 |
| 10. | ﻿In a polytropic process the n equals to specific heat ratio, then this type process is \_\_\_\_\_\_\_\_\_\_\_. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain Quasi-Static Process with neat sketch. | | CO1 | U | 3 |
| 12. | Calculate the specific gas constant for Oxygen (O2) and Nitrogen (N2). | | CO2 | U | 3 |
| 13. | List the limitations of first law of thermodynamics with suitable examples. | | CO3 | R | 3 |
| 14. | Deduce an equation for coefficient of performance (COP) of Heat-pump with neat sketch. | | CO4 | An | 3 |
| 15. | Write the relation among P, V, T for a reversible adiabatic process. | | CO5 | A | 3 |
| 16. | List the assumptions for idealization simplification of gas power cycles. | | 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. | Derive an expression for Steady Flow Energy Equation (S.F.E.E) with neat sketch. | CO1 | An | 8 |
|  | b. | Explain the following   1. Microscopic approach. ii. Macroscopic approach. | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Explain the characteristics of T-V diagram for different pressures with neat sketch. | CO2 | U | 6 |
|  | b. | Elaborate the P-V diagram with neat sketch for the water. | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Using Steady Flow Energy Equation, Deduce an expression for network done by the turbine with neat sketch. | CO3 | An | 5 |
|  | b. | ﻿A turbine operates under steady flow conditions, receiving steam at the following state: Pressure 1.2 MPa, temperature 188°C, enthalpy 2785kJ/kg, velocity 33.3 m/s and elevation 3 m. The steam leaves the turbine at the following state: Pressure 20 kPa, enthalpy 2512 kJ/kg, velocity 100m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW? | CO3 | E | 7 |
|  |  |  |  |  |  |
| 20. | a. | Define Reversible and Irreversible Process. Explain the Irreversibilities that causes the process irreversible. | CO4 | R | 6 |
|  | b. | Discuss the Carnot cycle with neat sketch. | U | 6 |
|  |  |  |  |  |  |
| 21. |  | ﻿Two vessels, A and B, both containing Oxygen, are connected by a valve which is opened to allow the contents to mix and achieve an equilibrium temperature of 26°C. Before mixing the following  information is known about the gases in the two vessels. Vessel A: P=1.2 MPa, T=50°C Contents = 0.7 kg moles; Vessel B: P=0.5 MPa, T=22°C, Contents = 3.5 kg. Calculate the final equilibrium pressure, and the amount of heat transferred to the surroundings. If the vessel had been perfectly insulated, calculate the final temperature and pressure which would have been reached. Take r = 1.34. Write your observations from the results. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | ﻿An inventor claims to have developed an engine that takes in 105 MJ at a temperature of 400 K, rejects 42 MJ at a temperature of 200 K, and delivers 15 kWh of mechanical work. Would you advise investing money to put this engine in the market? | CO3 | E | 7 |
|  | b. | ﻿A fluid undergoes a reversible adiabatic compression from0.5 MPa, 0.2 m3 to 0.05 m3 according to the law. pv1·3 = constant. Determine the change in enthalpy, internal energy and entropy, and the beat transfer and work transfer during the process. | CO5 | E | 5 |
|  |  |  |  |  |  |
| 23. | a. | Derive an equation for work and heat for a isobaric and isochoric process with neat sketch. | CO3 | A | 7 |
|  | b. | List the Maxwell’s equations for thermodynamic properties with proper nomenclature. | CO5 | R | 5 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | 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 kJ/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 | E | 12 |

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| **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 of 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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 7 | - | 8 | - | - | 17 |
| CO2 | - | 16 | 1 | - | - | - | 17 |
| CO3 | 4 | - | 8 | 5 | 14 | - | 31 |
| CO4 | 7 | 7 | 3 | - | - | - | 17 |
| CO5 | 1 | 1 | - | 3 | 22 | - | 27 |
| CO6 | 3 | - | - | - | 12 | - | 15 |
| Total | 17 | 31 | 12 | 16 | 48 | - | **124** |

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| **Course Code** | **20AE2009** | **Duration :** | **3 hrs** |
| **Course Name** | **AERODYNAMICS** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome / Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Conservation of energy is based on\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  a) First law of thermodynamics. b) Second law of thermodynamics.  c) Zeroth law of thermodynamics. d) Third law of thermodynamics. | CO1/R | 1 |
| 2. | In a thermodynamic system, the measurement of heat is called as \_\_\_\_\_\_\_\_\_.  a) Entropy b) Enthalpy c) Internal energy d) Heat transfer | CO1/R | 1 |
| 3. | Bernoulli’s equation is applicable only for \_\_\_\_\_\_\_\_\_.  a) Irrotational flow b) Viscous flow c) Inviscid, incompressible flow d) Compressible flow | CO2/R | 1 |
| 4. | What is the angle of attack of lift producing airfoil?  a) Angle of attack less than zero b) Angle of attack greater than zero c) Angle of attack is zero d) Angle of attack remains the same | CO2/R | 1 |
| 5. | Purpose of leading edge is to \_\_\_\_\_\_\_\_\_.  a) allow the wing to operate at high angle of attack.  b) allow the wing to operate at low angle of attack.  c) allow the wing to operate at stall condition.  d) allow the wing to operate in level condition. | CO3/R | 1 |
| 6. | Vortex flow occurs at \_\_\_\_\_\_\_\_\_\_  a) Leading edge b) Trailing edge c) Chord d) Chamber line | CO3/R | 1 |
| 7. | According to the reasoning given by Prandtl for his lifting line theory, finite wing is like a \_\_\_\_\_\_\_\_\_  a) Bound vortex b) Horseshoe vortex c) Free vortex d) Trailing vortex | CO4/R | 1 |
| 8. | For a finite wing, the local airfoil section sees the angle of attack which is called as \_\_\_\_\_\_\_\_  a) Downwash angle b) Induced angle of attack c) Relative angle of attack d) Effective angle of attack | CO4/R | 1 |
| 9. | What is the coefficient of pressure over the surface which is in shadow (no impact from the flow present)?  a) Zero b) 1 c) 2 d) Infinite | CO5/R | 1 |
| 10. | What is the value of derivative of flow field along characteristic line? a) Zero b) Indeterminate c) One d) 0.5 | CO5/R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Differentiate control volume and control surface. | CO1/U | 3 |
| 12. | What is meant by streamlining a body? | CO2/R | 3 |
| 13. | How will be the stream and potential lines in source vortex combination? | CO3/U | 3 |
| 14. | What is meant by Karman vortex sheet? | CO4/R | 3 |

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| 15. | How are wing tip vortices formed? – Explain in brief. | CO5/U | 3 |
| 16. | What is the effect of boundary layer in case of a Kutta – Joukovsky flow? | CO6/R | 3 |

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| **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 are the forces that can be experienced by the fluid flowing in a control volume? | CO1/R | 2 |
| b. | Illustrate the vorticity and dilation of a fluid element. | CO1/A | 6 |
| c. | List down the significance of continuity condition. | CO1/U | 4 |
|  |  |  |  |  |
| 18. | a. | Discuss about the Angular velocity and Strain rate in detail. | CO2/A | 4 |
| b. | Derive the expressions for stream function and velocity potential function. | CO2/An | 8 |
|  |  |  |  |  |
| 19. | a. | Difference between Washin and Washout for wings. | CO3/U | 4 |
| b. | State Kutta-Zoukowski theorem. | CO3/A | 8 |
|  |  |  |  |  |
| 20. | a. | Explain lifting line theory and give its limitations. | CO4/U | 2 |
| b. | Derive the fundamental equation for thin airfoil theory and give the assumptions that are made in thin aerofoil theory. | CO4/A | 10 |
|  |  |  |  |  |
| 21. | a. | Explain 2D Panel Methods. | CO5/A | 4 |
| b. | Explain in detail about Inviscid Panel Method. | CO5/U | 8 |
|  |  |  |  |  |
| 22. | a. | Enumerate the applications of Joukowski’s aerofoil. | CO3/R | 4 |
| b. | Derive the general x-momentum equation for an unsteady 3-D inviscid flow in partial differential form using a control volume approach. | CO1/An | 8 |
|  |  |  |  |  |
| 23. | a. | Describe the Starting vortex. | CO4/U | 4 |
| b. | Derive the Euler’s Equation of Motion. | CO2/An | 8 |
|  |  | **Compulsory:** | | |
| 24. | a. | What is meant by boundary layer? | CO6/R | 2 |
| b. | Discuss the types of drag produced due to the effects of viscosity. | CO6/R | 4 |
| c. | Describe the momentum thickness in boundary layer theory. | CO6/U | 6 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 7 | 6 | 8 | - | - | 25 |
| CO2 | 5 | - | 4 | 16 | - | - | 25 |
| CO3 | 6 | 7 | 8 | - | - | - | 21 |
| CO4 | 5 | 6 | 10 | - | - | - | 21 |
| CO5 | 2 | 11 | 4 | - | - | - | 17 |
| CO6 | 9 | 6 | - | - | - | - | 15 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Write the relationship between the number of members and number of joints for a perfect frame. | | CO1 | R | | 1 |
| 2. | Truss members are assumed to take forces along its direction as well as perpendicular direction. (True/ False) | | CO1 | U | | 1 |
| 3. | State whether the continuous beam is a determinate or indeterminate structure. | | CO2 | U | | 1 |
| 4. | Write the expression for the strain energy induced in a bar subjected to an axial load P. | | CO3 | R | | 1 |
| 5. | State one advantage of a continuous beam. | | CO3 | U | | 1 |
| 6. | By the principle of least work, the force R in the redundant member is such as to make the strain energy of the system a \_\_\_\_\_\_\_.   1. Minimum b. Maximum 2. Zero d. Arbitrary Value | | CO4 | U | | 1 |
| 7. | Member force in the redundant truss is not possible to calculate. (True/ False) | | CO4 | U | | 1 |
| 8. | State the end condition of the column for which the critical load is minimum. | | CO5 | R | | 1 |
| 9. | List the three different states of equilibrium in buckling. | | CO5 | R | | 1 |
| 10. | Maximum principal strain theory is not good for brittle materials. (True/ False). | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Give two examples of the structure made of trusses. | | CO1 | R | | 3 |
| 12. | Differentiate between determinate and indeterminate structures.. | | CO2 | U | | 3 |
| 13. | State Castigliano's second theorem and write its expression in mathematical form. | | CO3 | R | | 3 |
| 14. | Give an example for a redundant truss and mention the method of solving the truss. | | CO4 | U | | 3 |
| 15. | Explain South well plot and mention its application. | | CO5 | A | | 3 |
| 16. | When a ductile material is subjected to axial force failure occurs at 45o to the loading direction. 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. |  | Find the forces in all the members of the truss shown in Fig. by method of joints. | 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. | 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. Prove that the support reaction at the left support is  using Castigliano's theorem. | CO3 | A | 12 | |
|  |  |  |  |  |  | |
| 20. |  | The cross sectional area of each member of the truss shown is 400 mm2and Young’s modulus is 200 GPa. Determine the horizontal displacement of joint C if a 4 kN force is applied to the truss at C. | CO4 | A | | 12 |
|  |  |  |  |  | |  |
| 21. |  | An I-section as shown in Fig. with 10cm x 2cm top and bottom flange and 115cm x 2cm middle web is used as a column of length 3m with both ends pinned. If E=210GPa, calculate the load the column can carry. Derive the formula used. | CO5 | A | | 12 |
|  |  |  |  |  | |  |
| 22. |  | Determine the forces in the members of the truss shown in Fig. | CO4 | A | | 12 |
|  |  |  |  |  | |  |
| 23. |  | A mild steel bar of 100 mm diameter is bent as shown in Fig. It is fixed at end A and a load of 500 N is applied at D, Draw the bending moment diagram for the parts AB, BC, and CD and indicate the maximum value. Find the maximum bending stress. Find also the deflection at D. Take E = 2 x 105 N/mm2. | CO3 | A | | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | A mild steel shaft 120 mm diameter is subjected to a maximum torque of 20 kNm and a maximum bending moment of 12 kNm at a particular section. If the allowable equivalent stress in simple tension is 220 MN/m2, find the factor of safety according to  i) Maximum shear stress theory and  ii) Shear strain energy theory. | CO6 | A | | 12 |

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|  | **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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 1 | 12 |  |  |  | 17 |
| CO2 |  | 4 | 12 |  |  |  | 16 |
| CO3 | 4 | 1 | 24 |  |  |  | 29 |
| CO4 |  | 5 | 24 |  |  |  | 29 |
| CO5 | 2 |  | 15 |  |  |  | 17 |
| CO6 |  | 4 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

