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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define degrees of freedom of a system. | | CO1 | R | 1 |
| 2. | State the conditions for stability in a system. | | CO1 | R | 1 |
| 3. | Describe the contribution of the fuselage to static stability. | | CO2 | U | 1 |
| 4. | Identify the purpose of a stick-fixed neutral point. | | CO2 | U | 1 |
| 5. | Describe the effects of trim tabs on stick-free static longitudinal stability. | | CO3 | U | 1 |
| 6. | State the characteristics of adverse yaw in an aircraft. | | CO3 | R | 1 |
| 7. | Summarize the stabilizing criterion for dihedral effect. | | CO4 | U | 1 |
| 8. | State the concept of phugoid motion in dynamic stability. | | CO4 | R | 1 |
| 9. | Describe the importance of Routh’s discriminant in lateral dynamic stability. | | CO5 | U | 1 |
| 10. | Define auto-rotation in aircraft dynamics. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Interpret the effects of power on a propeller-driven airplane’s longitudinal stability. | | CO1 | A | 3 |
| 12. | Distinguish between stick-fixed and stick-free static longitudinal stability. | | CO2 | An | 3 |
| 13. | Analyze the contribution of the wing to directional stability. | | CO3 | An | 3 |
| 14. | Assess rolling moments and their conventions of an aircraft. | | CO4 | An | 3 |
| 15. | Examine the importance of stability derivatives in dynamic stability. | | CO5 | An | 3 |
| 16. | Compare Dutch roll with spiral instability in lateral dynamic stability. | | 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 equations of motion for static longitudinal stability and analyze the contributions of wings and tails. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe elevator hinge moments and estimate hinge moment parameters. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Investigate one-engine inoperative conditions and their effects on directional stability. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Assess the selection process for dihedral angles in lateral static stability. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Compare phugoid with short-period motion for longitudinal dynamic stability. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Examine spiral instability and its impact on spin recovery in lateral dynamic stability. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Analyze the contributions of vertical tail and propeller to directional stability. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the elevator requirements for static longitudinal stability in both jet-driven and propeller-driven airplanes and its associated challenges. | CO1 | An | 12 |

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

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

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

1. What is the definition of low-speed aerodynamics?

a) Aerodynamics at speeds above Mach 1.

b) Aerodynamics at speeds where compressibility effects are negligible.

c) Aerodynamics at speeds where air density changes significantly.

d) Aerodynamics related to hypersonic flow.

2. In incompressible flow, the density of the fluid:

a) Varies significantly with pressure.

b) Remains constant.

c) Changes with temperature.

d) Is affected by shock waves.

3. The continuity equation for incompressible flow states that:

a) The mass flow rate changes with time.

b) The velocity of the fluid is constant.

c) The volume flow rate is constant.

d) The pressure is uniform throughout the flow.

4. Which of the following is true about the Bernoulli's equation for incompressible flow?

a) It applies only to compressible flows.

b) It relates pressure, velocity, and height along a streamline.

c) It considers the effects of viscosity.

d) It is used to calculate the shock wave properties.

5. What is the typical Mach number range for low-speed flow?

a) Mach 0 to Mach 0.3.

b) Mach 1 to Mach 2.

c) Mach 3 to Mach 5.

d) Mach 5 and above.

6. For incompressible flow, the effect of compressibility can be neglected when the Mach number is:

a) Greater than 1.

b) Less than 0.3.

c) Between 0.5 and 1.

d) Equal to 1.

7. In low-speed aerodynamics, the primary forces acting on an airfoil are:

a) Thrust and drag.

b) Lift and weight.

c) Lift and drag.

b) Weight and thrust.

8. Which equation is commonly used to analyze the velocity field in incompressible flow?

a) Navier-Stokes equation.

b) Euler's equation.

c) Bernoulli's equation.

d) Continuity equation.

9. What is the role of the Kutta condition in low-speed aerodynamics?

a) To ensure the airfoil generates maximum lift.

b) To determine the location of the stagnation point.

c) To ensure smooth flow leaves the trailing edge of an airfoil.

d) To calculate the drag force on an airfoil.

10. Which of the following is a key assumption in incompressible aerodynamics?

a) The flow is inviscid.

b) The flow is rotational.

c) The flow has constant density.

d) The flow has variable density.

11. Which of the following describes the basic purpose of an airfoil?

a) To generate thrust.

b) To control the yaw movement.

c) To produce lift and reduce drag.

d) To provide structural integrity.

12. What is the definition of the angle of attack in airfoil theory?

a) The angle between the chord line and the lift vector.

b) The angle between the relative wind and the vertical stabilizer.

c) The angle between the chord line and the relative wind.

d) The angle between the chord line and the ground.

13. According to Bernoulli’s principle, how does the pressure change over the curved upper surface of an airfoil?

a) Pressure increases.

b) Pressure remains constant.

c) Pressure decreases.

d) Pressure becomes equal to the lower surface.

14. Which theory explains the lift generated by an airfoil by considering the circulation of air around it?

a) Momentum theory.

b) Circulation theory.

c) Vortex theory.

d) Boundary layer theory.

15. In thin airfoil theory, what assumption is made about the airfoil's shape?

a) It has a thick cross-section

b) It is cambered

c) It is a flat plate

d) It has a symmetrical shape

16. Which of the following is NOT a factor affecting the lift produced by an airfoil?

a) Airfoil shape

b) Angle of attack

c) Airspeed

d) Color of the airfoil

17. What is the primary cause of drag on an airfoil?

a) Pressure difference between upper and lower surfaces

b) Airfoil weight

c) Friction between air and airfoil surface

d) Airfoil temperature

18. What is the role of the Kutta-Joukowski theorem in airfoil theory?

a) It calculates the maximum speed of an aircraft

b) It determines the location of the stagnation point

c) It relates the lift force to the circulation around the airfoil

d) It calculates the drag force on an airfoil

19. In the context of airfoil performance, what is meant by the term "stall"?

a) A condition where the airfoil generates maximum lift

b) A condition where lift decreases rapidly due to airflow separation

c) A state of constant lift and drag

d) A phase where the airfoil maintains level flight

20. Which of the following airfoil shapes is commonly used to minimize drag at high speeds?

a) Flat plate

b) Symmetrical airfoil

c) Cambered airfoil

d) Supercritical airfoil

21. Define the term that describes the ability of a fluid to decrease in volume under pressure.

a) Elasticity

b) Compressibility

c) Density

d) Viscosity

22. Label the term that represents the ratio of inertial forces to elastic forces in a fluid.

a) Reynolds number

b) Mach number

c) Prandtl number

d) Froude number

23. Name the type of flow where compressibility effects are negligible.

a) Supersonic flow

b) Subsonic flow

c) Incompressible flow

d) Transonic flow

24. Describe the effect of an increase in area for a supersonic flow in a converging-diverging nozzle.  
a) Stagnation.  
b) Deceleration.  
c) Acceleration.  
d) Compression.

25. State the critical Mach number for choking in a nozzle.  
a) One.  
b) Zero.  
c) Two.  
d) Infinity.

26. Enumerate the parameters conserved across a normal shock wave.

a) Pressure, Momentum, Energy

b) Temperature, Pressure, Energy

c) Mass Flow, Momentum, Energy

d) Velocity, Energy, Density

27. Identify the angle formed between the oblique shock wave and the incoming flow.

a) Deflection Angle

b) Wave Angle

c) Shock Angle

d) Flow Angle

28. Describe the phenomenon when the flow velocity in a nozzle reaches the speed of sound.

(a) Subsonic flow

(b) Hypersonic flow

(c) Choked flow

(d) Isentropic flow

29. Examine the parameter that remains constant in an isentropic nozzle flow.

(a) Pressure

(b) Enthalpy

(c) Entropy

(d) Density

30. Identify the type of nozzle that accelerates subsonic flow to supersonic flow.

(a) Convergent nozzle

(b) Diffuser nozzle

(c) CD nozzle

(d) Divergent nozzle

31. For a linearly elastic, isotropic and homogeneous material, the number of elastic constants required to relate stress and strain is:

1. Two b) Three c) Four d) Six

32. For an isotropic, homogeneous and linearly elastic material, which obeys Hooke's law, the number of independent elastic constant is:

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

33. In a simple tension test, Hooke's law is valid as per [IAS-1998]

a) Elastic limit b) Limit of proportionality

c) Ultimate stress d) Breaking point

34. The materials which show direction dependent properties are called

a) Homogeneous materials b) Viscoelastic materials

c) Isotropic materials d) Anisotropic materials

35. 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)

