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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Reynolds number and Mach number. | | CO1 | R | 1 |
| 2. | Name the component that has converging passage upstream of the test section. | | CO2 | R | 1 |
| 3. | Recite the terms “Lift to Drag Ratio”. | | CO4 | R | 1 |
| 4. | Locate the use of honeycomb section in the wind tunnel. | | CO1 | R | 1 |
| 5. | Define different type of flows based on Mach number. | | CO3 | R | 1 |
| 6. | Distinguish between the terms “Yawing” and “Rolling”. | | CO5 | U | 1 |
| 7. | Infer the loads and moments acting on a body immersed in a stream of fluid. | | CO4 | U | 1 |
| 8. | State the use of LDA. | | CO5 | R | 1 |
| 9. | Indicate the use of “Shadowgraph visualization” system used in the wind tunnel. | | CO6 | U | 1 |
| 10. | Identify the applications of “PIV” in wind tunnel measurement system. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write the Compressible flow theory. | | CO4 | A | 3 |
| 12. | Distinguish between the “Hypersonic” and “Supersonic” condition in the wind tunnel. | | CO2 | U | 3 |
| 13. | Show the uses of diffuser and list the problems experienced in short diffusers. | | CO1 | U | 3 |
| 14. | Brief on the procedure to measure moments using internal balances. | | CO3 | U | 3 |
| 15. | Distinguish between optical and non-optical visualization techniques. | | CO6 | U | 3 |
| 16. | Write about the Heat flux measurements in wind tunnel. | | 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. | Illustrate the salient features of spin tunnel with a neat sketch. | CO1 | A | 6 |
|  | b. | Explain the various parts of a subsonic wind tunnel with help of a diagram and explain its working principle. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Appraise about the “Starting and stopping Loads” in Supersonic wind tunnel. | CO2 | An | 6 |
|  | b. | Compare the Continuous and intermittent type of wind tunnels. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Sketch the arrangement of shock tube, describe its construction and its notable performance with neat sketches. | CO2 | A | 6 |
|  | b. | Analyze the “Runtime mass flow rate” in the supersonic wind tunnel. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 20. |  | Write the operation of a “Hot wire Anemometry” and explain its arrangement with help of a schematic diagram. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Distinguish between the blow down and other types of wind tunnel. | CO2 | An | 6 |
|  | b. | Explain the working principle of Pitot tube and its applications in wind tunnel measurement. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the manometers used in wind tunnel. | CO5 | A | 6 |
|  | b. | Articulate the various parts of an “Internal Strain gauge balance” with help of a diagram and explain its working principle. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Illustrate how the thermocouples and temperature sensitive paint (TSP) are being used as various temperature measurement systems in wind tunnel with suitable sketch. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Compare the use of “surface oil flow” and “tufts” in visualization techniques used in wind tunnel. | CO6 | An | 6 |
|  | b. | Explain the “Schlieren flow visualization” technique used in wind tunnel measurement system with help of a neat sketch. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | | **COURSE OUTCOMES** | | | | | | | |
| CO1 | | Understand the various types of wind tunnels and test techniques. | | | | | | | |
| CO2 | | Choose proper high speed wind tunnel for required test | | | | | | | |
| CO3 | | Choose correct model for wind tunnel testing. | | | | | | | |
| CO4 | | Estimate the forces and moments for given model. | | | | | | | |
| CO5 | | Estimate pressure, velocity and temperature using measurement techniques. | | | | | | | |
| CO6 | | Choose the proper flow visualization techniques | | | | | | | |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | | |
| **CO** | | **R** | **U** | **A** | **An** | **E** | **C** | **Total** | |
| CO1 | | 2 | 3 | 12 | - | - | - | 17 | |
| CO2 | | 1 | 3 | 6 | 18 | - | - | 28 | |
| CO3 | | 1 | 3 | - | - | - | - | 4 | |
| CO4 | | 1 | 1 | 9 | 6 | - | - | 17 | |
| CO5 | | 1 | 1 | 24 | 12 | - | - | 38 | |
| CO6 | | - | 5 | 9 | 6 | - | - | 20 | |
|  | | | | | | | | **124** | |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | 1. Write down the difference between a turbofan engine and a turboprop engine. | | CO1 | R | 1 |
| 2. | Define the term "thrust-specific fuel consumption" in aircraft propulsion. | | CO1 | R | 1 |
| 3. | Define "bypass ratio" in a turbofan engine. | | CO2 | R | 1 |
| 4. | Write down the primary purpose of the compressor in a gas turbine engine. | | CO2 | R | 1 |
| 5. | State the function of the combustor in a gas turbine engine. | | CO3 | R | 1 |
| 6. | State the primary purpose of the compressor in a gas turbine engine. | | CO4 | R | 1 |
| 7. | Write down the role of the afterburner in a gas turbine engine. | | CO5 | R | 1 |
| 8. | Define the term "propulsive efficiency" in aircraft propulsion | | CO5 | R | 1 |
| 9. | List the role of the turbine in a gas turbine engine. | | CO4 | R | 1 |
| 10. | 1. Write down the difference between a single-shaft and a twin-shaft gas turbine engine. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | 1. Compare and contrast the operating principles of a turbojet engine and a turboprop engine. | | CO1 | U | 3 |
| 12. | Draw the Brayton cycle and explain each process. | | CO2 | R | 3 |
| 13. | Differentiate between centrifugal compressor and axial flow compressor. | | CO4 | An | 3 |
| 14. | Illustrate the purpose of the stator vanes in a gas turbine engine. | | CO4 | A | 3 |
| 15. | State the significance of holes in the flame tube. | | CO5 | R | 3 |
| 16. | Discuss how does the compressor behave during the off-design operation and how does it affect the overall performance. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | A turbojet aircraft flies at 875 kmph at an altitude of 10,000 m above sea level.  Diameter of air inlet section = 0.75m  Diameter of the pipe jet at the exit = 0.5 m  Velocity of the gas at the exit of the jet pipe = 500 m/s  Pressure at the exit of the jet pipe = 0.3 bar  Air to fuel ration = 40  Calculate  a. Air flow rate of the engine.  b. Thrust.  c. Specific impulse.  d. Specific thrust.  e. Thrust power  f. TSFC | CO1 | A | 6 |
|  | b. | Explain with neat sketch the working principle of turbofan engine. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Design a turbofan engine to meet specific performance requirements, including takeoff thrust, fuel efficiency, and noise reduction. Include a discussion of the engine components and design choices that impact performance. | CO2 | C | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the working principle of axial compressor and explain the various stages involved in the compression process. | CO3 | A | 8 |
|  | b. | Discuss the advantages and disadvantages of axial flow compressor. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the performance of centrifugal compressor stage for a turbojet engine with a design point pressure ratio of 4.5 and a mass flow rate of 60 kg/s. The inlet conditions are a pressure of 101 kPa and a temperature of 300 K, and the exit conditions are a pressure of 450 kPa and a temperature of 700 K. Assume an adiabatic efficiency of 85% and a hub-to-tip ratio of 0.5. Using the given design parameters and the compressor map, determine the following:  i. The rotational speed of the compressor.  ii. The number of compressor stages required to achieve the desired pressure ratio.  iii. The dimensions of the impeller blade at the inlet and exit.  iv. The hub and tip diameters of the impeller.  v. The inlet and exit flow angles of the impeller blade.   1. vi. The compressor work input required to achieve the desired pressure ratio. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | List the various types of combustion chamber in a gas turbine engine. | CO5 | R | 4 |
|  | b. | Describe the function and design of the combustion chamber in a gas turbine engine, and discuss how it affects engine performance. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 22. | a. | Compare and contrast the single spool and multi spool configuration in jet engine. | CO6 | An | 6 |
|  | b. | Discuss the working principle of each configuration and the advantage and disadvantage of each. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | State the purpose of velocity diagram. | CO4 | R | 4 |
|  | b. | Explain the velocity and pressure compounding in impulse turbine. | CO4 | A | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss the working principle, components and application of afterburner in a jet engine. | CO3 | U | 8 |
|  | b. | Explain how after burner improves the performance of the engine and what are the challenges associated with its use. | CO5 | A | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 combustion chamber, cooling and afterburner performance. |
| CO6 | Find the causes of under-performance and remedial measures. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 9 | 6 |  |  |  | 17 |
| CO2 | 5 |  |  |  |  | 12 | 17 |
| CO3 | 1 | 12 | 8 |  |  |  | 21 |
| CO4 | 6 |  | 11 | 3 | 12 |  | 32 |
| CO5 | 9 | 8 | 4 |  |  |  | 21 |
| CO6 | 1 | 9 |  | 6 |  |  | 16 |
|  | | | | | | | **124** |



**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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| **Course Code** | **18AE2014** | **Duration** | **3hrs** |
| **Course Name** | **GAS DYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Recall the expression of isothermal compressibility. | | CO1 | R | 1 |
| 2. | Define thermally perfect gas. | | CO1 | R | 1 |
| 3. | Define back pressure. | | CO2 | R | 1 |
| 4. | Recall the expression of velocity for subsonic flow in terms of correction coefficient. | | CO2 | R | 1 |
| 5. | Define critical Mach number. | | CO3 | R | 1 |
| 6. | Predict the graphical method to study shock behavior. | | CO3 | U | 1 |
| 7. | Compare strealined and bluff bodies. | | CO4 | U | 1 |
| 8. | Give an example of fanno flow. | | CO5 | U | 1 |
| 9. | Recall a role of knife edge in optical flow visualization method. | | CO6 | R | 1 |
| 10. | List anyone function of shock tube. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Recite the propagation of disturbance waves for a supersonic flow. | | CO1 | R | 3 |
| 12. | Recall Area- Mach number relation. | | CO2 | R | 3 |
| 13. | List out the changes across expansion fan. | | CO3 | R | 3 |
| 14. | Explain drag divergence Mach number. | | CO4 | U | 3 |
| 15. | Explain similarity rule. | | CO5 | U | 3 |
| 16. | Classify flow visualization methods. | | 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 pressure and temperature and the Mach number at the entry of a flow passage are 2 bar, 275 K and 1.3 respectively. If exit Mach number is 2.4, estimate the following  a. Velocity of sound at stagnation conditions  b. The maximum velocity  c. Temperature and pressure at exit  d. Critical Mach number at entrance and exit  Take  = 1.3 and R = 0.46 kJ/kgK. | CO1 | U | 3  3  3  3 |
|  |  |  |  |  |  |
| 18. |  | Explain the various flows in the C-D nozzle. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain Prandtl relation for a normal shock and discuss the results of it. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Air flow at Mach 4 and pressure 105 N/m2 is turned abruptly by a wall into the flowwith a turning angle of 20 deg, as shown in fig. below. If the shock is reflected by another wall, estimate the flow properties such as Mach number and pressure downstream of the reflected shock. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain small perturbation theory with an example. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the area rule for transonic flight. | CO4 | U | 6 |
|  | b. | Discuss the features of swept back wing. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Produce the expression of friction coefficient in terms of Mach number, Reynolds number and surface roughness. | CO5 | A | 8 |
|  | b. | Show the mollier diagram for 1D flow with friction. | CO5 | R | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the working principle of shadowgraph technique with a neat sketch. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 12 | - | - | - | - | 17 |
| CO2 | 5 | 12 | - | - | - | - | 17 |
| CO3 | 4 | 25 | - | - | - | - | 29 |
| CO4 | - | 28 | - | - | - | - | 28 |
| CO5 | 4 | 4 | 8 | - | - | - | 16 |
| CO6 | 1 | 16 | - | - | - | - | 17 |
|  | | | | | | | **124** |



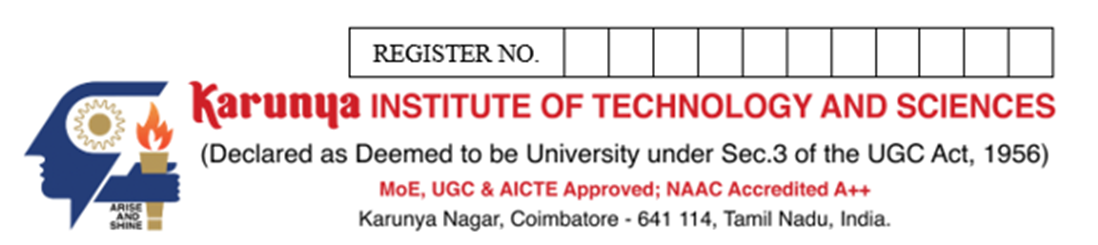
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| **Course Code** | **18AE2014/14AE2021/17AE2016** | **Duration** | **3hrs** |
| **Course Name** | **GAS DYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Recall calorically perfect gas. | | CO1 | R | 1 |
| 2. | State over-expanding nozzle. | | CO1 | R | 1 |
| 3. | State the working principle of Pitot tube. | | CO2 | R | 1 |
| 4. | Name aircraft nozzles. | | CO2 | R | 1 |
| 5. | Define isothermal process. | | CO3 | R | 1 |
| 6. | Identify 3D shock wave. | | CO3 | R | 1 |
| 7. | Recall the findings of P-G rule. | | CO4 | R | 1 |
| 8. | Define critical Mach number. | | CO4 | R | 1 |
| 9. | Recall the effect of friction in fanno curve. | | CO5 | R | 1 |
| 10. | Define flow separation. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Distinguish between compressible and incompressible flows. | | CO1 | U | 3 |
| 12. | Recall the expression of velocity for an incompressible flow. | | CO2 | R | 3 |
| 13. | Compare shock compression with isentropic compression. | | CO3 | U | 3 |
| 14. | Highlight the significance of supercritical airfoil. | | CO4 | R | 3 |
| 15. | List out any two assumptions of fanno flow. | | CO5 | R | 3 |
| 16. | Classify flow visualization methods. | | 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 of speed of sound with suitable assumptions. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Air enters a CD nozzle at 1.0 MPa and 800 K with a negligible velocity. The flow is steady, one dimensional and isentropic with an exit nozzle exit Mach number of 2 and throat area of 20 cm2. Estimate the following   1. Exit flow properties such as pressure, temperature, density and velocity 2. Mass flow rate | CO1 | U | 8  4 |
|  |  |  |  |  |  |
| 19. |  | Derive Rayleigh Pitot tube formula for supersonic flow. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain shock wave and its types with a neat sketch. | CO3 | U | 6 |
|  | b. | Discuss the properties of shock polar. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain transonic rule. | CO4 | U | 6 |
|  | b. | Discuss the importance of tip effects on an aircraft. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Explain small perturbation theory. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Produce the expression for 1D flow with heat addition and construct its  mollier diagram. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the working principle of shadowgraph technique with a neat sketch. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 | 12 | - | - | - | 29 |
| CO2 | 5 | - | 12 | - | - | - | 17 |
| CO3 | 2 | 15 | - | - | - | - | 17 |
| CO4 | 5 | 24 | - | - | - | - | 29 |
| CO5 | 4 | - | 12 | - | - | - | 16 |
| CO6 | 1 | 3 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |

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**SUPPLEMENTARY EXAMINATION - JUNE 2023**

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

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| **Q. No.** | **Questions** | | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | State the methods of noise suppression in nozzles. | | | 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 neutral burn. | | | CO3 | R | 1 |
| 6. | Draw the schematic diagram of solid rocket motor. | | | CO3 | R | 1 |
| 7. | State the advantages and disadvantages of integral ram rocket. | | | 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 requirement of igniter propellant. | | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Explain the performance of subsonic intake for high speed low mass flow. | | | CO1 | R | 3 |
| 12. | What is specific impulse and explain the significance of specific impulse in rocket propulsion. | | | CO2 | U | 3 |
| 13. | Mention the difference between gas generator and pre-burner. | | | CO3 | A | 3 |
| 14. | List any six criteria for selection of liquid propellants. | | | CO4 | R | 3 |
| 15. | Illustrate the operating principle of nuclear rocket. | | | CO5 | R | 3 |
| 16. | State the need for 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. | State the purpose of nozzle in a rocket motor. | CO1 | R | 4 |
|  | | b. | Explain any one of the variable area nozzle with a neat sketch. | CO1 | U | 8 |
|  | |  |  |  |  |  |
| 18. | | a. | Explain Staging and Clustering in a multi-staging rocket engine. | CO2 | A | 12 |
|  | |  |  |  |  |  |
| 19 | | a. | Explain the working principle of solid rocket motor with a neat sketch. | CO3 | A | 12 |
|  | |  |  |  |  |  |
| 20 | | a. | Explain the working principle of liquid rocket engine with a neat sketch. | CO4 | A | 12 |
|  | |  |  |  |  |  |
| 21. | | a. | Explain the various methods to cool the liquid rocket engine. | CO5 | A | 12 |
|  | |  |  |  |  |  |
| 22. | | a. | Draw the schematic diagram of turbo-pump feed system and explain each system. | CO4 | An | 12 |
|  | |  |  |  |  |  |
| 23. | | a. | Explain the various techniques used in thrust variation in liquid rocket engine. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | | a. | Explain the need for hypersonic vehicles. | 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 | 9 | 8 |  |  |  |  | 17 |
| CO2 | 1 | 4 | 12 |  |  |  | 17 |
| CO3 | 2 | 3 | 12 |  |  |  | 17 |
| CO4 | 3 | 1 | 12 | 12 |  |  | 28 |
| CO5 | 4 | 1 | 12 | 12 |  |  | 29 |
| CO6 | 4 | 12 |  |  |  |  | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Recall the difference between sea level thrust and vacuum thrust. | | CO1 | R | 1 |
| 2. | State the significance of thrust-to-weight ratio. | | CO1 | R | 1 |
| 3. | State the types of supersonic inlets. | | CO2 | R | 1 |
| 4. | Discuss the purpose of diffuser. | | CO2 | U | 1 |
| 5. | List the various application of solid rocket motor. | | CO3 | R | 1 |
| 6. | State the purpose of regenerative cooling in liquid rocket engine. | | CO4 | R | 1 |
| 7. | Classify the various types of injectors used in liquid rocket engine. | | CO4 | U | 1 |
| 8. | Illustrate the fuel used in Nuclear rocket engine. | | CO5 | U | 1 |
| 9. | Discuss the primary purpose of ion thrusters in electric propulsion. | | CO6 | U | 1 |
| 10. | State the difference in chemical propulsion and electric propulsion in terms of exhaust velocity. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | 1. Explain the concept of specific impulse and how it relates to rocket engine performance. | | CO1 | U | 3 |
| 12. | 1. Illustrate the major flow features of external flow near a subsonic inlet. | | CO2 | A | 3 |
| 13. | 1. Discuss the factors that determine the efficiency and performance of a rocket engine. | | CO3 | U | 3 |
| 14. | Compare double base propellant and composite propellant. | | CO3 | U | 3 |
| 15. | State the need of turbo-pump in a liquid rocket engine. | | CO4 | R | 3 |
| 16. | State the application of hypersonic vehicles. | | CO5 | 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. |  | 1. Discuss the factors that determine the efficiency and performance of a rocket engine. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Compare and contrast the different types of rocket propellants used in rocket engines. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | 1. Describe the function of a nozzle in a rocket engine and explain the difference between convergent and convergent-divergent nozzles. | CO2 | U | 6 |
|  | b. | 1. Define thrust vectoring and describe its advantages and disadvantages. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 20. | a. | 1. Describe the basic construction and components of solid rocket motor. | CO3 | U | 6 |
|  | b. | Explain how thrust is produced in solid rocket motor. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | 1. Discuss the various factors that affect the burn rate in solid rocket motor. | CO3 | An | 6 |
|  | b. | Explain the engine throttling in liquid rocket engines, including the methods used to achieve different thrust levels. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain monopropellant rocket engine with neat sketch. | CO5 | A | 10 |
|  | b. | State the advantage and disadvantage of monopropellant rocket engine. | CO5 | R | 2 |
|  |  |  |  |  |  |
| 23. | a. | 1. Explain the need for gel propellant. | CO5 | R | 6 |
|  | b. | State the advantages and disadvantages of using electric propulsion systems for space missions. | CO6 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the working principle of hall thruster. | CO6 | A | 8 |
|  | b. | State the difference between hall thruster and gridded ion thruster. | CO6 | R | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 3 | 12 | 12 |  |  | 29 |
| CO2 | 7 | 7 | 3 |  |  |  | 17 |
| CO3 | 1 | 12 | 6 | 6 |  |  | 25 |
| CO4 | 4 | 1 | 6 |  |  |  | 11 |
| CO5 | 11 | 1 | 10 |  |  |  | 22 |
| CO6 | 5 | 7 | 8 |  |  |  | 20 |
|  | | | | | | | **124** |



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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Reproduce the frequency range of C BAND. | | CO1 | R | 1 |
| 2. | Recall the use of radar in remote sensing. | | CO1 | R | 1 |
| 3. | Define Variometer. | | CO2 | R | 1 |
| 4. | Recite the frequency range of VOR. | | CO2 | R | 1 |
| 5. | State Coriolis Force. | | CO3 | R | 1 |
| 6. | Recognize the advantage of strapdown INS. | | CO3 | R | 1 |
| 7. | Define the purpose of electronic unit in missile guidance. | | CO4 | R | 1 |
| 8. | Name any 2 medium range ballistic missiles. | | CO4 | R | 1 |
| 9. | Define summing point. | | CO5 | R | 1 |
| 10. | Describe Absolutely stable system. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Describe RADAR. | | CO1 | U | 3 |
| 12. | Extend the use of marker beacons in ILS. | | CO2 | U | 3 |
| 13. | Label the block diagram of aircraft navigation system. | | CO3 | R | 3 |
| 14. | Rewrite Terrain matching navigation. | | CO4 | U | 3 |
| 15. | List different types of guidances used in missiles. | | CO5 | R | 3 |
| 16. | Convert the block diagram into equivalent signal flow graph. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the RADAR EQUATION to describe the performance of practical radar. | CO1 | U | 6 |
|  | b. | Explain the RADAR operation with a neat block diagram. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Describe in detail about the satellite Navigation. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Identify the use of Newton’s second law in accelerometers and explain the different types of accelerometers. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Recognize the basic lateral autopilot. | CO4 | R | 6 |
|  | b. | Illustrate Yaw orientational Control system. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Determine the overall gain of the system which is provided as a signal flow graph. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Using block diagram reduction techniques, determine the closed loop transfer function of the system.  Reduction Diagram | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the different types of guidance used in missiles. | CO4 | Un | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Sketch the Bode diagram for the following transfer function and obtain the gain and phase crossover frequency | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 15 |  |  |  |  | 17 |
| CO2 | 2 | 15 |  |  |  |  | 17 |
| CO3 | 5 | 12 |  |  |  |  | 17 |
| CO4 | 8 | 21 |  |  |  |  | 29 |
| CO5 | 4 |  | 24 |  |  |  | 28 |
| CO6 | 1 | 3 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the system that employs radio waves to determine the radial velocity of an object. | | CO1 | R | 1 |
| 2. | Define signal to noise ratio. | | CO1 | R | 1 |
| 3. | Give an example for an instrument needed for visual flight rules. | | CO2 | U | 1 |
| 4. | Identify the navigation that is based on the position of celestial bodies in space. | | CO2 | U | 1 |
| 5. | Indicate the device which utilizes earth’s gravity to determine the orientation of an object. | | CO3 | U | 1 |
| 6. | Identify the instrument used to measure linear acceleration of a moving object. | | CO3 | U | 1 |
| 7. | State guidance. | | CO4 | R | 1 |
| 8. | Cite another name of straightening method pertaining to missile guidance laws. | | CO4 | U | 1 |
| 9. | Write the expanded form of CLTF. | | CO5 | A | 1 |
| 10. | Choose the type of plot drawn for open loop systems. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate between horizontal and vertical polarization. | | CO1 | U | 3 |
| 12. | Classify airspace classes. | | CO2 | U | 3 |
| 13. | List out the reference frames used in navigation system. | | CO3 | R | 3 |
| 14. | Name the types of missile guidance laws. | | CO4 | R | 3 |
| 15. | Give examples of open loop transfer function. | | CO5 | U | 3 |
| 16. | Enumerate the applications of frequency response plots. | | 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. | Describe the radio detection and ranging system with the help of a block diagram. | CO1 | R | 6 |
|  | b. | Tabulate the range of frequencies of radio detection and ranging system. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the salient features of a hyperbolic navigation system with a schematic. | CO2 | R | 6 |
|  | b. | Enumerate the advantages of global positioning system. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the working principle of mass-spring type accelerometer. Summarize its merits and demerits. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the salient features of inertial navigation system. | CO3 | U | 6 |
|  | b. | Discuss the construction and working of inertial measurement unit. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the types of missile guidance laws. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Compute the transfer function for the following block diagram. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Write the differences between open and closed loop transfer function. | CO5 | A | 6 |
|  | b. | Write the steps to compute the transfer function from a signal flow graph using Mason’s rule. | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Classify the systems based on stability and briefly explain. | CO6 | U | 6 |
|  | b. | Explain the procedure employed for the construction of root locus. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 14 | 3 | - | - | - | - | 17 |
| CO2 | 12 | 5 | - | - | - | - | 17 |
| CO3 | 3 | 26 | - | - | - | - | 29 |
| CO4 | 4 | 1 | 12 | - | - | - | 17 |
| CO5 | - | 3 | 25 | - | - | - | 28 |
| CO6 | 3 | 6 | 7 | - | - | - | 16 |
|  | | | | | | | **124** |