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| **Course Code** | **20AE2012** | **Duration** | **3hrs** |
| **Course Name** | **PROPULSION-I** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | State the various types of power plant and their application. | CO1 | R | 1 |
| 2. | Mention the purpose of regenerator in the modified cycle. | CO1 | U | 1 |
| 3. | State the reason for increase in compressor exit temperature in a practical cycle. | CO2 | U | 1 |
| 4. | State the advantage of gas turbine engine over piston engine. | CO2 | R | 1 |
| 5. | Define surging. | CO4 | R | 1 |
| 6. | Mention the significance of surge line in a compressor. | CO4 | U | 1 |
| 7. | Mention the function of liners in combustion chamber. | CO5 | U | 1 |
| 8. | Define auto ignition temperature. | CO5 | R | 1 |
| 9. | Draw the velocity diagram of turbine blade. | CO4 | R | 1 |
| 10. | List the factors to be considered for choosing the pitch and chord of the turbine blade. | CO4 | U | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | State the principle of a jet engine and classify them based on the application. | CO1 | U | 3 |
| 12. | Mention the influence of pressure thrust on the overall thrust of an aircraft. | CO2 | U | 3 |
| 13. | Mention in detail the role of positive and negative impeller angle in a centrifugal compressor. | CO4 | U | 3 |
| 14. | With the help of neat sketches, explain the variation of pressure and velocity in an axial compressor. | CO4 | U | 3 |
| 15. | Mention the various requirements of combustion chamber for a gas turbine engine. | CO5 | R | 3 |
| 16. | Mention the purpose of stator, rotor, shroud and case of an axial flow turbine. | CO4 | A | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. |  | A gas turbine operates on a pressure ratio of 6. The inlet air temperature to the compressor is 300 K and the air entering the turbine is at a temperature of 577 ̊C. If the volume rate of air entering the compressor is 240 m3/s. Calculate the net power output of the cycle in MW. Also compute its efficiency. Assume that the cycle operates under ideal condition. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | In a gas turbine plant air enters the compressor at 0.8 bar and 277 K. It is compressed to 3.5bar with an isentropic efficiency of 82%. The maximum temperature at the inlet to the turbine is 850 C. The isentropic efficiency of the turbine is 85%. The calorific value of the fuel used is 43.1 MJ/kg. Calculate the following  1.Compressor work in KJ/kg  2. Heat supplied in KJ//kg  3. Turbine work in KJ/kg  4. Net-work in KJ/kg  5.Thermal efficiency  6. Air/Fuel ratio  7. Specific fuel consumption in kg  Take Cpa = 1.005 kJ/kg K, ϒa = 1.4,Cpg = 1.147 kJ/kg K,ϒg = 1.33 | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | A centrifugal compressor has an inlet eye 15 cm diameter. The impeller revolves at 20,000 rpm and the inlet air has an axial velocity of 107 m/s, inlet stagnation temperature 294 K and inlet pressure 1.03 kg/cm2. Determine  i. Theoretical angle of the blade at this point and  ii. Mach number of the flow at the tip of the eye | CO4 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Air at a temperature of 273 K enters a ten stage axial flow compressor at the rate of 7 kg/s. The pressure ratio is 6.5 and the isentropic efficiency is 92%, the compression process being adiabatic. The compressor has symmetrical blades. The axial velocity of 110 m/s is uniform across the stage and the mean blade speed of each stage is 190 m/s. Determine the direction of the air at the entry to the exit from the rotor and the stator blades and also the power given to the air. Assume Cp = 1.005 kJ/kg K and ϒ= 1.4 | CO6 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Discuss the behavior of turboprop engine for fuel flow rate as function of true air speed with the help of a neat sketch. | CO1 | A | 8 |
| b. | Mention the advantage and disadvantage of a turboprop engine | CO1 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Explain stability loop with appropriate sketch | CO5 | R | 6 |
| b. | With neat sketch explain the different methods of cooling the flame tube. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | List the requirement of a good atomizer. | CO3 | R | 4 |
| b. | With the help of a neat sketch explain the breakup mechanism for a swirl injector. | CO3 | U | 8 |
|  |  | **COMPULSORY QUESTION** | | | |
| 24. | a. | Discuss in detail the need for turbine blade cooling | CO5 | U | 3 |
| b. | Write a short note on turbine cooling methods  i. External cooling of blades  ii. Internal cooling of blades  iii. Cooling medium | CO5 | A | 9 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the performance of air breathing engines. |
| CO2 | Analyse the performance of different propulsion cycles. |
| CO3 | Understand the working of sub-systems of the propulsion system. |
| CO4 | Assess the performance of compressor and turbine |
| CO5 | Evaluate the performance of combustion chamber, cooling and afterburner |
| CO6 | Find the causes of under-performance and remedial measures |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 8 | 8 | 12 | - | - | 29 |
| CO2 | 1 | 4 |  | 12 |  |  | 17 |
| CO3 | 4 | 8 |  |  | - | - | 12 |
| CO4 | 2 | 8 | 3 | 12 |  |  | 25 |
| CO5 | 10 | 10 | 9 | - | - | - | 29 |
| CO6 |  |  |  | - | 12 | - | 12 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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

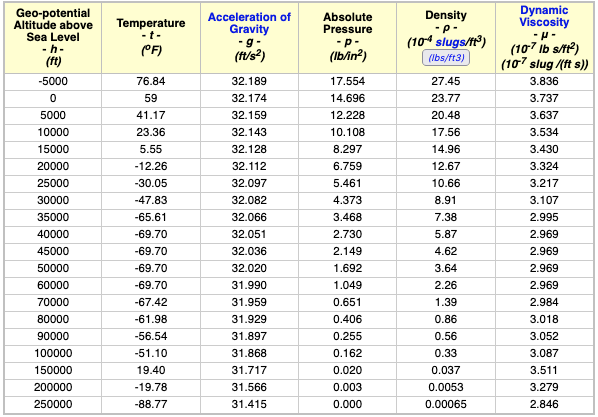
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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Recall the taper ratio. | CO1 | R | 1 |
| 2. | Write the definition for Reynolds number along with its general formula. | CO1 | R | 1 |
| 3. | Recall the expression for the drag-polar. | CO2 | U | 1 |
| 4. | Define the unaccelerated flight. | CO2 | U | 1 |
| 5. | Identify the maximum velocity through a thrust-velocity graphs. | CO3 | An | 1 |
| 6. | Mention the criteria for steady-level flight. | CO3 | U | 1 |
| 7. | Mark the maximum excess power in a power-velocity graph. | CO4 | A | 1 |
| 8. | Define the range of an aircraft. | CO4 | R | 1 |
| 9. | Write the equation for turn radius for a level turn. | CO5 | R | 1 |
| 10. | Write the equation for turn rate for a pull-down maneuver. | CO5 | R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | |
| 11. | Explain the angle of attack, flight path angle using a neat sketch. | | | CO1 | U | | 3 | |
| 12. | List the sources for noise generation in propeller driven aircraft, identify the most dominant source according to your opinion, justify your opinion. | | | CO2 | A | | 3 | |
| 13. | Explain the region of velocity stable and velocity instable. | | | CO3 | U | | 3 | |
| 14. | Find the maximum climb angle for an aircraft to clear the obstacle when it is flying at sea-level with gross weight 73,000 lb, thrust is 27,700 lb, surface area of the wings is 950 s.ft. During these conditions the Coefficient of drag due to zero lift and drag due to lift coefficient are observed as 0.015 and 0.08, respectively. | | | CO4 | An | | 3 | |
| 15. | A pilot intended to take a level turn at sea-level for the following flight conditions, gross weight is 80,000 lb, surface area is 970 S.ft., thrust is 28,000 lb, Cd,0 and K are 0.016 and 0.072 respectively. Calculate the velocity and load factor required to maintain the lowest possible minimum turn radius. | | | CO5 | An | | 3 | |
| 16. | Explain the approach and flare distance with neat sketch. | | | CO6 | R | | 3 | |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | | | | |
| 17. | a. | Explain the Down wash and induced drag for finite wing with the help of neat sketch. | CO1 | | | R | | 6 |
| b. | Explain the Drag Polar with a neat sketch. | CO1 | | | U | | 6 |
|  |  |  |  | | |  | |  |
| 18. | a. | A propeller-driven aircraft with 3 blade and has the following characteristics:Shaft Horse Power (SHP) is 500 hp, N = 2,800 rpm, Diameter of propeller is 7.2 ft, design Coefficient of propeller blade airfoil is 0.50, Activity Factor is 120. Predict the following performance characteristics.[For two blade propeller, CT/CP at AF 120 and CLi 0.50 is 2.32]   1. Coefficient of Power 2. Coefficient of thrust 3. Static Thrust | CO2 | | | An | | 7 |
| b. | Explain how the thrust varies with Mach number and altitude for a turbojet engine? | CO2 | | | A | | 5 |
|  |  |  |  | | |  | |  |
| 19. | a. | Prove that | CO3 | | | A | | 5 |
| b. | A steady-level flight is cruising at 30,000 ft above the sea-level with the gross weight 80,000 lb and wing surface area 970 ft2. At these flight conditions, the drag coefficient of due to zero-lift is 0.018 and drag due to lift coefficient is 0.06. Find the following performance parameters for this steady-level flight.   1. Velocity at 2. Thrust required at 3. Power required minimum | CO3 | | | An | | 7 |
|  |  |  |  | | |  | |  |
| 20. | a. | Derive the equation for Breguet-Range Equation for Jet-Propelled aircraft and list the conditions for obtaining the maximum range. | CO4 | | | U | | 7 |
| b. | A Boeing-737 took-off from Delhi airport with gross weight 80,000 lb and surface area of wing 1041 ft2to Coimbatore. During the cruise, the pilot has maintained 30,000 ft altitude. For this range (Delhi-Coimbatore) the thrust specific fuel consumption is 0.7 lb of fuel consumed per pound of thrust. The total fuel consumed for this flight journey was 30,000 lb. During the flight, the coefficient of drag due to zero-lift and drag due to lift coefficient are 0.016 and 0.09, respectively. Calculate the maximum rangethis aircraft could attain during the flight and the velocity required for the flight to achieve the maximum range. | CO4 | | | An | | 5 |
|  |  |  |  | | |  | |  |
| 21. | a. | Explain V-n diagram with neat sketch | CO5 | | | R | | 9 |
| b. | Find the corner velocity for a Jet-propelled aircraft flying at sea-level with the limiting load factor 4.5. The wing loading and are 76.84 lb/ft2 and 1.2, respectively. | CO5 | | | An | | 3 |
|  |  |  |  | | |  | |  |
| 22. | a. | Show that Velocity at = 1.32 \*Velocity at | CO3 | | | A | | 6 |
| b. | Prove that the velocity at equals to the times the velocity at thrust required minimum. | CO3 | | | A | | 6 |
|  |  |  |  | | |  | |  |
| 23. |  | For a Jet-Propelled aircraft, deduce the mathematical expression for the maximum rate of climb. | CO4 | | | R | | 12 |
|  |  | **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | List various velocities a flight has to attains during the ground roll while take-off event and explain them with neat sketch. | CO6 | | | R | | 7 |
| b. | A military aircraft with wing loading 78 lb/ft2 is ready to take-off from the ground, the maximum lift coefficient while taking-off is 1.86. Calculate the angle and distance of airborne the pilot has to maintain to clear the obstacle after lift -off from the ground. g = 32.2 ft/s2. | CO6 | | | An | | 5 |

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|  | **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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 8 | 9 | - | - | - | - | 17 |
| CO2 | 1 | 1 | 8 | 7 | - | - | 17 |
| CO3 | - | 4 | 17 | 8 | - | - | 29 |
| CO4 | 13 | 7 | 1 | 8 | - | - | 29 |
| CO5 | 11 | - | - | 6 | - | - | 17 |
| CO6 | 10 | - | - | 5 | - | - | 15 |
|  | | | | | | | **124** |

**Standard Atmosphere data needed for solving the numerical questions:**

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**Graphical user interface, application