36. Which one of the following is correct in respect of Poisson’s ratio (ν) limits for an isotropic elastic solid?

1. -∞ ≤ ν ≤∞ b) 1/4 ≤ ν ≤1/3 c) -1 ≤ ν ≤1/2 d) -1/2 ≤ ν ≤1/2

37. If a piece of material neither expands nor contracts in volume when subjected to stress, then the Poisson’s ratio must be

1. Zero b) 0.25 c) 0.33 d) 0.5

38. 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

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

a) b) c) d)

40. 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

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

a) Thermal stress b) Tensile stress

c) Compressive stress d) No stress

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

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

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

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

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

a) 0·30 b) 0·26 c) 0·25 d) 0·24

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

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

46. The ratio of Young's modulus of Elasticity E and Bulk Modulus K for a material is given by

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

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

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

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

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

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

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

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

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

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

50. The maximum shear stress (τmax) acting on a plane of an element is obtained by (σ1 and σ2­ are the principal stresses)

1. (σ1 + σ2)/2 b) (σ1 - σ2)/2

c) 2 (σ1 + σ2) d) 2(σ1 - σ2)

51. An element of a material subjected to a plane state of stress such that the maximum shear stress is equal to the maximum tensile stress, would correspond to





b)

a)



d)



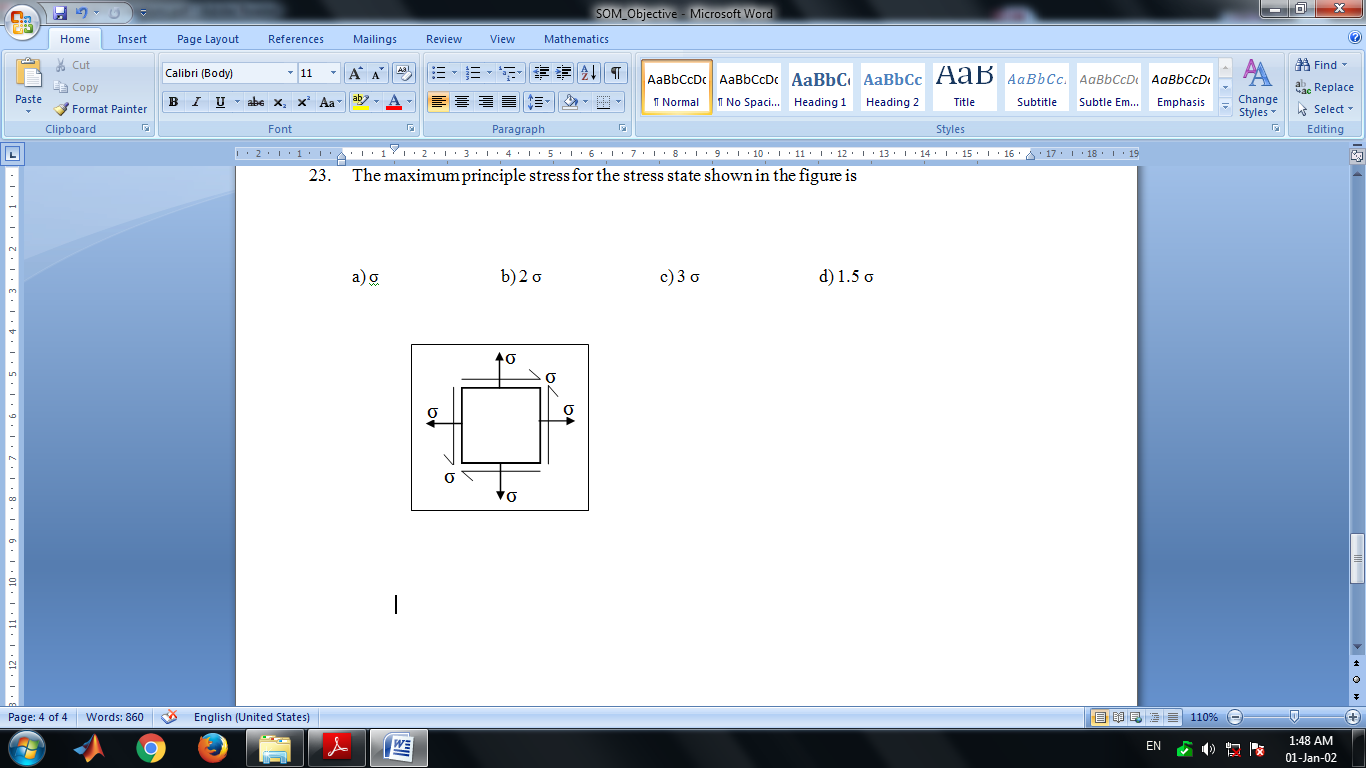
c)

52. A solid circular shaft is subjected to a maximum shearing stress of 140 MPa. The magnitude of the maximum normal stress developed in the shaft is:

a) 140 MPa b) 80 MPa c) 70 MPa d) 60 MPa

53. In a bi-axial stress state, the stresses in x and y directions are (σx = 200 MPa & σy =100 MPa. The maximum principal stress in MPa, is

a) 50 b) 100 c) 150 d) 200



54. The maximum principle stress for the stress state shown in the figure is

a) σ b) 2 σ c) 3 σ d) 1.5 σ

55. In a Mohr's circle, the radius of the circle is taken as

a) b)

c) d)

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

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

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

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

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

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

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

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

60. Given that one principal stress is twice the other, how can you determine the maximum principal stress in terms of τmax?

a) τmax b) 2τmax c) 4τmax d) 8τmax

61. Under what condition does one of the principal stresses become zero when a material is subjected to normal stresses (σx = σy) and shear stress (τxy)?

a) b) c) d)

62. How do you calculate the resultant normal stress on a plane inclined at 45° when equal but opposite normal stresses (±p) are applied perpendicularly?

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

63. For a plane element subjected to σx = 100 MPa, τxy = 100 MPa, and σy = 0, how can you determine the maximum shear stress?

a) b) c) d) 15

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

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

65. What physical quantity is obtained by dividing the area under a bending moment diagram by the flexural rigidity of the beam?