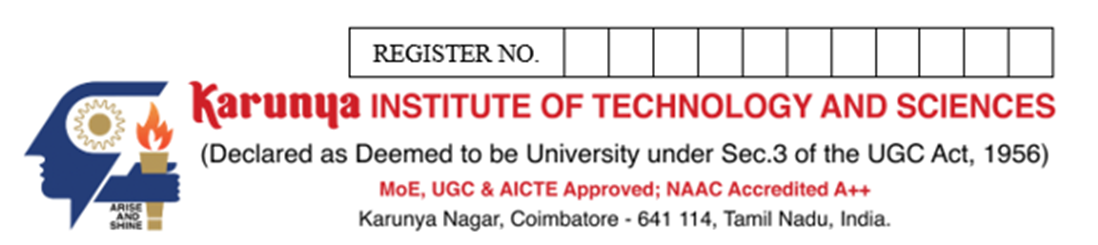
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| --- | --- | --- | --- |
| **Course Code** | **18AE2027** | **Duration** | **3hrs** |
| **Course Name** | **HEAT AND MASS TRANSFER** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define – Fourier's Law of heat conduction. | | CO1 | R | 1 |
| 2. | Retell - Critical radius of insulation. | | CO1 | R | 1 |
| 3. | Recall-Dimensional analysis. | | CO2 | R | 1 |
| 4. | Describe about thermal boundary layer thickness. | | CO2 | U | 1 |
| 5. | Define-Nucleate boiling. | | CO3 | R | 1 |
| 6. | Discuss the advantage of NTU method over the LMTD method. | | CO3 | U | 1 |
| 7. | Define-shape factor. | | CO4 | R | 1 |
| 8. | Describe about radiation shield. | | CO4 | U | 1 |
| 9. | Describe about aerodynamic heating. | | CO5 | U | 1 |
| 10. | Explain about mass diffusion velocity. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate – Transient and periodic heat transfer. | | CO1 | U | 3 |
| 12. | Recall the difference between free and forced convection. | | CO2 | R | 3 |
| 13. | Discuss about the factors involved in designing a heat exchangers. | | CO3 | U | 3 |
| 14. | Explain about radiation through gases. | | CO4 | U | 3 |
| 15. | Describe the applications of heat exchanger. | | CO5 | R | 3 |
| 16. | Predict some examples of diffusion mass 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. | Produce the three-dimensional heat-conduction equation for an elemental volume in cylindrical coordinates. | CO1 | A | 8 |
|  | b. | Discuss about lumped analysis. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | A steam pipe 10 cm OD runs horizontally in a room at 23° C. Take outside temperature of pipe as 165°C. Determine the heat loss per unit length of the pipe. Pipe surface temperature reduces to 80°C with 1.5 cm insulation. What is the reduction in heat loss? | CO2 | A | 9 |
|  | b. | Explain the flow over a flat plate and significance of the boundary layer. | CO2 | U | 3 |
|  |  |  |  |  |  |
| 19. | a. | A tube of 2 m length and 25 mm OD is to be used to condense saturated steam at 100°C while the tube surface is maintained at 92°C. Estimate the average heat transfer coefficient and the rate of condensation of steam if the tube is kept horizontal. The steam condenses on the outside of the tube. | CO3 | A | 9 |
|  | b. | Discuss about the assumptions made during LMTD analysis. | CO3 | U | 3 |
|  |  |  |  |  |  |
| 20. | a. | A surface at 100K with emissivity of 0.10 is protected from a radiation flux of 1250 W/m2 by a shield with emissivity of 0.05. Determine the percentage cut off and the shield temperature. Assume shape factor as 1. | CO4 | A | 8 |
|  | b. | Describe how the radiation from gases differ from that of solids. | CO4 | R | 4 |
|  |  |  |  |  |  |
| 21. | a. | Explain about transient heat conduction in a plane wall with necessary equations. | CO5 | U | 9 |
|  | b. | Discuss about ablative heat transfer. | CO5 | U | 3 |
|  |  |  |  |  |  |
| 22. | a. | A steel sphere of radius 60 mm which is initially at a uniform temperature of 325°C is suddenly exposed to an environment at 25°C; with convection heat transfer coefficient 500 W/m2K. Calculate the temperature at a radius 36 mm and the heat transferred 100 seconds after the sphere is exposed to the environment. | CO6 | A | 9 |
|  | b. | Discuss about Fick’s law of diffusion. | CO6 | U | 3 |
|  |  |  |  |  |  |
| 23. | a. | Air at 200 kPa and 200°C is heated as it flows through a tube with a diameter of 25 mm at a velocity of 10 m./sec. The wall temperature is maintained constant and is 20°C above the air temperature all along the length of tube. Calculate:  (i) The rate of heat transfer per unit length of the tube.  (ii) Increase in the bulk temperature of air over a 3m length of the tube. | CO2 | A | 8 |
|  | b. | Explain the significance of dimensionless numbers. | CO2 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A long rod is exposed to air at 298°C. It is heated at one end. At steady state conditions, the temperature at two points along the rod separated by 120 mm are found to be 130°C and 110°C respectively. The diameter of the rod is 25mm OD and its thermal conductivity is 116W/m°C. Calculate the heat transfer coefficient at the surface of the rod and also the heat transfer rate. | CO1 | A | 9 |
|  | b. | Explain about the uses of Heisler’s charts. | CO1 | U | 3 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 10 | 17 | - | - | - | 29 |
| CO2 | 4 | 8 | 17 | - | - | - | 29 |
| CO3 | 1 | 7 | 9 | - | - | - | 17 |
| CO4 | 5 | 4 | 8 | - | - | - | 17 |
| CO5 | 3 | 13 | - | - | - | - | 16 |
| CO6 | - | 7 | 9 | - | - | - | 16 |
|  | | | | | | | **124** |

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**SUPPLEMENTARY EXAMINATION - JUNE 2023**

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

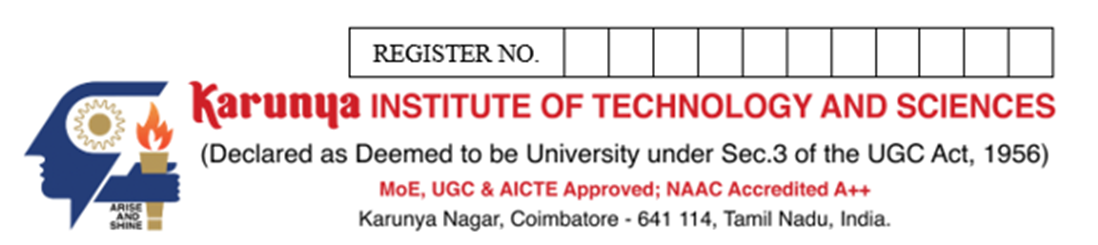
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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Heat transfer from one body to another without any transmitting medium is known as --------------- | | CO1 | R | 1 |
| 2. | Memorize steady state two dimensional conduction equation. | | CO1 | R | 1 |
| 3. | Recall-Reynolds number. | | CO2 | R | 1 |
| 4. | State boundary layer thickness. | | CO2 | U | 1 |
| 5. | The change of phase from vapour to liquid state is known as ----------- | | CO3 | R | 1 |
| 6. | Discuss about regenerators. | | CO3 | U | 1 |
| 7. | Define-gray body. | | CO4 | R | 1 |
| 8. | The heat transfer by radiation takes place by means of ----------------- | | CO4 | U | 1 |
| 9. | What is aerodynamic heating? | | CO5 | U | 1 |
| 10. | Explain about convective mass transfer. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain about critical radius of insulation or critical thickness. | | CO1 | U | 3 |
| 12. | Recall the limitations of dimensional analysis. | | CO2 | R | 3 |
| 13. | Discuss about LMTD. | | CO3 | U | 3 |
| 14. | Explain about Stefan-Boltzmann law. | | CO4 | U | 3 |
| 15. | Describe about ablative heat transfer. | | CO5 | R | 3 |
| 16. | Predict some examples of mass 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. | Produce the three-dimensional heat-conduction equation for an elemental volume in cylindrical coordinates. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Air at 20°C, at a pressure of 1 bar is flowing over a flat plate at a velocity of 3 m/s. If the plate is maintained at 60°C, calculate the heat transfer per unit width of the plate. Assume the length of the plate along the flow of air is 2m. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | An electric wire of 1.5 mm diameter and 200 mm long is laid horizontally and submerged in water at atmospheric pressure. The wire has an applied voltage of 16 V and carries a current of 42 ampheres. Determine heat flux and excess temperature. The following correlation for water boiling on horizontal submerged surface holds good. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | A pipe of outside diameter 30 cm having emissivity 0.6 and a temperature of 600 K runs centrally in a brick duct of 40 cm side square section having emissivity 0.8 and at a temperature of 300 K. Calculate the following: i) Heat exchange per meter length, ii) Convective heat transfer coefficient when surrounding of duct is 280 K. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain about transient heat conduction in a plane wall with necessary equations. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | A hollow cylinder 5 cm inner diameter and 10 cm outer diameter has inner surface temperature of 200°C and outer surface temperature of 100°C. Determine heat flow through the cylinder per meter length. Also determine the temperature of the point half way between the inner and outer surfaces. Take k = 1*W/mK*. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Air at 30°C and 1.013 bar flows over a flat plate at a velocity of 50 m/s. The plate is 1.5 m long and is maintained at 70°C. Calculate the heat transfer for unit width of the plate, taking into consideration both laminar and turbulent portion of the boundary layer. | CO2 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Hydrogen gases at 3 bar and 1 bar are separated by a plastic membrane having thickness 0.25 mm. The binary diffusion co-efficient of hydrogen in the plastic is The solubility of hydrogen in the memberane is An uniform temperature condition of 20° is assumed. Calculate the following, i) Molar concentration of hydrogen on both sides, ii) Molar flux of hydrogen, iii) Mass flux of hydrogen. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 3 | 24 | - | - | - | 29 |
| CO2 | 4 | 1 | 24 | - | - | - | 29 |
| CO3 | 1 | 4 | 12 | - | - | - | 17 |
| CO4 | 1 | 4 | 12 | - | - | - | 17 |
| CO5 | 3 | 13 | - | - | - | - | 16 |
| CO6 | - | 4 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |

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**SUPPLEMENTARY EXAMINATION - JUNE 2023**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Show the advisable L/D ratio in a low-speed wind tunnel. | | CO1 | U | 1 |
| 2. | List the applications of water tunnel. | | CO1 | R | 1 |
| 3. | Define the term ‘blow down” used in wind tunnel. | | CO3 | R | 1 |
| 4. | Indicate the use of convergent and divergent section in the wind tunnel. | | CO2 | U | 1 |
| 5. | State the various types of supersonic wind tunnel. | | CO2 | R | 1 |
| 6. | Define the “Total Pressure” in pitot tube. | | CO4 | R | 1 |
| 7. | Recite the use of pitot tube in wind tunnel. | | CO4 | R | 1 |
| 8. | Mention any one temperature measurement method used in wind tunnel test section. | | CO5 | R | 1 |
| 9. | Show the use of strut type balance used in wind tunnel measurement system. | | CO5 | U | 1 |
| 10. | List the various components of “hot wire anemometer”. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Classify the various types of wind tunnel. | | CO1 | U | 3 |
| 12. | Mention the “model sizing” of a supersonic wind tunnel by taking an example. | | CO3 | A | 3 |
| 13. | Differentiate between the terms “Pitching”, “Yawing” and “Rolling”. | | CO2 | U | 3 |
| 14. | Indicate the methods of model installation in a wind tunnel. | | CO4 | U | 3 |
| 15. | Express the use of pressure sensitive paint. | | CO5 | U | 3 |
| 16. | Compare the terms path line, streak line and stream lines. | | 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. | Write the various parts of a Subsonic wind tunnel with the help of a diagram and explain its working principle. | CO1 | A | 6 |
|  | b. | Explain the various parts of a “spin tunnel” and write the arrangement, working and applications. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Correlate the “Runtime mass flow rate” with help of a relation which can be used to evaluate the “mass flow rate” in the wind tunnel nozzle. | CO2 | A | 6 |
|  | b. | Distinguish between the blow down, continuous and intermittent types of wind tunnel. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the constructional detail, operation and applications of smoke tunnel in detail. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | With a neat sketch explain how the velocity, pressure and force measurements are being conducted in wind tunnels. | CO3 | An | 6 |
|  | b. | Write a short note on limitations of internal external balances. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate how the “Shadowgraph” technique can be used in wind tunnel with help of a neat sketch. | CO6 | A | 6 |
|  | b. | Write how the surface oil flow method can be used in wind tunnel measurements with suitable sketch. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Appraise the working principle of bourdon pressure tube. | CO4 | An | 6 |
|  | b. | Write the use of manometers and draw a “U type manometer”. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Distinguish between the “internal balance” and “outer balance “in wind tunnel measurement system. | CO4 | An | 6 |
|  | b. | Articulate a strain gauge circuit which can be used in wind tunnel measurement. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the operation of PLIF in detail with help of a schematic diagram. | CO5 | A | 6 |
|  | b. | Sketch the Laser Doppler Anemometer and explain its working principle in detail. | CO5 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **COURSE OUTCOMES** | | | | | | | |
| CO1 | | Understand the various types of wind tunnels and test techniques. | | | | | | | |
| CO2 | | Choose proper high speed wind tunnel for required test | | | | | | | |
| CO3 | | Choose correct model for wind tunnel testing. | | | | | | | |
| CO4 | | Estimate the forces and moments for given model. | | | | | | | |
| CO5 | | Estimate pressure, velocity and temperature using measurement techniques. | | | | | | | |
| CO6 | | Choose the proper flow visualization techniques | | | | | | | |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | | |
| **CO / P** | | **R** | **U** | **A** | **An** | **E** | **C** | **Total** | |
| CO1 | | 1 | 4 | 6 | 6 | - | - | 17 | |
| CO2 | | 1 | 4 | 12 | 12 | - | - | 29 | |
| CO3 | | 1 | - | 9 | 6 | - | - | 16 | |
| CO4 | | 2 | 3 | 12 | 12 | - | - | 29 | |
| CO5 | | 1 | 4 | 12 | - | - | - | 17 | |
| CO6 | | 1 | 3 | 12 | - | - | - | 16 | |
|  | | | | | | | | **124** | |



**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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

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| --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Name the shape function that offers the maximum error while discretizing a domain in FEA. | | | CO1 | R | 1 |
| 2. | Distinguish between continuum and discrete element. | | | CO1 | U | 1 |
| 3. | Define shape function. | | | CO2 | R | 1 |
| 4. | List the advantage of FEA. | | | CO2 | R | 1 |
| 5. | Show the number of DoF of a frame element. | | | CO3 | R | 1 |
| 6. | List the assumptions made while finding the forces in a truss. | | | CO3 | R | 1 |
| 7. | The sum of shape functions at any node within an element is \_\_\_\_\_\_\_\_. | | | CO4 | U | 1 |
| 8. | Name the six- noded triangular element. | | | CO4 | R | 1 |
| 9. | Explain the term functional. | | | CO5 | R | 1 |
| 10. | Give an example of axisymmetric solid. | | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | State the principle of weighted residual method. | | | CO1 | R | 3 |
| 12. | A two noded truss element is considered and its nodal displacements are u1= 3 mm at x1=20 mm and u2= -5 mm at x2= 36 mm. Estimate the shape functions N1 and N2. | | | CO2 | U | 3 |
| 13. | Explain about node numbering. | | | CO3 | R | 3 |
| 14. | Name any **THREE** FEA software packages. | | | CO4 | R | 3 |
| 15. | Recite Isoparametric mapping. | | | CO5 | R | 3 |
| 16. | List out the assumptions of axisymmetric problem. | | | 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 value of a1 in the trial function y= a1x(x-1) that satisfies d2y/dx2 -10x2 =5; 0≤x≤1 using the following methods:   1. Point collocation method 2. Subdomain method 3. Least squares method 4. Galerkin’s method   The boundary conditions are y(0)=0 and y(1)=0 | CO1 | U | 12 |
|  | |  |  |  |  |  |
| 18. | |  | A steel bar of length 800 mm is subjected to an axial load of 3kN as shown in fig. below. Estimate the elongation of the bar, neglecting self weight.    Take E = 2X 105 N/mm² , A = 300 mm² | CO2 | R | 12 |
|  | |  |  |  |  |  |
| 19. | | a. | 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. | 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. Calculate the deflection under the load and construct the shear force and bending moment diagrams for the beam.  Take E= 20X106 N/cm² and I = 2500 cm4 | CO3 | U | 12 |
|  | |  |  |  |  |  |
| 21. | |  | A wall of 0.6m thickness having thermal conductivity of 1.2W/mK. The wall is to be insulated with a material of thickness0.06 m having an average thermal conductivity of 0.3 W/mK. The inner surface temprature is 1000oC and outside of the insulation is exposed to atmospheric air at 30oC with heat transfer coefficient of 35W/m2K. Estimate the nodal tempratures. | CO4 | U | 12 |
|  | |  |  |  |  |  |
| 22. | |  | Show the expression of shape function for the eight-noded quadrilateral element. | CO5 | U | 12 |
|  | |  |  |  |  |  |
| 23. | |  | Estimate the stiffness matrix for the constant strain triangular (CST) element shown in fig. below. The coordinates are given in millimeters. Assume plane stress conditions. Take E= 210 GPa, ʋ = 0.25 and t= 10mm. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | |  | Show the expression of the element stresses of an axisymmetric element. | 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 | 5 | 24 | - | - | - | - | 29 |
| CO4 | 4 | 13 | - | - | - | - | 17 |
| CO5 | 4 | 24 | - | - | - | - | 28 |
| CO6 | - | 16 | - | - | - | - | 16 |
|  | | | | | | | **124** |



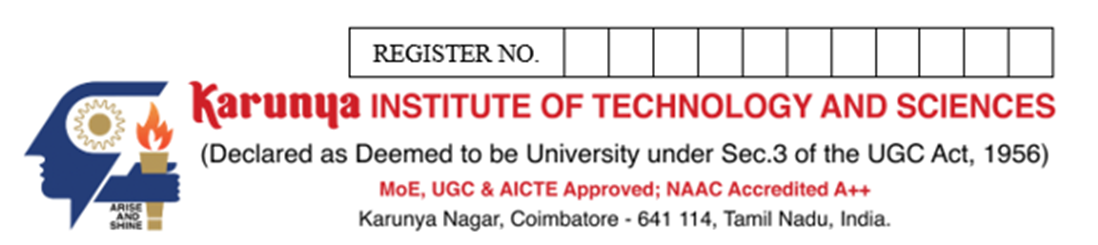
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| --- | --- | --- | --- |
| **Course Code** | **18AE2032** | **Duration** | **3hrs** |
| **Course Name** | **FINITE ELEMENT ANALYSIS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | | **CO** | **BL** | **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. | The nodes in a 1-D cubic element are \_\_\_\_\_\_\_\_\_\_\_. | | | CO1 | R | 1 |
| 3. | If the structure is divided into discrete areas or volumes then it is called \_\_\_\_\_\_\_. | | | CO2 | R | 1 |
| 4. | In the condensed form of assembly level equation, i.e. after implementing the boundary conditions, the system can be represented as: [K]{u} = {f} + {Q}  In the above equation, The unknown term is \_\_\_\_\_\_. | | | CO2 | R | 1 |
| 5. | Det(A-λI)=0 is a \_\_\_\_\_\_\_\_. | | | CO3 | U | 1 |
| 6. | Finite element method gives \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ . | | | CO3 | R | 1 |
| 7. | The sum of shape functions at any node within an element is \_\_\_\_\_\_\_\_. | | | CO4 | U | 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 Rayleigh-Ritz method. | | | CO1 | R | 3 |
| 12. | Comment on the characteristics of global stiffness matrix. | | | CO2 | U | 3 |
| 13. | Identify the expression of stiffness matrix for beam element. | | | CO3 | R | 3 |
| 14. | Define streamline. | | | CO4 | R | 3 |
| 15. | Outline Isoparametric mapping. | | | CO5 | R | 3 |
| 16. | Recall 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 = 2X 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 fixed beam of length 2 L carries a uniformly distributed load of w (N/m) which run over a length of L from the fixed end, as shown in fig. below. Estimate the rotation at point B. | CO4 | U | 12 |
|  | |  |  |  |  |  |
| 21. | |  | A wall of 0.6 m thickness having thermal conductivity of 1.2 W/mK. The wall is to be insulated with a material of thickness 0.06 m having an average thermal conductivity of 0.3 W/mK. The inner surface temperature is 1000ᵒC and outside of the insulation is exposed to atmospheric air at 30ᵒC with heat transfer coefficient of 35 W/m²K. Estimate the nodal temperatures. | CO4 | U | 12 |
|  | |  |  |  |  |  |
| 22. | |  | Find the expression of shape function for the eight-noded quadrilateral element. | CO5 | R | 12 |
|  | |  |  |  |  |  |
| 23. | |  | For the constant strain triangular element shown in fig. below, estimate the strain-displacement matrix. Take t= 20 mm and E=2X105 N/mm2.    All coordinates are in 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 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 | 4 | 25 | - | - | - | - | 29 |
| CO5 | 16 | 12 | - | - | - | - | 28 |
| CO6 | - | 16 | - | - | - | - | 16 |
|  | | | | | | | **124** |

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**SUPPLEMENTARY EXAMINATION - JUNE 2023**

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | | **CO** | **BL** | | **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. | Distinguish – Visual inspection & Liquid penetrant testing. | | | CO2 | U | | 1 |
| 4. | List out any two properties of a good developer. | | | CO2 | A | | 1 |
| 5. | Write the advantage of Magnetic particle testing. | | | CO3 | A | | 1 |
| 6. | Define the term ‘Rise time’ in Acoustic Emission Testing. | | | CO3 | U | | 1 |
| 7. | Indicate the disadvantage of Radiography Test. | | | CO4 | A | | 1 |
| 8. | State the linear location technique used in AE. | | | CO5 | R | | 1 |
| 9. | Differentiate between AE and Ultrasonic testing. | | | CO5 | U | | 1 |
| 10. | Define Thermography. | | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Outline the history of Non-Destructive Testing with necessary points. | | | CO1 | | A | 3 |
| 12. | Discuss about the disadvantages of liquid penetrant testing over other NDT techniques. | | | CO2 | | U | 3 |
| 13. | List out the essential properties required to increase sensitivity of the MPT test. | | | CO3 | | A | 3 |
| 14. | Evaluate the influencing factors affecting radiographic testing. | | | CO4 | | E | 3 |
| 15. | Distinguish between acoustic emission test and other NDT methods. | | | CO5 | | U | 3 |
| 16. | Describe about the applications of thermography test in aerospace industry. | | | CO6 | | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | | |
| 17. | | a. | Differentiate the features of NDT and destructive test with necessary points. | CO1 | | U | 9 |
|  | | b. | Discuss about the scope and features of NDT. | CO1 | | U | 3 |
|  | |  |  |  | |  |  |
| 18. | | a. | Explain the working of liquid penetrant inspection 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 eddy current testing. | CO3 | | A | 4 |
|  | |  |  |  | |  |  |
| 20. | | a. | Describe about Radiographic inspection and its limitations with neat sketch. | CO4 | | U | 12 |
|  | |  |  |  | |  |  |
| 21. | | a. | Enumerate the working principle of Ultrasonic technique with a block diagram and state its limitations. | CO5 | | R | 12 |
|  | |  |  |  | |  |  |
| 22. | | a. | Discuss about Acoustic emission testing, it’s sensitivity with neat sketch. | CO5 | | R | 12 |
|  | |  |  |  | |  |  |
| 23. | | a. | Explain the principle of eddy current testing and its limitation and applications with neat sketch. | CO3 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | | a. | Write the principle of Thermography test with a neat block diagram. | CO6 | | R | 8 |
|  | | b. | Discuss about the application of Thermography testing in Aerospace industry. | CO6 | | A | 4 |

|  |  |
| --- | --- |
|  | **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 | 12 | 3 | - | - | - | 17 |
| CO2 | - | 16 | 1 | - | - | - | 17 |
| CO3 | 8 | 13 | 8 | - | - | - | 29 |
| CO4 | - | 12 | 1 | - | 3 | - | 16 |
| CO5 | 25 | 4 | - | - | - | - | 29 |
| CO6 | 8 | 1 | 7 | - | - | - | 16 |
|  | | | | | | | **124** |