Description automatically generated with medium confidence**

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

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| **Q.**  **No.** | | **QUESTIONS** | | **Course Outcome** | | **Bloom’s Level** | | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | | |
| 1. | | The most mechanical properties are affected by \_\_\_\_electrons. | | CO1 | | R | | | 1 |
| 2. | | Name the material used in the construction of the [ZMC-2](https://en.wikipedia.org/wiki/ZMC-2) [airship](https://en.wikipedia.org/wiki/Airship). | | CO1 | | R | | | 1 |
| 3. | | Ductility represents that how easily a material gets deformed under stress. | | CO2 | | U | | | 1 |
| 4. | | The Phase transitions occur along . | | CO2 | | U | | | 1 |
| 5. | | The Increasing and decreasing temperature results . | | CO3 | | R | | | 1 |
| 6. | | Mention the temperature range of ultra high-temperature materials. | | CO3 | | R | | | 1 |
| 7. | | Define composite prepregs. | | CO4 | | R | | | 1 |
| 8. | | The superior levels of strength and stiffness are given to the composite by . | | CO4 | | R | | | 1 |
| 9. | | Annealing relieves in a part during cold forging or casting processes. | | CO5 | | U | | | 1 |
| 10. | | Grain refining uses\_\_\_\_\_\_and\_\_\_\_\_\_\_to create grain nucleus sites to achieve this fine structure. | | CO5 | | U | | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | | | |
| 11. | Compare the primary bonding with the secondary bonding. | | | CO1 | | U | | | 3 | |
| 12. | Define Hardenability. | | | CO2 | | R | | | 3 | |
| 13. | Explain the identification of high temperature materials. | | | CO3 | | U | | | 3 | |
| 14. | Classify composites. | | | CO4 | | R | | | 3 | |
| 15. | State the principle of spot-welding. | | | CO5 | | R | | | 3 | |
| 16. | Highlight the features of Graphene. | | | 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. |  | | Discuss about the crystal structures of metals with the neat sketches. | | CO1 | | U | 12 | | |
|  |  | |  | |  | |  |  | | |
| 18. | a. | | Explain the standards and applications of tension test. | | CO2 | | U | 6 | | |
|  | b. | | Explain the following   1. Three-point bending test 2. Four-point bending test | | CO2 | | U | 3  3 | | |
|  |  | |  | |  | |  |  | | |
| 19. |  | | Describe the characteristics of high temperature materials. | | CO3 | | U | 12 | | |
|  |  | |  | |  | |  |  | | |
| 20. |  | | Compare and contrast the RTM with pultrusion technique. | | CO4 | | U | 12 | | |
|  |  | |  | |  | |  |  | | |
| 21. | a. | | Explain the characteristics of Austenitic Manganese Steel. | | CO5 | | U | 6 | | |
|  | b. | | Discuss the manufacturing method of forged product. | | CO5 | | U | 6 | | |
|  |  | |  | |  | |  |  | | |
| 22. |  | | Explain in detail about the heat treatment of aluminum alloys. | | CO5 | | U | 12 | | |
|  |  | |  | |  | |  |  | | |
| 23. |  | | Discuss about the various imperfections in crystals. | | CO1 | | U | 12 | | |
| **COMPULSORY QUESTION** | | | | | | | | | | |
| 24. |  | | Explain about the selection of materials for storage of cryogenic propellants and pumps. | | CO6 | | U | 12 | | |

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|  | **COURSE OUTCOMES** |
| CO1 | Explain how the mechanical properties of metals and alloys are influenced by their microstructure. |
| CO2 | Understand the material properties. |
| CO3 | Classify the different materials. |
| CO4 | Identify the testing method of materials. |
| CO5 | Select the right material for a particular application. |
| CO6 | Develop new material combination based on requirement. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 24 | - | - | - | - | 29 |
| CO2 | - | 17 | - | - | - | - | 17 |
| CO3 | 2 | 15 | - | - | - | - | 17 |
| CO4 | 5 | 12 | - | - | - | - | 17 |
| CO5 | 3 | 26 | - | - | - | - | 29 |
| CO6 | 3 | 12 | - | - | - | - | 15 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | Write the fundamental expression for velocity of sound (acoustic velocity). | | CO1 | U | | | 1 |
| 2. | Define the Mach Cone. | | CO1 | R | | | 1 |
| 3. | Write the name of equipment to measure the total pressure for subsonic flows. | | CO2 | U | | | 1 |
| 4. | Define expansion ratio. | | CO2 | R | | | 1 |
| 5. | The flow through the shock is adiabatic but non-isentropic. Is this statement True/False….? | | CO3 | A | | | 1 |
| 6. | Write an equation for the ration of Total to static temperature for a calorically perfect gas as a function of Mach number. | | CO3 | U | | | 1 |
| 7. | Define Fanno Flow. | | CO4 | R | | | 1 |
| 8. | Define Rayleigh line. | | CO4 | R | | | 1 |
| 9. | Define shock detachment distance. | | CO5 | R | | | 1 |
| 10. | Write the significance of shock-expansion theory. | | CO5 | U | | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Calculate the Mac angle for Sonic flow. | | CO1 | U | | 3 | |
| 12. | Consider the isentropic flow through a convergent-divergent nozzle with an exit to throat area ratio of 10.25. The reservoir pressure and temperature are 5atm and 333.3 K, respectively. Calculate M, P, T at the exit of the nozzle. (Use Gas table for obtain the relevant data). | | CO2 | E | | 3 | |
| 13. | Write the isentropic relations for sonic conditions. | | CO3 | U | | 3 | |
| 14. | Write the mathematical expressions for the temperature ration for fanno flow. | | CO4 | U | | 3 | |
| 15. | A supersonic plane is flying at Mach 2 at an altitude of 16 km. Find the Mach angle. (Anderson oblique) | | CO5 | E | | 3 | |
| 16. | Sketch the shock waves and expansion wave for a flat plate at angle of attack in a supersonic flow. | | 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 Mac angle and Mach Cone with neat sketch. | CO1 | | R | | 4 |
| b. | Describe the following in detail  i. Incompressible flow ii) Compressible flow.  iii) Subsonic flow iv) Supersonic flow. | CO1 | | U | | 8 |
| 18. |  | Deduce an equation for area-velocity relation for convergent and divergent ducts and explain its significance. | CO2 | | An | | 12 |
| 19. | a. | Consider a normal shock wave in air where the upstream flow properties are u1=680 m/s, T1=288 K and p1 = 1 atm. Calculate the velocity, temperature and pressure downstream of the shock wave. (Use normal shock wave tables for data). | CO3 | | E | | 5 |
| b. | Consider a normal shock wave in a supersonic air stream. Where the pressure upstream of the shock is 1 atm. Calculate the loss of total pressure across the shock wave when upstream Mach number is (a) M1=2, and (b) M2=4. (Use normal shock wave tables for data). | CO3 | | E | | 7 |
| 20. | a. | The average friction factor of for 50 mm diameter pipe is 0.004. The Mach number of air at a particular section in the pipe is 0.25. Determine the length of the pipe, if the flow ends at a Mach number of 0.49. Assume Fanno Flow. (Use Fanno Tables). | CO4 | | E | | 6 |
| b. | Explain the following  i) Choking in Rayleigh Flow ii) State of Maximum Enthalpy. | CO4 | | A | | 6 |
| 21. | a. | Consider Supersonic flow with M=2 P=1 atm and T=288 K. this flow is deflected at a comparison corner through 200. Calculate M, P, T, Po and to behind the resulting oblique shock wave. (Use the oblique shock properties graph). | CO5 | | E | | 6 |
|  | b. | Consider an oblique shock wave with a wave angle of 300. The upstream flow Mach number is 2.4. Calculate the deflection angle of the flow, the pressure and temperature ratios across the shock wave, and the Mach number behind the wave. (Use the oblique shock properties graph). | CO5 | | E | | 6 |
| 22. |  | Derive equations for pressure and temperature rations across the normal shock wave. | CO3 | | A | | 12 |
| 23. |  | Explain the following with neat sketch.  i) Under expanded flow ii) Over expanded flow.  iii) Isentropic expansion. | CO4 | | U | | 12 |
|  | **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Explain the following.  a. Pitot tube for supersonic flow. b. Hot wire anemometer.  c. Shadowgraph flow visualization technique. | CO6 | | U | | 12 |

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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. | | | | | | | |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | |
| COs | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | | 8 | 9 | - | - | - | - | 17 |
| CO2 | | 1 | 1 | - | 12 | 3 | - | 17 |
| CO3 | | - | 4 | 1 | 12 | 12 | - | 29 |
| CO4 | | 1 | 16 | 6 | - | 6 | - | 29 |
| CO5 | | 1 | 1 | - | - | 15 | - | 17 |
| CO6 | | 3 | 12 | - | - | - | - | 15 |
|  | | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | One form of energy is converted into another form in a \_\_\_\_\_\_ system. | | CO1 | R | | 1 |
| 2. | Measured variable is termed as \_\_\_\_\_\_. | | CO1 | U | | 1 |
| 3. | Gyroscope is used to measure\_\_\_\_\_\_ velocity. | | CO2 | U | | 1 |
| 4. | Altimeter is an example of \_\_\_\_\_\_ instruments. | | CO2 | R | | 1 |
| 5. | \_\_\_\_\_\_ is an example of a transducer. | | CO3 | U | | 1 |
| 6. | Forces due to acceleration in an aircraft is measured by \_\_\_\_\_\_. | | CO3 | U | | 1 |
| 7. | Sub-system of avionics consists of \_\_\_\_\_\_ elements. | | CO4 | U | | 1 |
| 8. | \_\_\_\_\_\_is a combination of aircraft and electronics. | | CO4 | R | | 1 |
| 9. | Abbreviate the term AFDX \_\_\_\_\_\_. | | CO5 | U | | 1 |
| 10. | Pilot can see outside through the glass and \_\_\_\_\_\_ in HUD system. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Define calibration. | | CO1 | | R | 3 |
| 12. | List some aircraft instruments. | | CO2 | | R | 3 |
| 13. | Identify the sensors used to measure temperature. | | CO3 | | U | 3 |
| 14. | Enumerate the merits of fly-by-wire system. | | CO4 | | R | 3 |
| 15. | List out the elements of ARINC 629. | | CO5 | | R | 3 |
| 16. | Compare enhanced and synthetic vision system. | | 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. |  | List the various elements of a generalized measurement system and explain with the aid of a neat schematic. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. |  | Describe the power requirements of cockpit system. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 19. |  | Sketch any two types of airdata instruments and articulate about them. | CO3 | | A | 12 |
|  |  |  |  | |  |  |
| 20. |  | Enumerate any two types of pressure measuring devices for aircraft applications. | CO3 | | R | 12 |
|  |  |  |  | |  |  |
| 21. |  | Illustrate any two types of fuel flow rate measuring devices used in an aircraft and explain their advantages and disadvantages. | CO4 | | A | 12 |
|  |  |  |  | |  |  |
| 22. |  | Describe the construction and functions of a flight control system with a neat schematic. | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 23. |  | Summarize the salient features of MIL-STD-1553B data bus in avionics. | CO5 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Illustrate any two types of cockpit display systems and explain their merits and demerits. | CO6 | | A | 12 |