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

66. What is the primary source of aerodynamic force on an aircraft?

a) Engine thrust b) Pressure distribution over the surface

c) Gravity d) Weight of the aircraft

67. Which aerodynamic force is responsible for keeping an aircraft in the air?

a) Thrust b) Drag

c) Lift d) Weight

68. What is the point along the chord line where the pitching moment remains constant?

a) Center of pressure b) Aerodynamic center

c) Neutral point d) Leading edge

69. What is the effect of increasing Reynolds number on an airfoil?

a) Increased skin friction drag b) Delayed boundary layer separation

c) Decreased lift coefficient d) Increased wave drag

70. Which of the following is a high-lift device?

a) Aileron b) Spoiler

c) Flap d) Rudder

71. Which of the following statements about specific fuel consumption (SFC) is correct?

a) It decreases with increasing altitude

b) It increases with decreasing velocity

c) It remains constant for all engines

d) It is highest for turbojet engines at low speeds

72. What is the primary factor affecting propeller performance?

a) Number of blades b) Blade twist distribution

c) Tip speed d) All of the above

73. Which engine type has the highest power-to-weight ratio?

a) Reciprocating engine b) Turbojet

c) Turboprop d) Electric motor

74. Which theory is used to analyze propeller performance?

a) Bernoulli’s theorem b) Momentum theory

c) Navier-Stokes equation d) Euler’s equation

75. Which factor significantly contributes to propeller noise?

a) High-speed blade tips b) Increased blade diameter

c) Reduced RPM d) Lower air density

76. Which condition is necessary for steady level flight?

a) Thrust > Drag b) Lift > Weight

c) Thrust = Drag and Lift = Weight d) Weight > Lift

77. What is the effect of drag divergence on maximum velocity?

a) Increases maximum velocity b) Decreases maximum velocity

c) Has no effect on velocity d) Reduces lift

78. What is the relationship between power available and maximum speed?

a) Higher power available increases maximum speed

b) Power available has no effect on speed

c) Power available decreases with speed

d) Power available depends only on altitude

79. What is the minimum drag condition in level flight?

a) When lift-to-drag ratio is maximum

b) When thrust required is maximum

c) When power required is minimum

d) When Reynolds number is lowest

80. Which factor primarily determines the thrust required for level flight?

a) Aircraft weight b) Drag coefficient

c) Wing aspect ratio d) Fuel consumption

81. What does the Breguet formula determine?

a) Rate of climb b) Range and endurance

c) Maximum velocity d) Takeoff distance

82. Which of the following affects the rate of climb?

a) Wind direction b) Thrust-to-weight ratio

c) Altitude d) All of the above

83. What happens to turn radius if the bank angle is increased?

a) Increases b) Decreases

c) Remains constant d) Has no effect on turning

84. Which maneuver involves a rapid nose-up motion followed by a quick nose-down recovery?

a) Pull-up maneuver b) Cobra maneuver

c) Chandelle maneuver d) Barrel roll

85. Which factor has the greatest influence on takeoff distance?

a) Aircraft weight b) Wind speed

c) Runway surface condition d) All of the above

86. Which type of drag is caused by the formation of vortices at the wingtips?

a) Parasitic drag b) Wave drag

c) Induced drag d) Skin friction drag

87. What happens to the rate of climb as the aircraft gains altitude?

a) Increases b) Decreases

c) Remains constant d) Becomes infinite

88. What is the significance of the V-n diagram in aircraft performance?

a) Shows the relationship between lift and drag

b) Represents load factor limits and structural integrity

c) Predicts fuel consumption

d) Determines engine thrust

89. Which type of high-lift device delays boundary layer separation?

a) Spoilers b) Slats

c) Rudder d) Winglets

90. Which factor influences the ground roll distance during takeoff?

a) Aircraft weight b) Thrust-to-weight ratio

c) Runway slope d) All of the above

91. Which of the following conic sections represents a closed orbit?

a) Parabola b) Hyperbola

c) Ellipse d) None of the above

92. What is the angular momentum of an orbiting body in a central force motion?

a) Constant b) Varies with time

c) Depends on the semi-major axis d) Constant for a given orbit

93. Which equation is used to determine the position of an object in an elliptic or hyperbolic orbit as a function of time?

a) Kepler’s equation b) Newton’s second law

c) Euler’s equation d) Bernoulli’s equation

94. Which parameter is required to compute the position and velocity vectors from orbital elements?

a) Eccentricity b) True anomaly

c) Semi-major axis d) All of the above

95. What is an osculating orbit?

a) The instantaneous Keplerian orbit that an object follows at a given time

b) A perfectly circular orbit

c) A hyperbolic escape trajectory

d) A fixed orbit around Earth

96. Which of the following is a primary cause of orbit perturbations?

a) Earth's oblateness

b) Atmospheric drag

c) Third-body effects from the Sun and Moon

d) All of the above

97. A Sun-synchronous orbit is designed to maintain what specific characteristic?

a) Constant altitude

b) Consistent lighting conditions over the observed region

c) Geostationary positioning

d) Maximum speed variation

98. Which method is commonly used for numerical orbit perturbation analysis?

a) Bernoulli’s method b) Cowell’s method

c) Hohmann transfer method d) Synodic period method

99. The Hohmann transfer maneuver is most efficient when transferring between orbits that are:

a) Coplanar and circular b) Highly elliptical

c) Perpendicular to each other d) In different inclination planes

100. What is the primary advantage of a bi-elliptic transfer over a Hohmann transfer?

a) It requires less time b) It is more fuel-efficient for large orbit changes

c) It requires fewer calculations d) It only works in hyperbolic orbits

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name two engineering elastic constants. | | CO1 | R | 1 |
| 2. | List two advantages of composite materials over metals. | | CO1 | R | 1 |
| 3. | Define plane strain condition. | | CO2 | R | 1 |
| 4. | State Hooke’s law. | | CO2 | R | 1 |
| 5. | Distinguish between lamina and laminate. | | CO3 | U | 1 |
| 6. | Define global coordinate system. | | CO3 | R | 1 |
| 7. | Define density of composites. | | CO4 | R | 1 |
| 8. | Define matrix volume fraction. | | CO4 | R | 1 |
| 9. | State the assumption used in Classical Laminate theory. | | CO5 | R | 1 |
| 10. | Name three different forms of fibers. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Distinguish between Composite and Alloy. | | CO1 | U | 3 |
| 12. | Explain plane stress conditions. | | CO2 | A | 3 |
| 13. | Describe  i. Stiffness matrix [C]  ii. Compliance matrix [S] | | CO3 | U | 3 |
| 14. | If a composite material of 100g contains 80g resin and 20g fiber, calculate the mass fraction of matrix and mass fraction of reinforcement. | | CO4 | A | 3 |
| 15. | Represent the composite layers for the laminate codes:  i. [0/-45/902/60/0]  ii. [0/-45/90/60/30] | | CO5 | U | 3 |
| 16. | Explain plain weave fibers. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the different types of Composite materials in detail. | CO1 | U | 6 |
|  | b. | Explain Hooke’s law for different types of materials. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | Develop a generalized Hooke’s law for unidirectional lamina and reduce to two dimensions. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the relationship between the compliance and stiffness matrices and determine the engineering elastic constants of a lamina. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Develop Hooke's law for a two-dimensional angle-ply composite lamina with transformed and reduced stiffness matrix. | CO3 | A | 6 |
|  | b. | Calculate the engineering elastic constants for unidirectional angle lamina. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain Tsai-Hill Failure theory and Tsai-Wu failure theory for an angle lamina. | CO3 | U | 6 |
|  | b. | Explain micromechanical analysis of composite lamina. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Determine Longitudinal Young’s modulus E1 and Transverse Young’s modulus E2 using strength of materials approach. | CO4 | A | 6 |
|  | b. | A glass/epoxy lamina consists of 70% fiber volume fraction. The density of glass fiber and epoxy are given as ρf = 2500kg/m3 and ρm = 1200kg/m3  Calculate:  i. Density of lamina.  ii. Mass fraction of glass & epoxy.  iii. Volume of composite lamina if the mass of lamina is 4kg. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Develop stress strain relation for a composite laminate using classical laminate theory. | CO5 | A | 9 |
|  | b. | Define classical laminate theory and state the assumptions made in this theory. | CO5 | R | 3 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain in detail the manufacturing processes used for producing various composite fibers used in composite material fabrication. | CO6 | U | 12 |

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

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

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define simple harmonic motion. | | CO1 | R | 1 |
| 2. | State the condition for resonance in forced vibrations. | | CO1 | R | 1 |
| 3. | Define degrees of freedom in a vibrating system. | | CO2 | R | 1 |
| 4. | Write the general form of Lagrange’s equation. | | CO2 | A | 1 |
| 5. | Define continuous systems in vibration analysis. | | CO3 | R | 1 |
| 6. | Write the geometric boundary conditions used in the vibration of a fixed-free bar. | | CO3 | A | 1 |
| 7. | Describe how Young’s modulus affects the natural frequency of a bar in longitudinal vibration. | | CO3 | U | 1 |
| 8. | State the advantage of studying the matrix iteration method in determining the mode shape and frequency of a given system. | | CO4 | R | 1 |
| 9. | Define aeroelasticity. | | CO5 | R | 1 |
| 10. | List the two types of vibration measuring instruments. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the difference between free and forced vibrations. | | CO1 | U | 3 |
| 12. | Give two examples of a two degrees of freedom system. | | CO2 | R | 3 |
| 13. | List the common types of boundary conditions existing in the torsional vibration of a shaft. | | CO3 | R | 3 |
| 14. | Write the properties of a mass matrix and deflection matrix used in vibration. | | CO4 | A | 3 |
| 15. | Describe the significance of Collar’s triangle in aeroelasticity. | | CO5 | U | 3 |
| 16. | List the methods for measuring vibration in aircraft structures. | | 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. |  | Determine the natural frequency of the spring mass system shown in Figure.  Consider | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | A two-degree-of-freedom torsional system, as shown in Figure, consists of two disks with moments of inertia J1 = 5 kgm² and J2 = 3 kgm², connected by shafts with torsional stiffness values k1 = 600 Nm/rad and k2 = 400 Nm/rad. The lengths of the shafts are a = 1.2 m and b = 0.8 m. Determine the natural frequencies of the system. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Derive the expression for the frequency of a simply supported string under vibration. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Derive the orthogonality condition for a 2-degree freedom system as given by . | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the various aeroelastic phenomena, including divergence, flutter, control reversal, and buffeting, which arise from the interaction of aerodynamic, elastic, and inertia forces. Use Collar’s Triangle to illustrate the relationships between these forces and how they contribute to different types of aeroelastic instability. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Derive the essential equation to explain the working principle of a vibrometer, a vibration measuring instrument and illustrate it with a clear diagram. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Derive an expression for the wing divergence speed using static aeroelastic analysis. Consider an airfoil section with elastic and aerodynamic centers separated by a distance e. Use the relations for lift, moment about the aerodynamic center, and dynamic pressure to determine the critical speed at which divergence occurs. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A spring-mass-pendulum system consists of a 5 kg mass (m1) attached to a spring with a stiffness of 200 N/m, with a 1.2 m long pendulum having a 2 kg bob (m2) attached to it as shown in Figure. The system is slightly displaced and released. Determine the natural frequencies of the system. Consider g = 9.81 m/s2. | CO2 | A | 12 |