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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the various manufacturing 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. | State the functions of Emulsifier applied during LPT. | | CO2 | U | 1 |
| 4. | List out any two properties of a good penetrant. | | CO2 | A | 1 |
| 5. | Write the advantage of Magnetic particle testing. | | CO3 | A | 1 |
| 6. | Define the term ‘Peak Amplitude’ in Acoustic Emission Testing. | | CO3 | U | 1 |
| 7. | Indicate the advantage of Radiography Test. | | CO4 | A | 1 |
| 8. | State the Angular location technique used in AE. | | CO5 | An | 1 |
| 9. | Differentiate between 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 LPT. | | 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 between acoustic emission test and other NDT methods. | | CO5 | U | 3 |
| 15. | Evaluate the factors affecting radiographic testing. | | CO5 | E | 3 |
| 16. | Describe the advantages and limitation 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 Magnetic particle testing with neat sketch and state its applications, merits and limitations. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | In detail explain the physical principle of Liquid penetration test procedure with neat sketch. | CO3 | R | 8 |
|  | b. | Write down the advantages and disadvantages of LPT. | 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 about the application of Thermography testing in Aerospace industry. | CO6 | A | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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** |



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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State the boiling point temperature of liquid air and liquid oxygen. | | CO1 | R | 1 |
| 2. | State the various application of liquid hydrogen. | | CO1 | R | 1 |
| 3. | State the significance of 2nd compressor in Linde dual pressure system. | | CO2 | R | 1 |
| 4. | Define Joules-Thompson inversion curve. | | CO2 | R | 1 |
| 5. | List any two refrigerator that can be used between temperature range of 10-150 K. | | CO3 | R | 1 |
| 6. | State the advantage of mechanical dilution refrigeration over cryogenic refrigeration. | | CO3 | R | 1 |
| 7. | State the effect of uninsulated cryogenic plumbing line. | | CO4 | R | 1 |
| 8. | State the need for manhole in the cryogenic storage tank. | | CO4 | R | 1 |
| 9. | List the types of reflective insulation used for insulation of cryogenic containers. | | CO5 | R | 1 |
| 10. | Define aparent thermal conductivity. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain ductile to brittle transition DBT with a neat sketch. | | CO1 | A | 3 |
| 12. | Differentiate between J-T expansion and adiabatic expansion. | | CO2 | An | 3 |
| 13. | Differentiate between Gifford Mc-Mohan (G-M) refrigerators. | | CO3 | An | 3 |
| 14. | Write down the need for personal protective equipment for handling cryogenics. | | CO4 | R | 3 |
| 15. | Explain the factors to be considered before determining the type of insulation for a cryogenic container. | | CO5 | U | 3 |
| 16. | State the application of liquid nitrogen as a cryogen. | | 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. | State the physics involved in shrinking of metal when exposed to cryogenic temperature. | CO1 | R | 6 |
|  | b. | State the effect of cryogenics on electrical conductivity. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain Linde-Hampson system with a neat sketch. | CO2 | A | 6 |
|  | b. | Develop work required per unit mass of gas liquefied equation for simple Linde Hampson system. | CO2 | C | 6 |
|  |  |  |  |  |  |
| 19. | a. | Recall Magneto caloric effect. | CO3 | R | 4 |
|  | b. | Explain magnetic refrigeration with neat sketch. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 20. |  | Write down the various safety precautions to be taken for transportation of the Cryogens.  1. Transport within the laboratory or lab building.  2. Transport between buildings.  3. Vehicular transport. | CO4 | R | 4  4  4 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the design procedure of inner and outer vessel for a cryogenic vessel. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | List the various cryogenic propellants used in rocket engines. | CO5 | R | 4 |
|  | b. | Explain fuel rich stage combustion with neat sketch. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 23. |  | Explain cascade gas liquefaction system with neat sketch. | CO2 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the various application of cryogenics in Aerospace application. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the thermal, physical and fluid dynamic properties of cryogenic fluids. |
| CO2 | Recognize the liquefaction systems to produce cryogenic fluids. |
| CO3 | Known the Cryogenic refrigeration systems. |
| CO4 | Recognize the methods of Cryogenic fluid storage and transfer systems for Aerospace application. |
| CO5 | Categorize the Cryogenic Engine for Rockets. |
| CO6 | Design the various cryogenic equipment used in Aerospace application. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 14 |  | 3 |  |  |  | 17 |
| CO2 | 2 |  | 18 | 3 |  | 6 | 29 |
| CO3 | 6 |  | 8 | 3 |  |  | 17 |
| CO4 | 17 |  | 12 |  |  |  | 29 |
| CO5 | 6 | 11 |  |  |  |  | 17 |
| CO6 | 3 |  | 12 |  |  |  | 15 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | If **f** is the law of attraction towards the origin, the equation of motion is d2**r**/dt2 = -**f** or d2**r**/dt2 = **f**. | | CO1 | U | 1 |
| 2. | The Kepler’s equation is M = E – e sin E or M = E - e cos E. | | CO1 | R | 1 |
| 3. | If the orbital period of a satellite is T, then its mean motion n is 2π/T or 2π/T2. | | CO2 | A | 1 |
| 4. | The distance formulae is r = a (1 - e cos E) or r = a (1 - e sin E). | | CO2 | A | 1 |
| 5. | Find the mass parameter (μ) of Sun-Jupiter system. Masses of Sun and Jupiter are 2.0 x1030 and 2.0 x1027 kg, respectively. | | CO3 | A | 1 |
| 6. | Write an expression for finding the centre of mass of Sun-Jupiter system. Masses of Sun and Jupiter are m1 and m2, respectively. The distance between them is d. | | CO3 | A | 1 |
| 7. | At the equilateral points L4 and L5, four characteristic roots are pure imaginary, if the mass parameter (µ) is ≤ 0.03852 or > 0.03852. | | CO4 | U | 1 |
| 8. | At the collinear points Li (i=1, 2, 3), (two/four) characteristic roots are pure imaginary. | | 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, or sz < si (i =1, 2, 3). | | CO5 | R | 1 |
| 10. | If in two-body problem, the angular momentum is h and z component of h is hz, then the orbital inclination i is given by cos i = hz/h or sin i = hz/h. | | CO5 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | For one-dimensional motion, by assuming x ≥ 0, using the equation of energy K2/x – (dx/dt)2/2 = hK,  for the case of zero energy (hK = 0), prove that x = (9 K2/2)1/3 t2/3. K2 = k2(M + m), k2 is the universal gravitational constant, M and m are the masses of the two bodies. | | CO1 | E | 3 |
| 12. | With the help of a neat diagram, explain Lambert’s theorem for elliptic orbits. | | CO2 | R | 3 |
| 13. | Define planar restricted three-body problem. | | CO3 | R | 3 |
| 14. | Draw a neat diagram to show the locations of the equilateral points of the planar restricted three-body problem. | | CO4 | U | 3 |
| 15. | The Tisserand's criterion for the identification of comets for elliptic orbits is 1/(2a) + [a(1 – e2)]1/2 cos i = constant or 1/(2a) + [a(1 – e2)]1/2 sin i = constant. | | CO5 | U | 3 |
| 16. | The halo orbits in the restricted three-body problem exist at collinear/equilateral points. These are in the plane of the two primaries/three-dimensional orbits. These are periodic/quasi-periodic orbits. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | If two point masses m1and m2 are acted upon only by the mutual force of gravity between them, prove that the centre of mass of this system moves with constant velocity in a straight line. Prove that the motion of m2 around m1 is governed by a second-order non-linear differential equation d2**r**/dt2 = - µ**r**/r3, µ is the gravitational constant. | CO1 | E | 12 |
| 18. | a. | Derive Lambert’s theorem for elliptic orbits analytically. | CO2 | E | 12 |
| 19. | a. | Derive equations of motion for planar restricted three-body problem in synodic (rotating) coordinate system. | CO3 | E | 12 |
| 20. | a. | Derive the location of the collinear point L1 or L2. | CO4 | E | 12 |
| 21. | a. | Derive Tisserand criterion for identification of comets in an elliptic orbit. | CO5 | E | 12 |
| 22. | a. | Using the values of partial derivatives of the second-order derivatives at the equilateral point L4: Ωxx = 3/4, Ωxy = 3.31/2 (μ - 1/2)/2, Ωyy = 9/4, prove that the characteristic equation is λ4 + λ2 + 27μ (1 - μ)/4 = 0. | CO4 | E | 12 |
| 23. | a. | For one-dimensional motion, using the transformation from ordinary to fictitious time performed by d/dt = (1/x)(d/ds), the equation of motion d2x/dt2 + K2/x2 = 0 and equation of energy given in (11) are transformed as xd2x/ds2 + (dx/ds)2 + K2x = 0 and (dx/ds)2 = 2(K2x – hKx2). | CO1 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write the equations of motion for planar photo-gravitational restricted three-body problem. Obtain the two equations to find the locations of the five Lagrangian points. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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



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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | If f is the law of attraction towards the origin, the equation of motion is d2**r**/dt2 = \_\_\_\_\_\_\_\_\_. | | CO1 | U | 1 |
| 2. | The Kepler’s equation is M = E – e sin E or M = E + e sin E. | | CO1 | R | 1 |
| 3. | If the orbital period (T) of a satellite is 6600 s, its mean motion (n) is \_\_\_\_\_. | | CO2 | A | 1 |
| 4. | Using the distance formulae r = a (1 - e cos E), find the value of r, if a, e and E are 8000 km, 0.05, 30 degrees, respectively. | | CO2 | A | 1 |
| 5. | Find the mass parameter (μ) of Sun-Jupiter system. Masses of Sun and Jupiter are 2.0 x1030 and 1.9 x1027 kg, respectively. | | CO3 | A | 1 |
| 6. | Find the center of mass of Sun-Jupiter system. Masses of Sun and Jupiter are 2.0 x1030 and 1.9 x1027 kg, respectively. The distance between them is 779 x106 km. | | CO3 | A | 1 |
| 7. | At the equilateral points L4 and L5, four characteristic roots are (pure imaginary/real), if the mass parameter (µ) is ≤ 0.03852. | | CO4 | U | 1 |
| 8. | At the collinear points Li (i=1, 2, 3), (two/four) characteristic roots are real. | | 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 = 6000 km2/s, find the value of the orbital inclination i in degrees. | | CO5 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | For one-dimensional motion, by assuming x ≥ 0, using the equation of energy K2/x – (dx/dt)2/2 = hK,  for the case of zero energy (hK = 0), prove that x = (9 K2/2)1/3 t2/3. K2 = k2(M + m), k2 is the universal gravitational constant, M and m are the masses of the two bodies. | | CO1 | E | 3 |
| 12. | With the help of a neat diagram, explain Lambert’s theorem for elliptic orbits. | | CO2 | R | 3 |
| 13. | Define planar restricted three-body problem. | | CO3 | R | 3 |
| 14. | Draw a neat diagram to show the locations of the collinear and equilateral points of the planar restricted three-body problem. | | CO4 | U | 3 |
| 15. | Write Tisserand's criterion for the identification of comets for elliptic orbits and explain its utility. | | CO5 | U | 3 |
| 16. | Define halo orbits. Explain their utility in Earth-moon RTBP. | | 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. |  | If two point masses m1and m2 are acted upon only by the mutual force of gravity between them, prove that the centre of mass of this system moves with constant velocity in a straight line. Prove that the motion of m2 around m1 is governed by a second-order non-linear differential equation d2**r**/dt2 = - µ**r**/r3, µ is the gravitational constant. | CO1 | E | 12 |
| 18. |  | Derive Lambert’s theorem for elliptic orbits analytically. | CO2 | E | 12 |
| 19. |  | Derive equations of motion for planar restricted three body problem in synodic (rotating) coordinate system. Derive Jacobi’s integral. | CO3 | E | 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. | CO4 | E | 12 |
| 21. |  | Derive Tisserand criterion for identification of comets in an elliptic orbit. | CO5 | E | 12 |
| 22. |  | Prove that the second-order derivatives at the equilateral point L4 are Ωxx = 3/4, Ωxy = 3.31/2 (μ - 1/2)/2, Ωyy = 9/4.Using these values of partial derivatives, prove that the characteristic equation is λ4 + λ2 + 27μ (1 - μ)/4 = 0. | CO4 | E | 12 |
| 23. |  | For one-dimensional motion, using the transformation from ordinary to fictitious time performed by d/dt = (1/x)(d/ds), the equation of motion d2x/dt2 + K2/x2 = 0 and equation of energy given in (11) are transformed as xd2x/ds2 + (dx/ds)2 + K2x = 0 and (dx/ds)2 = 2(K2x – hKx2). For hK = 0, prove that x = K2s2/3 and t = K2s3/6. | CO1 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Write the equations of motion for planar photo-gravitational restricted three-body problem. Obtain the two equations to find the locations of the five Lagrangian points. Prove that the locations of the triangular Lagrangian points is given by r1=q1/3, r2 = 1. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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



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| --- | --- | --- | --- |
| **Course Code** | **18AE2042** | **Duration** | **3hrs** |
| **Course Name** | **AIR TRAFFIC CONTROL AND AERODROME DETAILS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define ATC. | | CO1 | R | 1 |
| 2. | Give examples of information provided by Flight information centres. | | CO1 | U | 1 |
| 3. | Define ANP. | | CO2 | R | 1 |
| 4. | List the procedure to adjust cruising level en route. | | CO2 | U | 1 |
| 5. | Define Radar. | | CO3 | R | 1 |
| 6. | List the rules of the air. | | CO3 | U | 1 |
| 7. | List aerodrome data. | | CO4 | R | 1 |
| 8. | What is aerodrome reference temperature? | | CO4 | R | 1 |
| 9. | Expand VASI and PAPI. | | CO5 | R | 1 |
| 10. | Discuss about air safety. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Identify the purpose of ATC with necessary points. | | CO1 | R | 3 |
| 12. | Summarize the contents of flight plan. | | CO2 | U | 3 |
| 13. | Discuss about alerting services. | | CO3 | U | 3 |
| 14. | Explain about runway length specifications. | | CO4 | U | 3 |
| 15. | Discuss about aerodrome beacons. | | CO5 | U | 3 |
| 16. | Describe about airworthiness with necessary points. | | 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. | List the types of Airspaces and describe each type briefly. | CO1 | R | 9 |
|  | b. | Predict the Altimeter setting procedure. | CO1 | U | 3 |
|  |  |  |  |  |  |
| 18. | a. | Summarize RNP. | CO2 | U | 9 |
|  | b. | Describe in detail RNAV. | CO2 | R | 3 |
|  |  |  |  |  |  |
| 19. | a. | Explain about co-ordination and emergency procedures in detail. | CO3 | U | 9 |
|  | b. | Differentiate primary radar and secondary radar. | CO3 | U | 3 |
|  |  |  |  |  |  |
| 20. | a. | Discuss in detail the components of an airport layout. | CO4 | U | 8 |
|  | b. | Differentiate Instrument runway and non-instrument runway. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 21. | a. | Describe about simple approach lighting system and various lighting systems. | CO5 | R | 10 |
|  | b. | Review about landing direction indicator. | CO5 | U | 2 |
|  |  |  |  |  |  |
| 22. | a. | Explain the air safety circulars released in recent years. | CO6 | U | 10 |
|  | b. | Describe air transport based on civil aviation regulation (CAR). | CO6 | R | 2 |
|  |  |  |  |  |  |
| 23. | a. | Discuss in detail the location and characteristics of signal area. | CO5 | A | 9 |
|  | b. | Review about identification beacons. | CO5 | A | 3 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain about Flight information and advisory service. | CO3 | U | 9 |
|  | b. | Describe about emergency procedures in airport. | CO3 | R | 3 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the basic concepts of ATS and its services. |
| CO2 | Distinguish the flight operations between different altitudes. |
| CO3 | Exemplify the working routines of radar services. |
| CO4 | Identify the Aerodrome layouts and the design. |
| CO5 | Illustrate the runway restrictions, various approach systems and guidances. |
| CO6 | Understand the need for Civil Aviation Requirements. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 13 | 4 |  |  |  |  | 17 |
| CO2 | 4 | 13 |  |  |  |  | 17 |
| CO3 | 4 | 25 |  |  |  |  | 29 |
| CO4 | 2 | 15 |  |  |  |  | 17 |
| CO5 | 11 | 5 | 12 |  |  |  | 28 |
| CO6 | 5 | 11 |  |  |  |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**SUPPLEMENTARY EXAMINATION – JUNE 2023**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **18AE2042** | **Duration** | **3hrs** |
| **Course Name** | **AIR TRAFFIC CONTROL AND AERODROME DETAILS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define air traffic control units. | | CO1 | R | 1 |
| 2. | Describe VFR. | | CO1 | U | 1 |
| 3. | List the services provided by ATC service. | | CO2 | R | 1 |
| 4. | Identify the elements of RNAV functional requirements. | | CO2 | U | 1 |
| 5. | Define – Primary Radar. | | CO3 | R | 1 |
| 6. | Describe about emergency descent. | | CO3 | U | 1 |
| 7. | Define – Taxiway. | | CO4 | R | 1 |
| 8. | Describe about aerodrome reference point. | | CO4 | R | 1 |
| 9. | Describe visual aids in airport. | | CO5 | R | 1 |
| 10. | Discuss about airworthiness. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List different types of airports. | | CO1 | R | 3 |
| 12. | Indicate the clearance for departing aircraft. | | CO2 | U | 3 |
| 13. | Discuss about alerting services. | | CO3 | U | 3 |
| 14. | Differentiate – Instrument runway and non-instrument runway. | | CO4 | U | 3 |
| 15. | Discuss about identification beacons. | | CO5 | U | 3 |
| 16. | Describe about air safety with necessary points. | | 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. | Recall Division of responsibility of control of ATC. | CO1 | R | 9 |
|  | b. | Classify airport area. | CO1 | U | 3 |
|  |  |  |  |  |  |
| 18. | a. | Summarize about Vertical, lateral and longitudinal separation of flights based on time and distance. | CO2 | U | 9 |
|  | b. | Recite the Contents of position reports. | CO2 | R | 3 |
|  |  |  |  |  |  |
| 19. | a. | Describe in detail about Instrument Runway/Instrument Approach Runway with necessary diagram. | CO3 | U | 9 |
|  | b. | Differentiate – Visual Flight Rules and Instrument Flight Rules. | CO3 | U | 3 |
|  |  |  |  |  |  |
| 20. | a. | Explain about Obstacles Limitation Surface with necessary sketches. | CO4 | U | 8 |
|  | b. | Explain about aerodrome elevation. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 21. | a. | Describe about VASI & PAPI with necessary sketches. | CO5 | R | 10 |
|  | b. | Review about aerodrome beacons. | CO5 | U | 2 |
|  |  |  |  |  |  |
| 22. | a. | Explain about air navigation circulars released in recent years. | CO6 | U | 10 |
|  | b. | Describe about environment protection based on civil aviation regulation (CAR). | CO6 | R | 2 |
|  |  |  |  |  |  |
| 23. | a. | Discuss in detail about various lighting systems used in aerodrome. | CO5 | U | 9 |
|  | b. | Review about emergency and other services. | CO5 | U | 3 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain about radar services and basic radar terminology. | CO3 | U | 9 |
|  | b. | Describe about rules of the air in aerodrome. | CO3 | R | 3 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Recall the basic concepts of ATS and its services. |
| CO2 | Distinguish the flight operations between different altitudes. |
| CO3 | Exemplify the working routines of radar services. |
| CO4 | Identify the Aerodrome layouts and the design. |
| CO5 | Illustrate the runway restrictions, various approach systems and guidances. |
| CO6 | Understand the need for Civil Aviation Requirements. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 13 | 4 |  |  |  |  | 17 |
| CO2 | 4 | 13 |  |  |  |  | 17 |
| CO3 | 4 | 25 |  |  |  |  | 29 |
| CO4 | 2 | 15 |  |  |  |  | 17 |
| CO5 | 11 | 17 |  |  |  |  | 28 |
| CO6 | 5 | 11 |  |  |  |  | 16 |
|  | | | | | | | **124** |



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| --- | --- | --- | --- |
| **Course Code** | **18AE2043** | **Duration** | **3hrs** |
| **Course Name** | **AIRCRAFT SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Highlight anyone function of hydraulic oil. | | CO1 | R | 1 |
| 2. | Find the pump to produce low pressure air in pneumatic system. | | CO1 | R | 1 |
| 3. | Name the type of landing gear of an aircraft that operates to and from the surface of water. | | CO2 | R | 1 |
| 4. | Quote the mechanism to attach landing gear with an aircraft. | | CO3 | R | 1 |
| 5. | Recall fuel blending. | | CO3 | R | 1 |
| 6. | Find the location of lubricating oil in wet-sump lubrication system. | | CO4 | R | 1 |
| 7. | Define hypoxia. | | CO5 | R | 1 |
| 8. | Name the adequate method of cooling for equipment with low loads. | | CO5 | R | 1 |
| 9. | Recall the main purpose of Auxiliary Power Unit. | | CO6 | R | 1 |
| 10. | Classify ice protection system. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List the features of Bagasse. | | CO1 | R | 3 |
| 12. | Classify the types of landing gear wheel arrangement. | | CO2 | U | 3 |
| 13. | Compare and contrast liquid fuels and solid fuels. | | CO3 | U | 3 |
| 14. | Discover the role of cabin pressure control valve. | | CO4 | U | 3 |
| 15. | Explain oxygen masks in flight. | | CO5 | U | 3 |
| 16. | List the causes of aircraft fire. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the components of typical hydraulic system with a neat sketch. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the working principle of nose wheel steering system. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the characteristics and properties of aviation fuel. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the requirements of reciprocating engine ignition system. | CO4 | U | 6 |
|  | b. | Discuss about battery ignition system. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain turbine engine cooling system with a neat sketch. | CO4 | U | 6 |
|  | b. | Compare wet and dry-sump lubrication systems in aircraft. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Explain the salient features of air distribution system. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Discuss about Molecular Sieve Oxygen Concentrators. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain about rain removal system. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the principles Aircraft Hydraulic systems. |
| CO2 | Obtain knowledge on the Landing Gear systems. |
| CO3 | Obtain knowledge on Fuel systems and Engine starting systems. |
| CO4 | Diagnose aircraft engine starting systems performance. |
| CO5 | Obtain knowledge on Cabin atmosphere control systems. |
| CO6 | Understand the basics of auxilliary systems in aircraft. |

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



**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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| **Course Code** | **18AE2043** | **Duration** | **3hrs** |
| **Course Name** | **AIRCRAFT SYSTEMS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name the driving force of cavitation wear. | | CO1 | R | 1 |
| 2. | Highlight the significance of fine coating over the surface of cellulose cartridge. | | CO1 | R | 1 |
| 3. | Find the landing gear of helicopter. | | CO2 | R | 1 |
| 4. | Find the aircraft that uses power boost system. | | CO2 | R | 1 |
| 5. | Give the condition for full register position in ignition system. | | CO3 | R | 1 |
| 6. | Find colour of grade 115/145 Gasoline when it is trapped in hose for short period of time. | | CO3 | R | 1 |
| 7. | Find the location of lubricating oil in wet-sump lubrication system. | | CO4 | R | 1 |
| 8. | Find the altitude upto which there is no change on human body. | | CO5 | R | 1 |
| 9. | Expand MSOC. | | CO5 | R | 1 |
| 10. | Name the ice protection system that prevents ice on aircraft. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Name any THREE fluid contamination tests. | | CO1 | R | 3 |
| 12. | Classify shimmy dampers. | | CO2 | U | 3 |
| 13. | Explain the characteristics of gaseous fuels. | | CO3 | U | 3 |
| 14. | Summarize the cooling methods of reciprocating engine. | | CO4 | U | 3 |
| 15. | Give the main purpose of cabin distribution system. | | CO5 | R | 3 |
| 16. | Give the occasion of fire in aircraft. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Describe the function of typical pneumatic system with a neat sketch. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the basic arrangements of landing gear. | CO2 | U | 6 |
|  | b. | Illustrate the working principle of hydraulic landing gear retraction system. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the components and operation of magneto ignition system. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Discuss the characteristics of aviation fuel and its quality testing methods. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain dry-sump lubrication system with a neat sketch. | CO4 | U | 6 |
|  | b. | Describe turbine engine cooling methods. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Discuss about aircraft cabin pressurization system. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the salient features of rain removal system | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain aircraft position and warning system. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Understand the principles Aircraft Hydraulic systems |
| CO2 | Obtain knowledge on the Landing Gear systems |
| CO3 | Obtain knowledge on Fuel systems and Engine starting systems |
| CO4 | Diagnose aircraft engine starting systems performance |
| CO5 | Obtain knowledge on Cabin atmosphere control systems |
| CO6 | Understand the basics of auxilliary systems in aircraft |