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|  | **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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 13 | - | - | - | - | 17 |
| CO2 | 4 | 13 | - | - | - | - | 17 |
| CO3 | 12 | 5 | 12 | - | - | - | 29 |
| CO4 | 4 | 13 | 12 | - | - | - | 29 |
| CO5 | 3 | 13 | - | - | - | - | 16 |
| CO6 | - | 4 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Statement: As the number of stages n of a multistage rocket are increased higher values of ΔV are obtained. Is this statement true or false? | | CO1 | A | 1 |
| 2. | Recall the thrust equation for a rocket. | | CO1 | R | 1 |
| 3. | List the superior Planets. | | CO2 | R | 1 |
| 4. | ﻿Outline the method to identify the planets rotation and its north pole  Direction. | | CO2 | R | 1 |
| 5. | ﻿Show the variation of Time period of a circular orbit with altitude with help of 2-dimensional plot. | | CO3 | U | 1 |
| 6. | In a two body problem: the acceleration of the center of mass ‘G’ of the system of two bodies m1 and m2 is zero. Isa this statement is true/false? | | CO3 | R | 1 |
| 7. | ﻿Define the orbit perturbation. | | CO4 | R | 1 |
| 8. | ﻿Draw the shapes of J2 and J3 earth oblateness effects. | | CO4 | R | 1 |
| 9. | Hohmann transfer is using for only raising the orbits (increasing the orbit diameters while transferring the satellite). Is this statement true or false? | | CO5 | A | 1 |
| 10. | Recall the expression for mass of the propellant consume for Impulse maneuver as a function of ∆v and Specific Impulse. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | The characteristic velocity of a solid rocket is 1.437 km/s and coefficient of thrust is 1.62. Calculate the specific impulse of the rocket in seconds. | | CO1 | An | 3 |
| 12. | Discuss vernal equinox briefly with neat sketch. | | CO2 | R | 3 |
| 13. | ﻿Deduce an equation showing that the angular momentum is constant at any position in an orbit with neat sketch. | | CO3 | An | 3 |
| 14. | Define critical inclination with the help of suitable mathematical expression and list the critical inclination angles. | | CO4 | R | 3 |
| 15. | A 400 kg of satellite has to perform the single Impulse maneuver in a circular orbit (LEO) to change its course. The Isp and Delta V required for this maneuver are 320 s and 70 m/s. Estimate the mass of the propellant required to perform this maneuver. | | CO5 | E | 3 |
| 16. | Sketch the ﻿Hohmann transfer from inner planet 1 to outer planet 2 and write the equation for ΔV at planet 1 departure. | | 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 four-stage rocket is used to put up a satellite of 40 kg mass in a Low Earth Orbit (LEO). The approximate values of mass of the propellant, mass of structure and jet velocity for each stage are given below:    ﻿Determine:  (a) The payload mass fraction of the total rocket (Satellite launch  vehicle).  (b) Structural mass fraction of each stage.  (c) The ideal ΔV provided by each stage and the total ΔV.  (d) If the first stage fires for a period of 50 seconds and the rate of mass depletion can be assumed to be constant, what would be the acceleration of the rocket at take off? | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. |  | Discuss the following   1. Asteroids. 2. Comets. 3. Meteoroids. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. | a. | ﻿Deduce an equation that proves the statement “Energy of the body revolving in an orbit around another body at focus is constant”. Write energy equation as a function of semi-major axis of ellipse. | CO3 | An | 8 |
|  | b. | ﻿Calculate the altitude and speed of geostationary earth satellite. Gravitational Parameter for an earth is 398600 km3/s2. | CO3 | E | 4 |
|  |  |  |  |  |  |
| 20. | a. | List the causes for the perturbation of satellite in an orbit and explain at least two of them. | CO4 | R | 4 |
|  | b. | Consider an artificial satellite in a plane at 30o from equator (i=30o) with perigee and apogee heights hp= 161 km and ha=837 km. Neglect the effects of the drag. Calculate the secular variations of the orbital elements. | E | 8 |
|  |  |  |  |  |  |
| 21. |  | ﻿A spacecraft is in a 480 km by 800 km earth orbit (orbit 1 in Figure 6.3). Calculate (a) the v required at perigee A to place the spacecraft in a 480 km by 16 000 km transfer orbit (orbit 2); and (b) the v (apogee kick) required at B of the transfer orbit to establish a circular orbit of 16 000 km altitude (orbit 3). | CO5 | E | 12 |
| 22. |  | ﻿An earth satellite is in an orbit with perigee altitude Zp= 400 km and an eccentricity e = 0.6. Find (a) the perigee velocity, Vp; (b) the apogee radius, ra; (c) the semimajor axis, a; (d) the true-anomaly-averaged radius θ; (e) the apogee velocity; (f) the period of the orbit; (g) the true anomaly when r =θ; | CO3 | E | 12 |
| 23. |  | Calculate the total delta-v requirement for a bi-elliptical Hohmann transfer from a geocentric circular orbit of 7000 km radius to one of 105 000 km radius. Let the apogee of the first ellipse be 210 000 km. Compare the delta-v schedule and total flight time with that for an ordinary single Hohmann transfer ellipse (draw neat sketch of orbits while solving the numerical). | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Derive an equation for a sync period with the help of neat sketch. | CO6 | R | 7 |
|  | b. | Calculate the synodic period of Mars relative to the earth. | An | 5 |

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|  | **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. | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | | |
| CO / P | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | | 1 |  | 1 | 3 | 12 |  | 17 |
| CO2 | | 17 |  |  |  |  |  | 17 |
| CO3 | | 1 | 1 |  | 11 | 16 |  | 29 |
| CO4 | | 9 |  |  |  | 8 |  | 17 |
| CO5 | | 1 |  | 1 |  | 27 |  | 29 |
| CO6 | | 7 | 3 |  | 5 |  |  | 15 |
|  | | 36 | 4 | 2 | 19 | 63 |  | **124** |

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

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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | The angle between the direction of bending and the neutral axis is \_\_\_\_\_\_\_\_\_. | CO1 | R | | 1 |
| 2. | Sketch the bending stress distribution across the cross section of a rectangular beam. | CO1 | Ap | | 1 |
| 3. | Product of moment of inertia of a section having one axis of symmetry is \_\_\_\_\_\_\_\_\_. | CO2 | R | | 1 |
| 4. | Locate the shear center for a beam of T cross section with help of a neat sketch. | CO2 | R | | 1 |
| 5. | To carry a given load, a monocoque structure is heavier than semi monocoque construction. (True / False). | CO3 | R | | 1 |
| 6. | State the compatibility condition in single cell beam subjected to lateral load passes through the shear center. | CO3 | R | | 1 |
| 7. | Give the expression for the flexural rigidity of the plate. | CO4 | U | | 1 |
| 8. | Lowest value of buckling coefficient for simply supported plates is \_\_\_\_\_\_\_. | CO4 | U | | 1 |
| 9. | State the compatibility condition in multi cell tube subjected to torque. | CO5 | R | | 1 |
| 10. | State the two types of riveted joints, depending upon the way in which the members are connected. | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish symmetrical and unsymmetrical bending. | CO1 | | U | 3 |
| 12. | Describe pure bending. | CO2 | | U | 3 |
| 13. | State Bredt-Batho formula and mention the assumption involved. | CO3 | | R | 3 |
| 14. | Write short notes on local buckling of plates. | CO4 | | A | 3 |
| 15. | Write short notes on complete tension field beam. | CO5 | | A | 3 |
| 16. | Explain briefly any one failure of the riveted Joint. | 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 wood cantilever beam of rectangular cross section supports an inclined load P at its free end as shown in Figure. Calculate the maximum tensile stress (σmax) and the maximum deflection (δ) of the due to the load P. Data for the beam are as follows: breath (b) = 75 mm, depth (d) = 150 mm, Length (L) = 1.5 m, load (P) = 800 N, angle (θ) = 300 and Young’s modulus E = 12 GPa. | CO1 | | A | 12 |
|  |  |  | |  |  |
| 18. | Find the shear flow distribution and locate the shear center for the section shown in figure. Each of the stringers has an area of 4 cm2 and the section is subjected to a vertical force of 50 kN. | CO2 | | A | 12 |
|  |  |  | |  |  |
| 19. | Determine the shear flow in the walls of the two-cell tube structure shown in Figure, for an applied torque of T = 250 kNm. Calculate also the twist per unit length using G = 75 GPa. Thickness t = 0.25cm for all walls. | CO3 | | A | 12 |
|  |  |  | |  |  |
| 20. | Determine the crippling stress for the formed section shown in Fig using angle method. if material is aluminium alloy 2024-T3.  Fcy = 2.75x108 N/m2. Ec = 70x109 N/m2. | CO4 | | A | 12 |
|  |  |  | |  |  |
| 21. | A fuselage bulkhead of 1 m diameter has 12 stringers equally placed around the section. Each stringer area is 6.25 cm2. The bulk head is subjected to a symmetrical load of 10 kN. Find the shear flow around the bulk head. | CO5 | | A | 12 |
|  |  |  | |  |  |
| 22. | Obtain the shear flow and shear center location for the cannel section as shown in Figure subjected to a vertical upward shear load of 750 N. Thickness of flanges and web is 1 mm. | CO1 | | A | 12 |
|  |  |  | |  |  |
| 23. | Find the shear flow, shear stress and angle of twist per unit length of the figure shown. Take shear modulus G = 25x105 N/cm2 and the radius R = 10 cm. | CO3 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | A double riveted double cover butt joint is made in 20 mm thick plates with 25 mm diameter rivets and 100 mm pitch. The permissible stresses are;  Shear stress in rivets = 80 MPa,  Crushing stress of plates = 160 MPa and  Tearing stress of plates = 100 MPa.  Determine the efficiency of the joint. | CO6 | | A | 12 |

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|  | **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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 3 | 25 |  |  |  | 29 |
| CO2 | 2 | 3 | 12 |  |  |  | 17 |
| CO3 | 5 |  | 24 |  |  |  | 29 |
| CO4 |  | 2 | 15 |  |  |  | 17 |
| CO5 | 2 |  | 15 |  |  |  | 17 |
| CO6 |  |  | 15 |  |  |  | 15 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | Classify the various supersonic intakes. | | | CO1 | R | | 1 |
| 2. | State the methods of noise suppression in nozzles. | | | CO1 | R | | 1 |
| 3. | Describe in short the application of cold gas in rocket propulsion. | | | CO2 | R | | 1 |
| 4. | List the propellants used in monopropellant thrusters. | | | CO2 | R | | 1 |
| 5. | Define neutral burn. | | | CO3 | R | | 1 |
| 6. | Differentiate between case bonded and cartridge loaded grains. | | | CO3 | R | | 1 |
| 7. | State the advantages and disadvantages of integral ram rocket. | | | CO4 | R | | 1 |
| 8. | List any two materials widely used in combustion chamber of liquid rocket engine. | | | CO4 | R | | 1 |
| 9. | State the requirement of igniter propellant. | | | CO5 | R | | 1 |
| 10. | Mention the need for working fluid in Ion propulsion system. | | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Differentiate between podded intake, integrated and flush intake. | | | CO1 | | An | 3 |
| 12. | Mention the difference between gas generator and preburner. | | | CO2 | | U | 3 |
| 13. | Illustrate the performance of the following oxidizer with respect to Specific impulse for variation in concentration AP, AN, KP & HMX. | | | CO3 | | A | 3 |
| 14. | List any six criteria for selection of liquid propellants. | | | CO4 | | U | 3 |
| 15. | State the advantage and disadvantage of scramjet propulsion system. | | | CO5 | | U | 3 |
| 16. | Classify the electrical propulsion. | | | 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. | Illustrate the variable area nozzle types as below   1. Central plug at nozzle outlet Ejector type 2. Iris nozzle | CO1 | | U | 4  4  4 |
|  | |  |  |  | |  |  |
| 18. | | a. | Explain multi-staging and clustering of rockets. | CO2 | | A | 12 |
|  | |  |  |  | |  |  |
| 19. | | a. | Mention the requirements of an igniter propellant (any four). | CO3 | | R | 2 |
|  | | b. | Explain pyrotechnic igniter and pyrogen igniter with a neat sketch. | CO3 | | U | 10 |
|  | |  |  |  | |  |  |
| 20. | | a. | Draw the schematic diagram of turbo-pump feed system with fuel rich stage combustion. | CO4 | | R | 4 |
|  | | b. | Explain the fuel rich stage combustion and state their advantages over pressure feed system. | CO4 | | A | 8 |
|  | |  |  |  | |  |  |
| 21. | | a. | Mention the process of heat transfer in the combustion chamber of a liquid rocket engine. | CO5 | | U | 4 |
|  | | b. | Explain regenerative cooling and transpiration cooling with neat sketch. | CO5 | | A | 8 |
|  | |  |  |  | |  |  |
| 22. | | a. | Explain the process of atomization and combustion of fuel for a single element injector. | CO5 | | A | 8 |
|  | | b. | State the difference between pressure injector and air blast injector. | CO5 | | U | 4 |
|  | |  |  |  | |  |  |
| 23. | | a. | Design a supersonic nozzle to operate at 10 km altitude with an area ratio of 8.0.For the hot gas take To = 3000 K, R = 378 J/kg-K and k = 1.3. Determine the exit Mach number, exit velocity, and exit temperature, as well as the chamber pressure.  If this chamber pressure is doubled, what happens to the thrust and the exit velocity? Assume no change in gas properties. How close to optimum nozzle expansion is this nozzle? | CO1 | | An | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | | a. | Give an overview of electric propulsion and explain magneto-plasma dynamics (MPD) thruster with neat sketch. | CO6 | | A | 12 |