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

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

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the person, who used Ammonia instead of air for the first time as coolant in a refrigeration system. | | CO1 | R | 1 |
| 2. | Describe the properties of Helium-4. | | CO1 | U | 1 |
| 3. | Indicate the boiling point of liquid air in Kelvin. | | CO2 | U | 1 |
| 4. | Define J-T inversion curve. | | CO2 | R | 1 |
| 5. | Write the equation of energy added isothermally in an ideal refrigeration system. | | CO3 | A | 1 |
| 6. | State the function of hot and cold reservoir. | | CO3 | R | 1 |
| 7. | State the purpose of inner-vessel stiffening ring in the storage vessel of cryogens. | | CO4 | R | 1 |
| 8. | Write the minimum thickness of the inner shell for a cylindrical vessel. | | CO4 | A | 1 |
| 9. | Define accomodation coefficient. | | CO5 | R | 1 |
| 10. | State the need of cryogenics propellants in liquid rocket engine. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the importance of slip planes in material section for cryogenic applications. | | CO1 | U | 3 |
| 12. | Discuss the four process of Carnot cycle. | | CO2 | U | 3 |
| 13. | Describe the magneto caloric effect. | | CO3 | R | 3 |
| 14. | Explain the types of cryogenic valves in detail. | | CO4 | U | 3 |
| 15. | State the function of evacuated powder cryogenic insulation techniques. | | CO5 | R | 3 |
| 16. | Discuss the various applications of liquid Helium as a cryogen. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | State the importance of magnetic properties of cryogenic materials. | CO1 | R | 6 |
|  | b. | Describe the historical evolution of cryogenics along a timeline. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Explain the concept Joule-Thomson effect with neat sketch and equations. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain Philips refrigerator with necessary equations and sketches. | CO3 | A | 8 |
|  | b. | Differentiate – Vuilleumier refrigerator and Gifford – Mc-Mohan refrigerator. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. |  | Describe the detailed procedure and precautions of transferring the cryogenic fluid. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the requirements of insulation for cryogenic propellant tank. | CO5 | A | 4 |
|  | b. | Explain in detail the evacuated powder insulation method used for insulating cryogenic containers. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 22. |  | Describe the Kapitza liquefaction system with necessary sketch and equations. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain magnetic refrigeration system with neat sketch. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the working principle of liquid oxygen –liquid hydrogen rocket engine. | CO6 | U | 8 |
|  | b. | State the advantage of cryogenic over semi cryogenic rocket engines. | CO6 | R | 4 |

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

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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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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | **Define** a rocket and a missile. | | CO1 | R | 1 |
| 2. | Differentiate between solid and liquid propulsion systems. | | CO1 | U | 1 |
| 3. | **Identify** the primary forces acting on a missile in flight. | | CO2 | R | 1 |
| 4. | **List** different components of rockets airframe. | | CO2 | R | 1 |
| 5. | **Describe** the importance of aerodynamic damping in missile motion. | | CO3 | U | 1 |
| 6. | **State** the significance of airframe components in rocket design. | | CO3 | U | 1 |
| 7. | **Outline** the purpose of multi-staging in rockets. | | CO4 | U | 1 |
| 8. | **Define burnout time.** | | CO4 | U | 1 |
| 9. | **Illustrate** the concept of burnout velocity. | | CO5 | A | 1 |
| 10. | **Name** two Indian missile systems manufactured from DRDO. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | **List** different types of guidance system and explain any two. | | CO1 | U | 3 |
| 12. | **Interpret** the design philosophy of reentry capsule. | | CO2 | U | 3 |
| 13. | **Illustrate** the forces acting on a missile while passing through the atmosphere. | | CO3 | A | 3 |
| 14. | **Analyze** the significance of gravity turn trajectory in rocket launches. | | CO4 | An | 3 |
| 15. | **Examine** the effects of upwash and downwash in missile aerodynamics. | | CO5 | An | 3 |
| 16. | **Discuss** the importance of burnout altitude in rocket flight. | | 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. |  | **Analyze** and **differentiate** various rocket classifications based on propulsion system. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | **Illustrate** different fore-body designs with a labeled sketch and a detailed explanation of their aerodynamic significance. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | **Derive** the equations governing forces and moments acting on a rocket or missile in atmospheric flight and draw neat sketches. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | **Formulate** the equation of motion for a 2D rocket in free space and **interpret** its physical significance. | CO4 | C | 12 |
|  |  |  |  |  |  |
| 21. | a. | A space vehicle in gravitational free space and drag-less space launches a smaller spacecraft into a meteor shower region. Given that the instrument package limits maximum acceleration to 50 m/s² and is launched using a solid rocket motor (ISP = 260s, ε = 0.88), **calculate** the maximum allowable burn plane assuming steady propellant mass flow. | CO4 | E | 6 |
|  | b. | **Derive** expressions for burnout altitude and cumulative altitude for a staged launch. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | **Explain** various stage separation techniques in rockets and **justify** their application in multi-stage launch vehicles. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | **Develop** an analytical model for lateral aerodynamic damping moments in a missile and **assess** its impact on stability. | CO3 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | **Critically examine** the role of aerodynamics and jet control methods in modern missile guidance and **propose** enhancements for efficiency. | CO6 | E | 12 |

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

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



**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the pioneers of the first successful powered flight. | | CO1 | R | 1 |
| 2. | State the full form of RPA and RCA in the context of Unmanned Aircraft Systems (UAS). | | CO1 | R | 1 |
| 3. | Define the term scale factor from the perspective of UAS. | | CO2 | R | 1 |
| 4. | State the significance of convertible rotor arrangement in unmanned aircraft. | | CO2 | R | 1 |
| 5. | State the full form of DGCA and CASA. | | CO3 | R | 1 |
| 6. | Name the authority which monitors the safe operation of civilian UAV in Europe. | | CO3 | R | 1 |
| 7. | Name the three primary control surfaces of an UAV and their functions. | | CO4 | U | 1 |
| 8. | State the significance of radio tracking in navigation, in launching and recovery of UAV. | | CO4 | R | 1 |
| 9. | State the importance of system certification from the perspective of in-flight testing. | | CO5 | U | 1 |
| 10. | Name two future developments in the field of UAS airframe configuration. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare and contrast the dangerous roles and research roles of UAS. | | CO1 | U | 3 |
| 12. | Differentiate the various stages involved in the design process of Unmanned Aircraft Systems (UAS). | | CO2 | An | 3 |
| 13. | Explain the factors to be considered for reducing the thermal signature in the design of UAV stealth technology. | | CO3 | A | 3 |
| 14. | Describe the relevance of global positioning navigation system from the context of unmanned aircraft maneuverability. | | CO4 | U | 3 |
| 15. | Write a shot explanation on human factors in unmanned aircraft systems. | | CO5 | A | 3 |
| 16. | Describe the different methods of recovering aircraft launched using the catapult technique, highlighting their mode of operation. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Classify the various roles of Unmanned Aircraft Systems (UAS) based on their operational functions and mission objectives. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Classify the different aspects of airframe design that need to be considered while designing an Unmanned Aerial Vehicle (UAV). | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Describe the design standards and regulatory aspects of military and civil UAVs from the perspective of human safety. | CO3 | U | 6 |
|  | b. | Compare and contrast the factors influencing acoustic and radar signatures in the design of stealth aircraft. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | Categorize the steps involved in the procedure of CCD image processing and elaborate on their significance in remote sensing applications. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the various procedures involved in in-flight testing of an unmanned aircraft vehicle, from test site preparation to system certification. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Classify the naval roles of UAVs into distinct categories based on their operational objectives and capabilities. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Differentiate between the essential elements of a UAS based on the functions and operational significance. | CO1 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Compare the various methods of launch and recovery of both HTOL and VTOL UAV. | CO6 | U | 12 |