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



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Who is referred as the “Glider man”? | | CO1 | R | 1 |
| 2. | Aerial Steam Carriage, the fixed-wing airplane powered by a steam engine was developed by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ . | | CO1 | R | 1 |
| 3. | Draw the 4 basic forces acting on an aircraft. | | CO2 | U | 1 |
| 4. | Name the three principal motions associated with an aircraft while flying. | | CO2 | U | 1 |
| 5. | Write the 4 principal structural parts of an aircraft wing. | | CO3 | R | 1 |
| 6. | Write the use of Slats on an aircraft wing. | | CO3 | U | 1 |
| 7. | The predominant type of fuselage structure used in commercial aircrafts are \_\_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 8. | \_\_\_\_\_\_\_\_ alloy is generally used in hypersonic aircraft structures. | | CO4 | R | 1 |
| 9. | Gas turbine engines work on \_\_\_\_\_\_\_\_\_\_\_ cycle. | | CO5 | R | 1 |
| 10. | In a turboprop engine, approximately \_\_\_\_\_\_\_ % of the thrust comes from the propeller and the remaining \_\_\_\_\_\_\_\_ % comes from the jet exhaust. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate monoplane and biplane. Explain why a monoplane is aerodynamically more efficient than a biplane. | | CO1 | U | 3 |
| 12. | Explain the features of the first successful flight by the Wright brothers. | | CO2 | R | 3 |
| 13. | Discuss the reason why the equal transit theory is not right in explaining the generation of lift. | | CO3 | R | 3 |
| 14. | Write the use of reinforced plastics in aircraft structures. | | CO4 | R | 3 |
| 15. | State the use of Nickel alloys in high temperature applications in aircrafts. | | CO5 | R | 3 |
| 16. | Write the names of 3 launch vehicles developed in India. | | 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. |  | Enumerate the salient contributions of Otto Lilienthal to the early developments of aircrafts. | CO1 | R | 12 |
| 18. |  | Explain the function and use of the basic instruments used for flying. | CO2 | U | 12 |
| 19. |  | Explain the 3 predominant structures of fuselage types and its construction with a schematic representation. | CO3 | R | 12 |
| 20. |  | Explain the different metallic materials used for the construction of aircraft structures. | CO4 | R | 12 |
| 21. |  | Explain the working of a turbojet engine with a neat sketch. | CO5 | R | 12 |
| 22. |  | Explain the principle and working of a liquid propellant rocket engine. | CO5 | R | 12 |
| 23. |  | Describe the achievements of India in Space in terms of lunar missions. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the parts and functions of a typical aircraft with a neat sketch. | CO2 | R | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 14 | 3 | - | - | - | - | 17 |
| CO2 | 15 | 14 | - | - | - | - | 29 |
| CO3 | 16 | 1 | - | - | - | - | 17 |
| CO4 | 17 | 0 | - | - | - | - | 17 |
| CO5 | 28 | 0 | - | - | - | - | 28 |
| CO6 | 3 | 13 | - | - | - | - | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are known for their shorter wingspan, which allows for greater maneuverability. | | CO1 | R | 1 |
| 2. | The concept of Aerial steam engine was proposed by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | The force caused by air resistance that slows down an airplane is known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 | U | 1 |
| 4. | Name the three principal motions associated with an aircraft while flying. | | CO2 | U | 1 |
| 5. | Major aircraft component which holds the passengers along with cargo is called as \_\_\_\_\_\_\_\_\_\_. | | CO3 | R | 1 |
| 6. | Flaps are located at the leading edge of the airplane wing. True / False | | CO3 | U | 1 |
| 7. | High pressure air can escape around the tip and flow up around to the top surface leading to \_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 8. | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the stress that tends to shorten or squeeze aircraft parts. | | CO4 | R | 1 |
| 9. | Gas turbine engines work on \_\_\_\_\_\_\_\_\_\_\_ cycle. | | CO5 | R | 1 |
| 10. | The thrust of the \_\_\_\_\_\_\_\_\_\_\_\_ engine is a combination of thrust produced by fan blades and jet from the exhaust nozzle. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Paraphrase the working principle of Ornithopters. | | CO1 | U | 3 |
| 12. | Outline the stages in the development of an aircraft. | | CO2 | R | 3 |
| 13. | Explain how lift is generated using Newtonian theory. | | CO3 | R | 3 |
| 14. | Write the use of steel in aircraft structures. | | CO4 | R | 3 |
| 15. | Explain the role of matrix and reinforcements in a composite. | | CO5 | R | 3 |
| 16. | Why are high earth orbits also known as geosynchronous orbits? | | 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. | Enumerate the salient contributions of Sir George Cayley to the early developments of aircrafts. | CO1 | R | 12 |
| 18. | a. | Explain the working principle of Pitot tube-based and gyro-based instruments in aircrafts. | CO2 | U | 12 |
| 19. | a. | Explain the 3 predominant structures of fuselage types and its construction with a schematic representation. | CO3 | R | 12 |
| 20. | a. | Explain the different non-metallic materials used for the construction of aircraft structures. | CO4 | R | 12 |
| 21. | a. | Explain the working of a turbofan engine with a neat sketch. | CO5 | R | 12 |
| 22. | a. | Explain the principle and working of a solid propellant rocket engine. | CO5 | R | 12 |
| 23. | a. | Describe the features of Mangalyan mission by ISRO. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the 5 major parts and functions of a typical aircraft with a neat sketch. | CO2 | R | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 14 | 3 | - | - | - | - | 17 |
| CO2 | 15 | 14 | - | - | - | - | 29 |
| CO3 | 16 | 1 | - | - | - | - | 17 |
| CO4 | 17 | 0 | - | - | - | - | 17 |
| CO5 | 28 | 0 | - | - | - | - | 28 |
| CO6 | 3 | 13 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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| --- | --- | --- | --- |
| **Course Code** | **18AE3016** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED FINITE ELEMENT ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain about finite element. State the three phases of finite element method. | CO2 | R | 8 |
|  | b. | What are the differences between implicit and explicit direct integration methods? What is Plane stress and Plane strain condition? | CO2 | U | 12 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Differentiate material non linearity and geometric non linearity.  Define shape function and state its characteristics. | CO2 | U | 8 |
|  | b. | Differentiate CST and LST elements. Derive the shape function for the 8 noded rectangular element. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 3. |  | Derive the expression for stress strain relationship for 2D element in plane stress and plane strain conditions. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Find the deflection at the centre of a simply supported beam of span length “L” subjected to uniformly distributed load throughout its length using  (a) point collocation method,  (b) Least squares method. | CO1 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | For the beam and loading shown in fig. calculate the nodal displacements.  Take E =210 GPa, I = 6×10-6 m4. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Calculate the element stiffness matrix and the temperature force vector for the plane stress element as shown in figure. The element experiences a 20°C increase in temperature, Assume coefficient of thermal expansion is 6 x 10-6/°C. Take Young’s modulus E = 2 X 105N/mm2. | CO5 | Ap | 20 |
|  |  |  |  |  |  |
| 7. |  | Derive the expression for strain-displacement relationship for axisymmetric element. | CO6 | Ap | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Determine the natural frequency for the axial vibration of a steel bar shown in fig. Take E =2.1×105 N mm2, ρ = 7800 Kg/m3. | CO2 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Consider the differential equation 𝒅𝟐𝒚 /𝒅𝒙𝟐 + 𝟒𝟎𝟎x𝟐 = 𝟎 for 𝟎 ≤ 𝒙 ≤ 𝟏 subject to boundary conditions y(0) = 0, y(1) = 0. The functions corresponding to this problem, to be eternized is given by . Find the solution of the problem using Ray Light Ritz method by considering a two term solution as  y(𝒙)= 𝒄𝟏𝒙( 𝟏 – 𝒙) + 𝒄𝟐𝒙𝟐 (𝟏 − 𝒙) | CO1 | An | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  |  | 20 | 20 |  |  | 40 |
| CO2 | 16 | 12 |  | 20 |  |  | 48 |
| CO3 |  |  | 32 |  |  |  | 32 |
| CO4 |  |  |  | 20 |  |  | 20 |
| CO5 |  |  | 20 |  |  |  | 20 |
| CO6 |  |  | 20 |  |  |  | 20 |
|  | | | | | | | **180** |



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| --- | --- | --- | --- |
| **Course Code** | **18AE3019** | **Duration** | **3hrs** |
| **Course Name** | **COMPOSITE MATERIALS & STRUCTURES ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the role of matrix and reinforcements in composites. | CO1 | U | 10 |
|  | b. | Explain the different types of composites. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the different matrix materials and reinforcements of composites. | CO1 | An | 10 |
|  | b. | Compare the characteristics of traditional materials with composites. | CO1 | An | 10 |
|  |  |  |  |  |  |
| 3. |  | For a graphite epoxy composite with 60% fiber volume fraction find E1, E2, G12 and ν12 also find the mass fraction of fiber and matrix. Given Ef = 230 GPa, Em = 3.4 GPa, νm = 0.3, νf = 0.3, ρm = 1200 kg/m3 and ρf = 1800 kg/m3. | CO2 | Ap | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Discuss about particle reinforces and fibre reinforced composites and compare them. | CO2 | An | 10 |
|  | b. | A glass epoxy laminate has the following material properties Ef = 95 GPa, Em = 3.4 GPa, Vm = 0.3 and Vf = 0.25, find the minor Poisson’s ratio ν21 and G12 for volume fraction of 60% . | CO2 | Ap | 10 |
|  |  |  |  |  |  |
| 5. |  | A laminate has 3 layers with [0/90/0] orientation with t1 = t3 = 2 mm (thickness of the outer layers) and t2 = 3 mm (thickness of the middle layer). Calculate the matrices [A], [B] and [D] matrices. Given E1 = 40 GPa, E2 = 8 GPa, υ12 = 0.25 and G12 = 4 GPa. | CO3 | Ap | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Find A, B, and D matrices for the 3-ply laminate as shown in the figure. Assume stiffness matrix Q as follows:    For Layer 2    For Layers 1 and 3 | CO3 | Ap | 20 |
|  |  |  |  |  |  |
| 7. |  | Derive the constants involved in the constitutive relation of an orthotropic material. | CO4 | Ap | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Find the compliance and stiffness matrix for a graphite/epoxy lamina. The material properties are given as  E1 = 181 GPa, E2 = 10.3 GPa, E3 = 10.3 GPa, ν12 = 0.28, ν23 = 0.60, ν13 = 0.27, G12 = 7.17 GPa, G23 = 3.0 GPa, G31=7.00 GPa. | CO5 | Ap | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the applications of composites in various fields. | CO6 | U | 10 |
|  | b. | Explain the mechanical test method of fatigue resistance test. | CO6 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Classify the composite materials and Get knowledge in manufacture of composites. |
| CO2 | Discuss the design the composite structures. |
| CO3 | Estimate the behaviour Composite Materials under Various Loads. |
| CO4 | Analyse the different Failure modes of Composite Materials. |
| CO5 | Design the composite plate. |
| CO6 | Choose composite material and structures for various application. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 20 |  | 20 |  |  | 40 |
| CO2 |  |  | 30 | 10 |  |  | 40 |
| CO3 |  |  | 40 |  |  |  | 40 |
| CO4 |  |  | 20 |  |  |  | 20 |
| CO5 |  |  | 20 |  |  |  | 20 |
| CO6 |  | 20 |  |  |  |  | 20 |
|  | | | | | | | **180** |



**SUPPLEMENTARY EXAMINATION – JUNE 2023**

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Discuss the types of Unmanned Aerial Vehicle (UAV) and also explain its merits and demerits. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. |  | Explain the following UAV airframe configurations with a neat sketch.   1. HTOL 2. VTOL | CO1 | U | 8  8 |
|  |  |  |  |  |  |
| 3. | a. | Explain the UAV power plants and also its power generation systems. | CO2 | U | 8 |
|  | b. | Discuss about the aerodynamic forces on UAV. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 4. |  | Discuss about the design requirements of stealth UAV. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 5. | a. | Explain about the different media of UAV communication and also explain its salient features. | CO4 | U | 8 |
|  | b. | Explain the types of UAV payloads and its design limits. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 6. |  | Discuss the various launch devices of UAV and justify its features help to attain the mission. | CO4 | U | 16 |
|  |  |  |  |  |  |
| 7. |  | Explain about the sub assembly and subsystem testing of UAV. | CO5 | U | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | Explain in detail about the significant role of UAV technology in military, commercial and medical applications. | CO6 | U | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the components of Unmanned Aerial Vehicle (UAV). | CO1 | U | 12 |
|  | b. | Distinguish between UAS and drone. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 2. |  | Explain the various UAV airframe configurations with suitable examples. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 3. | a. | Explain the following   1. Scale effect 2. Packaging density | CO2 | U | 4  4 |
|  | b. | Explain in detail about the types of drag on UAV. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 4. |  | Discuss about the design requirements of stealth UAV. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 5. | a. | Explain about the various antennas of UAV. | CO4 | U | 8 |
|  | b. | Classify the types of payloads of UAV. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 6. |  | Explain about the launch and recovery devices of UAV. | CO4 | U | 16 |
|  |  |  |  |  |  |
| 7. |  | Explain about the preparation and stem in-flight testing of UAV. | CO5 | U | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | Discuss the roles of UAV in Indian Armed Forces, agriculture, paramedical, commercial and civil applications. | CO6 | U | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List out the various types of design. | | CO1 | R | 1 |
| 2. | Define the Product life cycle process. | | CO1 | R | 1 |
| 3. | Mention any two ideas which can be developed in order to develop a technical product. | | CO3 | U | 1 |
| 4. | Show the application of TRIZ. | | CO2 | U | 1 |
| 5. | State the reasons for developing “Alternates” | | CO3 | R | 1 |
| 6. | Indicate the year and place where the concept of value engineering started. | | CO3 | U | 1 |
| 7. | Comapre the “make” or “buy” decision . | | CO4 | U | 1 |
| 8. | Show the relation between “value” and “cost” by drawing a related sketch. | | CO5 | R | 1 |
| 9. | Indicate the value Engineering team members. | | CO6 | U | 1 |
| 10. | Define the term “Value Engineering” | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the use of Quality function deployment (QFD). | | CO1 | A | 3 |
| 12. | On what basis an idea to be selected? List out the factors to be considered during the selection of an idea. | | CO3 | U | 3 |
| 13. | Mention the full form of AEE and state its objectives. | | CO3 | A | 3 |
| 14. | Differentiate the “Value Engineering” and “Value analysis”. | | CO6 | U | 3 |
| 15. | Write how to measure the profit of a business. | | CO5 | A | 3 |
| 16. | Indicate the applications of Concurrent Engineering. | | 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 help of a pictorial representation, write the PESTEL analysis in detail. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Draw a block diagram which indicates the various idea / design process and explain in detail. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Appraise the parameters to be considered while assigning a rupee equivalent to a product. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate with an example how the value of a product increased in value Engineering. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | With an example classify the Benefit cost, Opportunities cost and Total cost in decision making process. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Analyze with help of a block diagram, the steps of construction of a FAST diagram. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Mention the various phases of “construction management contract” and explain in detail. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Sketch an arrangement of “Selective Laser Sintering” rapid prototyping method and explain in detail. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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 | Carry out 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 | 2 | - | 15 | - | - | - | 17 |
| CO2 | - | 1 | 12 | - | - | - | 13 |
| CO3 | 1 | 5 | 3 | 12 | - | - | 21 |
| CO4 | - | 1 | - | 12 | - | - | 13 |
| CO5 | 1 | - | 3 | 24 | - | - | 28 |
| CO6 | 1 | 7 | 24 | - | - | - | 32 |
|  | | | | | | | **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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Discuss Imperial 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.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 the law of conservation of momentum. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate – heavier than air & lighter than air. | | CO1 | An | 3 |
| 12. | Describe Mach number with equation | | CO2 | U | 3 |
| 13. | Differentiate – monocoque and semi-monocoque fuselage structure. | | CO3 | An | 3 |
| 14. | Describe the wing structural members. | | CO4 | U | 3 |
| 15. | Compare solid 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. |  | Elaborate the history of flight in India with necessary timelines. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe about aircraft components and its functions with necessary sketches. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | Elaborate the structure of aircraft wing and its sub components 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 flight in western countries 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 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Stoke is the unit of \_\_\_\_\_\_\_\_. | | CO1 | U | 1 |
| 2. | Pascal’s law states that pressure at a point is equal in all directions in a \_\_\_\_\_\_ at rest. | | CO2 | R | 1 |
| 3. | In \_\_\_\_\_\_ flow the characteristics like velocity, pressure and density do not change with time. | | CO2 | U | 1 |
| 4. | If the metacentre of the floating body is above the centre of gravity, the floating body will be in \_\_\_\_\_\_\_\_\_\_ equilibrium. | | CO3 | R | 1 |
| 5. | Bernoulli’s theorem deals with the law of conservation of \_\_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 6. | Pitot tube is used for the measurement of \_\_\_\_\_\_\_\_\_\_. | | CO4 | R | 1 |
| 7. | The shape of velocity profile in a laminar flow through a circular pipe is \_\_\_\_\_\_\_\_\_. | | CO5 | R | 1 |
| 8. | A pipe having 400 mm diameter and length 1000 m carrying water at a velocity of 1.5 m/s. If the friction factor is 0.0075 then head loss will be \_\_\_\_\_\_\_\_. | | CO5 | A | 1 |
| 9. | Mach number is given by the relation \_\_\_\_\_\_\_\_\_\_\_. | | CO6 | R | 1 |
| 10. | The force exerted by a jet of water on a stationary vertical plate in the direction of jet is given by \_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Calculate the density, specific weight and weight of one litre of Petrol of specific gravity 0.7. | | CO1 | U | 3 |
| 12. | Define the terms ‘buoyancy’ and ‘centre of buoyancy’. | | CO3 | U | 3 |
| 13. | Define Bernoulli’s theorem. | | CO4 | R | 3 |
| 14. | Water is flowing through a horizontal pipe of diameter 200 mm at a velocity of 3 m/s. A circular solid plate of diameter 150mm is placed in the pipe to obstruct the flow. Find the loss of head due to obstruction in the pipe if Cc=0.62. | | CO5 | A | 3 |
| 15. | State Buckingham π theorem. | | CO6 | R | 3 |
| 16. | Estimate the force exerted by a jet of water of diameter 75mm on a stationary flat plate, when the jet strikes the plate normally with a velocity of 20 m/s. | | CO2 | 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. | A flat plate of area 1.5 x 106 mm2 is pulled with a speed of 0.4 m/s relative to another plate located at a distance of 0.15 mm from it. Determine the force and power required to maintain this speed, if the fluid separating them is having viscosity as 1 poise. | CO1 | A | 6 |
|  | b. | The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Estimate the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20cm. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | The stream function for a two dimensional flow is given by ψ=8xy, calculate the velocity at the point P(4,5). Determine the velocity potential function φ. | CO2 | R | 6 |
|  | b. | An open circular cylinder of 15 cm diameter and 100 cm long contains water upto a height of 80cm. Find the maximum speed at which the cylinder is to be rotated about its vertical axis so that no water spills. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | A uniform flow of 10m/s is flowing over a doublet of strength 15m2/s. The doublet is in the line of the uniform flow. The polar co-ordinates of a point P in the flow field are 0.9 m and 300. Determine i) stream function and ii) the resultant velocity at the point. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | An orifice meter with orifice diameter 15cm is inserted in a pipe of 30cm diameter. The pressure gauges fitted upstream and downstream of the orifice meter give readings of 14.715 N/cm2 and 9.81 N/cm2 respectively. Calculate the rate of flow of water through the pipe in litres/s. Take Cd=0.6. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Determine the head loss due to friction in a pipe of diameter 300 mm and length 50m, through which water is flowing at a velocity of 3 m/s using i) Darcy’s formula ii) Chezy’s formula for which C=60. Take kinematic viscosity (υ) for water as 0.01 stroke. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | The rate of flow of water through the horizontal pipe is 0.25m3/s. The diameter of the pipe which is 200mm is suddenly enlarged to 400mm. The pressure intensity in the smaller pipe is 11.772N/cm2. Determine i) Loss of head due to sudden enlargement. ii) Pressure intensity in the large pipe. iii) Power loss due to enlargement. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft l, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A jet of water of diameter 75 mm moving with a velocity of 25 m/s strikes a fixed plate in such a way that the angle between the jet and plate is 600. Find the force exerted by the jet on the plate i) the direction normal to the plate ii) in the direction of the jet. | CO2 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 4 | 12 | - | - | - | 16 |
| CO2 | 8 | 1 | 33 | - | - | - | 42 |
| CO3 | 1 | 3 | - | - | - | - | 4 |
| CO4 | 5 | - | 12 | - | - | - | 17 |
| CO5 | 1 |  | 28 |  |  |  | 29 |
| CO6 | 4 |  | 12 |  |  |  | 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** | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Write the expression to find the volumetric strain in terms of longitudinal strain in three mutually perpendicular direction. | CO1 | Ap | 1 |
| 2. | Give example for the structure subjected to strain without stress. | CO1 | R | 1 |
| 3. | List the types of beam supports. | CO2 | R | 1 |
| 4. | At the point of contra flexure \_\_\_\_\_\_ changes its sign. (shear force, bending moment, axial force) | CO2 | R | 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. | The slope and deflection at the center of a simply supported beam carrying a central point load are \_\_\_\_\_ and \_\_\_\_\_ respectively.  a. zero, maximum b. Maximum, maximum  c.Zero, zero d. Maximum, zero | CO4 | U | 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. | A cantilever beam of length 10 m is fixed at the left end and carries a point load at a distance of 3 m from the free end. Determine the values of shear forces at sections 1 m and 5 m from the free end. | 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 uniform distributed load over the entire length is doubled, determine the increase in the maximum deflection of the beam. | CO4 | Ap | 3 |
| 15. | Write the torque equation and explain the terms involved. | CO5 | Ap | 3 |
| 16. | The two non-zero principal stresses at a point in a thin plate are 𝜎n1 = 25 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. | A load of 2 MN is applied on a short concrete column 500 mm x 500 mm in section. The column is reinforced with four steel bars of 10 mm diameter one in each corner. Find the stresses in the concrete and steel bars. Take Es = 210 GPa, Ec = 14 GPa. | CO1 | Ap | 12 |
| 18. | Sketch the shear force and bending moment diagram for the beam shown in figure. | CO2 | Ap | 12 |
| 19. | A wooden beam of an ‘I’ section shown in Fig. is used as a cantilever beam for a span of 10 m and subjected to a load of 40 kN at the free end. The ‘I’ section has the dimensions of 350 x 150 mm has a web thickness of 10 mm and flange thickness of 20 mm. Determine the bending stress induced in the beam and sketch the distribution of the bending stress. | CO3 | Ap | 12 |
|  |  |  |  |  |
| 20. | Calculate the maximum deflection of the beam shown in the Figure. Consider the Young’s modulus = 70 GPa and Moment of inertia = 100 cm4. | CO4 | Ap | 12 |
|  |  |  |  |  |
| 21. | A solid circular shaft transmits a torque (T) 50 Nm. Calculate the shaft diameter, if the twist in the shaft not to exceed 1o in 2 meters length of shaft and shear stress not to exceed 50 MN/m2. Take shear modulus G = 100 GN/m2. | CO5 | Ap | 12 |
|  |  |  |  |  |
| 22. | A copper bar shown in Figure is subjected to a tensile load of 30 KN. Determine elongation of the bar if E = 100 GPa. 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 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 | 1 |  | 28 |  |  |  | 29 |
| CO2 | 2 |  | 27 |  |  |  | 29 |
| CO3 |  | 2 | 15 |  |  |  | 17 |
| CO4 | 2 |  | 15 |  |  |  | 17 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  | 4 | 12 |  |  |  | 16 |
|  | | | | | | | **124** |