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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 engine. |
| 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 / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 12 |  | 15 |  |  | 29 |
| CO2 | 2 | 3 | 12 |  |  |  | 17 |
| CO3 | 4 | 10 | 3 |  |  |  | 17 |
| CO4 | 6 | 3 | 8 |  |  |  | 17 |
| CO5 | 1 | 11 | 16 |  |  |  | 28 |
| CO6 |  | 4 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Flow is said to be incompressible if \_\_\_\_\_ is constant. | | CO1 | U | 1 |
| 2. | Flow is said to be steady and inviscid if \_\_\_\_\_\_\_ and \_\_\_\_\_\_ are zero. | | CO1 | R | 1 |
| 3. | Rewrite the limiting value of Reynolds number based on displacement thickness that aids the growth of unstable waves in a boundary layer. | | CO2 | R | 1 |
| 4. | Rewrite the critical value of Reynolds number for pipe flow | | CO2 | R | 1 |
| 5. | \_\_\_\_\_\_\_\_\_\_\_ is a process where the space in which a problem is solved is divided into smaller regions. | | CO3 | U | 1 |
| 6. | List two terms that are neglected in forward difference method. | | CO3 | R | 1 |
| 7. | Reproduce first order wave equation. | | CO4 | U | 1 |
| 8. | Reproduce one-dimensional transient heat conduction equation. | | CO4 | R | 1 |
| 9. | State the governing equation for fully developed flow in a pipe with zero pressure gradient. | | CO5 | A | 1 |
| 10. | State an equation that is hyperbolic in nature. | | CO5 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the forces that can possibly act on fluid element in motion. | | CO1 | R | 3 |
| 12. | Define turbulence and list various sources that aid the growth of fluctuations. | | CO2 | U | 3 |
| 13. | Determine three point forward differencing formula. | | CO3 | A | 3 |
| 14. | Discretize the equation following explicit scheme and Crank-Nicolson implicit scheme. | | CO4 | U | 3 |
| 15. | Explain the scenarios where Thomas algorithm can be applied. | | CO5 | A | 3 |
| 16. | Describe the advantages of upwind scheme. | | 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. | Derive X – component of moment equation and reduces it to Euler’s equation (write necessary assumptions). | CO1 | A | 6 |
|  | b. | Derive an appropriate equation that describes the conservation of mass. | CO1 | A | 6 |
| 18. | a. | Define transition and describe the composition of velocity and their rules for time-averages following Reynolds decomposition | CO2 | A | 4 |
|  | b. | Derive RANS for X-momentum equation. | CO2 | A | 8 |
| 19. | a. | Start from the general form of PDE and describe a method to find the nature and character of PDE. | CO3 | A | 6 |
|  | b. | Write Laplace equation and discuss on the type of equation and type of problem. | CO3 | A | 6 |
| 20. | a. | Start with steady state heat conduction equation in two dimension and predict the temperature at any point using finite difference method. | CO4 | U | 6 |
|  | b. | Predict temperature at “i” “n+1”, if is equal to unity. | CO4 | U | 6 |
| 21. | a. | Summarize various boundary condition for flow through a pipe. | CO5 | U | 6 |
|  | b. | Describe the procedure of Thomas Algorithm. | CO5 | U | 6 |
| 22. | a. | Write an appropriate equation describing a marching problem. Give one example of marching problem that is encountered in fluid mechanics.  Write a PDE that has the characteristic of hyperbola and show the procedure how the equation can be called as a hyperbolic equation. | CO3 | U | 6 |
|  | b. | Discuss the form of solution in terms of characteristics variables for a hyperbolic equation. | CO3 | U | 6 |
| 23. | a. | List various forces that can act on a fluid element and relate to various terms in momentum equation. | CO1 | R | 6 |
|  | b. | Identify that the governing equation for inviscid flows are Laplace equations. | CO1 | R | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Define staggered grid and discretize continuity equation. | CO6 | U | 6 |
|  | b. | Discretize the X-momentum equation on a staggered grid. | CO6 | A | 6 |

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|  | **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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 16 | 1 | 12 |  |  |  | 29 |
| CO2 | 2 | 3 | 12 |  |  |  | 17 |
| CO3 | 1 | 13 | 15 |  |  |  | 29 |
| CO4 | 1 | 16 |  |  |  |  | 17 |
| CO5 |  | 12 | 5 |  |  |  | 17 |
| CO6 |  | 9 | 6 |  |  |  | 15 |
|  | | | | | | | **124** |

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| Course Code : | 20AE2044 | Duration : | 3hrs |
| Course Name : | BOUNDARY LAYER THEORY | Max. Marks : | 100 |

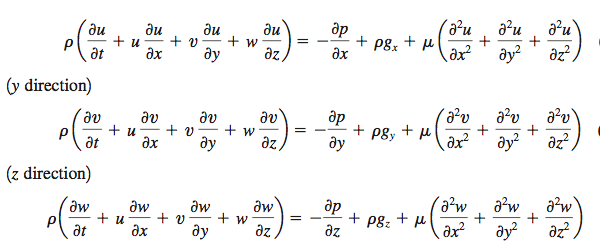
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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | **Course Outcome** | | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Sketch the hydrodynamic and thermal boundary layers for steady incompressible laminar flow of a constant property fluid over a thin flat plate, showing the relative size for *Pr<*1*, Pr =*1and *Pr>*1. | | CO1 | R | 1 |
| 2. | Specify the type of flow that can be analyzed by the Euler momentum equations | | CO1 | R | 1 |
| 3. | Sketch the laminar and turbulent hydrodynamic boundary layer for steady incompressible laminar flow of a constant property fluid over a thin flat plate, showing shape and relative sizes and comment on the velocity profiles in laminar and turbulent flow | | CO4 | U | 1 |
| 4. | The main observation by Prandtl based on which the boundary layer equations are developed is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | CO1 | R | 1 |
| 5. | Express in one sentence, the meaning of hydrodynamically fully developed flow. | | CO2 | U | 1 |
| 6. | Differentiate the Darcy friction factor and Fanning friction coefficient | | CO2 | U | 1 |
| 7. | State the non dimensional numbers that are analogous to each other in hydrodynamic, thermal and concentration boundary layers | | CO2 | R | 1 |
| 8. | A liquid metal to water heat exchanger used in a nuclear reactor has water on the shell side and liquid sodium on the tube side. 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. | | CO2 | U | 1 |
| 9. | What are the relative sizes of the thermal and hydrodynamic boundary layer in natural convection? | | CO2 | U | 1 |
| 10. | Laminar to Turbulent Transition happens are Reynolds number of \_\_\_\_\_\_ for internal flow and \_\_\_\_\_\_\_for external flow. | | CO4 | R | 1 |

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|  | | **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Express the most general law of conservation of mass in **differential** form  (a) If the flow is steady, what equation will result? Will the resulting equation represent a flow that is compressible or incompressible?  (b) If the flow is incompressible, what equation will result? Can this flow be unsteady? If yes, which quantities would vary with time? | | CO1 | A | 3 |
|  |  | |  |  |  |
| ‘12. | A nozzle is designed to accelerate the fluid from a velocity *V1*to *V2*in a linear fashion. That is, *V = ax + b*, where *a, b* are constants. If the flow is steady with *V1*= 5*m/s* at *x1*= 0 and *V2*= 15 *m/s* at *x2*= 1 *m* determine the local, convective and total acceleration of the field at points 1 and 2 | | CO2 | A | 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. | 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 . Usingthe momentum integral method the local boundary layer thickness for this velocity profile is given by the equation , where the local Reynolds number is and *x* is the distance along the plate.  Express the skin friction coefficient as a function of *Rex*.  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.*. | | CO2 | An | 3 |
|  |  | |  |  |  |
| 16. | List the advantages of the Karman-Pohlhausen momentum integral method in solving the Navier Stokes equations, compared to Blasius solution. | | CO5 | R | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23, Q.No. 24 is Compulsory)** | | | | |
| 17. | A tank of 0.05 *m3*volume contains air at 800 *kPA* (absolute) and 15*oC*. At time *t* = 0, air escapes from the tank through a valve with a flow area of 65 *mm2*. The air passing through the valve at *t* = 0has a velocity of 311 *m/*s and a density of 6.13 *kg/m3*. Properties of the rest of the tank may be assumed to be uniform. Determine the instantaneous rate of change of density in the tank at *t* = 0. | CO2 | An | 12 |
|  |  |  |  |  |
| 18. | With a neat sketch write a note on boundary layer separation and list few methods to control it? | CO3 | A | 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 cubic velocity profile for the hydrodynamic boundary layer with appropriate boundary conditions. | CO5 | An | 12 |
|  |  |  |  |  |
| 21. | Determine a cubic temperature profile for the thermal boundary layer with appropriate boundary conditions. | CO5 | An | 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 | CO5 | E | 12 |
|  |  |  |  |  |
| 23. | (a) Describe the boundary layer effects in hypersonic flows.  (b) Explain the differences between the analysis of hypersonic boundary layers compared to icompressible boundary layers.  (c) Explain the differences between two and three dimensional boundary layers. | CO6 | 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 Momentum Boundary Layer equation, in terms of the local Reynolds number and Prandtl No, for *Pr*> 1. Assume a lineartemperature profile in the thermal boundary layer and laminar boundary layers. | CO5 | E | 12 |

Some useful information required

**Properties Required –Density of air = 1.16 kg/m3, Dynamic Viscosity of air = 184.6 x 10-7N.s/m2**



For a thin flat plate

|  |  |
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|  | **COURSE OUTCOMES** |
|  | The student will be able to |
| CO1 | Define the fundamentals of boundary layer theory. |
| CO2 | Solve the equations involved in boundary layer theory. |
| CO3 | Analyze the different kinds of boundary layer control. |
| CO4 | Differentiate turbulent and laminar boundary layers. |
| CO5 | Estimate the boundary layer thickness for flow over a different bodies. |
| CO6 | Attain knowledge of boundary layer effects in hypersonic flows. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 3 |  | 3 |  |  |  | 6 |
| CO2 | 1 | 10 | 15 | 15 |  |  | 41 |
| CO3 |  |  | 12 |  |  |  | 12 |
| CO4 | 1 | 1 |  |  |  |  | 2 |
| CO5 | 3 |  |  | 24 | 24 |  | 51 |
| CO6 |  |  |  |  | 12 |  | 12 |
|  | **8** | **11** | **30** | **39** | **36** | **0** | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Who successfully performed the first trans-Atlantic flight, from where and in how many hours? | | CO1 | R | | 1 |
| 2. | Define wingspan of an aircraft wing. | | CO1 | R | | 1 |
| 3. | \_\_\_\_\_\_\_\_\_ are forming elements of the structure of a wing. | | CO2 | R | | 1 |
| 4. | \_\_\_\_\_\_\_\_\_ connects this entire nacelle/engine assembly to the aircraft. | | CO2 | R | | 1 |
| 5. | Name 4 common non-metallic materials used in aircrafts. | | CO3 | R | | 1 |
| 6. | What is the use of pushback trucks? | | CO3 | R | | 1 |
| 7. | Differentiate primary and secondary aircraft structures. | | CO4 | R | | 1 |
| 8. | The thrust of the \_\_\_\_\_\_\_\_\_\_\_\_ engine is a combination of thrust produced by fan blades and jet from the exhaust nozzle. | | CO4 | R | | 1 |
| 9. | Write the use of telemetry in a multicopter. | | CO5 | R | | 1 |
| 10. | India’s mission to the moon is called as \_\_\_\_\_\_\_\_\_ . | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Write few characteristics of Aerial steam engine. | | CO1 | | R | 3 |
| 12. | Differentiate interference drag and skin friction drag. | | CO2 | | R | 3 |
| 13. | Illustrate the 5 major stress acting on aircraft components. | | CO3 | | R | 3 |
| 14. | Draw the stress-strain curve of a typical composite material. | | CO4 | | R | 3 |
| 15. | Elaborate the Geostationary orbit and list its applications. | | CO5 | | R | 3 |
| 16. | List the societal applications of 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. |  | Elucidate the contributions of Sir George Cayley to the development of Aeronautics. | CO1 | | R | 12 |
|  |  |  |  | |  |  |
| 18. |  | Explain the function and working of basic flight instruments used in aircrafts. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 19. |  | Explain the different fuselage types with its merits and demerits. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 20. |  | Explain the use of metallic materials used for the construction of aircraft structures over the years. | CO3 | | R | 12 |
|  |  |  |  | |  |  |
| 21. |  | Explain the working of a turbofan engine with a neat sketch. | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 22. |  | Explain the working, types and disadvantages of a solid propellant rocket engine. | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 23. |  | Explain the basic components of a multicopter drone with neat sketch. | CO6 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Explain the growth in the development of indigenous launch vehicles in India. | CO5 | | U | 12 |

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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 Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 5 | 12 | - | - | - | - | 17 |
| CO2 | 5 | 24 | - | - | - | - | 29 |
| CO3 | 5 | 12 | - | - | - | - | 17 |
| CO4 | 5 | 24 | - | - | - | - | 29 |
| CO5 | 4 | 12 | - | - | - | - | 16 |
| CO6 | 4 | 12 | - | - | - | - | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