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

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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 aerodynamic principles to design UAS. |
| **CO4** | Obtain knowledge on payloads and launch systems for UAS. |
| **CO5** | Understand the basic principles of UAV Testing. |
| **CO6** | Apply the principles to design UAS for specific applications. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Analyse the performance of a simple Brayton cycle and show how various modifications affect the work output and efficiency. | CO1 | An | 8 |
|  | b. | Define thrust and power in the context of aircraft engines. Analyze the factors that affect thrust and power output, including altitude, Mach number, ambient temperature, and engine design parameters. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 2. |  | Explain surge margin and explain its significance in ensuring the stable operation of compressors in GTEs. Analyze the factors that influence surge margin requirements, including compressor design, operating conditions, and transient maneuvers. Describe the methods used to determine and improve surge margin. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 3. |  | The following measurements were made in a sea level test of a solid propellant rocket motor:  Burn duration t = 40 sec  Initial mass before test, mo =1210 kg  Mass of rocket motor after test, mf = 215 kg  Average thrust F = 62,250 N  Chamber pressure P1 = 7.00 Mpa  Nozzle exit pressure P2 = 0.070 Mpa  Nozzle throat diameter dt = 0.0855 m  Nozzle exit diameter d2 =0.2703 m  Evalaute v2, C\*, C, and *Isp at sea level, and c and Isp at 1000m and 25,000 m altitude. Take p=0.0898 Mpa at 1000 m and p = 0.00255 Mpa at 25,000.* | CO3 | E | 16 |
|  |  |  |  |  |  |
| 4. | a. | Explain in detail the step-by-step procedure to be followed in designing a liquid rocket engine. | CO4 | A | 8 |
|  | b. | Describe "green propellants" in the context of rocket propulsion. Explain the increasing need and importance of developing and implementing green propellants, highlighting the environmental and safety concerns associated with traditional propellants. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain the processing and formulation techniques for ADN and KDN-based solid propellants. Discuss the challenges associated with achieving stable combustion and high performance with these propellants. | CO5 | A | 8 |
|  | b. | Explain the principles of operation for electro-magnetic thrusters, including plasma electro-magnetic thrusters with neat sketch. Discuss the methods used to generate and accelerate plasma in these thrusters. Analyze the performance characteristics and applications of electro-magnetic propulsion systems. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 6. |  | Explain the theoretical concept of photon rockets and solar sails. Analyze their potential applications for interstellar travel. Discuss the challenges associated with achieving practical implementation of these technologies. | CO6 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Describe the concepts of laser rockets and solar thermal rockets. Explain their potential applications and challenges in terms of energy source availability and system design. | CO6 | U | 8 |
|  | b. | Summarize the various hypersonic propulsion systems, including ramjets, scramjets, and dual-mode ramjets/scramjets. | CO6 | E | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Analyze the challenges associated with achieving stable and efficient combustion in supersonic flows. Discuss the design and operational principles of supersonic combustors (scramjets). Explain the factors that influence combustor performance, including fuel injection, mixing, and flameholding. | CO6 | An | 20 |

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

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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 and hypersonic systems |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Analyze the difference between static and dynamic system models and explain their application in simulation techniques. | CO1 | An | 16 |
|  |  |  |  |  |  |
| 2. |  | Evaluate the role of simulation languages in representing discrete events and gathering statistical data and explain how it contributes to autopilot simulation. | CO2 | E | 16 |
|  |  |  |  |  |  |
| 3. |  | Analyze the stability derivatives in nonlinear aircraft models and explain their significance in performance assessment. | CO3 | An | 16 |
|  |  |  |  |  |  |
| 4. |  | Evaluate the impact of fault tree analysis on system design validation and explain certification requirements under FARs guidelines. | CO4 | E | 16 |
|  |  |  |  |  |  |
| 5. |  | Apply system dynamics diagrams to represent time delays in flight simulation and explain their importance in dynamo model language. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Analyze how mathematical models contribute to simulating aircraft systems, including structure and cockpit systems. | CO5 | An | 16 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the effectiveness of flight simulators as training devices compared to traditional methods. | CO6 | E | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Evaluate the process of aircraft model creation for simulation purposes and compare state-space models, transfer function models, and linear models, emphasizing their applications and limitations. | CO3 | E | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Analyse 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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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Apply Turing test to evaluate a chatbot’s performance in a customer service scenario. | CO1 | A | 6 |
|  | b. | In a real-world scenario, compare the behavior of goal-based agent with a simple reflex agent. | CO1 | An | 10 |
|  |  |  |  |  |  |
| 2. | a. | Apply Bayes' theorem to a situation where an AI system needs to approve the take-off of an aircraft, given certain observation of the climate. | CO2 | A | 6 |
|  | b. | For the search problem represented by the tree diagram with the given leaf node utility values, find the optimal value by applying alpha-beta pruning algorithm. Clearly indicate the steps followed. Assume the maximizer starting the search.  [5, 2, 7, 3, 1, 6, 9, 4, 8, 0, 3, 2, 7, 6, 3, 4] | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. |  | Analyze the critical components involved in designing an AI-based expert system for avionics. | CO3 | An | 16 |
|  |  |  |  |  |  |
| 4. | a. | Diagnose whether a model is suffering from high bias or high variance based on the model complexity. | CO4 | An | 6 |
|  | b. | For the given data, develop a linear regression model. Also, evaluate the performance of the model.  Input feature: Landing frequency of the aircraft.  Target: Number of tyres consumed   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Landing Frequency  of the aircraft | 623 | 239 | 289 | 302 | 504 | 656 | 405 | 462 | 745 | 543 | | Tyre Consumption | 70 | 26 | 36 | 33 | 54 | 54 | 48 | 51 | 83 | 76 | | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Interpret the perceptron training process with the aid of pseudocode and vector diagram. Apply relevant mathematical concepts. | CO4 | A | 6 |
|  | b. | Apply SVM to a given dataset of aircraft performance metrics to classify different flight modes. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 6. | a. | A classifier has been trained to classify the satellite images of two types of landscapes. The actual and predicted classes are as follows.  Actual= [‘Urban’, ‘Forest’, ‘Urban’, ‘Forest’, ‘Urban’, ‘Urban’, ‘Forest’, ‘Urban’, ‘Forest’, ‘Urban’]  Predicted= [‘Urban’, ‘Urban’, ‘Urban’, ‘Forest’, ‘Urban’, ‘Urban’, ‘Forest’, ‘Forest’, ‘Forest’, ‘Forest’].  Construct the confusion matrix and calculate all the performance metrics. | CO5 | A | 6 |
|  | b. | Apply k-NN to detect abnormal flight behavior in a given flight data with multiple features (altitude, speed, engine temperature), | CO5 | A | 10 |
|  |  |  |  |  |  |
| 7. |  | Analyze the application Gini Index in decision tree algorithm to decide which feature to split on at each node. | CO5 | An | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | The classification dataset of aircraft types based on remote sensing images has a total of 4000 valid aircrafts, which is divided into 8 classes :  1. Air superiority fighter 2. Fighter-bomber 3. Heavy fighter 4. Interceptor 5. Light fighter, 6. All-weather fighter 7. Reconnaissance fighter 8. Strategic fighter.  Design an ANN based classifier. Select the proper architecture. Each image is a grey image with size 256×256. | CO6 | A | 20 |

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

|  |  |
| --- | --- |
|  | **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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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Articulate on the major differences between a biological and artificial neural network (ANN). List out the various advantages, limitations and applications of ANN. | CO1 | A | 10 |
|  | b. | Explain briefly the various learning rules in ANN with the mathematical expression. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Describe the perceptron model for a single layer neural network with the aid of a schematic. Classify the perceptron based on activation function and discuss about the limitations of the perceptrons. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. | a. | Classify unmanned aerial vehicle (UAV) on the basis of weight, wings, flight endurance and altitude. Enumerate various civil and military applications of UAVs. | CO3 | U | 10 |
|  | b. | Discuss about the transformative impact of artificial intelligence (AI) on UAVs. Highlight the key applications, technological advancements and challenges in implementing AI-driven autonomy. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Examine the various UAV sensors used for monitoring surveillance and agriculture applications. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Sketch the components of UAV communication system. Explain in detail the purpose and the operation of flight controller and ground control station (GCS). | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Compare 3D terrain modeling approaches - digital surface model (DSM) creation and digital terrain model (DTM) Creation. Highlight the applications of DSM and DTM. | CO6 | U | 10 |
|  | b. | Illustrate the purpose and application of multispectral imaging system in UAVs. | CO6 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Construct a neuron in McCulloch-Pitts (MP) model and realize logic circuit NAND and NAND Gate in MP model. | CO1 | A | 10 |
|  | b. | Explain supervised, unsupervised and reinforcement learning strategy. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss the key regulatory challenges and considerations surrounding the integration of UAS into civil airspace. | CO3 | A | 10 |
|  | b. | Discuss the ethical considerations and potential societal impacts associated with the increasing use of UAS technology in urban environments. Analyze the trade-offs between the benefits of UAS applications (e.g., surveillance for public safety, delivery services) and concerns related to privacy, data security, and potential misuse. | CO3 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe with the help of a block diagram the concept of first person view (FPV) in creating situational awareness and real-time decision-making in UAV operations. | CO6 | U | 10 |
|  | b. | Discuss the principle of operation, advantages and application of airborne light detection and ranging (LiDAR) system. | CO6 | U | 10 |