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

**Property: Tables should be allowed into the examination hall**

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define – control volume and control surface. | | CO1 | R | 1 |
| 2. | Retell – Thermodynamic work. | | CO1 | R | 1 |
| 3. | Recall-pure substances. | | CO2 | R | 1 |
| 4. | Describe about dryness fraction of steam. | | CO2 | U | 1 |
| 5. | Define the term internal energy. | | CO3 | R | 1 |
| 6. | Discuss the steady flow process. | | CO3 | U | 1 |
| 7. | List the causes of entropy increase. | | CO4 | R | 1 |
| 8. | Describe about the maximum efficiency at Carnot cycle. | | CO4 | U | 1 |
| 9. | Determine the molecular volume of any perfect gas at 600N/m2 and 300 C. Universal gas constant may be taken as 8314J/kg mole-K | | CO5 | A | 1 |
| 10. | The regenerative Rankine cycle is used to \_\_\_\_\_\_\_\_\_\_\_\_ of the cycle.  The reheat Rankine cycle is used to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the cycle. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Show – the difference in specific heat capacities equal to | | CO1 | U | 3 |
| 12. | The following expression is used for a thermodynamic system for the differential of pressure, *p* (*T* is temperature, *v* is specific volume, *a*, *b*, and *R* are constants)  Show that *p* is a property | | CO2 | An | 3 |
| 13. | Discuss about the application of first law of thermodynamics to closed system. | | CO3 | U | 3 |
| 14. | Deduce the efficiency of Carnot cycle in terms of temperature from its p-v diagram. | | CO4 | An | 3 |
| 15. | Calculate the available energy in the heat energy of 1000 *kJ* in reservoir at 820 *K*. The surrounding is at 320 *K*. Can one expect a heat engine to develop 500 *kJ* of work? Can one expect a heat engine to develop 700 *kJ* of work? Justify both your answers. | | CO5 | An | 3 |
| 16. | Describe about vapor compression cycle with necessary sketch. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7m/s velocity, 100kPa pressure, and 0.95m3 /kg volume, and leaving at 5 m/s, 700 kPa, and 0.19 m3 /kg. The internal energy of the air leaving is 90kJ/kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58 kW. (a) Compute the rate of shaft work input to the air in kW. (b) Find the ratio of the inlet pipe diameter to outlet pipe diameter. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A vessel having a capacity of 0.05m3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10kg. Find the following(i) The pressure, (ii) The mass, (iii) The specific volume,(iv)The specific enthalpy,(v)The specific entropy, and(vi)The specific internal energy. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Carbon-di-oxide enters a steady state steady flow heater at 300 kPa, 600 K and exits at 275 kPA, 1400 K. Changes in kinetic and potential energies are negligible. Calculate the required heat transfer per kilogram of Carbon di-oxide, flowing through the heater. Make necessary assumptions to simplify the calculations, but justify them. If there is a more accurate way of calculation, briefly mention the method. Need not calculate. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | A reversible engine is supplied with heat from two constant temperature sources at 900K and 600K and rejects heat to a constant temperature sink at 300K. The engine develops work equivalent to 90KJ/s and rejects heat at the rate of 56KJ/s. Estimate (i) Heat supplied by each source and (ii) Thermal efficiency of the engine. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | A rigid tank contains 1 k mol of Ar gas at 220 K and 5 MPa. A valve is now opened, and 3 k mol of N2 gas is allowed to enter the tank at 190 K and 8 MPa. The final mixture temperature is 200 K. Determine the pressure of the mixture, using (a) the ideal-gas equation of state and (b) the compressibility chart and Dalton’s law. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Cooling water leaves the condenser of a power plant and enters a wet cooling tower at 35°C at a rate of 100 kg/s. Water is cooled to 22°C in the cooling tower by air that enters the tower at 1 atm, 20°C, and 60 percent relative humidity and leaves saturated at 30°C. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Produce the equation of enthalpy of an ideal gas has to be a function of temperature only. | CO2 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | In a single heater regenerative cycle, the steam enters the turbine at 30 bar, 400°C and the exhaust pressure is 0.10 bar. The feed water heater is a direct - contact type which operates at 5 bar. Find (i) the efficiencyand the steam rate of the cycle, and (ii) the increase in mean temperature of heat addition, efficiency and steam rate as compared to the Rankine cycle (without regeneration) Neglect pump work | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 3 | 12 | - | - | - | 17 |
| CO2 | 1 | 1 | 24 | 3 | - | - | 29 |
| CO3 | 1 | 4 | - | - | 12 | - | 17 |
| CO4 | 1 | 1 | 12 | 3 | - | - | 17 |
| CO5 | - | - | 13 | 3 | - | - | 16 |
| CO6 | - | 4 | 24 | - | - | - | 28 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Reynolds number. | | CO1 | R | 1 |
| 2. | Give the expression of potential function for doublet flow. | | CO1 | R | 1 |
| 3. | State Magnus effect. | | CO2 | R | 1 |
| 4. | State Bernoulli’s principle. | | CO2 | R | 1 |
| 5. | Define vortex sheet. | | CO3 | R | 1 |
| 6. | Draw Cl vs α graph for a symmetrical airfoil. | | CO3 | R | 1 |
| 7. | Define downwash. | | CO4 | R | 1 |
| 8. | Define control point. | | CO5 | R | 1 |
| 9. | Give the relation between induced drag coefficient and aspect ratio. | | CO4 | R | 1 |
| 10. | Give the expression of momentum thickness. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define centre of pressure. | | CO1 | R | 3 |
| 12. | Compare and contrast vortex and rotational flows. | | CO2 | U | 3 |
| 13. | List the characteristics of symmetric and cambered airfoil. | | CO3 | R | 3 |
| 14. | Explain induced drag. | | CO4 | U | 3 |
| 15. | Highlight the steps involved in panel method. | | CO5 | U | 3 |
| 16. | Explain boundary layer. | | 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 the momentum equation in integral form. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the important features of Kutta-Joukowski’s theorem with a neat sketch. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Derive thin airfoil theory for symmetrical airfoil and discover its results. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the following:   1. Biot-savart law 2. Horse shoe vortex | CO4 | U | 6  6 |
|  |  |  |  |  |  |
| 21. |  | Discuss Kutta condition and Kelvin’s circulation theorem with a neat sketches. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Produce lift force of a finite wing with horse shoe vortex. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain about source panel method. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Derive the expression for displacement thickness of boundary layer. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | - | 12 | - | - | - | 17 |
| CO2 | 2 | 15 | - | - | - | - | 17 |
| CO3 | 5 | 12 | 12 | - | - | - | 29 |
| CO4 | 2 | 27 | - | - | - | - | 29 |
| CO5 | 1 | 15 | - | - | - | - | 16 |
| CO6 | 1 | 3 | 12 | - | - | - | 16 |
|  | | | | | | | **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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | The simplest perfect frame is a triangle. State True or False? | | CO1 | U | 1 |
| 2. | A continuous beam is said to be a statically indeterminate structure. State True or False? | | CO1 | U | 1 |
| 3. | Name any methods to solve statically indeterminate structures. | | CO2 | R | 1 |
| 4. | Write the strain energy equation of an axial member. | | CO3 | U | 1 |
| 5. | Maximum bending moment occurs where the curvature is \_\_\_\_\_\_\_. | | CO3 | U | 1 |
| 6. | If U be the strain energy stored by a redundant structure which is a function of redundant quantity P, then the redundant quantity P is given by the condition, = \_\_\_\_\_\_\_. | | CO4 | U | 1 |
| 7. | Define slenderness ratio of a column. | | CO5 | R | 1 |
| 8. | Rankine's formula is valid for both short and long columns. State True or False. | | CO5 | U | 1 |
| 9. | According to Saint-Venant's theory, failure of a material is a based on  a) Maximum principal strain theory or b) Maximum strain energy theory? | | CO6 | U | 1 |
| 10. | Name any two failure theories for ductile materials. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Name any two common methods for analysis of trusses and discuss briefly. | | CO1 | U | 3 |
| 12. | Write a short note on moment distribution method. | | CO2 | R | 3 |
| 13. | Determine the ratio between the elastic limit in shear and the elastic limit in tension is the amount of strain energy per cubic meter, which can be stored without permanent set, is the same in tension and shear. | | CO3 | A | 3 |
| 14. | State Castigliano’s theorem. | | CO4 | R | 3 |
| 15. | Mention the critical load expression for a long column having pinned-pinned end conditions using Euler’s theory. | | CO5 | A | 3 |
| 16. | Discuss failure envelope. | | 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 truss is supported in an inclined angle of 30° as shown in the Figure. Determine the internal forces on each member of the truss structure. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A continuous beam ABC, simply supported at A, B and C is loaded with a uniformly distributed load of w1 = 6 kN/m throughout the span AB and a uniformly distributed load of w2 = 10 kN/m throughout the span BC. Find the moments over the beam and draw bending moment and shear force diagrams using Claypeyron’s equation of three moments. The span dimensions are as follows: Total span ABC = 10 m; Span AB = 4 m and Span BC = 6 m. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | A prismatically steel bar of 250 mm long and 100 mm2 in cross sectional area is compressed by a force P = 18 kN. Determine the amount of strain energy for the following two cases: i) If the weight of the bar is ignored and ii) If the bar is strained by its own weight of 200 kg. Take the elastic limit of steel as 210 GPa. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | The cross-sectional area of each member of the truss shown is 400 mm2 and 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. |  | Derive the expression of buckling load of a long column having fixed-free end conditions using Euler’s theory. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | A hollow cast iron column of 4.5 m long has an outside diameter of 200 mm and a thickness of 20 mm and it is fixed at both ends. Evaluate the safe load, which the column can carry using Rankine’s formula. Take σc = 550 N/mm2, 𝛂 = 1/1600 and E = 94 GPa. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Derive an expression to determine the failure of the material according to i) Maximum normal stress theory and ii) Maximum shear stress theory | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | At a section of a mild steel shaft, the maximum torque is 8500 Nm and maximum bending moment is 4250 Nm. The diameter of the shaft is 100 mm and the stress at the elastic limit in simple tension for the material of the shaft is 250 N/mm2. Determine the failure stress and verify whether the material fails or not according to maximum normal stress theory and maximum strain energy theory. Take E = 210 GPa and 𝝂 = 0.3. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 condition. |
| 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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 5 | 12 |  |  |  | 17 |
| CO2 | 4 |  | 12 |  |  |  | 16 |
| CO3 |  | 2 | 3 | 12 |  |  | 17 |
| CO4 | 3 | 1 | 12 |  |  |  | 16 |
| CO5 | 1 | 1 | 15 | 12 |  |  | 29 |
| CO6 |  | 5 | 12 | 12 |  |  | 29 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Thrust specific fuel consumption. | | CO1 | R | 1 |
| 2. | Illustrate the P-V diagram for Brayton cycle. | | CO1 | R | 1 |
| 3. | Recall Ram Effect in aircraft engine. | | CO2 | R | 1 |
| 4. | What is the use of reduction gears in aircraft engine? | | CO2 | U | 1 |
| 5. | Define Isolated system. | | CO3 | R | 1 |
| 6. | Illustrate the exit velocity triangle of centrifugal compressor, if | | CO3 | U | 1 |
| 7. | Define-Angular momentum. | | CO4 | R | 1 |
| 8. | State the need for stages of axial flow compressor. | | CO4 | U | 1 |
| 9. | What is dilution zone in combustion chamber? | | CO5 | U | 1 |
| 10. | List the needs of turbine blade cooling. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate open cycle & closed cycle gas turbine engines. | | CO1 | U | 3 |
| 12. | Differentiate pulse jet and ram jet engine. | | CO2 | R | 3 |
| 13. | Discuss about slip in centrifugal compressor. | | CO3 | U | 3 |
| 14. | Explain the requirements of axial flow compressor. | | CO4 | U | 3 |
| 15. | Describe the purpose of flame holder with necessary diagram. | | CO5 | R | 3 |
| 16. | Differentiate radial flow and axial flow turbine. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain about Brayton cycle with necessary sketches. | CO1 | U | 8 |
|  | b. | Discuss about the factors affecting thrust. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Discuss about the thrust augmentation techniques. | CO2 | U | 6 |
|  | b. | A flight speed of a turbojet is 800 kmph at 10000 m altitude. The density of air at that altitude is 0.17kg/m3. The Thrust for a plane is 6.8kN. The propulsive efficiency of the jet is 60%. Calculate SFC, ratio of mass flow rate of air and fuel, jet velocity. Assume the calorific value of fuel is 45MJ/Kg & overall efficiency is 18%. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain about velocity triangles of centrifugal compressor with necessary diagrams. | CO3 | U | 9 |
|  | b. | Discuss about the advantages and disadvantages of centrifugal compressor. | CO3 | U | 3 |
|  |  |  |  |  |  |
| 20. | a. | An axial compressor stage has mean diameter 600mm and runs at 250rps. The actual temperature rise is 30°C and the pressure ratio developed is 1.35. Initial temperature is 35°C and temperature rise in the rotor is 20°C. Mass flow rate is 50kg/s and the mechanical efficiency is 85%. Find out, (i) Power required to drive the compressor, (ii) Loading coefficient, (iii) Degree of reaction, (iv) Stage efficiency. | CO4 | A | 8 |
|  | b. | Describe about surging in axial flow compressor with sketches. | CO4 | R | 4 |
|  |  |  |  |  |  |
| 21. | a. | Explain the factors affecting combustion chamber design. | CO5 | U | 8 |
|  | b. | Discuss about flame stabilizers. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the velocity triangles for a turbine machines with necessary equations. | CO6 | A | 8 |
|  | b. | Predict the limiting factors in gas turbine design. | CO6 | A | 4 |
|  |  |  |  |  |  |
| 23. | a. | Differentiate Low by-pass and high by-pass turbo fan engine with necessary diagram. | CO2 | U | 8 |
|  | b. | Explain the thrust Vs altitude graph for turbo jet engine. | CO2 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Classify the types of combustion chambers with necessary diagrams. | CO5 | U | 7 |
|  | b. | Explain the flame tube cooling methods with sketches. | CO5 | U | 5 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Estimate the performance of Brayton cycle. |
| CO2 | Analyze the performance of various air breathing engines. |
| CO3 | Understand the working of sub-systems of jet engines. |
| CO4 | Assess the performance of compressor and turbine. |
| CO5 | Evaluate combustion chamber, cooling and afterburner performance. |
| CO6 | Understand the procedure for matching compressor and turbine. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 | - | - | - | - | 17 |
| CO2 | 4 | 19 | 6 | - | - | - | 29 |
| CO3 | 1 | 16 | - | - | - | - | 17 |
| CO4 | 5 | 4 | 8 | - | - | - | 17 |
| CO5 | 3 | 25 | - | - | - | - | 28 |
| CO6 | - | 4 | 12 | - | - | - | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define the center of pressure. | | CO1 | R | 1 |
| 2. | State the purpose of winglets in the wing. | | CO1 | R | 1 |
| 3. | Explain the purpose of diffuser in a jet engine. | | CO2 | U | 1 |
| 4. | Mass flow rate in propeller engine is greater than that of the jet engine. (True/ False) | | CO2 | R | 1 |
| 5. | State the governing equation of motion for a steady level flight. | | CO3 | R | 1 |
| 6. | Define the term wing loading. | | CO3 | U | 1 |
| 7. | Draw the power available and the power required curve vs. free stream velocity (V∞) for a propeller driven airplane and indicate the excess power available. | | CO4 | U | 1 |
| 8. | State the condition on load factor and free stream velocity to obtain the maximum possible turn rate. | | CO5 | R | 1 |
| 9. | Write the expression for the load facor for unaccelerated level turn of an airplane. | | CO5 | A | 1 |
| 10. | Define decision speed during ground roll. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Draw CL versus α and CD versus α curves in one plot and indicate the salient features. | | CO1 | U | 3 |
| 12. | Define advance ratio (J) of a propeller driven airplane. | | CO2 | R | 3 |
| 13. | Draw the thrust required (TR) vs. free stream velocity (V∞) at two different altitudes. | | CO3 | U | 3 |
| 14. | Draw the sketch of a climbing flight and indicate the forces acting on it and write the governing equation of motion. | | CO4 | U | 3 |
| 15. | The maximum possible load factor for a sustained level turn is constrained by \_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_. | | CO5 | R | 3 |
| 16. | Explain the take-off distance with the help of a neat sketch. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Compare and justify the lift of an airfoil and lift of a finite wing made of same airfoil with a neat sketch. | CO1 | A | 8 |
|  | b. | Briefly explain about the profile drag. | CO1 | R | 4 |
| 18. |  | Explain about the dependency of propeller efficiency on the free stream velocity with a neat sketch and draw the propeller efficiency curve as a function of advance ratio. | CO2 | R | 12 |
| 19. |  | Derive the expression for velocity at minimum thrust required in a level flight. Also draw the thrust required (TR) vs. free stream velocity (V∞) curve and explain the reason for nature of this curve using drag polar equation and also explain the reduction in the angle of attack as V∞ increases. | CO3 | A | 12 |
| 20. |  | Derive the expression for rate of climb for a steady, un-accelerated climbing flight in terms of thrust to weight ratio, wing loading and drag polar. Also draw the hodograph and indicate clearly the maximum angle of climb, climb angle for maximum rate of climb and their corresponding velocities. | CO4 | A | 12 |
| 21. |  | Derive the expression for maximum turn rate from and . (Note that n is a function of ) | CO5 | A | 12 |
| 22. |  | Describe the various phases of take-off flight and derive the expression to estimate the take-off ground roll distance of an airplane. | CO6 | U | 12 |
| 23. |  | Explain about the high lift devices commonly used with schematic diagram of various configuration of airfoils. | CO1 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Elaborately explain the V-n diagram with a neat sketch indicating the limit load factor and ultimate load factor. | CO5 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 | 15 | 8 |  |  |  | 29 |
| CO2 | 16 | 1 |  |  |  |  | 17 |
| CO3 | 1 | 4 | 12 |  |  |  | 17 |
| CO4 |  | 4 | 12 |  |  |  | 16 |
| CO5 | 4 | 12 | 13 |  |  |  | 29 |
| CO6 | 1 | 15 |  |  |  |  | 16 |
|  | | | | | | | **124** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define alloy. | | CO1 | U | 1 |
| 2. | The relation between edge length (a) and radius of atom (r) for BCC lattice is \_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | Name any two methods of flexural testing. | | CO2 | R | 1 |
| 4. | Define S-N curve. | | CO2 | U | 1 |
| 5. | Name any two high temperature materials used in aerospace industry. | | CO3 | R | 1 |
| 6. | Define specific modulus. | | CO4 | U | 1 |
| 7. | The stiffness of glass fiber is higher than carbon fiber. Mention whether the statement is True or False? | | CO4 | U | 1 |
| 8. | Annealing is a heat treatment process, which is generraly carried out to \_\_\_\_\_\_\_ ductility and \_\_\_\_\_\_\_ the hardness. | | CO5 | U | 1 |
| 9. | \_\_\_\_\_\_\_ is the principal alloying element in 7000 series commercial aluminium alloys. | | CO5 | R | 1 |
| 10. | What is the stiffness of a graphene material? | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate between a ductile and brittle material. | | CO1 | U | 3 |
| 12. | Discuss hydrostatic test. | | CO2 | U | 3 |
| 13. | What are the requirements of high temperature materials? | | CO3 | U | 3 |
| 14. | Mention the classification of composite materials based on its matrix material. | | CO4 | R | 3 |
| 15. | Discuss about various heat treatment processes of a steel. | | CO5 | U | 3 |
| 16. | What are the materials used to make solid propellants and binders? | | 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. | Define and list out salient features of phase diagram. | CO1 | U | 4 |
|  | b. | Explain in detail about the Iron-Carbon phase diagram with a neat sketch. | CO1 | A | 8 |
| 18. | a. | Discuss in detail the various mechanical testing methods of a material and its ASTM standards. | CO2 | U | 6 |
|  | b. | Explain in detail the importance of low cycle and high cycle fatigue. | CO2 | A | 6 |
| 19. | a. | Discuss the historical development of high temperature materials. | CO3 | U | 4 |
|  | b. | Explain in detail about the need for high temperature materials for aerospace industry. Write a case study on the design and development of high temperature materials by considering the following two requirements: Creep and Thermo-mechanical fatigue. | CO3 | A | 8 |
| 20. | a. | List down the different types of fibers and polymers. | CO4 | R | 4 |
|  | b. | Explain about the manufacturing of glass fiber with a neat sketch. | CO4 | A | 8 |
| 21. | a. | What are the different types of carbon steels and mention its composition? | CO5 | R | 4 |
|  | b. | Discuss various casting methods. | CO5 | U | 8 |
| 22. | a. | Write a short note on aluminium alloys. | CO5 | U | 4 |
|  | b. | Explain in detail the heat treatment of aluminium alloys. | CO5 | A | 8 |
| 23. | a. | Write a short note on steels used in solid propellant and liquid propellant rocket motors. | CO6 | U | 4 |
|  | b. | Explain in detail about the requirements of materials used for storage of cryogenic propellants and pumps | CO6 | U | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Define prepregs. | CO4 | U | 4 |
|  | b. | List down the advanced methods for fabricating fiber reinforced polymers and explain in detail about any one method. | CO4 | A | 8 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 8 | 8 |  |  |  | 17 |
| CO2 | 1 | 16 |  |  |  |  | 17 |
| CO3 | 1 | 7 | 8 |  |  |  | 16 |
| CO4 | 7 | 6 | 16 |  |  |  | 29 |
| CO5 | 5 | 16 | 8 |  |  |  | 29 |
| CO6 | 4 | 12 |  |  |  |  | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Calculate the speed of sound wave in air at 25°C and 1 atm. | | CO1 | A | 1 |
| 2. | Define ‘Mach angle’. | | CO1 | R | 1 |
| 3. | Write the condition of the flow at the exit, if the back pressure is less than the critical pressure. | | CO2 | R | 1 |
| 4. | Write the effect of increase of area on velocity for supersonic flows. | | CO2 | U | 1 |
| 5. | Identify what happens to total temperature ahead and behind the expansion wave. | | CO3 | U | 1 |
| 6. | Write the expression for finding out the slope of Hugoniot curve. | | CO3 | R | 1 |
| 7. | Define ‘Fanno Flow’. | | CO4 | R | 1 |
| 8. | Identify the effect of heat addition on pressure for supersonic flow. | | CO4 | U | 1 |
| 9. | Define ‘Prandtl-Meyer expansion’. | | CO5 | R | 1 |
| 10. | State ‘Seebeck principle’. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | A supersonic aircraft is travelling with constant speed of Mach number 0.7 at an altitude of 4 km. How much time will it take to travel a distance of 2000 km? | | CO1 | An | 3 |
| 12. | Air at stagnation state of 3 atm and 300 K is accelerated to 200 m/s. Determine the Mach number of the flow? | | CO2 | An | 3 |
| 13. | Describe the concept of formation of shock in supersonic flows. | | CO3 | U | 3 |
| 14. | Draw Rayleigh curve for simple T0 change. | | CO4 | U | 3 |
| 15. | An oblique shock in air causes an entropy increase of 11.5 J/kg K. If the shock angle is 25ο , determine the Mach number ahead of the shock and the flow deflection angle. | | CO5 | An | 3 |
| 16. | Write any two methods for determining the test section Mach number of supersonic wind tunnels. | | 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. | Air flows through a duct. The pressure and temperature at station 1 are P1= 0.7 atm. and T1= 30οC, respectively. At a second station, the pressure is 0.5 atm. Calculate temperature and density at the second station. Assume the flow to be isentropic. | CO1 | An | 6 |
|  | b. | Derive the expression for calculation of entropy for a perfect gas. | CO1 | A | 6 |
| 18. |  | A ramjet flies at 11 km altitude with a flight Mach number of 0.9. In the inlet diffuser, the air is brought to the stagnation condition so that it is stationary just before the combustion chamber. Combustion takes place at constant pressure and a temperature increase of 1500 K results. The combustion products are then ejected through the nozzle. (a) Calculate the stagnation pressure and temperature. (b) What will be the nozzle exit velocity? (At inlet Pα = 0.3 atm and Tα = 213 K, at exit Pexit = 0.3 atm.) | CO2 | An | 12 |
| 19. |  | Derive the normal shock relations for a perfect gas. | CO3 | A | 12 |
| 20. |  | Atmospheric air at pressure 1.0135Χ105 N/m2 and temperature 300 K is drawn through a friction less bell-mouth entrance into a 3m long tube having a 0.05 m diameter. The average friction coefficient is 0.005, for the tube. The system is perfectly insulated. a) Find the maximum mass flow rate and the range of back pressure that will produce this flow? b) What is the exit pressure required to produce 90% of the maximum mass flow rate, and what will be the stagnation pressure and the velocity at the exit for that mass flow rate? | CO4 | An | 12 |
| 21. |  | Derive the relation between deflection angle, wave angle and Mach number. | CO5 | A | 12 |
| 22. |  | Derive the energy equation for isentropic flow process of gases. | CO2 | A | 12 |
| 23. |  | A convergent- divergent nozzle is designed to deliver Mach 1.8 helium stream. If this nozzle has to be run with air, with the normal shock at the exit, determine the stagnation pressure required if the back pressure is 30 kPa. Also find the Mach number ahead of the shock. | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the working principle of shadowgraph technique with a neat sketch, also write the comparison of Schlieren and shadowgraph methods. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | - | 7 | 9 | - | - | 17 |
| CO2 | 1 | 1 | 12 | 15 | - | - | 29 |
| CO3 | 1 | 4 | 12 | 12 | - | - | 29 |
| CO4 | 1 | 4 | - | 12 | - | - | 17 |
| CO5 | 1 | - | 12 | 3 | - | - | 16 |
| CO6 | 4 | 12 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name the system, which provides information about the physical value of the variable to be measured. | | CO1 | R | 1 |
| 2. | Define measurement error. | | CO1 | R | 1 |
| 3. | Give an example for gyroscopic instrument. | | CO2 | U | 1 |
| 4. | Select the instrument that is used to assist the pilot in navigation. | | CO2 | U | 1 |
| 5. | Indicate the value of atmospheric pressure in metre of water column. | | CO3 | U | 1 |
| 6. | Identify the temperature-measuring instrument in which hot and cold junctions are present. | | CO3 | U | 1 |
| 7. | State cabin differential pressure. | | CO4 | R | 1 |
| 8. | Cite another name of communication management unit used in avionics. | | CO4 | U | 1 |
| 9. | Write the expanded form of ARINC. | | CO5 | A | 1 |
| 10. | Choose a cockpit display system that employs a cathode ray tube. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Differentiate between precision and accuracy. | | CO1 | U | 3 |
| 12. | Classify aircraft instruments. | | CO2 | U | 3 |
| 13. | List out the instruments used in aircraft engine. | | CO3 | R | 3 |
| 14. | Define avionics. | | CO4 | R | 3 |
| 15. | Give examples of avionics data buses. | | CO5 | U | 3 |
| 16. | Enumerate the display technology employed in civil and military aircrafts. | | 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. |  | State the elements of the measurement system and discuss in detail with the help of block diagram. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | Describe the construction and working principle of pneumatic operated vacuum driven system. | CO2 | R | 8 |
|  | b. | Enumerate the salient features of a heading instrument. | CO2 | R | 4 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the construction and operation of an accelerometer. | CO3 | U | 8 |
|  | b. | Compare position and displacement transducer. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. |  | Explain the salient features of the temperature probes used in the measurement of exhaust gas temperature with the neat schematic. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Sketch the flight management system and explain its construction. | CO4 | A | 8 |
|  | b. | Explain briefly about the flight recorder system. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 22. |  | Construct the architecture of ARINC 429 data bus and summarize its salient features. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Articulate about the power requirements of cockpit system. | CO6 | A | 8 |
|  | b. | Write short notes on synthetic and enhanced vision display system. | CO6 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the following types of display system employed in civil and military aircraft.  (i) Multi function display.  (ii) Direct voice input. | CO6 | A | 8 |
|  | b. | Write short notes on civil and military aircraft cockpit. | CO6 | A | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 14 | 3 | - | - | - | - | 17 |
| CO2 | 12 | 5 | - | - | - | - | 17 |
| CO3 | 3 | 26 | - | - | - | - | 29 |
| CO4 | 4 | 1 | 12 | - | - | - | 17 |
| CO5 | - | 3 | 13 | - | - | - | 16 |
| CO6 | 3 | - | 25 | - | - | - | 28 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Recall the thrust equation for a rocket. | | CO1 | R | 1 |
| 2. | ﻿Write the equation for ΔV in terms of mass fractions. | | CO1 | U | 1 |
| 3. | ﻿Sketch the planetary configuration for opposition. | | CO2 | U | 1 |
| 4. | Outline the method to identify the planets rotation and its north pole  Direction. | | CO2 | R | 1 |
| 5. | ﻿Show the variation of velocity 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 varies with time. Isa this statement is true/false? | | CO3 | U | 1 |
| 7. | Sketch the shapes of J2 and J3 earth oblateness effects. | | CO4 | U | 1 |
| 8. | Write the expression for the argument of perigee rate. | | CO4 | U | 1 |
| 9. | Two satellites (S1 and S2) are around the earth in a LEO and GEO, respectively. Categorize which satellite has higher orbital velocity and orbital time period? | | CO5 | R | 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 1.8 km/s and coefficient of thrust is 1.52. Calculate the specific impulse of the rocket in seconds. | | CO1 | An | 3 |
| 12. | State Kepler’s laws of orbital motion. | | CO2 | U | 3 |
| 13. | Sketch the shape of hyperbolic and parabolic orbits with proper notations. | | CO3 | U | 3 |
| 14. | ﻿Define ﻿Sun-Synchronous Orbits and mention the rate of ascending node for sun-synchronous orbit with respective earth. | | CO4 | R | 3 |
| 15. | A 300 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 350 s and 50 m/s. Estimate the mass of the propellant required to perform this maneuver. | | CO5 | E | 3 |
| 16. | ﻿Calculate the synodic period of Mars relative to the earth. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. |  | ﻿A 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:  (i) The payload mass fraction of the total rocket (Satellite launch  vehicle).  (ii) Structural mass fraction of each stage.  (iii) The ideal ΔV provided by each stage and the total ΔV.  (iv) 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. Meteors and Meteorites | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | ﻿Deduce the solution for Kepler’s first law of orbital motion. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 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= 600 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. | Explain Interplanetary Hohmann Transfer with neat sketch. | CO6 | U | 6 |
|  | b. | Derive an equation for a sync period with the help of neat sketch. | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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. |