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

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| **Q. No.** | **Questions** | **Course Outcome / Pattern** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Define Thermal Conductivity. | CO1 / R | 1 |
| 2. | Classify the modes of heat transfer. | CO1 / U | 1 |
| 3. | Recall the effectiveness of a fin. | CO2 / R | 1 |
| 4. | The heat transfer from higher temperature to low temperature takes place according to \_\_\_\_\_\_\_\_\_. | CO2 / R | 1 |
| 5. | The ratio of inertial forces to viscous forces within a fluid which is subjected to relative internal movement due to different fluid velocities is known as \_\_\_\_\_\_\_\_\_. | CO3 / U | 1 |
| 6. | Prandtl number (Pr) is defined as the ratio of molecular \_\_\_\_\_\_\_\_\_ to thermal diffusivity. | CO3 / U | 1 |
| 7. | Infer the significance of irradiation. | CO4/ U | 1 |
| 8. | The \_\_\_\_\_\_\_\_\_ of a surface is defined as the fraction of the irradiation that is reflected from the surface. | CO4 /An | 1 |
| 9. | Give any two applications of heat exchanger. | CO5 / R | 1 |
| 10. | Relate the term LMTD in heat exchanger. | CO5 / U | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Recall the equation for conduction of heat through a hollow cylinder. | CO1 / R | 3 |
| 12. | List the applications of extended surface and its selection of a suitable fin geometry. | CO2 /A | 3 |
| 13. | Define Hydrodynamic boundary layer thickness. | CO3 / R | 3 |
| 14. | Identify the significance of free or natural convection. | CO4 / U | 3 |
| 15. | Infer the Planck’s distribution law. | CO5 / U | 3 |
| 16. | What is meant by compact heat exchangers? | CO6 / U | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23. Q.No 24 is Compulsory)** | | | | | |
| 17. | a. | **Categorize in the order of magnitude for thermal conductivity as given**  **(i) metals, (ii) solid insulating materials, (iii) liquids, (iv) gases.** | CO1/An | | 4 |
| b. | **Analyze with the three-dimensional heat-conduction analysis equation for an elemental volume in cylindrical coordinates.** | CO1/ A | | 8 |
|  |  |  |  | |  |
| 18. | a. | Relate the significance of lumped system with suitable example. | CO2 / U | | 4 |
| b. | A large plane wall thickness of 0.2 m, thermal conductivity k = 1.2 W/m °C, and surface area A = 15 m2. The two sides of the wall are maintained at constant temperatures of T1 = 120° C and T2 = 50° C, respectively, as shown in Figure 1. Determine (i) the variation of temperature within the wall and the value of temperature at x = 0.1 m and (ii) the rate of heat conduction through the wall under steady conditions. | CO2 /A | | 8 |
|  |  |  |  | |  |
| 19. | a. | Identify the functions of Reynolds Analogy for turbulent flow over plane surfaces. | CO3 /U | | 4 |
| b. | Water entering at 10°C is to be heated to 40°C in a tube of 0.02-m-ID at a mass flow rate of 0.01 kg/s. The outside of the tube is wrapped with an insulated electric-heating element that produces a uniform flux of 15,000 W/m2 over the surface. Neglecting any entrance effects, determine (i) the Reynolds number (ii) the heat transfer coefficient. | CO3 /A | | 8 |
|  |  |  |  | |  |
| 20. | a. | Summarize the significance of natural convection with examples. | CO4 / U | | 4 |
| b. | Engine oil at 60° C flows over the upper surface of a 5 m long flat plate whose temperature is 20° C with a velocity of 2 m/s. Calculate the total drag force and the rate of heat transfer per unit width of the entire plate. | CO4 /A | | 8 |
|  |  |  |  | |  |
| 21. | a. | Explain in detail absorptivity, reflectivity and transmissibility with a neat sketch. | CO5 / U | | 4 |
| b. | Summarize the fraction of the radiation leaving the base of the cylindrical enclosure shown in Figure 3 that escapes through a coaxial ring opening at its top surface. The radius and the length of the enclosure are r1 = 10 cm and L*=* 10 cm, while the inner and outer radii of the ring are r2 = 5 cm and *r*3 = 8 cm, respectively.  Figure 3 | CO5 / A | | 8 |
|  |  |  | |  |  |
| 22. | a. | Define emissive power [E] and monochromatic emissive power [Ebλ]. | | CO1 / U | 4 |
| b. | Explain the terms. i) Black body, ii) Stefan–Boltzmann law,  iii) Planck’s law and iv) Kirchoff’s law. | | CO1 / U | 8 |
|  |  |  | |  |  |
| 23. | a. | Examine in detail with suitable sketch and the flow patterns of i) Laminar flow and ii) Turbulent flow in non-circular tubes. | | CO2 /A | 4 |
| b. | Water enters a 2.5 cm internal diameter thin copper tube of a heat exchanger at 15°C at a rate of 0.3 kg/s, and is heated by steam condensing outside at 120°C. If the average heat transfer coefficient is 800 W/m2 oC, calculate the length of the tube required in order to heat the water to 115° C. | | CO2 /A | 8 |
|  |  |  | |  |  |
|  |  | **Compulsory:** | | | |
| 24. | a. | Classify Heat exchangers with its applications. | | CO6 / U | 4 |
| b. | A counter-flow double-pipe heat exchanger is to heat water from 20° C to 80° C at a rate of 1.2 kg/s. The heating is to be accomplished by geothermal water available at 160° C at a mass flow rate of 2 kg/s. The inner tube is thin-walled and has a diameter of 1.5 cm. If the overall heat transfer coefficient of the heat exchanger is 640 W/m2 °C, experiment with heat exchanger, the length required to achieve the desired heating. | | CO6 / A | 8 |

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|  | **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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 13 | 8 | 4 | - | - | 29 |
| CO2 | 2 | 4 | 23 | - | - | - | 29 |
| CO3 | 3 | 6 | 8 | - | - | - | 17 |
| CO4 | - | 8 | 8 | 1 | - | - | 17 |
| CO5 | 1 | 8 | 8 | - | - | - | 17 |
| CO6 | - | 7 | 8 | - | - | - | 15 |
|  | | | | | | | **124** |

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| **Course Code** | **21AE3001** | **Duration:** | **3hrs** |
| **Course Name** | **ADVANCED AERODYNAMICS** | **Max.Mark:** | **100** |

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| **Q.**  **No.** | **SubDiv.** | **Questions** | **Course Outcome**  **/Bloom’s level** | | **Marks** |
| **PART– A(5 X16 =80MARKS)**  **(Answeranyfivefrom thefollowing)** | | | | | |
| 1. | a. | Describe a mathematical condition for irrotational flow field and comment whether viscous fluids produce irrotational flow fields. | CO1/U | 4 | |
|  | b. | Derive equation of continuity for unsteady two-dimensional flow field. | CO1/U | 4 | |
|  | c. | For an irrotational flow a scalar potential () exists. From the continuity equation [Q 1. (b)] show that . | CO1/U | 4 | |
|  | d. | Obtain an equation to find conservation of mass. | CO1/U | 4 | |
|  |  |  |  |  | |
| 2. | a. | Define conditions for fully developed flow. | CO1/U | 4 | |
|  | b. | List differences between Couette and Planar Poiseuille flow. | CO1/U | 4 | |
|  | c. | Consider a scenario as shown in the following figure.  List necessary assumptions and show that | CO1/U | 4 | |
|  | d. | Draw velocity profiles for different values of pressure gradient. | CO1/A | 4 | |
|  |  |  |  |  | |
| 3. |  | For boundary layer solution over a flat plate of length unity, show that Blasius equation and its corresponding boundary conditions are | CO2/An | 16 | |
|  |  |  |  |  | |
| 4. | a. | Starting from the definition of compressibility prove that speed of sound | CO3/ A | 10 | |
|  | b. | From the ratio of kinetic energy to internal energy obtain Mach number relation | CO3/ A | 6 | |
|  |  |  |  |  | |
| 5. |  | Starting from the governing equation of normal shock obtain Prandtl’s relation | CO4 /U | 16 | |
|  |  |  |  |  | |
| 6. |  | Obtain the pressure difference relation across a normal shock. | CO5/A | 16 | |
|  |  |  |  |  | |
| 7. | a. | Formulate an appropriate representation to understand the changes in property in time and space. | CO1/U | 10 | |
|  | b. | Show thar the Moment generated by the viscous stresses about the center of the fluid element is zero. | CO1/U | 6 | |
| **PART– B (1 X20 =20MARKS)**  **(CompulsoryQuestion)** | | | | | |
| 8. |  | Define Fanno flow and Rayleigh flow. Write the differences between them. Write their governing equations. | CO6/U | 20 | |

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|  | **COURSEOUTCOMES** |
| 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 Pitotstatictube. |
| CO4 | Assess the nature of compressible flow over air foils and finite wings. |
| CO5 | Use the computational tools to evaluate hypersonic flows. |
| CO6 | Understand the basic principles of expansion waves. |

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| **AssessmentPatternas perBloom’s Taxonomy** | | | | | | | |
| CO | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 44 | 4 |  |  |  | 48 |
| CO2 |  |  |  | 16 |  |  | 16 |
| CO3 |  |  | 16 |  |  |  | 16 |
| CO4 |  | 16 |  |  |  |  | 16 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  | 20 |  |  |  |  | 20 |
|  | | | | | | | **132** |

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

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| **Q. No.** | **Questions** | | **Course Outcome** | | | **Bloom’s Level** | | | **Marks** | | | |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | | | | | | | | |
| 1. |  | The strain components at a point with respect to the and axes are . The co-ordinate axes are rotated about the axis through in counter clockwise direction, determine the new strain components. | | | CO1 | | | A | | 16 | | |
|  |  |  | | |  | | |  | |  | | |
| 2. |  | Deduce the hooke’s law for isotropic materials. | | | CO2 | | | A | | 16 | | |
|  |  |  | | |  | | |  | |  | | |
| 3. |  | For a graphite/epoxy unidirectional lamina, find the following  1. Compliance matrix  2. Minor Poisson’s ratio  3. Reduced stiffness matrix  4. Strains in the 1–2 coordinate system if the applied stresses are  σ1 = 2 MPa, σ2 = –3 MPa, and τ12 = 4 MPa. Assume E1 = 181 GPa, E2 = 10 GPa, G12 = 7 GPa and ν12 =0.28. | | | CO3 | | | E | | 16 | | |
|  |  |  | | |  | | |  | |  | | |
| 4. |  | 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. | | | CO4 | | | E | | 16 | | |
|  |  |  | | |  | | |  | |  | | |
| 5. |  | Find 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 | | 16 | | |
|  |  |  | | |  | | |  | |  | | |
| 6. |  | The sheet stringer panel shown in Fig. is loaded in compression by means of rigid members. The sheet is assumed to be simply supported at the loaded ends and at the rivet lines and to be free at the sides. Each stringer has an area of 0.65 cm2. Assume E = 70 GPa for the sheet and stringers. Find the total compressive load P:  (a) when the sheet first buckles  (b) When the stringers stress is 70 MN/m2  (c) When the stringers stress is 210 MN/m2. | | | CO | | | An | | 16 | | |
|  |  |  | | |  | | |  | |  | | |
| 7. |  | Find the shear flow and twist per unit length of the two cell tube made of aluminium as shown Fig. and is subjected to a torque 90000 Ncm | | | CO | | | A | | 16 | | |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | | | | | | | | |
| 8. |  | A cantilever beam as shown in Fig. carries concentrated loads as shown. Calculate the distribution of stiffener loads and the shear flow distribution in the web panels assuming that the latter are effective only in shear. | | CO6 | | | A | | | | 20 |

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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. | | | | | | | |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | |
| CO / P | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | | - | - | 32 | - | - | - | 32 |
| CO2 | | - | - | - | - | 16 | - | 16 |
| CO3 | | - | - | - | - | 16 | - | 16 |
| CO4 | | - | - | 32 | - | - | - | 32 |
| CO5 | | - | - | - | 16 | - | - | 16 |
| CO6 | | - | - | 20 | - | - | - | 20 |
|  | | | | | | | | **132** |