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

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

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer any four questions)** | | | | | |
| 1. | a. | Articulate on the major differences between a biological and artificial neural network (ANN). List out the various advantages, limitations and applications of ANN. | CO1 | A | 10 |
|  | b. | Explain briefly the various learning rules in ANN with the mathematical expression. | CO1 | A | 10 |
| 2. |  | Describe the perceptron model for a single layer neural network with the aid of a schematic. Classify the perceptron based on activation function and discuss about the limitations of the perceptrons. | CO2 | U | 20 |
| 3. | a. | Classify unmanned aerial vehicle (UAV) on the basis of weight, wings, flight endurance and altitude. Enumerate various civil and military applications of UAVs. | CO3 | U | 10 |
|  | b. | Discuss about the transformative impact of artificial intelligence (AI) on UAVs. Highlight the key applications, technological advancements and challenges in implementing AI-driven autonomy. | CO3 | U | 10 |
| 4. |  | Examine the various UAV sensors used for monitoring surveillance and agriculture applications. | CO4 | A | 20 |
| 5. |  | Sketch the components of UAV communication system. Explain in detail the purpose and the operation of flight controller and ground control station (GCS). | CO5 | A | 20 |
| 6. | a. | Compare 3D terrain modeling approaches - digital surface model (DSM) creation and digital terrain model (DTM) Creation. Highlight the applications of DSM and DTM. | CO6 | U | 12 |
|  | b. | Illustrate the purpose and application of multispectral imaging system in UAVs. | CO6 | U | 8 |
| 7. | a. | Construct a neuron in McCulloch-Pitts (MP) model and realize logic circuit NAND and NAND Gate in MP model. | CO1 | A | 10 |
|  | b. | Explain supervised, unsupervised and reinforcement learning strategy. | CO1 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 8. | a. | Describe with the help of a block diagram, the concept of first person view (FPV) in creating situational awareness and real-time decision-making in UAV operations. | CO6 | U | 10 |
|  | b. | Discuss about the principle of operation, advantages and application of airborne light detection and ranging (LiDAR) system. | CO6 | U | 10 |

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

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

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List three essential qualities of integrity in professional life. | | CO1 | U | 1 |
| 2. | State the meaning of empathy. | | CO1 | R | 1 |
| 3. | List three key moral issues commonly faced by engineers. | | CO2 | R | 1 |
| 4. | State the significance of environmental ethics in engineering decisions. | | CO2 | R | 1 |
| 5. | Define engineering as social experimentation. | | CO3 | U | 1 |
| 6. | Identify the role of Codes of Ethics in engineering decision-making. | | CO3 | R | 1 |
| 7. | List two key components of risk assessment in engineering projects. | | CO4 | U | 1 |
| 8. | Define safety in the context of engineering ethics. | | CO4 | R | 1 |
| 9. | Identify one major ethical concern related to occupational crime. | | CO5 | U | 1 |
| 10. | Define the purpose of a code of ethics in airport and air travel operations. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze how time management contributes to personal and professional success. | | CO1 | An | 3 |
| 12. | Illustrate different models of professional roles in engineering with examples. | | CO2 | U | 3 |
| 13. | Show the importance of stress management in ensuring ethical engineering practices. | | CO3 | An | 3 |
| 14. | Describe the steps involved in assessing safety and risk in engineering projects. | | CO4 | U | 3 |
| 15. | Analyze the professional rights of employees in an organization. | | CO5 | An | 3 |
| 16. | Explain the importance of moral discipline in air travel and airport management. | | 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 different theories of leadership and evaluate their effectiveness in modern organizations. | CO1 | U | 6 |
|  | b. | Examine the relationship between integrity, work ethic and respect for others in professional ethics. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Compare Kohlberg’s and Gilligan’s theories of moral development and evaluate their relevance in professional ethics. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Examine the ethical challenges faced by engineers as responsible experimenters and analyze their impact on public safety. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Discuss the role of risk-benefit analysis in ethical decision-making and assess its limitations. | CO4 | A | 6 |
|  | b. | Illustrate a real-world example of how respect for authority improves workplace safety. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Analyze the role of corporate social responsibility (CSR) in addressing global issues and evaluate its impact on sustainable business practices. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Discuss the role of customs and religion in shaping engineering ethics and assess their influence on ethical decision-making. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Compare various conflict management techniques and evaluate their effectiveness in workplace disputes. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Examine the role of fraud awareness training in ensuring ethical behavior among aviation employees and analyze its effectiveness. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Identify the various approaches in organizations relating to Ethical values. |
| **CO2** | Deduce the role of leaders in ethically managed Engineering society. |
| **CO3** | Apply professional ethics in leadership practices and interpersonal skills. |
| **CO4** | Assess the effectiveness of their capability and performance in meeting organizational values and goals. |
| **CO5** | Evaluate the impact of non-compliance of ethical values in organizations |
| **CO6** | Demonstrate ethical values needed in aviation industries. |



**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define collinear force system. | | CO1 | R | 1 |
| 2. | State the principle of transmissibility of forces. | | CO1 | R | 1 |
| 3. | If the sum of horizontal forces and vertical forces are 95.01 N and 178.2 N respectively, the resultant of the forces is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO2 | A | 1 |
| 4. | State Lami’s Theorem. | | CO2 | R | 1 |
| 5. | Define time of flight. | | CO3 | R | 1 |
| 6. | A car is moving with a velocity of 20 m/s. The car is brought to rest by applying brakes in 6 seconds. Calculate the Retardation. | | CO4 | Ap | 1 |
| 7. | Define inelastic collision. | | CO4 | R | 1 |
| 8. | Define period of restitution | | CO5 | R | 1 |
| 9. | State the impulse-momentum principle. | | CO5 | R | 1 |
| 10. | Define coefficient of friction. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Two concurrent forces of 12 N and 18 N are acting at an angle of 60º. Calculate the resultant force. | | CO1 | Ap | 3 |
| 12. | State and prove Varignon’s theorem. | | CO2 | R | 3 |
| 13. | State and illustrate parallel axis theorem with a diagram. | | CO3 | R | 3 |
| 14. | Define centroid and write the formula for the Centroid of a triangle of height “h” and base “b”. | | CO3 | R | 3 |
| 15. | A body starts from rest and moves with a uniform acceleration of 2 m/s². Determine the distance traveled by the body in the 5th second. | | CO4 | Ap | 3 |
| 16. | Explain cone of friction with a neat sketch. | | CO5 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Determine the resultant of the Coplanar concurrent force system shown in the Figure. | CO1 | Ap | 12 |
|  |  |  |  |  |  |
| 18. |  | ABCD is a weightless rod under the action of four forces P,Q,S and T as shown in Figure. If P = 10 N, Q = 4 N, S = 8 N and T = 12 N, calculate the resultant and mark the same in direction with respect to the end A of the rod. | CO2 | Ap | 12 |
|  |  |  |  |  |  |
| 19. |  | Determine the Moment of Inertia of the I Section shown in Figure. | CO3 | Ap | 12 |
|  |  |  |  |  |  |
| 20. |  | A particle is projected with an initial velocity of 60 m/s at an angle of 75º with the horizontal. Determine a) maximum height attained by the particle b) horizontal range of the particle c) time taken by the particle to reach the highest point d) time of flight. | CO4 | Ap | 12 |
|  |  |  |  |  |  |
| 21. |  | A body of mass 15 kg is initially at rest on a 10º inclined plane. Then it slides down. Calculate the distance moved by the body, on the inclined plane, when the velocity reaches 6 m/s using D’Alembert’s principle. The coefficient of friction between the body and the plane is 0.1. | CO4 | Ap | 12 |
|  |  |  |  |  |  |
| 22. |  | A body of weight 200 N kept on a horizontal plane is pulled by a force of 150 N applied at an angle of 60º to the horizontal. The block moves with an instant velocity of 2 m/s while the coefficient of friction between the body and the surface is 0.25. Determine the velocity of the body after 15 sec using impulse-momentum method. | CO5 | Ap | 12 |
|  |  |  |  |  |  |
| 23. |  | Two weights 80N and 20N are connected by a thread and move along a rough horizontal plane under the action of a force 40N, applied to the first weight of 80N as shown in the Figure. The coefficient of friction between the sliding surfaces of the weights and the plane is 0.3. Determine the acceleration of the weights and the tension in the thread using work-energy equation. | CO5 | Ap | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Block 2 rests on block 1 and is attached by a horizontal rope AB to the wall as shown in the Figure. Calculate the force P that is necessary to cause motion of block 1 to impend ? The coefficient of friction between the blocks is 1/4 and between the floor and the block is 1/3. Mass of the blocks 1 and 2 are 14 kg and 9 kg respectively. | CO6 | Ap | 12 |