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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 | 13 | 4 |  |  |  |  | 17 |
| CO3 |  | 5 |  | 12 | 12 |  | 29 |
| CO4 | 7 | 2 |  |  | 8 |  | 17 |
| CO5 | 2 |  |  |  | 27 |  | 29 |
| CO6 |  | 12 |  | 3 |  |  | 15 |
|  | 23 | 24 |  | 18 | 59 |  | **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** | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Explain neutral axis in bending of beam. | CO1 | Ap | 1 |
| 2. | Sketch the bending stress distribution across the cross section of a rectangular beam. | CO1 | Ap | 1 |
| 3. | Indicate the shear center for an angle section. | CO2 | U | 1 |
| 4. | Give two examples of single symmetric section. | CO2 | U | 1 |
| 5. | Identify the correct statement:  The shear center position of a thin walled section can be changed by   1. Altering the dimension b) Changing the material 2. Changing both the dimension and the material | CO3 | R | 1 |
| 6. | To carry a given load, a monocoque structure is heavier than semi monocoque construction. (True / False) | CO3 | R | 1 |
| 7. | Give the expression for the flexural rigidity of the plate. | CO4 | U | 1 |
| 8. | Critical buckling load of the plate is independent of the length of the plate. (True/ False). | CO4 | U | 1 |
| 9. | State whether a single cell structure subjected to torque is a determinate or indeterminate structure. | CO5 | R | 1 |
| 10. | Explain the pitch of Rivets. | CO6 | Ap | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Explain unsymmetrical bending with examples. | CO1 | Ap | 3 |
| 12. | Explain about the shear center. | CO2 | Ap | 3 |
| 13. | Explain the reason for constant shear flow between two booms in a shear web beam. | CO3 | Ap | 3 |
| 14. | Write short notes on local buckling of plates. | CO4 | Ap | 3 |
| 15. | Write short notes on complete tension field beam. | CO5 | Ap | 3 |
| 16. | Explain the purpose of caulking in rivet with neat sketch. | CO6 | Ap | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | |
| 17. | A cantilever I-section 2.4 m long is subjected to a load at its free end as shown in figure. Determine the resulting bending stress at corners A and B on the fixed section of the cantilever. | CO1 | Ap | 12 |
|  |  |  |  |  |
| 18. | Determine the shear flow and locate the shear center for the “C” section shear web beam as shown in the figure. Assume area of each boom = 4 cm2. | CO2 | Ap | 12 |
|  |  |  |  |  |
| 19. | Determine the shear flow in the walls of the multi-cell tube structure shown in figure, for an applied torque of 1.4 kNm. Calculate also the twist per unit length using G = 75 GPa. Thickness t = 2 mm for all walls. | CO3 | Ap | 12 |
|  |  |  |  |  |
| 20. | 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. Determine 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. | CO4 | Ap | 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 | Ap | 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 | Ap | 12 |
|  |  |  |  |  |
| 23. | Find the shear flow and twist per unit length of the two cell tube made of aluminium as shown Figure and is subjected to a torque 90000 Ncm | CO3 | Ap | 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 | Ap | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 |  |  | 29 |  |  |  | 29 |
| CO2 |  | 2 | 15 |  |  |  | 17 |
| CO3 | 2 |  | 27 |  |  |  | 29 |
| CO4 |  | 2 | 15 |  |  |  | 17 |
| CO5 | 1 |  | 15 |  |  |  | 16 |
| CO6 |  |  | 16 |  |  |  | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | | **CO** | **BL** | **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 arcjet 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   1. High Speed low mass flow 2. Low speed high mass flow | | | CO2 | U | 3 |
| 13. | Group the following based on the propellant combination  1. Double base a. AP,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 between 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.   1. Subcritical 2. Critical 3. 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 the various components of scramjet engine. | CO6 | R | 4 |
|  | | b. | Explain supersonic combustion with neat sketch. | CO6 | U | 8 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Recite boundedness. | | CO1 | R | 1 |
| 2. | Recall continuity equation for moving control volume in non-conservative form. | | CO1 | R | 1 |
| 3. | Define Skewness. | | CO2 | R | 1 |
| 4. | Explain turbulent energy cascade. | | CO2 | U | 1 |
| 5. | Rewrite ∂T/∂x using forward difference scheme. | | CO3 | U | 1 |
| 6. | Recall time marching. | | CO3 | R | 1 |
| 7. | Recall relaxation technique in CFD. | | CO4 | R | 1 |
| 8. | Explain SIMPLE algorithm. | | CO5 | U | 1 |
| 9. | Label the domains of hyperbolic equation. | | CO5 | R | 1 |
| 10. | Identify turbulence models for external aerodynamics. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain substantial derivative with an example. | | CO1 | U | 3 |
| 12. | Recall Reynolds decomposition. | | CO2 | R | 3 |
| 13. | Explain Courant number. | | CO3 | U | 3 |
| 14. | Explain hybrid scheme. | | CO4 | U | 3 |
| 15. | Compare and contrast SIMPLE and SIMPLER algorithms. | | CO5 | U | 3 |
| 16. | List out the applications of k-ԑ model. | | 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 the types of partial differential equation and highlight the features with suitable examples. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Derive non-conservative form of momentum equation for a fixed control volume. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Produce finite difference equation for steady two dimensional heat equation. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain explicit and implicit methods with a suitable example. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Discuss the Tri-Diagonal Matrix Algorithm for solution of set of linear algebraic equations. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the characteristics of staggered grid in pressure equation. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain upwind difference scheme. | CO4 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss RANS turbulence models. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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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 Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 | 12 | - | - | - | 29 |
| CO2 | 4 | 1 | 12 | - | - | - | 17 |
| CO3 | 1 | 16 | - | - | - | - | 17 |
| CO4 | 1 | 27 | - | - | - | - | 28 |
| CO5 | 1 | 16 | - | - | - | - | 17 |
| CO6 | 4 | 12 | - | - | - | - | 16 |
|  | | | | | | | **124** |



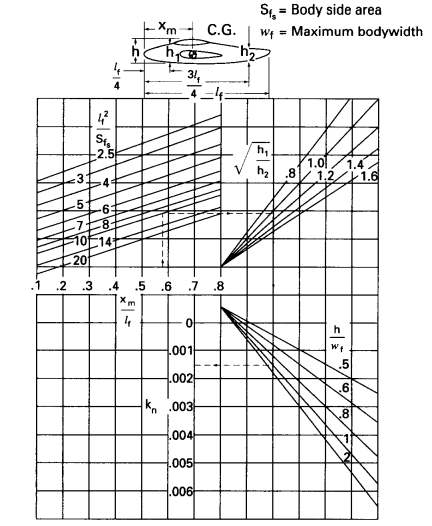
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| --- | --- | --- | --- |
| **Course Code** | **20AE2025** | **Duration** | **3hrs** |
| **Course Name** | **AIRCRAFT STABILITY AND CONTROL** | **Max. Marks** | **100** |

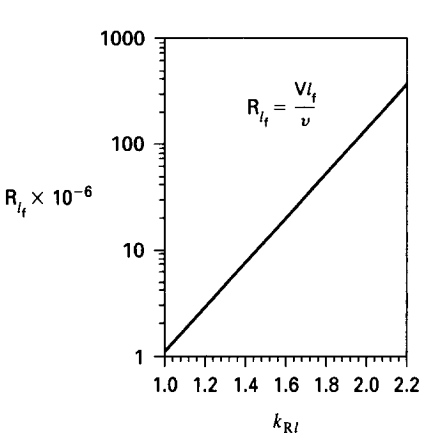
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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State the conditions for static longitudinal stability. | | CO1 | U | 1 |
| 2. | Define degree of freedom of a system. | | CO1 | U | 1 |
| 3. | Define stick force gradients. | | CO2 | R | 1 |
| 4. | What is meant by slender body? | | CO2 | R | 1 |
| 5. | Define angle of yaw. | | CO3 | R | 1 |
| 6. | State the use of dorsal fins. | | CO3 | U | 1 |
| 7. | Define anhedral angle. | | CO4 | R | 1 |
| 8. | List the conditions for lateral stability. | | CO4 | R | 1 |
| 9. | Define dynamic stability. | | CO5 | R | 1 |
| 10. | What is Dutch roll? | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe about upwash and downwash. | | CO1 | R | 3 |
| 12. | State hinge moment with necessary equations. | | CO2 | R | 3 |
| 13. | Describe about rudder lock with neat sketch. | | CO3 | R | 3 |
| 14. | Explain about the basic principle behind roll control. | | CO4 | U | 3 |
| 15. | Discuss about the relation between wind axes system and reference body axes systems. | | CO5 | U | 3 |
| 16. | Explain about auto rotation with necessary sketches. | | 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. | Infer the equation of tail contribution in static longitudinal stability. | CO1 | U | 10 |
|  | b. | Discuss about neutral point. | CO1 | U | 2 |
| 18. | a. | Assume that the pitching moment curve for the landing configuration at its forward most center of gravity position as follows: , where is in degrees. Calculate the size of the elevator to trim the aircraft at the landing angle of attack . Assume that the elevator angle is constrained to Tail area is given 43 feet2. ( | CO2 | A | 6 |
|  | b. | Infer the equation of elevator hinge moment with necessary diagrams. | CO2 | U | 6 |
| 19. |  | Discuss in detail the requirements for (rudder) directional control with necessary equations and diagrams. | CO3 | U | 12 |
| 20. | a. | The lift curve of a light airplane wing of rectangular planform is almost straight between angle of zero lift (-30) and the incidence of 100 at which CL =1.066. The wing chord is 2.14 m, the aspect ratio is 8.3 and the dihedral angle is 50. Assuming that the level flight speed is 41.15 m/s, calculate rolling moment set up by a sudden yaw of 50. | CO4 | A | 8 |
|  | b. | Discuss in detail about aerodynamic balancing. | CO4 | U | 4 |
| 21. | a. | Describe phugoid and short period concepts with neat sketch. | CO5 | U | 6 |
|  | b. | Explain about stability derivatives for dynamic stability. | CO5 | U | 6 |
| 22. | a. | Infer the equation of motion for lateral dynamic stability. | CO6 | U | 8 |
|  | b. | Explain about spin with necessary sketch. | CO6 | U | 4 |
| 23. | a. | Infer the equation of wing contribution in static longitudinal stability. | CO1 | U | 6 |
|  | b. | Describe about power effects in static longitudinal stability. | CO1 | R | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | A fuselage has the following dimensions. Obtain its contribution to Cnβ at sea level at a speed of 120 m/s.  lf = 13.7 m, xm = 8.0m, wf = 1.6m, Sfs = 15.4 m2  h =1.6 m, h1 = 1.6 m, h2 = 1.07, ν=14.6×10-6  Wing: area = 26.81 m2 , span =13.7 m. (Refer the graph) | CO3 | A | 7 |
|  | b. | Infer the equation of rudder effectiveness for directional stability. | CO3 | U | 5 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 | 23 | - | - | - | - | 29 |
| CO2 | 5 | 6 | 6 | - | - | - | 17 |
| CO3 | 7 | 15 | 7 | - | - | - | 29 |
| CO4 | 2 | 7 | 8 | - | - | - | 17 |
| CO5 | 1 | 15 | - | - | - | - | 16 |
| CO6 | 1 | 15 | - | - | - | - | 16 |
|  | | | | | | | **124** |







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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Weighted- Residual method. | | CO1 | U | 1 |
| 2. | Give the limitation of finite element methods. | | CO1 | U | 1 |
| 3. | List the softwares used to evaluate the problems in FEM. | | CO2 | R | 1 |
| 4. | At fixed support, the displacements are equal to \_\_\_\_\_\_\_\_\_\_. | | CO2 | U | 1 |
| 5. | Write down the expression of 2D element stiffness matrix for a truss element. | | CO3 | U | 1 |
| 6. | Write the interpolation polynomial equation for 1D cubic element. | | CO5 | A | 1 |
| 7. | A three noded triangular element is called as\_\_\_\_\_\_\_\_\_. | | CO5 | R | 1 |
| 8. | Define serendipity element. | | CO5 | R | 1 |
| 9. | Write down the finite element equation for 1D heat conduction with free end convection. | | CO6 | R | 1 |
| 10. | List the different modes of heat transfer. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write the advantages and applications of FEM. | | CO1 | U | 3 |
| 12. | Discuss the local and global coordinates. | | CO2 | R | 3 |
| 13. | List out the assumptions made in the derivation of stiffness matrix. | | CO3 | U | 3 |
| 14. | Derive the shape function for constant strain triangular (CST) element. | | CO4 | R | 3 |
| 15. | State Isoparametric, Super parametric and Sub parametric elements. | | CO5 | U | 3 |
| 16. | Write the general stiffness matrix and force vector for 1-D heat transfer in a fin. | | 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. | | Solve the differential equation for a physical problem expressed as  d2y/dx2 + 50 = 0, 0≤x≤10 where boundary conditions as y (0) = 0 and y (10) = 0 using the trial function y = a1x (10-x) find the value of the parameters a1 by the following methods. (i) Least squares method and (ii) Galerkin method. | CO1 | An | 12 |
|  | |  |  |  |  |
| 18. | | Consider a bar as shown in figure.1.,Young’s modulus  E = 2x 105N/mm2. A1= 2cm2, A2 = 1cm2 and force of 100N is applied. Determine the (i) Nodal displacements (ii) Element stresses (iii) Reaction forces    Figure.1 | CO2 | An | 12 |
|  | |  |  |  |  |
| 19. | | For the two-bar Truss shown in figure. 2, determine: (i) Nodal displacements (ii). Element stresses (iii). Reaction forces, Take E=70GPa, A=200mm2    Figure.2 | CO3 | An | 12 |
|  | |  |  |  |  |
| 20. | | For the beam and loading shown in figure.3 determine : (i) slope at 2 and 3, Take E=200GPa, I=4 x 106 mm4    Figure.3 | CO4 | An | 12 |
|  | |  |  |  |  |
| 21. (a) | | Determine the shape function N1, N2 & N3 at the interior point P for the triangular element shown in Figure. 4  (2,3) 1  2 (7,4)  3 (4,7)  •  y  x  P(3.5,5)  Figure.4 | CO5 | A | 6 |
| (b) | | The nodal coordinates of the triangular element are shown in figure. 5. At the interior point P the x coordinate is 3.5 and the shape function at node 1 N1 is 0.4. Determine the shape functions at nodes 2 and 3 and also the y coordinate of the point P.    Figure.5 | CO5 | A | 6 |
|  | |  |  |  |  |
| 22. | | Derive the shape function for the eight-noded quadrilateral element. | CO5 | E | 12 |
|  | |  |  |  |  |
| 23. | | Derive the shape function for the constant strain triangular element. | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | | A furnace wall is made up of three layers, inside layer with thermal conductivity 8.5 W/mK, the middle layer with conductivity 0.25 W/mK, the outer layer with conductivity 0.08 W/mK. The respective thicknesses of the inner, middle and outer layer are 25cm, 5cm and 3 cm respectively. The inside temperature of the wall is 6000C and outside of the wall is exposed to atmospheric air at 300C with heat transfer coefficient of 45 W/m2K. Determine the nodal temperatures. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 5 | - | 12 | - | - | 17 |
| CO2 | 4 | 1 | - | 12 | - | - | 17 |
| CO3 | - | 4 | - | 12 | - | - | 16 |
| CO4 | 3 | - | - | 12 | - | - | 15 |
| CO5 | 2 | 3 | 13 | - | 24 | - | 42 |
| CO6 | 1 | 1 | 3 | 12 | - | - | 17 |
|  | | | | | | | **124** |



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| **Course Code** | **20AE2030** | **Duration** | **3hrs** |
| **Course Name** | **TECHNICAL APTITUDE** | **Max. Marks** | **100** |

**(Answer all questions)**

1. Natural frequency of a spring mass system with a mass of 1 kg and spring stiffness is
   1. 2 rad/s b. 5 rad/s c. 0.5 rad/s d. 0.2 rad/s
2. A 1 kg mass attached to a spring elongates it by 16 mm. Natural frequency of the system is
   1. 24.75 rad/s b. 49.5 rad/s c. 0.24 rad/s d. 0.49 rad/s
3. For a critically damped single degree of freedom, spring mass damper with a damping constant of 4 Ns/m and spring constant of 16 N/m, the system mass m is

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

1. A spring mass damper system with a mass of 1 kg is found to have a damping ratio of 0.2 and a natural frequency of 5 rad/s. The damping of the system is given by
2. 2 Ns/m b. 2 N/s c. 0.2 kg/s d. 0.2 N/s
3. The sum of natural frequencies of an elastic beam with cantilever boundary conditions is
   1. 1 b. 3 c. 1000 d. Infinite
4. A 0.5 kg mass is suspended vertically from the point fixed on the earth by a spring having a stiffness of 5 N/mm. The static displacement (in mm) of the mass is (Take g = 9.81 m/s2). .
   1. 1 mm b. 3 mm c. 1000 mm d. 0.981 mm
5. A linear mass-spring dashpot is over-damped. In free vibration, this system undergoes

a. non-oscillatory motion b. random motion

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

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

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

1. The motion completed during one time period is known as \_\_\_\_\_\_\_.
   1. Cycle b. Period of vibration c. Frequency d. Time period
2. The static deflection of a spring under gravity, when a mass of 1 kg is suspended from it, is 1 mm. Assume the acceleration due to gravity g = 10m/s2. The natural frequency of this spring-mass system (in rad/s) is\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. 100 b. 1 c. 10 d. 0.1
3. A mass on a spring undergoes SHM. The maximum displacement from the equilibrium is called.
   1. Amplitude b. Frequency c. Time period d. Wavelength
4. In a periodic process, the number of cycles per unit time is called
   1. Amplitude b. Frequency c. Time period d. Wavelength
5. A mass-spring oscillating system undergoes SHM with maximum amplitude A. If the spring constant ‘k’ is doubled. Then the frequency vibration of the system increases by
   1. 2 times b. times c. times d. times
6. A mass-spring oscillating system undergoes SHM with maximum amplitude A. If the mass ‘m’ is doubled. Then the frequency vibration of the system increases by
   1. 2 times b. times c. times d. times
7. In which direction does the viscous damping force acts?
   1. Opposite to the direction of motion
   2. Along the direction of motion
   3. Perpendicular to direction of motion
   4. Any direction irrespective of direction of motion
8. Determine natural frequency of a system, which has equivalent spring stiffness of 1000 N/m and mass of 10 kg.
   1. 10 rad/s b. 100 rad/s c. 1000 rad/s d. 1 rad/s
9. In order to double the period of a simple pendulum, the length of the string should be
10. Doubled b. Halved c. Quadrupled d. Tripled
11. The critical damping coefficient is given by
12. b. c. d.
13. For any part of the beam subjected to uniform distributed load, shear force diagram is a

a) Horizontal straight line b) Line inclined to x-axis

c) Parabolic curve d) Cubic curve

1. A portion of the beam between two sections is said to be in pure bending when there is

a) Constant bending moment and zero shear force b) Constant shear force and zero bending

moment

c) Constant bending moment and constant shear force d) Zero bending moment and zero shear force