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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | The following data represent the length of life in years, measured to the nearest tenth, of 30 similar fuel pumps: 2.0 3.0 0.3 3.3 1.3 0.4 0.2 6.0 5.5 6.5 0.2 2.3 1.5 4.0 5.9 1.8 4.7 0.7 4.5 0.3 1.5 0.5 2.5 5.0 1.0 6.0 5.6 6.0 1.2 0.2  (a) Construct a stem-and-leaf plot for the life in years of the fuel pumps, using the digit to the left of the decimal point as the stem for each observation.  (b) Set up a relative frequency distribution.  (c) Compute the sample mean, sample range, and sample standard deviation. | CO1 | Apply | 16 |
|  |  |  |  |  |  |
| 2. |  | The following data are the measures of the diameters of 36 rivet heads in 1/100 of an inch.  6.72 6.77 6.82 6.70 6.78 6.70 6.62 6.75 6.66 6.66 6.64 6.76 6.73 6.80 6.72 6.76 6.76 6.68 6.66 6.62 6.72 6.76 6.70 6.78 6.76 6.67 6.70 6.72 6.74 6.81 6.79 6.78 6.66 6.76 6.76 6.72  (a) Compute the sample mean and sample standard deviation.  (b) Construct a relative frequency histogram of the data.  (c) Comment on whether or not there is any clear indication that the sample came from a population that has a bell-shaped distribution. | CO2 | Apply | 16 |
|  |  |  |  |  |  |
| 3. | a. | Consider the sample space S = {copper, sodium, nitrogen, potassium, uranium, oxygen, zinc} and the events A = {copper, sodium, zinc}, B = {sodium, nitrogen, potassium}, C = {oxygen}. List the elements of the sets corresponding to the following events: (a) A ′ ; (b) A ∪ C; (c) (A ∩ B ′ ) ∪ C ′ ; (d) B ′ ∩ C ′ ; (e) A ∩ B ∩ C; (f) (A ′ ∪ B ′ ) ∩ (A ′ ∩ C). | CO3 | Apply | 8 |
|  | b. | Consider two bags where bag 1 contains 4 blue and 6 green balls, bag 2 contains 5 blue and 5 green balls. Bag is selected at random and ball is drawn from it.   1. What is the probability that the ball drawn is green? 2. What is the probability that it is drawn from bag 2? | CO3 | Apply | 8 |
|  |  |  |  |  |  |
| 4. |  | An experiment involves tossing a pair of dice, one green and one red, and recording the numbers that come up. If x equals the outcome on the green die and y the outcome on the red die, describe the sample space S  (a) by listing the elements (x, y); (b) by using the rule method  (c) list the elements corresponding to the event A that the sum is greater than 8; (d) list the elements corresponding to the event B that a 2 occurs on either die; (e) list the elements corresponding to the event C that a number greater than 4 comes up on the green die; (f) list the elements corresponding to the event A ∩ C; (g) list the elements corresponding to the event A ∩ B; (h) list the elements corresponding to the event B ∩ C; (i) construct a Venn diagram to illustrate the intersections and unions of the events A, B, and C. | CO4 | Apply | 16 |
|  |  |  |  |  |  |
| 5. |  | The following data set gives the percentages of the families that are in the upper income level, for the same individual schools.  72.2 31.9 26.5 29.1 27.3 8.6 22.3 26.5 20.4 12.8 25.1 19.2 24.1 58.2 68.1 89.2 55.1 9.4 14.5 13.9 20.7 17.9 8.5 55.4 38.1 54.2 21.5 26.2 59.1 43.3  (a) Calculate the sample mean.  (b) Calculate the sample median.  (c) Construct a relative frequency histogram of the data.  (d) Compute the 10% trimmed mean. | CO2 | Apply | 16 |
|  |  |  |  |  |  |
| 6. |  | The table below gives experimental data for force(N) and velocity (m/s) for an object suspended in a wind tunnel   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Velocity (m/s) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | | Force(N) | 24 | 68 | 378 | 552 | 608 | 1218 | 831 | 1452 |  1. Use the linear least square regression to determine the coefficients a and b in the function that best fits the data 2. Estimate the force when the velocity is 55m/s | CO5 | Apply | 16 |
|  |  |  |  |  |  |
| 7. |  | A study was done to study the effect of ambient temperature x on the electric power consumed by a chemical plant y. Other factors were held constant, and the data were collected from an experimental pilot plant.   |  |  |  |  | | --- | --- | --- | --- | | y (BTU) | x ( ◦F) | y (BTU) | x ( ◦F) | | 250 | 27 | 265 | 31 | | 85 | 45 | 298 | 60 | | 320 | 72 | 267 | 34 | | 295 | 58 | 321 | 74 |   (a) Plot the data  (b) Estimate the slope and intercept in a simple linear regression model.  (c) Predict power consumption for an ambient temperature of 65◦F. | CO6 |  | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | In a certain type of metal test specimen, the normal stress on a specimen is known to be functionally related to the shear resistance. The following is a set of coded experimental data on the two variables:   |  |  | | --- | --- | | Normal Stress, x | Shear Resistance, y | | 26.8 | 26.5 | | 25.4 | 27.3 | | 28.9 | 24.2 | | 23.6 | 27.1 | | 27.7 | 23.6 | | 23.9 | 25.9 | | 24.7 | 26.3 | | 28.1 | 22.5 | | 26.9 | 21.7 | | 27.4 | 21.4 | | 22.6 | 25.8 | | 25.6 | 24.9 |  1. Estimate the regression line 2. Estimate the shear resistance for a normal stress of 24.5 3. Evaluate | CO6 |  | 20 |

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|  | **COURSE OUTCOMES** |
| CO1 | Find a meaningful pattern in data. |
| CO2 | Graphically interpret the data. |
| CO3 | Implement the analytic algorithm. |
| CO4 | Handle large scale analytic projects from various domain. |
| CO5 | Develop intelligent decision support system. |
| CO6 | Understand various techniques in handling data. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  |  | 16 |  |  |  | 16 |
| CO2 |  |  | 32 |  |  |  | 32 |
| CO3 |  |  | 16 |  |  |  | 16 |
| CO4 |  |  | 16 |  |  |  | 16 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 36 |  |  |  | 36 |
|  | | | | | | | **132** |

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| **Graphical user interface, application  Description automatically generated with medium confidence**   |  |  |  |  | | --- | --- | --- | --- | | **Course Code** | **21AE3006** | **Duration** | **3hrs** | | **Course Name** | **ADVANCED PROPULSION TECHNOLOGY** | **Max. Marks** | **100** | | | | | | | | | | | | |  |  |  |
| **Q. No.** | **Sub Div.** | **Questions** | **Course Outcome** | | **Bloom’s Level** | | | **Marks** | | |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | | | | | | |
| 1. | a. | Explain with suitable graphs the performance of a turbojet engine. | | CO2 | | | R | | | 8 |
|  | b. | Explain the general matching procedure of components of gas turbine engine. | | CO1 | | | U | | | 8 |
|  |  |  | |  | | |  | | |  |
| 2. |  | Derive the expression for specific work output and the efficiency of a simple cycle with intercooler, heat exchanger and reheat. Draw their trends as a function of pressure ratio and explain the observation. | | CO1 | | | An | | | 16 |
|  |  |  | |  | | |  | | |  |
| 3. |  | A gas turbine unit operates at a mass flow of 30 kg/s. Air enters the compressor at a pressure of 1 bar and temperature 15̊ C and is discharged from the compressor at a pressure of 10.5 bar. Combustion occurs at constant pressure and results in a temperature rise of 420 K. If the flow leaves the turbine at a pressure ratio of 1.2 bar, determine the net power output from the unit and also the thermal efficiency. | | CO1 | | | A | | | 16 |
|  |  |  | |  | | |  | | |  |
| 4. | a. | The following measurements were made in a sea level test of a solid  propellant rocket motor:  Burn duration 100 sec  Initial mass before test 8552 kg  Mass of rocket motor after test 562 kg  Average thrust 1,22,570 kg  Chamber pressure 7 MPa  Nozzle exit pressure 0.25 MPa  Nozzle throat diameter 0.162 m  Nozzle exit diameter 0.45 m  Determine, V2, C\*, C, and *Is* at sea level, and c and *Is* at 5000 and 15,000 m altitude. At 5000 m & 10,000 m the pressure is 0.053313 and 0.026151 MPa respectively  Assume an invariant thrust and mass flow rate and negligible short start and stop transients. | | CO3 | | | E | | | 12 |
|  | b. | From the above problem summarize the performance of the rocket motor for various altitude conditions. | | CO4 | | | An | | | 4 |
|  |  |  | |  | | |  | | |  |
| 5. | a. | With neat sketch explain fuel rich stage combustion | | CO3 | | | R | | | 8 |
|  | b. | Explain the combustion process and the flame structure of a double-base propellant with a strand burner in an inert atmosphere | | CO4 | | | U | | | 8 |
|  |  |  | |  | | |  | | |  |
| 6. | a. | Briefly explain the following green propellants alternative for AP   1. Ammonium Nitrate   (AN) 2. Hydrazinium Nitroformate (HNF) 3. Ammonium Dinitramide (ADN) 4. Potassium Dinitramide (KDN) | | CO5 | | | R | | | 8 |
|  | b. | Mention the need for green propulsion and list their importance. | | CO3 | | | C | | | 8 |
|  |  |  | |  | | |  | | |  |
| 7. |  | Mention the significance of ion thruster and explain the design procedure of ion thruster for deep space application. | | CO6 | | | R | | | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | | | | | | |
| 8. | a. | Explain the significance of scramjet combustion. | | CO4 | | A | | | 6 | |
|  | b. | Explain the following type of scramjet combustor with neat sketch   1. Ramp-cavity. 2. Wedge shaped strut injector. | | CO4 | | A | | | 14 | |

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|  | **COURSE OUTCOMES** |
| CO1 | Illustrate the performance of various cycles of turbine engine. |
| CO2 | Estimate the performance of aircraft engines. |
| CO3 | Design the subsystems for chemical rockets. |
| CO4 | Analyse and compare the performance of chemical rockets. |
| CO5 | Design the subsystems for green propulsion systems. |
| CO6 | Evaluate the performance of space thrusters. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 8 | 16 | 16 |  |  | 40 |
| CO2 | 8 |  |  |  |  |  | 8 |
| CO3 | 8 |  |  |  | 12 | 8 | 28 |
| CO4 |  | 8 | 20 | 4 |  |  | 32 |
| CO5 | 8 |  |  |  |  |  | 8 |
| CO6 | 16 |  |  |  |  |  | 16 |
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| **Course Code** | **21AE3009** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED AVIONICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Examine the components of an aircraft sub-system with a neat sketch. | CO1 | R | 8 |
|  | b. | Enumerate the salient features of the protocol developed at Wright Patterson aircraft base. | CO1 | R | 8 |
| 2. | a. | Summarize the merits and demerits of a display system in which a microprocessor and liquid crystal display are used. | CO2 | U | 8 |
|  | b. | Identify and explain the display system that consists of a glass and windscreen. | CO2 | U | 8 |
| 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. |  | Explain the functions of the flight system that controls the lateral and vertical path of an aircraft, with the help of a simple sketch.Write the benefits of that system. | CO4 | A | 16 |
| 5. | a. | Illustrate the types of controls used to control the direction and altitude of an aircraft. | CO5 | A | 8 |
|  | b. | Sketch the phases of a flight and explain. | CO5 | A | 8 |
| 6. | a. | Explain the onboard router system in an aircraft with the help of a diagram. | CO6 | A | 8 |
|  | b. | Establish the hardware architecture of a communication management function. | CO6 | A | 8 |
| 7. |  | Describe the advanced protocol standard to interconnect avionics sub-system. | CO1 | R | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | Differentiate the types of pressure sensors employed in an aircraft. | CO5 | U | 20 |

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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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 32 |  |  |  |  |  | 32 |
| CO2 |  | 16 |  |  |  |  | 16 |
| CO3 |  |  | 16 |  |  |  | 16 |
| CO4 |  |  | 16 |  |  |  | 16 |
| CO5 |  | 20 | 16 |  |  |  | 36 |
| CO6 |  |  | 16 |  |  |  | 16 |
|  | | | | | | | **132** |

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

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| **Q. No.** | **Sub Div.** | **Questions** | **Course Outcome / Pattern** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | |
| 1. | a. | Classify the steels used in aircraft construction. | CO1 / P | 4 |
|  | b. | Describe in detail the heat treatment procedures for various aircraft steels. | CO1 / P | 8 |
|  | c. | Explain the basic requirements and criteria for material selection for aerospace applications. | CO1 / P | 4 |
|  |  |  |  |  |
| 2. | a. | Explain the manufacturing processes associated with super alloys. | CO2 / P | 6 |
|  | b. | Describe briefly the heat treatment and surface treatment of super alloys. | CO2 / P | 6 |
|  | c. | Explain about iron based and cobalt based super alloys, their composition and applications. | CO2 / P | 4 |
|  |  |  |  |  |
| 3. | a. | Define composite materials. What are the major constituents in composite materials? | CO3 / P | 6 |
|  | b. | What are metal matrix composites? What are the advantages and applications of metal matrix composites? | CO3 / P | 6 |
|  | c. | What are lightweight metals? Discuss its uses in aerospace industry. | CO3 / P | 4 |
|  |  |  |  |  |
| 4. | a. | Discuss in detail the production of Ceramic Matrix Composites, its properties, advantages and applications. | CO4 / P | 10 |
|  | b. | Briefly describe fracture and fatigue of non-oxide ceramics. | CO4 / P | 6 |
|  |  |  |  |  |
| 5. | a. | Describe the composites manufacturing using prepreg. | CO5 / P | 6 |
|  | b. | Explain the drawbacks and applications of polymer matrix composites. | CO5 / P | 6 |
|  | c. | Explain in detail the design concepts of sandwich construction. | CO5 / P | 4 |
|  |  |  |  |  |
| 6. | a. | Describe the application of high temperature materials in aircraft components. | CO4 / P | 6 |
|  | b. | Briefly describe the properties of materials. | CO1 / P | 6 |
|  | c. | Explain the alloys used in aircraft engines. | CO2 / P | 4 |
|  |  |  |  |  |
| 7. | a. | Explain the Silicon nitride matrix composites. | CO4 / P | 10 |
|  | b. | Describe the composites manufacturing by resin infusion. | CO5 / P | 6 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | |
| 8. | a. | Compare shape memory alloys and super alloys. | CO6 / P | 6 |
|  | b. | Describe in detail the properties and applications of Electrostrictive ceramics and Magnetic smart materials. | CO6 / P | 8 |
|  | c. | Explain fire resistant composite. | CO6 / P | 6 |