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

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

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **23AE2011** | **Duration** | **3hrs** |
| **Course Title** | **AEROSPACE STRUCTURES - I** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List any two assumptions in the analysis of truss. | | CO1 | R | 1 |
| 2. | Define cantilever truss. | | CO1 | R | 1 |
| 3. | Define stiffness factor. | | CO2 | R | 1 |
| 4. | State the significance of continuous beam over simply supported beam. | | CO2 | R | 1 |
| 5. | Write Clapeyron’s three-moment equations for a fixed beam. | | CO3 | A | 1 |
| 6. | Define carry over moment. | | CO3 | R | 1 |
| 7. | Define proof resilience. | | CO4 | R | 1 |
| 8. | Write the expression of strain energy due to bending. | | CO4 | A | 1 |
| 9. | Write Rankine’s formula for the short column. | | CO5 | A | 1 |
| 10. | State the significance of failure envelope. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between statically determinate and indeterminate truss. | | CO1 | U | 3 |
| 12. | Explain moment distribution method. | | CO2 | U | 3 |
| 13. | Write the expression of midpoint deflection of a cantilever beam subjected to point load at its free end. | | CO3 | A | 3 |
| 14. | Explain the procedure for unit load method. | | CO4 | U | 3 |
| 15. | State the significance of south well plot. | | CO5 | R | 3 |
| 16. | Explain the condition of failure according to maximum shear stress theory. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Determine the force in members AB, BD and CD of the truss as shown in figure below. Also solve for the force on members FH, DF and DG. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Determine the fixed end moments of the continuous beam shown in figure below by using Clapeyron’s three moment theorem and also sketch bending moment and shear force diagram. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Determine the maximum deflection of a simply supported beam. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | The cross-sectional area of each member of the truss shown in figure is 400 mm² and modulus of elasticity of the material is 200 GPa. Calculate the horizontal and vertical displacement of joint C if the force of 4 kN is applied to the truss at C. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Compare a long column with a short column. | CO5 | U | 4 |
|  | b. | Produce Euler’s expression of crippling load for the column with pinned-pinned end conditions. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 22. |  | Determine the forces in the members of the truss as shown in figure below. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Produce Rankine’s formula for a short column. | CO5 | A | 6 |
|  | b. | A hollow cast iron column 200 mm outside diameter and 150 mm inside diameter, 8 m long has both ends fixed. It is subjected to an axial compressive load. Determine the safe Rankine load by considering safety factor, FoS= 6, crushing stress, σc= 560 N/mm², Rankine’s constant, α = 1/1600. | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Determine the diameter of a bolt which is subjected to an axial pull of 9 kN together with a transverse shear force of 4.5 kN using:   1. Maximum principal stress theory and 2. Maximum principal strain theory | CO6 | A | 6  6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Determine the forces of each member in a truss. |
| **CO2** | Analyze statically indeterminate beam under different support/ loading conditions. |
| **CO3** | Calculate 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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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **23AE2012** | **Duration** | **3hrs** |
| **Course Title** | **PROPULSION-I** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the various assumption made in ideal cycle. | | CO1 | R | 1 |
| 2. | List the major components in a ramjet engine. | | CO2 | R | 1 |
| 3. | State the purpose of gear box in turboprop engine. | | CO3 | R | 1 |
| 4. | State the application of pre-whirl and types used in a centrifugal compressor. | | CO4 | R | 1 |
| 5. | State the advantages and disadvantages of centrifugal compressor. | | CO4 | R | 1 |
| 6. | Explain tip leakage losses in a axial flow compressor. | | CO4 | U | 1 |
| 7. | Define upper explosive limit. | | CO5 | R | 1 |
| 8. | Define combustion efficiency. | | CO5 | R | 1 |
| 9. | Describe the difference between impulse and reaction turbine blading. | | CO6 | R | 1 |
| 10. | Explain the key parameters used to define a turbine blade's geometry. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State the purpose of intercooler between two compressors. | | CO1 | R | 3 |
| 12. | Differentiate between turbojet engine and ramjet engine. | | CO2 | U | 3 |
| 13. | Draw the velocity triangle of an impeller exit for a radial blade. | | CO3 | R | 3 |
| 14. | State the types of diffusers used in a centrifugal compressor. | | CO4 | R | 3 |
| 15. | Explain any three types of additives added in the aviation fuel. | | CO5 | A | 3 |
| 16. | A turbine stage has an inlet velocity of 500 m/s and an outlet velocity of 300 m/s. Calculate the change in kinetic energy per unit mass. If the stage efficiency is 80%, estimate the actual work output per unit mass. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the working of a simple cycle of gas turbine engine with P-V and T-S diagram. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | State the assumptions for ideal Brayton cycle. | CO2 | R | 2 |
|  | b. | In an air-standard cycle heat supply is at constant-volume and the heat rejection is at constant-pressure. The compression and expansion are isentropic and the air at the start of the compression is at 30°C and 1 bar. The pressure ratio is 6. The heat supply is 860 kJ/kg of air and air flow is 2.0 kg/s.  Assume Cp = 1.005 kJ/kg K and Cv = 0.717 kJ/kg K.  Calculate,  (i) temperature at the end of each process,  (ii) the power developed, and  (iii) the thermal efficiency. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 19. |  | A simple gas turbine takes in air at 1.0 bar and 27°C and compresses to a pressure of 6 bar with the isentropic efficiency of compression being 85%. The air passes to the combustion chamber, and after combustion the gases enter the turbine at a temperature of 560°C and expand to 1.00 bar, the turbine efficiency being 80%. Neglecting the change of mass flow rate due to fuel, calculate the flow of air in kg per second for a net output of 1500 kW making the following assumptions: Loss of pressure in combustion chamber = 0.08 bar. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | A centrifugal compressor compresses 30 kg of air per second at a rotating speed of 15000 rpm. The air enters the compressor axially, and the conditions at the exit sections are radius of 0.3 m, relative velocity of the air at the tip is 100 m/s at an angle of 80֯ C with respect to the plane of rotation. Take po1 = 1 bar and To1 = 300 K. Calculate the torque and power required to drive the compressor and also the head developed. | CO4 | A | 8 |
|  | b. | Explain the phenomenon of surge in an axial flow compressor. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 21. |  | Air at a temperature of 290 K enters a ten stage axial flow compressor at the rate of 3 kg/s. The pressure ratio is 6.5 and the isentropic efficiency is 90%, the compression process being adiabatic. The compressor has symmetrical blades. The axial velocity of 110 m/s is uniform across the stage and the mean blade speed of each stage is 180 m/s.  Determine the direction of the air at entry to and exit from rotor and the stator blades and also the power given to the air. Assume Cp= 1.005 kJ/kg K and γ = 1.4. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the basic requirements of a combustion chamber in a gas turbine engine. | CO5 | U | 4 |
|  | b. | Illustrate the significance of combustion stability limit for flame stabilization and explain the significance of rich and weak limit. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 23. |  | Explain the working principle of afterburner with neat sketch in Turbo Ramjets. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the losses and efficiency of an impulse turbine using energy flow diagram. | CO6 | U | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the working of various types of air-breathing engine. |
| **CO2** | Analyse the performance of various air-breathing engines. |
| **CO3** | Understand the working of sub-systems of jet engines. |
| **CO4** | Analyse the performance of compressor. |
| **CO5** | Analyse the performance of combustion chamber. |
| **CO6** | Analyse the performance of turbine. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **23AE2013** | **Duration** | **3hrs** |
| **Course Title** | **AIRCRAFT INSTRUMENTATION AND AVIONICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the different classifications of instruments in a generalized measurement system. | | CO1 | R | 1 |
| 2. | Differentiate between precision and accuracy. | | CO1 | U | 1 |
| 3. | Identify the primary components of a pitot-static system. | | CO2 | U | 1 |
| 4. | Define gyroscopic instruments and their role in aircraft instrumentation. | | CO2 | R | 1 |
| 5. | Write the purpose of an accelerometer in aircraft measurement systems. | | CO3 | A | 1 |
| 6. | State the working principle of a fuel flow measurement system. | | CO3 | R | 1 |
| 7. | State the significance of avionics in military aircraft systems. | | CO4 | R | 1 |
| 8. | Write the function of a Flight Management System (FMS) in avionics. | | CO4 | A | 1 |
| 9. | Define ARINC 629 and its role in aircraft data communication. | | CO5 | R | 1 |
| 10. | Explain the significance of DVI in modern aircraft cockpits. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the principle behind the temperature measuring instrument used in aircraft. | | CO1 | U | 3 |
| 12. | Differentiate between optical gyro and mechanical gyro. | | CO2 | U | 3 |
| 13. | List the types of RTDs used in aircraft with an explanation. | | CO3 | R | 3 |
| 14. | Explain the independent avionics architecture used in aircraft. | | CO4 | U | 3 |
| 15. | Describe the function of LRU used in aircraft avionics. | | CO5 | R | 3 |
| 16. | Discuss the advantages of MFK in aircraft. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the Dynamic Characteristics of Measuring Instruments. | CO1 | R | 6 |
|  | b. | Differentiate between deflecting instrument and null deflecting instrument. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Explain the concept of a pitot-static system with a neat diagram. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the different types of pressure measuring instruments used in aircraft. | CO3 | U | 8 |
|  | b. | Differentiate between Synchronous and Asynchronous data transmission system. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. |  | Discuss the types of avionics system architectures with an example. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the function of AFDX and its elements of aircraft avionics. | CO5 | A | 4 |
|  | b. | Explain the word format of ARINC 429 with an example. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 22. |  | Describe the vacuum driven systems in aircraft with a neat sketch. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the working principle of fuel quantity indicating system of an aircraft with neat sketches. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the working of Multifunction Display (MFDs) in aircraft. | CO6 | U | 8 |
|  | b. | State the advantages of head up display (HUD), head down display (HDD) and helmet mount display (HMD) in aircraft. | CO6 | R | 4 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Realize the basics of measurements and their function. |
| **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** | Articulate various display technologies and their working principles. |