1. A prismatic beam when subjected to pure bending assumes the shape of

a) Cubic parabola b) Quadratic parabola c) Arc of circle d) Can’t be defined

1. Choose the statically determinate beam

a) Cantilever beam b) Simply supported beam

c) Fixed-fixed beam d) Both a and b

1. When a shaft is subjected to a twisting moment, every cross-section of the shaft will be under

a) tensile stress b) bending stress c) shear stress d) compressive stress

1. When a shaft, is subjected to torsion, the shear stress induced in the shaft varies from

a) minimum at the centre to maximum at the circumference

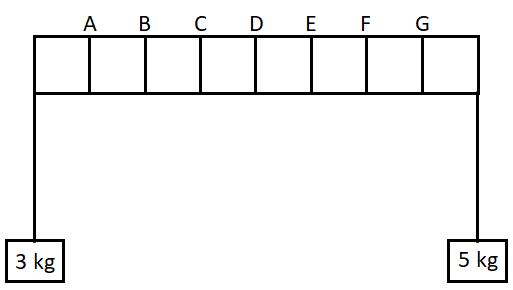
b) maximum at the centre to minimum at the circumference

c) zero at the centre to maximum at the circumference

1. maximum at the centre to zero at the circumference
2. In a simple tension test, Hooke's law is valid up to the

a) Elastic limit b) Yield stress

c) Ultimate stress d) Breaking point

1. The mechanics deals with rigid bodies at rest is called as \_\_\_\_\_\_\_\_
2. Statics b) Dynamics
3. Quasi static d) Hydraulics
4. A rigid body is one which upon the application of loads will \_\_\_\_\_\_\_\_
5. Deform significantly
6. Never deform
7. Deform moderately
8. Deform negligibly
9. Effect of a loading which is assumed to act at a point on a body is called as a \_\_\_\_\_\_\_
10. Uniformly distributed force
11. Concentrated force
12. Concentrated moment
13. Uniformly distributed moment
14. Newton’s second law may be expressed mathematically as
15. b) F = ma c) d)
16. Law governing the gravitational attraction between any two particles can be stated mathematically as
17. Any physical quantity that requires both a magnitude and a direction for its complete description is known as a
18. Tensor b) Scalar c) Vector d) Cannot be defined
19. Newton’s third law states that
20. For every action, there is an equal and opposite reaction
21. The rate of change of momentum is equal to the force applied
22. The body tends to be rotated if the force is applied tangentially
23. The body is rest until a force is applied
24. If five equal (say 5 N) forces are acting on the single particle and having an angle of 72˚ between each and are coplanar, then:
25. The net force acting on the body is zero
26. The net force acting on the body is horizontal
27. The net force acting on the body is vertical
28. The net force acting on the body is at an angle of 45˚
29. If two forces of magnitude 5 N are acting on a point. If the angle between them 60o, then the magnitude of the resultant force is given by
30. N
31. N
32. N
33. N
34. There are two block of mass 3 kg and 5 kg hanging from the ends of a rod of negligible mass. The rod is marked in 8 equal parts as shown in Fig. Locate a point on the rod to which a string is attached such that the rod remains in the horizontal position when suspended from string.
35. E
36. C
37. D
38. B
39. The materials which show direction dependent properties are called

a) Homogeneous materials b) Viscoelastic materials

c) Isotropic materials d) Anisotropic materials

1. In the case of an engineering material under unidirectional stress in the x-direction, the

Poisson's ratio is equal to

1. b) c) d)
2. Young's modulus of elasticity and Poisson's ratio of a material are 1.25 × 105 MPa and 0.34 respectively. The modulus of rigidity of the material is:

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

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

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

a) Tensile stress b) Compressive stress

c) Tensile strain d) Compressive strain

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

a) Thermal stress b) Tensile stress

c) Compressive stress d) No stress

1. What happens if an aircraft yaws about its center of gravity?

a) A slideslip angle arises. b) Aircraft will crash

c) Aircraft will start descending d) Angle of attack increases

1. Which of the following is not an aerodynamic coefficient?

a) Pressure coefficient b) Absolute temperature

c) Lift coefficient d) Drag coefficient

1. The equilibrium roll angle is known as\_\_\_\_\_\_\_\_\_\_

a) Roll angle b) Angle of incidence c) Zero bank angle d) Angle of attack

1. Increment in the skin friction drag due to prop-wash is called \_\_\_\_\_\_\_\_\_

a) scrubbing drag b) vortex c) swirl d) curling flow

1. Induced drag of the airfoil is \_\_\_\_\_

a) 0.0N b) 1.2N c) 20 N d) 25.8KN

1. Wave drag is produced due to \_\_\_\_\_\_\_\_

a) shock wave formation b) incompressible flow

c) fluid is not compressible d) flow separation of incompressible flow

1. What is a trim in aircraft performance?

a) The state of equilibrium where the forces and moments are balanced

b) The state of equilibrium where the forces and moments are not balanced

c) The state of equilibrium where only the forces are balanced

d) The state of equilibrium where only the moments are balanced

1. Angle of attack of the vertical tail is also known as \_\_\_\_\_\_\_\_\_\_

a) Sideslip angle b) Critical angle

c) Zero bank angle d) Angle of incidence

1. The term canard is used to describe the \_\_\_\_\_\_\_\_\_\_ configuration of an aircraft.

a) Seating b) Wing c) Flap d) Engine

1. If an aircraft can slow down during turn then, it is termed as \_\_\_\_\_\_\_\_\_\_

a) instantaneous turn b) non instantaneous turn

c) straight flight d) cruise segment

1. Typically, a high performance unpowered aircraft is called \_\_\_\_\_\_\_\_

a) sailplane b) glider c) jet d) twin engine

1. For an aircraft to be statically stable, the center of gravity must always be
2. Ahead of wing aerodynamic centre b) Aft of the wing aerodynamic centre
3. Ahead of neutral point d) Aft of neutral point
4. For a tailless aircraft,
5. The neutral point coincides with aerodynamic centre
6. The neutral point lies ahead of aerodynamic centre
7. The neutral point lies behind of aerodynamic entre
8. The neutral point varies with aerodynamic centre
9. For an aircraft considering wing alone to be destabilizing, the center of gravity must always be
10. Ahead of wing aerodynamic centre b) Aft of the wing aerodynamic centre
11. Ahead of neutral point d) Aft of neutral point
12. In swept-back wing aircraft, the dutch roll is solved by installing
13. Frise aileron b) Dihedral angles
14. Yaw damper d) All of the above
15. The Dutch roll damping is increased by
16. Large directional stability and small dihedral
17. Small directional stability and small dihedral
18. Large directional stability and large dihedral
19. Small directional stability and large dihedral
20. Which of the following is not part of takeoff?
21. Ground roll b) Transition
22. Climb d) Descending
23. Which of the following is correct?
24. Aircraft decelerates from Approach to Touchdown speed during flare
25. Lift is always same as weight
26. Drag is always same as Thrust
27. Thrust loading is defined as the ratio of lift to drag
28. Final velocity at the end of the landing phase will be \_\_\_\_\_\_\_\_\_\_\_\_
29. zero
30. same as Approach speed
31. touchdown speed
32. same as climb rate
33. Which of the following is not true about yaw?
34. About the vertical body axis
35. Positive with the nose to starboard
36. Measured in Hertz
37. Type of rotation
38. The maximum distance between mean camber line and the chord line, measured perpendicular to the chord line is \_\_\_\_\_\_\_\_.
39. Camber b. thickness c. wing span d. sweep angle
40. Find taper ratio λ of wing with root chord and tip chord values are 40 cm and 15 cm respectively.
41. 0.5 b. 0.375 c. 1.5 d. 1.375
42. Which one tends to rotate the aircraft about the vertical axis?
43. rolling moment b. pitching moment c. Yawing moment d. All the above
44. Identify the correct statement.
45. Cm ≠ f ( Cl )b. Cm ≠ f(Cp)c. Cm = f(Cd)d. Cm = f(Cp)
46. Consider an airfoil in a flow with a free stream velocity of 45 m/s. The velocity at a given point on the airfoil is 70 m/s. Calculate the pressure co-efficient.
47. 1.43 b. 0.43 c. -1.43 d. -0.43
48. Flow past an airfoil is to be modeled using a vortex sheet. The strength of the vortex sheet at the trailing edge will be \_\_\_\_\_\_\_\_\_\_\_\_\_.
49. Zero b. one c. 2(phi) d. infinity
50. Lift, drag and moment are acting at\_\_\_\_\_\_\_.
51. aerodynamic center b. center of pressure c. neutral point d. nose
52. A solid boundary represents \_\_\_\_\_\_\_\_\_\_\_.
53. streak line b. stream line c. path line d. none of the above
54. The aircraft fly based on which principle \_\_\_\_\_\_\_\_\_.
55. Newton’s third law b. Conservation of mass c. Bernoulli’s principle d. Gravity
56. The coefficient of pressure at stagnation point is \_\_\_\_\_\_\_\_\_\_\_.
57. 0 b. 1 c. 2 d. 0.5
58. The curl of velocity equals to \_\_\_\_\_\_\_.

a. velocity b. pressure c. vorticity d. angular velocity

1. The lower end of the Pitot tube is bent at an angle of \_\_\_\_\_\_\_\_\_\_\_\_.

a. 120 degrees b. 360 degrees c. 90 degrees d. 45 degrees

1. The flow around a cylinder with a vortex of finite strength, lift is directly proportional to \_\_\_\_\_\_\_\_\_\_.
2. Camber b. circulation c. downstream velocity d. stagnation pressure
3. For laminar boundary layers on flat plates, the boundary layer thickness is \_\_\_\_\_\_\_\_\_\_\_\_\_.
4. 4.64x/(Rex)1/2  b.0.383x/ (Rex)1/5 c. 3.83x/ (Rex)1/5 d. 0.464x/(Rex)1/2
5. NACA 6-Series is relied on specifying the desired \_\_\_\_\_\_\_\_\_\_\_distribution.
6. Velocity b. pressure c. supercritical speeds d. boundary layer thickness
7. The horseshoe vortex consists of \_\_\_\_\_\_\_\_\_\_
8. Starting & bound vortices b. starting vortex
9. bound vortex d. None of the above
10. Joukowski transformation results the flow around airfoil from flow around \_\_\_\_\_\_\_with circulation.
11. ellipse b. cylinder c. flat plate d. sphere
12. In NACA 5 digit series, the second and third digits, when divided by 2, give the position of \_\_\_\_\_\_\_\_\_\_\_\_in percentage of chord.
13. maximum camber b. thickness c. lift coefficient d. drag coefficient
14. Two pipes of constant sections but different diameters carry water at the same volume flow rate. The Reynolds number, based on the pipe diameter is
15. the same in both pipes
16. larger in the narrower pipe
17. smaller in the narrower pipe
18. depends on the material of the pipe
19. The Joukowski airfoil is studied in aerodynamics because\_\_\_\_\_\_\_\_\_\_\_.
20. It is used in many aircraft
21. It is easily transformed into a circle mathematically
22. It has a simple geometry
23. It has the highest lift curve slope among all airfoils
24. Normal shock waves can be treated as shock wave \_\_\_ to the flow
25. Perpendicular b) Parallel c)Inclined d) Opposite
26. When flow passes from supersonic to subsonic state,
27. Pressure increases b) Velocity remains same
28. Pressure decreases d) Velocity increases
29. When the oblique shock wave is detached with the flow it forms
30. Bow shock b) Oblique shock c) Inclined shock d) Induced shock
31. In a supersonic flow density change is faster than velocity change by the factor of
32. Square of Mach number b) Square root of Mach number
33. Cube of Mach number d) Mach number
34. If the velocity of the flow changes with respect to the space, then the type of flow is
35. Non-uniform b) Uniform c) Steady d) Unsteady
36. The product of the slope of equipotential line and the slope of the streamline at the point of intersection is equal to
37. -1 b) 1 c) 2 d) 0
38. Conical pressure wave front produced by a body moving at a speed greater than that of sound is called
39. Mach cone b) Elliptical cone c) Unit cone d) State cone
40. The shape of the supersonic diffuser that slow down a supersonic flow to subsonic speeds
41. Converging
42. Diverging
43. Converging diverging
44. Diverging converging
45. The range of Mach number (M) in transonic flow is \_\_\_\_\_\_\_\_\_\_\_\_.
46. 0.8≤M≥1.2 b) 1.2 to 1.8 c) 0.3≤M≥1.6 d) 0.4 to 0.6
47. A compression wave reflects as\_\_\_\_\_\_\_\_\_ when it incident on a solid boundary.
48. Compression wave b) Longitudinal wave
49. Pressure wave d) Sound wave
50. The boundary layer separation is due to \_\_\_\_\_\_\_\_.
51. Adverse pressure gradient
52. Velocity gradient
53. Shock wave
54. Temperature variation
55. The free stream Mach number at which large drag rise begins is called \_\_\_\_\_.
56. Drag divergence
57. Drag convergence
58. Drag distribution
59. Drag coincident
60. If actual Mach number is less than unity, the characteristic Mach number will be \_\_\_\_\_\_.
61. <1 b) =1 c) >1 d) = 0
62. The Mach number behind the oblique shock is always\_\_\_\_\_\_\_\_\_\_\_.
63. M>1 b) M=1 c) M<1 d) M>0.5
64. In a subsonic nozzle, velocity increases as area \_\_\_\_\_\_\_.
65. Decreases b) Increases
66. Increase and then decreases d) Is constant
67. The combustion process in a turboshaft engine during idling operation is
68. Isentropic b) Isobaric c) Isochoric d) Isothermal
69. As altitude increases, air density\_\_\_\_\_, which leads to decrease in the thrust because of less mass flow rate
70. Decreases b) Remains constant
71. Increases d) Decreases and then increases
72. In a Brayton cycle the compression process is a \_\_
73. Isobaric Process b) Adiabatic process
74. Isentropic process d) Isenthalpic process
75. An expansion fan emanating from a sharp convex corner is called a
76. Prandtl-Meyer expansion wave
77. Expansion wave
78. Oblique wave
79. Transverse wave
80. In physics, a \_\_\_\_\_ is a type of propagating disturbance that moves faster than the local speed of sound in the medium.
81. Shock wave b) Expansion wave
82. Oblique wave d) Transverse wave

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

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| **Q. No.** | **Questions** | | **CO** | | **BL** | | **Marks** | |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | | | | |
| 1. | State the various application of liquid hydrogen. | | CO1 | | R | | 1 | |
| 2. | State the reason for increase in thermal conductivity of pure copper below 100 K. | | CO1 | | R | | 1 | |
| 3. | Define Joules-Thompson inversion curve. | | CO2 | | R | | 1 | |
| 4. | State the type of refrigeration used for temperatures below 4 K. | | CO3 | | R | | 1 | |
| 5. | State the advantage of mechanical dilution refrigeration over cryogenic refrigeration. | | CO3 | | R | | 1 | |
| 6. | State the purpose of vent line in a cryogenic storage container. | | CO4 | | R | | 1 | |
| 7. | State the need for manhole in the cryogenic storage tank. | | CO4 | | R | | 1 | |
| 8. | List the types of reflective insulation used for insulation of cryogenic containers. | | CO5 | | R | | 1 | |
| 9. | Define aparent thermal conductivity. | | CO5 | | R | | 1 | |
| 10. | Explain the need of cryogenics in liquid rocket engine. | | CO6 | | A | | 1 | |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | | | | |
| 11. | Explain the physics involved in metal shrinking when exposed to cryogenic temperature. | | CO1 | | U | | 3 | |
| 12. | Differentiate between J-T expansion and adiabatic expansion. | | CO2 | | U | | 3 | |
| 13. | State the influence of shape on the storage tank design handling cryogenics. | | CO3 | | R | | 3 | |
| 14. | Write down the need for personal protective equipment for handling cryogenics. | | CO4 | | A | | 3 | |
| 15. | State the need of insulation requirement for a cryogenic container. | | CO5 | | R | | 3 | |
| 16. | State the application of liquid nitrogen as a cryogen. | | 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. | State the significance of slip planes in a material. | | CO1 | | R | | 6 |
|  | b. | Illustrate the effect of slip planes in ductility. | | CO1 | | A | | 6 |
|  |  |  | |  | |  | |  |
| 18. | a. | Explain Linde-Hampson system with a neat sketch. | | CO2 | | A | | 6 |
|  | b. | Develop the equation for work required per unit mass of gas liquefied for simple Linde Hampson system. | | CO2 | | A | | 6 |
|  |  |  | |  | |  | |  |
| 19. |  | Determine the liquid yield, work per unit mass compressed and work per unit of mass liquefied for simple Linde Hampson and Pre-cooled Linde Hampson system. The working fluid is nitrogen and freon-12 is the refrigerant. The operating condition for nitrogen are 101.3 kPa and 300 K and 20.3 MPa at point The enthalpies are h a = 207.94 kJ/kg at 101.3 kPa and 300 K h1 =462 J/g at 1 atm 300K, hb = 250.20 kJ/kg at 68.7 kPa and 373 K h2 = 432 J/g at 300 K, 200 atm, hc = 61.23 kJ/kg and 300 K saturated liquid hf = 29 J/g at 1 atm | | CO2 | | A | | 12 |
|  |  |  | |  | |  | |  |
| 20. |  | Explain ideal refrigeration system with neat sketch. | | CO3 | | U | | 12 |
|  |  |  | |  | |  | |  |
| 21. |  | Write down the various safety precautions to be taken for transportation of the Cryogens.  1. Transport within the laboratory or lab building.  2. Transport between buildings.  3. Vehicular transport. | | CO4 | | A | | 4  4  4 |
|  |  |  | |  | |  | |  |
| 22. | a. | Explain the requirements of insulation for cryogenic propellant tank. | | CO5 | | U | | 4 |
|  | b. | Explain in detail any one of the insulation methods used for insulating cryogenic containers. | | CO5 | | A | | 8 |
|  |  |  | |  | |  | |  |
| 23. |  | Explain the role of the following in the safe operation of cryogenics  1. Oxygen detectors.  2. Pressure relief valve.  3. Bursting disc. | | CO4 | | An | | 4  4  4 |
| **COMPULSORY QUESTION** | | | | | | | | |
| 24. | a. | Illustrate the working principle of liquid oxygen –liquid hydrogen rocket engine. | | CO6 | | A | | 8 |
|  | b. | State the advantage of cryogenic engine over semi cryogenic rocket engine. | | CO6 | | R | | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | | **E** | **C** | **Total** |
| CO1 | 8 | 3 | 6 |  | |  |  | 17 |
| CO2 | 1 | 3 | 24 | - | - | | - | 28 |
| CO3 | 5 | 12 | - | - | - | | - | 17 |
| CO4 | 2 | - | 15 | 12 | - | | - | 29 |
| CO5 | 5 | 4 | 8 | - | - | | - | 17 |
| CO6 | 7 | - | 9 | - | - | | - | 16 |
|  | | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Expand MALE. | | CO1 | R | 1 |
| 2. | Give the endurance value of mini UAV. | | CO1 | R | 1 |
| 3. | Define payload. | | CO2 | R | 1 |
| 4. | Outline Line-of-Sight. | | CO2 | R | 1 |
| 5. | State blade element theory. | | CO3 | R | 1 |
| 6. | Name a sensor in UAV. | | CO4 | R | 1 |
| 7. | Recall electronic intelligence. | | CO4 | R | 1 |
| 8. | Find 4Ws in UAV failure analysis. | | CO5 | R | 1 |
| 9. | Outline up-link. | | CO4 | R | 1 |
| 10. | Give a merit of VTOL system. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Distinguish between UAS and drone. | | CO1 | U | 3 |
| 12. | List the disadvantages of fixed wing UAV. | | CO2 | R | 3 |
| 13. | Explain parasitic drag. | | CO3 | R | 3 |
| 14. | Explain controlled airspace. | | CO4 | U | 3 |
| 15. | List four levels of UAV failure. | | CO5 | U | 3 |
| 16. | Identify the parameters affecting launch of UAV. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the milestones in the development of UAV with suitable examples. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the classification of UAV and also compare range, endurance, mass and range of each category. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Discuss about the purpose of stealth design. | CO3 | U | 6 |
|  | b. | Explain the methods of detection of stealth UAV in the air. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Compare and contrast between dispensable and non-dispensable payloads used in UAV | CO4 | U | 4 |
|  | b. | Explain the components of electro-optic payloads that affect the sharpness of an image. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 21. |  | Explain about the complete testing methods of HTOL and VTOL UAV. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain about UAV launch devices. | CO4 | U | 6 |
|  | b. | Discuss the UAV recovery.   1. Guided flight onto an arresting pole 2. Parachute deployment |  |  | 3  3 |
|  |  |  |  |  |  |
| 23. |  | Discuss the benefits of hybrid aircraft configurations with suitable examples. | CO2 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain about the involvement of UAV in agriculture, paramedical, commercial and civil applications. | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 | - | - | - | - | 17 |
| CO2 | 5 | 24 | - | - | - | - | 29 |
| CO3 | 4 | 12 | - | - | - | - | 16 |
| CO4 | 3 | 27 | - | - | - | - | 30 |
| CO5 | 1 | 15 | - | - | - | - | 16 |
| CO6 | 1 | 15 | - | - | - | - | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Indicate the applications of wind tunnels. | | CO1 | U | 1 |
| 2. | Define “Mach number”. | | CO3 | R | 1 |
| 3. | Recite the Compressible flow theory. | | CO4 | R | 1 |
| 4. | Locate the use of honeycomb section in the wind tunnel. | | CO1 | R | 1 |
| 5. | Show the “Shock Tube” in wind tunnel measurement and write its applications. | | CO2 | U | 1 |
| 6. | Mention the use of “LDA” in the wind tunnel measurement. | | CO5 | R | 1 |
| 7. | Mention the application of a “wind tunnel balance”. | | CO4 | U | 1 |
| 8. | State the use of “Sting” in the wind tunnel | | CO3 | R | 1 |
| 9. | Identify the applications of “PIV” in wind tunnel measurement system. | | CO5 | U | 1 |
| 10. | Indicate the use of “Schlieren imaging” system in the wind tunnel. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write the classifications of wind tunnel. | | CO1 | A | 3 |
| 12. | List out the parameters which can be measured by use of wind tunnel. | | CO5 | R | 3 |
| 13. | Elaborate the history and innovation of the wind tunnel. | | CO1 | U | 3 |
| 14. | Show an “Aircraft Aerofoil” and indicate the various forces and moments acting on it. | | CO2 | U | 3 |
| 15. | Write about the Heat flux measurements in wind tunnel. | | CO5 | A | 3 |
| 16. | Explain the application of “Interferometer” concept in the wind tunnel system. | | 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. | With the help of a schematic diagram, illustrate the operation of “closed circuit” wind tunnel in detail. | CO2 | A | 6 |
|  | b. | Illustrate the operation of a water tunnel in detail with help of a schematic diagram. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the various parts of a subsonic wind tunnel with help of a diagram and explain its working principle. | CO1 | A | 6 |
|  | b. | Distinguish between the “Hypersonic” and “Supersonic” condition in the wind tunnel. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Compare the Continuous and intermittent type of wind tunnels. | CO1 | An | 6 |
|  | b. | Analyze the “Runtime mass flow rate” in the supersonic wind tunnel. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 20. |  | With the help of a schematic diagram, illustrate the operation of a laser Doppler Anemometry. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Sketch the Hypersonic wind tunnel, explain its nomenclature and working principle. | CO2 | A | 6 |
|  | b. | Appraise about the “starting and stopping loads” in hypersonic wind tunnel. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Articulate the various parts of an “Internal Strain gauge balance” with help of a diagram and explain its working principle. | CO4 | A | 6 |
|  | b. | Relate the Strut type balance with other types of balances with suitable sketches and description. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | With help of a schematic diagram, illustrate the operation of “particle image velocimetry”. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Draw a layout diagram of a Shadowgraph technique and explain its construction and working principle in detail. | CO6 | A | 6 |
|  | b. | Explain how the “Tufts” can be fixed to the model and testing is being conducted. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 4 | 9 | 6 | - | - | 20 |
| CO2 | - | 4 | 18 | 6 | - | - | 28 |
| CO3 | 2 | - | 6 | - | - | - | 8 |
| CO4 | 1 | 1 | 6 | 12 |  |  | 20 |
| CO5 | 4 | 1 | 3 | 24 |  |  | 32 |
| CO6 | - | 1 | 15 | - | - | - | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **20AE2054** | **Duration** | **3hrs** |
| **Course Name** | **INTERNET OF THINGS IN AEROSPACE APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Internet of Things. | | CO1 | U | 1 |
| 2. | List the characteristics of IoT. | | CO1 | R | 1 |
| 3. | What is a MAC layer? | | CO2 | U | 1 |
| 4. | Define Software-Defined Networking. | | CO2 | R | 1 |
| 5. | Expand 6LoWPAN. | | CO3 | U | 1 |
| 6. | What is Zigbee protocol? | | CO3 | R | 1 |
| 7. | What is the IoT Cloud? | | CO4 | U | 1 |
| 8. | List the key elements of NFV. | | CO4 | R | 1 |
| 9. | State the imporatnce of data visualisation. | | CO5 | U | 1 |
| 10. | List two applications of IoT. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | How does the Internet of Things (IoT) work? | | CO1 | U | 3 |
| 12. | Give generic block diagram of an IoT Device. | | CO2 | U | 3 |
| 13. | What is Wi-Fi protocol for the Internet of Things (IoT)? | | CO3 | U | 3 |
| 14. | What is meant by Machine-to-Machine (M2M)? | | CO3 | U | 3 |
| 15. | State the need for IoT systems management. | | CO5 | U | 3 |
| 16. | Explain the challenges faced by IoT industry applications. | | 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 the functional blocks of an IoT ecosystem with simplified block diagram. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the architecture of IoT with core IoT functional stack. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the components and levels of an IoT system. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain in detail the differences and similarities of M2M and IoT. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | With an aid of a flow chart, explain Internet of Things design methodology. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Discuss briefly Cloud computing paradigm and Cloud platform services. | CO4 | A | 8 |
|  | b. | List out cloud computing features and advantages. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 23. |  | What are IoT application requirements and capabilities? Explain IoT application in industries. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | What are future factory concepts? Describe the benefits of Internet of Things in aviation. | CO6 | An | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the concept of IoT technologies. |
| CO2 | Explain IoT architecture. |
| CO3 | Understand the wired and wireless communication protocols. |
| CO4 | Learn the concepts of cloud systems, parallel processing in the cloud. |
| CO5 | Understand patterns and behaviours of data obtained from different data streams. |
| CO6 | Apply concepts of IoT in aerospace applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 4 | 12 |  |  |  | 17 |
| CO2 | 1 | 16 | 12 |  |  |  | 29 |
| CO3 | 1 | 7 |  | 24 |  |  | 32 |
| CO4 | 1 | 1 | 12 |  |  |  | 14 |
| CO5 |  | 4 |  |  |  |  | 04 |
| CO6 | 1 | 3 |  | 24 |  |  | 28 |
|  | | | | | | | **124** |