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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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 8 | - | 14 | - | - | - | 22 |
| CO2 | - | 16 | 4 | - | - | - | 20 |
| CO3 | 10 | 6 | - | - | - | - | 16 |
| CO4 | - | 10 | 6 | 16 |  |  | 32 |
| CO5 | - | 12 | 10 | - |  |  | 22 |
| CO6 | - | - | 8 | 12 | - | - | 20 |
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| **Course Code** | **21AE3011** | **Duration** | **3hrs** |
| **Course Name** | **SIMULATION AND MODEL BASED SYSTEMS ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Define system engineer and give an overview of system engineering. | CO1 | R | 8 |
|  | b. | Explain systems of systems with necessary sketch. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Explain the various elements of a model and their characteristics. | CO2 | U | 8 |
|  | b. | Explain the presentations and its requirements for a systems engineering process. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | State the need and significance of pattern based system engineering. | CO3 | R | 8 |
|  | b. | Analyze architecture model and analytical model and draw your inference. | CO3 | An | 8 |
|  |  |  |  |  |  |
| 4. | a. | Illustrate traceability pattern and its application in system engineering. | CO4 | A | 8 |
|  | b. | Explain SysML with block diagram. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the significance of evidence pattern. | CO5 | An | 8 |
|  | b. | Evaluate MBSE for Aerospace industries. | CO5 | E | 8 |
|  |  |  |  |  |  |
| 6. | a. | Briefly explain model retro-fitting unstructured model. | CO6 | A | 8 |
|  | b. | Analyze the significance of model maturity. | CO6 | An | 8 |
|  |  |  |  |  |  |
| 7. |  | Briefly explain system architecture model and analytical model. | CO3 | A | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | XYZ is the customer for an ABC Bearing company. The ABC bearing company needs to supply the ball bearing for the axial wheel, based on the customer’s requirement. Suggest the roles and responsibility of the system engineers and the various modelling tools to be used for the optimum operation of the entire system. | CO6 | An | 20 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand System Engineering and its usage. |
| CO2 | To understand how Model Based Engineering used in development of Systems. |
| CO3 | To articulate the usage of Modelling Patterns. |
| CO4 | To illustrate the concepts of MBSE. |
| CO5 | To understand the concepts of Modelling Patterns. |
| CO6 | To examine applications and case studies of Modelling Patterns. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 8 | 8 |  |  |  |  | 16 |
| CO2 |  | 8 | 8 |  |  |  | 16 |
| CO3 | 8 |  | 16 | 8 |  |  | 32 |
| CO4 |  |  | 16 |  |  |  | 16 |
| CO5 |  |  |  | 8 | 8 |  | 16 |
| CO6 |  |  | 8 | 28 |  |  | 36 |
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| **Course Code** | **21AE3013** | **Duration** | **3hrs** |
| **Course Name** | **DATA ANALYTICS AND VISUALIZATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Differentiate structured and unstructured data with examples. Write the five main characteristics of big data and highlight the most important V amongst the 5 V's of big data. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. |  | With the help of a neat flow chart, explain how to build text classification system. Also discuss the importance of text classification and write some popular applications where the text classification is used in real-world scenarios. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 3. |  | Determine the mean, median, mode, range, variance and standard deviation for the given temperature data in degrees Celsius. Also illustrate the importance of statistics in this data analysis.  {13, 18, 13, 14, 13, 16, 14, 22, 13} | CO3 | A | 16 |
|  |  |  |  |  |  |
| 4. | a. | Explain the validation approaches applicable for the four levels of visualization design. | CO4 | U | 10 |
|  | b. | You are given a data set consisting of variables with missing values. Identify the methods for filling in missing values and list the best practices for data cleaning. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 5. |  | Compare the data visualization software power BI desktop and the power BI service and explain the basic concepts for the designers in the power BI. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 6. |  | The following table lists values of few *x* and *y* observations. Estimate the regression parameters using the least square regression method.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | *x* | 11 | 21 | 31 | 40 | 50 | | *y* | 23 | 43 | 63 | 83 | 103 | | CO3 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Describe the detailed structure of the four basic dataset types with the help of a neat diagram and write the basics of Natural Language Processing. | CO2 | R | 10 |
|  | b. | Consider the following histogram that represents the weights of 34 newborn babies in a hospital. If the children weighing between 6.5 lb to 8.5 lb are considered healthy, then find the percentage of the children of this hospital that are healthy. Also write some important facts about the histograms and list the uses of the histogram charts. | CO2 | A | 6 |
|  |  |  |  |  |  |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Interpret the information found in the following visualizations. Write the important concepts about the scatter graph and the line of best fit. Also write the uses of scatter plots. | CO6 | An | 12 |
|  | b. | Construct a whisker’s plot using the five number summary for the given data and explain how it is used in data visualization.  18, 27, 34, 52, 54, 59, 61, 68, 78, 82, 85, 87, 91, 93, 100 | CO6 | A | 8 |

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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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 16 | - | - | - | - | 16 |
| CO2 | 10 | 16 | 6 | - | - | - | 32 |
| CO3 | - | - | 32 | - | - | - | 32 |
| CO4 | - | 16 | - | - | - | - | 16 |
| CO5 | - | 16 | - | - | - | - | 16 |
| CO6 | - | - | 8 | 12 | - | - | 20 |
|  | | | | | | | **132** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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| **Course Code** | **20AE2001** | **Duration** | **3hrs** |
| **Course Name** | **INTRODUCTION TO AEROSPACE ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | |
| 1. | Discuss TATA airways. | | | | CO1 | U | | 1 |
| 2. | Label the glider name. | | | | CO1 | R | | 1 |
| 3. | Describe the functions of an airfoil. | | | | CO2 | R | | 1 |
| 4. | Cite the type of airfoil | | | | CO2 | R | | 1 |
| 5. | Discuss monocoque fuselage structure. | | | | CO3 | U | | 1 |
| 6. | https://www.engineeringcivil.com/wp-content/uploads/2010/08/Howe-Truss-Warren-Truss-and-Pratt-Truss.JPGLabel the structure type | | | | CO3 | R | | 1 |
| 7. | How a Car Engine Works | Engine Components and Engine PartsCite the stroke of piston engine | | | | CO4 | U | | 1 |
| 8. | Describe the functions of propeller. | | | | CO4 | R | | 1 |
| 9. | Classify the types of rocket engines. | | | | CO5 | U | | 1 |
| 10. | Describe Newton’s 2nd law. | | | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | |
| 11. | Differentiate – heavier than air & lighter than air. | | | | CO1 | | An | 3 |
| 12. | Describe Reynolds number with equation. | | | | CO2 | | U | 3 |
| 13. | Differentiate – monocoque and semi-monocoque fuselage structure. | | | | CO3 | | An | 3 |
| 14. | Describe the empennage structural members. | | | | CO4 | | U | 3 |
| 15. | Compare hybrid rocket engine with liquid rocket engine. | | | | CO5 | | An | 3 |
| 16. | Explain Kepler’s law of motion. | | | | 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 different types of flight vehicles with necessary diagrams. | | CO1 | | U | 12 |
| 18. | |  | Describe about aircraft components and its functions with necessary sketches. | | CO2 | | R | 12 |
| 19. | |  | Elaborate the types of aircraft fuselage structures with necessary sketches. | | CO3 | | U | 12 |
| 20. | |  | Discuss in detail about the working procedure of reciprocating engine with its separate stroke diagrams. | | CO4 | | U | 12 |
| 21. | |  | Classify the types of rockets based on their propellants used with necessary diagrams. | | CO5 | | U | 12 |
| 22. | |  | Discuss in detail about the history of aviation in India with necessary timelines. | | CO1 | | U | 12 |
| 23. | |  | Explain about the materials used in Aircraft structures with necessary points. | | CO3 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | | | |
| 24. | |  | | Deduce the Vis-viva equation for orbiting bodies. | CO6 | | An | 12 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 25 |  | 3 |  |  | 29 |
| CO2 | 13 | 4 |  |  |  |  | 17 |
| CO3 | 1 | 25 |  | 3 |  |  | 29 |
| CO4 | 1 | 16 |  |  |  |  | 17 |
| CO5 |  | 13 |  | 3 |  |  | 16 |
| CO6 | 1 | 3 |  | 12 |  |  | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Derive the general differential equations of motion for a fluid in terms of stresses, velocities and density. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 2. |  | Derive Navier-Stokes equation in terms of cylindrical polar coordinates from stress-deformation relationships for incompressible and newtonian fluid. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. |  | Derive the equation of gas velocity to be measured using pitot-tube for incompressible, subsonic and supersonic flows. | CO3 | A | 16 |
|  |  |  |  |  |  |
| 4. | a. | Produce the alternative forms of energy equation. | CO4 | A | 10 |
|  | b. | Relate shock compression with isentropic compression. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 5. |  | Apply Runge Kutta method to solve boundary layer equation. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Derive Blasius equation for the flow over a flat plate of length unity. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 7. |  | Explain about the construction and function of shock tube. | CO6 | U | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Derive the expression for 1D flow with heat addition. | CO6 | A | 15 |
|  | b. | Construct mollier diagram for 1D flow with heat addition. | CO6 | A | 5 |

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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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | - | 16 | - | - | - | 16 |
| CO2 | - | - | 32 | - | - | - | 32 |
| CO3 | - | - | 16 | - | - | - | 16 |
| CO4 | - | - | 16 | - | - | - | 16 |
| CO5 | - | - | 16 | - | - | - | 16 |
| CO6 |  | 16 | 20 | - | - | - | 36 |
|  | | | | | | | **132** |



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

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| **Q. No.** | **Questions** | | **Course Outcome** | | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | | |
| 1. |  | Deduce the Equations of Equilibrium for an elastic body. | | CO1 | A | 16 |
|  |  |  | |  |  |  |
| 2. |  | Deduce the hooke’s law for orthotropic materials. | | CO2 | A | 16 |
|  |  |  | |  |  |  |
| 3. |  | Derive the shear flow induced in a thin walled open section beam subjected to a shear force V­. | | CO3 | A | 16 |
|  |  |  | |  |  |  |
| 4. |  | Find the shear flow and twist per unit length of the two cell tube made of aluminium as shown Fig. and is subjected to a torque 90000 Ncm | | CO4 | A | 16 |
|  |  |  | |  |  |  |
| 5. |  | Determine using angle method, the crippling stress for the formed section shown in Fig. if material is aluminium alloy 2024-T3.  Fcy = 2.75x108 N/m2. Ec = 70x109N/m2. | | CO5 | A | 16 |
|  |  |  | |  |  |  |
| 6. |  | Find the margin of safety in buckling for the box beam shown in figure. Given P1= P2=10 kN. Area of each stringer = 2 cm2and the sheet thickness = 1.5 mm. Assume the sheets are effective in bending and made of 2024-T3aluminium alloy. For a/b = 2, kc = 5 &ks = 6.5 and for a/b = 3, kc = 4 &ks=5.8. | | CO6 | A | 16 |
|  |  |  | |  |  |  |
| 7. |  | A cantilever beam as shown in Fig. carries concentrated loads as shown. Calculate the distribution of stiffener loads and the shear flow distribution in the web panels assuming that the latter are effective only in shear. | | CO6 | A | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | | |
| 8. |  | Determine the shear flow for the shear resistant beam shown in Fig. Vertical shear load = 60 kN. Area (A) = 2.5 cm2. | | CO3 | A | 20 |

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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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  |  | 16 |  |  |  | 16 |
| CO2 |  |  | 16 |  |  |  | 16 |
| CO3 |  |  | 36 |  |  |  | 36 |
| CO4 |  |  | 16 |  |  |  | 16 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 32 |  |  |  | 32 |
|  | | | | | | | **132** |