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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** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | The concept of Aerial steam engine was proposed by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 2. | Chanute designed hang gliders with \_\_\_\_\_\_\_\_\_method of structural rigging. | | CO1 | R | 1 |
| 3. | Define wing span. | | CO2 | R | 1 |
| 4. | Major aircraft component which holds the passengers along with cargo is called as \_\_\_\_\_\_\_\_\_\_. | | CO2 | R | 1 |
| 5. | Write the forming elements that form the main part in the structure of an aircraft wing. | | CO3 | R | 1 |
| 6. | Name 4 common metals used in aircrafts. | | CO4 | R | 1 |
| 7. | Cite how the forward force produced by the power plant/propeller or rotor is referred to. | | CO5 | R | 1 |
| 8. | Identify the name of the portion that connects the entire nacelle/engine assembly to the aircraft. | | CO5 | R | 1 |
| 9. | Define period of rotation. | | CO6 | R | 1 |
| 10. | In a 1045 propeller, 45 denotes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the unique characteristics of Aerial steam engine. | | CO1 | R | 3 |
| 12. | Compare the advantages of monoplanes over biplanes. | | CO2 | U | 3 |
| 13. | Discuss the reason why the equal transit theory is not right in explaining the generation of lift. | | CO3 | U | 3 |
| 14. | Write the use of reinforced plastics in aircraft structures. | | CO4 | R | 3 |
| 15. | Differentiate interference drag and skin friction drag. | | CO5 | U | 3 |
| 16. | Write the use of Electronic Speed Controller. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Describe the contributions of Sir George Caley to early developments in aviation. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the function and use of the basic instruments used for flying. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the predominant types of fuselage structure with neat sketches. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe the use of metallic and composite materials used in the construction of aircraft structures. | CO4 | R | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the principle and working of a pump-fed and pressure-fed liquid propulsion system. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. |  | Describe the principle and working of a turboprop engine with a sketch. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the functions of a) Flight controller b) GPS and c) Telemetry in a multi-copter Drone. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Describe the five major components of an aircraft with a line sketch. | CO2 | R | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | As the temperature increases, the thermal conductivity of a gas \_\_\_\_\_\_\_\_. | | CO1 | U | 1 |
| 2. | The rate of heat transfer is maximum in \_\_\_\_\_\_\_\_\_\_. | | CO1 | R | 1 |
| 3. | Conduction of heat transfer is governed by \_\_\_\_\_\_\_\_\_. | | CO2 | R | 1 |
| 4. | The critical thickness of insulation for a cylindrical pipe is \_\_\_\_\_\_. | | CO2 | R | 1 |
| 5. | Natural Convection occurs due to \_\_\_\_\_\_\_\_ differences caused by temperature differences. | | CO3 | U | 1 |
| 6. | Laminar boundary layers are \_\_\_\_\_\_\_\_ than turbulent boundary layer. | | CO3 | R | 1 |
| 7. | Poiseulle flow means \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO4 | U | 1 |
| 8. | Characteristic length of cylinder is **\_\_\_\_\_\_\_\_.** | | CO4 | R | 1 |
| 9. | A gray surface is a surface whose emissivity and absorptivity does not depend on \_\_\_\_\_\_\_\_\_\_\_\_. | | CO5 | R | 1 |
| 10. | When the mixing of two fluids are undesirable, \_\_\_\_\_\_\_\_ are used. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Recite the modes of heat transfer. | | CO1 | R | 3 |
| 12. | Define Prandtl number. | | CO2 | R | 3 |
| 13. | 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 =1 and Pr > 1. | | CO3 | R | 3 |
| 14. | Define hydrodynamic entrance length and write the formula to find it for laminar flow. | | CO4 | R | 3 |
| 15. | Outline the advantages of radiation shield. | | CO5 | R | 3 |
| 16. | Classify the heat exchangers. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. |  | Explain the steps involved to obtain heat conduction equation in polar coordinate system. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | A wall of 0.6 m thickness having thermal conductivity of 1.2 W/mK. The wall is to be insulated with a material having an average thermal conductivity of 0.3 W/mK. Inner and outer surface temperatures are 1000ᵒC and 10ᵒC respectively. If heat transfer rate is 1400 W/m², estimate the thickness of insulation. | CO2 | U | 12 |
| 19. |  | Explain the regions of thermal boundary layer and highlight its significant features. | CO3 | U | 12 |
| 20. |  | Air at 30ᵒC, 0.2 m/s flows across a 120 W electric bulb at 130ᵒC. Find heat transfer and power lost due to convection if bulb diameter is 70 mm. | CO3 | U | 12 |
| 21. |  | A plate of 6 cm X 8 cm X 14 cm size maintained at a temperature of 60ᵒC and heat lost to the air is at 0ᵒC. The vertical dimension is 14 cm. Estimate heat transfer coefficient. | CO4 | U | 12 |
| 22. |  | The temperature of a black surface 0.25 m² of area is 650ᵒC. Estimate the following   1. Total rate of energy emission 2. Intensity of normal radiation 3. Wavelength of maximum monochromatic emissive power | CO5 | R | 12 |
| 23. |  | Two large parallel plates are maintained at 600 K and 900 K and emissivities are 0.4 and 0.7 respectively. Estimate heat transfer by radiation, percentage reduction in heat transfer and shield temperature when another plate of emissivity 0.05 introduced in between them. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | In a counter flow heat exchanger, water is heated from 20ᵒC to 80ᵒC by an oil with a specific heat of 2.5 kJ/kgK and mass flow rate of 0.5 kg/s. The oil is cooled from 110ᵒC to 40ᵒC. If the overall heat transfer coefficient is 1400 W/m²K, find the following by using NTU method   1. Mass flow rate of water 2. Effectiveness of heat exchanger 3. Surface area | CO6 | U | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 then to solve practical convective heat transfer problems. |
| CO5 | Understand the physical mechanisms involved in radiation heat transfer. |
| CO6 | Select and design heat exchangers for a given application and heat load. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 4 | 13 | - | - | - | - | 17 |
| CO2 | 5 | 12 | - | - | - | - | 17 |
| CO3 | 4 | 25 | - | - | - | - | 29 |
| CO4 | 4 | 13 | - | - | - | - | 17 |
| CO5 | 16 | 12 | - | - | - | - | 28 |
| CO6 | - | 16 | - | - | - | - | 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** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Derive the continuity equation for a fixed and non-deforming control volume and highlight all the assumptions. | CO1 | A | 16 |
|  |  |  |  |  |  |
| 2. | a. | Explain the regions of boundary layer. | CO2 | U | 6 |
|  | b. | Produce the solutions of viscous flow between parallel plates with bottom plate fixed and upper plate moving. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Relate the variation of flow Area with Mach number relation for a C-D nozzle. | CO3 | A | 10 |
|  | b. | Show the various flow conditions in C-D nozzle. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 4. | a. | Discover the variation of flow properties across a normal shock. | CO4 | A | 10 |
|  | b. | Discuss the findings of Rankine-Hugoniot equation. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 5. |  | Apply any numerical method to solve boundary layer equation. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Show that Blasius equation and its corresponding boundary conditions are | CO2 | A | 16 |
|  |  |  |  |  |  |
| 7. |  | Illustrate the working principle of shock tube with a neat diagram. | CO6 | A | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Derive the expression for 1D flow with friction. | CO6 | A | 15 |
|  | b. | Construct the mollier diagram for 1D flow with friction. | CO6 | A | 5 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 |  | 6 | 26 |  |  |  | 32 |
| CO3 |  |  | 16 |  |  |  | 16 |
| CO4 |  | 6 | 10 |  |  |  | 16 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 36 |  |  |  | 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** | | **CO** | **BL** | **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 orthotropic materials. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. |  | A cantilever beam of rectangular section is subjected to a load of 1000 N which is inclined at an angle of 30° to the vertical. What is the stress due to bending at point D near the built-in-end? | CO3 | A | 16 |
|  |  |  |  |  |  |
| 4. |  | The Fig. shows a single cell beam with two booms at A and B. Find the internal shear flow force system when the beam carries an external load of 100 N as shown. Assume webs take shear and booms take bending stress. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 5. |  | 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. | 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 cm2 and the sheet thickness = 1.5 mm. Assume the sheets are effective in bending and made of 2024-T3 aluminium 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. |  | 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. | CO4 | A | 20 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

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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 |  |  | 16 |  |  |  | 16 |
| CO4 |  |  | 36 |  |  |  | 36 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 32 |  |  |  | 32 |
|  | | | | | | | **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** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | A study of the effects of smoking on sleep patterns is conducted. The measure observed is the time, in minutes, that it takes to fall asleep. These data are obtained:  Smokers: 69.3 56.0 22.1 47.6 53.2 48.1 52.7 34.4 60.2 43.8 23.2 13.8  Nonsmokers: 28.6 25.1 26.4 34.9 29.8 28.4 38.5 30.2 30.6 31.8 41.6 21.1 36.0 37.9 13.9  (a) Find the sample mean for each group.  (b) Find the sample standard deviation for each group.  (c) Make a dot plot of the data sets A and B on the same line.  (d) Comment on what kind of impact smoking appears to have on the time required to fall asleep. | CO1 | Apply | 16 |
|  |  |  |  |  |  |
| 2. |  | The following scores represent the final examination grades for an elementary statistics course: 23 60 79 32 57 74 52 70 82 36 80 77 81 95 41 65 92 85 55 76 52 10 64 75 78 25 80 98 81 67 41 71 83 54 64 72 88 62 74 43 60 78 89 76 84 48 84 90 15 79 34 67 17 82 69 74 63 80 85 61  (a) Construct a stem-and-leaf plot for the examination grades.  (b) Construct a relative frequency histogram, draw an estimate of the graph of the distribution, and discuss the skewness of the distribution.  (c) Compute the sample mean, sample median, and sample standard deviation. | CO2 | Apply | 16 |
|  |  |  |  |  |  |
| 3. | a. | If S = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9} and A = {0, 2, 4, 6, 8}, B = {1, 3, 5, 7, 9}, C = {2, 3, 4, 5}, and D = {1, 6, 7}, list the elements of the sets corresponding to the following events: (a) A ∪ C; (b) A ∩ B; (c) C ′ ; (d) (C ′ ∩ D) ∪ B; (e) (S ∩ C) ′ ; (f) A ∩ C ∩ D ′ | CO3 | Apply | 8 |
|  | b. | List the elements of each of the following sample spaces:  (a) the set of integers between 1 and 50 divisible by 8;  (b) the set S = {x | x 2 + 4x − 5=0};  (c) the set of outcomes when a coin is tossed until a tail or three heads appear;  (d) the set S = {x | x is a continent};  (e) the set S = {x | 2x − 4 ≥ 0 and x < 1}. | CO3 | Apply | 8 |
|  |  |  |  |  |  |
| 4. | a. | An experiment consists of flipping a coin and then flipping it a second time if a head occurs. If a tail occurs on the first flip, then a die is tossed once. List the elements of the sample space providing the most information by constructing the tree diagram. | CO4 | Apply | 8 |
|  | b. | A random variable has the following distribution.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | P(x) | k | 2k | 2k | 3k |  | 2 | 7+k |   Find out  i) the value of k  ii) p (1)  iii) p (x6) | CO4 | Apply | 8 |
|  |  |  |  |  |  |
| 5. |  | The lengths of power failures, in minutes, are recorded in the following table. 22 18 135 15 90 78 69 98 102 83 55 28 121 120 13 22 124 112 70 66 74 89 103 24 21 112 21 40 98 87 132 115 21 28 43 37 50 96 118 158 74 78 83 93 95  (a) Find the sample mean and sample median of the power-failure times.  (b) Find the sample standard deviation of the powerfailure times. | CO2 | Apply | 16 |
|  |  |  |  |  |  |
| 6. |  | The thrust of an engine (y) is a function of exhaust temperature (x) in ◦F when other important variables are held constant. Consider the following data   |  |  |  |  | | --- | --- | --- | --- | | y | x | y | x | | 4300 | 1760 | 4010 | 1665 | | 4650 | 1652 | 3810 | 1550 | | 3200 | 1485 | 4500 | 1700 | | 3150 | 1390 | 3008 | 1270 | | 4950 | 1820 |  |  |   (a) Plot the data.  (b) Fit a simple linear regression to the data and plot the line through the data. | CO5 | Apply | 16 |
|  |  |  |  |  |  |
| 7. |  | Use the data set   |  |  | | --- | --- | | y | x | | 7 | 2 | | 50 | 15 | | 100 | 30 | | 40 | 10 | | 70 | 20 |   (a) Plot the data.  (b) Fit a regression line through the origin.  (c) Plot the regression line on the graph with the data.  (d) Give a general formula (in terms of the yi and the slope b1) for the estimator of σ 2 .  (e) Give a formula for Var(ˆyi), i = 1, 2,...,n, for this case.  (f) Plot 95% confidence limits for the mean response on the graph around the regression line | CO6 |  | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | The table gives the experimental data for force (N) and velocity (m/s) for an object suspended in 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 squares regression to determine the coefficients a and b in the function 2. Estimate the force when the velocity is 55 m/s. 3. Find | CO6 |  | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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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| **Course Code** | **21AE3006** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED PROPULSION TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Determine the temperature and pressure at the exit of the high-pressure turbine and the mass flow rate of air for a modified Brayton cycle with air as the working fluid operates at a specified pressure ratio. Assumptions:  1) Steady operating condition exists 2) The air-standard assumptions are applicable 3) Kinetic and potential energy changes are negligible 4) Air is an ideal gas with constant specific heats.  Properties The properties of air are given as cv = 0.718 kJ/kg·K, cp = 1.005 kJ/kg·K, R = 0.287 kJ/kg·K, k = 1.4, P1= 100 KPa, Pressure ratio of 8 bar. | CO1 | A | 10 |
|  | b. | State the influence of surging on the compressor performance. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 2. | a. | Determine the ramjet engine performance parameters for being flown at a velocity of 610 m/s and burning a hydrocarbon fuel with a heating value of 44,200 kJ/kg. The uninstalled specific thrust *F/* is 736 N.s/kg and the specific fuel consumption S is 62.3 g/(kN.s). | CO2 | A | 10 |
|  | b. | State the advantage of ramjet engine over turbojet engine. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the working principle of monopropellant thruster with neat sketch. | CO3 | U | 8 |
|  | b. | Determine the values of *T, M, k, c\*, CF,* and Is using the water-gas equilibrium conditions for liquid monopropellant called nitromethane (CH3NO2), which can be decomposed into gaseous reaction products.  Assume no dissociations and no O2.Take chamber pressure as 69 atm and nozzle exit pressure as 1 atm. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 4. | a. | Explain the significance of green propellants. | CO4 | U | 8 |
|  | b. | Illustrate Nitrous oxide as green candidates for hybrid rockets. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain Kaufman Ion Thruster with neat sketch. | CO5 | A | 12 |
|  | b. | State the advantage of Kaufman Ion Thrusters over rf thrusters. | CO5 | R | 4 |
|  |  |  |  |  |  |
| 6. | a. | State the purpose of continuous flow ground testing. | CO6 | R | 6 |
|  | b. | Explain the working principle of continuous flow ground testing. | CO6 | A | 10 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the thrust chamber and nozzle for a static test of liquid rocket engine working on LOX-RP-1 propellant at sea level condition.  The molecular weight of RP-1 is 175 Maximum thrust produced is 1000 N Combustion chamber pressure is  3 MPa Combustion chamber temperature is 3500 ̊C Mixture ratio is 2.5 Take nozzle divergence angle as 15 ̊ and convergent angle as 45 ̊. Take k = 1.24, Density of LOX = 1150 kg/m3 , Density of kerosene = 810 kg/m3. Draw the thrust chamber and nozzle as per the design calculation with details of the flow conditions. | CO3 | E | 16 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Explain the various considerations made for the development of hypersonic expansion system. | CO6 | An | 10 |
|  | b. | Design the various zones involved in the analysis of the hypersonic expansion system. | CO6 | C | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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 | Analyze 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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 | - | 10 | - | - | - | 16 |
| CO2 | 6 | - | 10 | - | - | - | 16 |
| CO3 | - | 8 | 8 | - | 16 | - | 32 |
| CO4 | - | 8 | 8 | - | - | - | 16 |
| CO5 | 4 | - | 12 | - | - | - | 16 |
| CO6 | 6 | - | 10 | 10 | - | 10 | 36 |
|  | | | | | | | **132** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Describe the types of models using a tree diagram and explain the analogy between the electrical and mechanical model. | CO1 | U | 8 |
|  | b. | Show that the demand for the commodity will be low when the price is high and it will increase as the price drops with the mathematical expressions. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Enumerate on the four principles used in modeling. | CO1 | R | 8 |
|  | b. | Examine the simulation numerical technique based on a continuous model. Plot the graph representing the sales made. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 3. | a. | Articulate the aerodynamic forces acting on an airfoil with the help of a schematic. | CO2 | A | 8 |
|  | b. | Develop an expression for a simple mechanical system considering the state variables based on the energy storage elements. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 4. | a. | List the various qualities considered for evaluating an architecture. Describe how the availability is considered for architecture evaluation with an example. | CO3 | R | 8 |
|  | b. | Explain fault tolerance and various stages of graceful degradation. | CO3 | R | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain the feedback loops employed in flight simulation. | CO4 | U | 8 |
|  | b. | Show the stock and flow diagram and indicate its salient features. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 6. |  | Establish the transfer function of the ballistic missile American vanguard missile, which is taken for a time of maximum pressure, occurred at 75 sec after launch, at altitude of 36,000ft, a velocity of 1285 ft/sec, and a mass of 445 slugs. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Sketch the (i) simulation programming task and (ii) Execution of simulation algorithm and discuss on the same. | CO1 | A | 8 |
|  | b. | Explain any six commonly used tools while gathering statistics in the simulation programming tasks. | CO1 | A | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Examine the effectiveness of a flight simulator and highlight its advantages. | CO6 | A | 10 |
|  | b. | Write about the simulator certification procedures, in detail. | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 16 | 16 | 16 | - | - | - | 48 |
| CO2 | - | - | 16 | - | - | - | 16 |
| CO3 | 16 | - | - | - | - | - | 16 |
| CO4 | - | 16 | - | - | - | - | 16 |
| CO5 | - | - | 16 | - | - | - | 16 |
| CO6 | - | - | 20 | - | - | - | 20 |
|  | | | | | | | **132** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Classify the woods used in aircraft industries. | CO1 | U | 10 |
|  | b. | Explain the need and properties wood and steel materials. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Describe in detail the heat treatment procedures for various aircraft steels. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Summarize the different types of alloys and super alloys in detail. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain in detail the production of polymer Matrix Composites, its properties, advantages and applications. | CO3 | U | 10 |
|  | b. | Illustrate the application of high temperature materials in aircraft components. | CO3 | R | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain any of the heat treatment process of steel with a neat diagram. | CO4 | U | 10 |
|  | b. | Describe the types surface hardening process of steel. | CO4 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the design, phases and heat treatment of Nickel based super alloy. | CO4 | R | 10 |
|  | b. | Explain the corrosion and heat resistant steels in detail. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the carbon steels, nickel steels, and molybdenum steels. | CO5 | A | 10 |
|  | b. | Describe in detail the properties and applications of Electro strictive ceramics and Magnetic smart materials. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Illustrate the properties, engineering effect and application of shape memory alloys. | CO5 | E | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe the properties, theorem and performance of piezoelectric materials. | CO6 | C | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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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** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 | 10 | - | - | - | - | 20 |
| CO2 | - | 20 | - | 20 | - | - | 40 |
| CO3 | 10 | 10 | - | - | - | - | 20 |
| CO4 | 20 | 20 | - | - | - | - | 40 |
| CO5 | - | 10 | 10 | - | 20 | - | 40 |
| CO6 | - | - | - | - | - | 20 | 20 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | What is turing test? List the features required for a machine to pass the turing test. | CO1 | R | 6 |
|  | b. | Classify the artificial intelligence agent based on degree of capability and intelligence. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 2. | a. | Summarize alpha beta pruning. | CO2 | U | 6 |
|  | b. | Explain knowledge-based agent in the field of artificial intelligence. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | List the merits and demerits of expert systems. | CO3 | R | 6 |
|  | b. | Identify the design considerations of artificial intelligence based avionic applications. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 4. | a. | Analyze the intelligent monitoring and diagnostic system in the field of aerospace. | CO3 | An | 10 |
|  | b. | What are the steps to be done to find the class label of the test data using k-NN algorithm? | CO5 | R | 6 |
|  |  |  |  |  |  |
| 5. | a. | Explain support vector machine in detail with necessary illustrations. | CO4 | U | 10 |
|  | b. | List the characteristics of expert system. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 6. | a. | Illustrate underfitting and overfitting problems in machine learning. | CO4 | U | 6 |
|  | b. | Analyze how the logistic regression algorithm is useful for binary classification. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | List the advantages and disadvantages of k-Nearest Neighbour Classifier. | CO5 | R | 6 |
|  | b. | Construct a decision tree and classify the speed of the vehicle as Slow or Fast for the dataset given below.   |  |  |  |  | | --- | --- | --- | --- | | **Road Type** | **Obstruction** | **Speed Limit** | **Speed** | | Steep | Yes | Yes | Slow | | Steep | No | Yes | Slow | | Flat | Yes | No | Fast | | Steep | No | No | Fast | | CO5 | A | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Explain the Optimization of tuning parameters in machine learning. | CO6 | U | 10 |
|  | b. | Calculate the accuracy, sensitivity, specificity, precision and F1 score of a machine learning model whose TP=460, TN=670, FP=161, FN=40. | CO6 | A | 10 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 6 | 10 | - | - | - | - | 16 |
| CO2 | - | 16 | - | - | - | - | 16 |
| CO3 | 12 | - | 10 | 10 | - | - | 32 |
| CO4 | - | 16 | 10 | - | - | - | 26 |
| CO5 | 12 | - | 10 | - | - | - | 22 |
| CO6 | - | 10 | 10 | - | - | - | 20 |
|  | | | | | | | **132** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain supervised, unsupervised and reinforcement learning with an example. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the different architectures of ANN. | CO1 | U | 15 |
|  | b. | Write the advantages of Artificial neural networks. | CO1 | U | 5 |
|  |  |  |  |  |  |
| 3. |  | What is a feed forward neural network system? Distinguish between single-layer perceptron and multi-layer perceptron. | CO2 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain how internet of things can be implemented in Drone modelling. | CO2 | A | 15 |
|  | b. | State the limitations of perception model. | CO2 | U | 5 |
|  |  |  |  |  |  |
| 5. |  | Detail the specifications and working principle of typical components in a multi-copter drone. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the use of sensors in UAVs and the process of integration. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Describe the process of UAV Data transfer between the Telemetry System and Ground Control Station? | CO5 | U | 10 |
|  | b. | What is meant by drone jamming? How is it implemented? | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the principle and working of stealth technology used in UAVs. | CO6 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Compare and contrast the use of digital elevation model, digital surface model and digital terrain model. | CO4 | E | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 40 | - | - | - | - | 40 |
| CO2 | - | 5 | 35 | - | - | - | 40 |
| CO3 | - | 40 | - | - | - | - | 40 |
| CO4 | - | - | - | - | 20 | - | 20 |
| CO5 | - | 20 | - | - | - | - | 20 |
| CO6 | - | 20 | - | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **22AE3002** | **Duration** | **3hrs** |
| **Course Name** | **COMPOSITE PRODUCT PROCESSING METHODS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Describe the different types of thermoset resins used in composite manufacturing. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Interpret the 4 major steps used in the process of selecting materials for composite manufacturing. | CO1 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Describe the different phases of product development. | CO2 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Summarize the guidelines for the implementation of design for manufacturing (DFM) guidelines. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Paraphrase the four basic steps involved in composites part fabrication. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain the principle of resin transfer moulding process with its advantages and disadvantages. | CO3 | R | 20 |
|  |  |  |  |  |  |
| 7. |  | Describe the hot press technique used for composite fabrication with its advantages and disadvantages. | CO4 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Compare and contrast some of the challenges in machining composites with the traditional metals. | CO5 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Sketch the process of water jet cutting used for machining composites. | CO6 | Ap | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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

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