END SEMESTER EXAMINATION – MAY / JUNE 2025

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| **Course Code** | **23AE2014** | **Duration** | **3hrs** |
| **Course Title** | **AERODYNAMICS** | **Max. Marks** | **100** |

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| **Q.**  **No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define aerodynamic center. | | CO1 | U | 1 |
| 2. | Write the expression to calculate the pressure coefficient. | | CO1 | R | 1 |
| 3. | Define streamline. | | CO2 | U | 1 |
| 4. | Define potential flow. | | CO2 | R | 1 |
| 5. | Define circulation. | | CO3 | U | 1 |
| 6. | Define a vortex sheet. | | CO3 | R | 1 |
| 7. | Define induced drag. | | CO4 | R | 1 |
| 8. | What is bound vortex? | | CO4 | U | 1 |
| 9. | Write the significance of 2D panel methods. | | CO5 | U | 1 |
| 10. | Define boundary layer. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State the aerodynamic forces and moments experienced by an airplane. | | CO1 | U | 3 |
| 12. | Write a short note on elementary flows. | | CO2 | U | 3 |
| 13. | What is conformal transformation? State its importance in aerodynamics. | | CO3 | U | 3 |
| 14. | Write a short note on horse-shoe vortex system. | | CO4 | U | 3 |
| 15. | What is vortex lattice method? State its significance. | | CO5 | U | 3 |
| 16. | Differentiate between displacement thickness and momentum thickness of a 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. | a. | With a neat sketch, explain about the nomenclature of NACA 4-digit, 5-digit and  6-series airfoils. | CO1 | U | 9 |
|  | b. | Write the integral and differential forms of momentum equation. | CO1 | U | 3 |
|  |  |  |  |  |  |
| 18. | a. | Derive Bernoulli’s equation. | CO2 | U | 8 |
|  | b. | Consider an airfoil in a flow at standard sea level conditions with a freestream  velocity of 50 m/s. At a given point on the airfoil, the pressure is 0.9 × 105 N/m2. Calculate the velocity at this point. | CO2 | E | 4 |
|  |  |  |  |  |  |
| 19. | a. | With necessary figures, explain in detail about the Kutta condition. | CO3 | U | 7 |
|  | b. | Discuss about Kelvin’s circulation theorem with appropriate figures and  relations. | CO3 | U | 5 |
|  |  |  |  |  |  |
| 20. |  | Derive the fundamental equation of Prandtl’s lifting line theory. Discuss about  the three main aerodynamic characteristics of a finite wing that can be obtained from this equation. | CO4 | A | 12 |

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| 21. |  | For a body of arbitrary shape, apply source panel method and derive the relevant  expressions. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Find the displacement thickness and momentum thickness of a laminar boundary  2  with a velocity distribution given by, 𝑢 = 2 (𝑦 − 𝑦  ) ( )  𝑈 𝛅 𝛅 | CO6 | E | 8 |
|  | b. | Discuss about boundary layer separation with a neat schematic. | CO6 | A | 4 |
|  |  |  |  |  |  |
| 23. |  | With a suitable combination of elementary flows, produce a non-lifting flow over  a circular cylinder and derive the relations for velocity field. Also, find the non-dimensional pressure distribution over the surface of the cylinder. | CO2 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Derive the expression for the aerodynamic properties of thin symmetric airfoil  using classical thin airfoil theory. | CO3 | E | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Model and analyze flow fields using the governing equations. |
| **CO2** | Utilize potential flow theory to construct complex flows from elementary flows. |
| **CO3** | Derive the Joukowski family of airfoils and calculate lift using Kutta condition and Kelvin’s circulation  theorem. |
| **CO4** | Estimate the flow parameters over finite wings using Prandtl Lifting Line Theory. |
| **CO5** | Construct streamlines using 2D panel methods. |
| **CO6** | Determine skin friction drag using boundary layer theory. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **23AE2016** | **Duration** | **3hrs** |
| **Course Title** | **AIRPLANE PERFORMANCE** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List any two types of drag acting on an aircraft. | | CO1 | R | 1 |
| 2. | Define the aspect ratio of a wing. | | CO1 | R | 1 |
| 3. | Explain how air density influences propeller performance. | | CO2 | U | 1 |
| 4. | Define thrust specific fuel consumption (TSFC). | | CO2 | R | 1 |
| 5. | Name the engine most suited for high-speed military aircraft. | | CO2 | R | 1 |
| 6. | An aircraft is flying at a speed of 150 m/s, at an altitude where the air density is 1.2 kg/m3. The wing area is 30 m2. The weight of the aircraft is 40,000 N. Determine the coefficient of lift (CL). | | CO3 | A | 1 |
| 7. | Explain the relationship between lift and weight in steady level flight. | | CO3 | U | 1 |
| 8. | An aircraft with a thrust of 25,000 N and a drag of 10,000 N weighs 100,000 N. Calculate the maximum climb angle. | | CO4 | A | 1 |
| 9. | State the effect of increasing bank angle on the lift (L) of the aircraft. | | CO5 | R | 1 |
| 10. | Explain the relationship between bank angle and load factor in turning flight. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Discuss the differences between lift generated by finite and infinite wings. | | CO1 | U | 3 |
| 12. | Justify the decrease in engine efficiency at high aircraft speeds. | | CO2 | U | 3 |
| 13. | Derive the relationship between drag and lift using the drag polar equation for a level flight. | | CO3 | A | 3 |
| 14. | Indicate the parameters on which the rate of climb depends and their effects on the rate of climb. | | CO4 | U | 3 |
| 15. | Compare the load factor values for steady level flight, climbing flight, and level turning flight. | | CO5 | U | 3 |
| 16. | Explain the difference in runway length required for landing during summer and winter. | | 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 the lift generated by an airfoil and a finite wing constructed from the same airfoil, and justify the differences with a clear sketch. | CO1 | U | 8 |
|  | b. | State the reason for studying the lift coefficient, drag coefficient, and moment coefficient instead of directly analyzing lift, drag, and moment. | CO1 | R | 4 |
|  |  |  |  |  |  |
| 18. |  | Derive the expression for the propulsion efficiency of a jet engine, by | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | An airplane has a wing loading of 2400 N/m2, and its drag equation is . Calculate its maximum lift/drag ratio and the speed at which drag is minimum. Assume a typical sea-level air density, ρ = 1.225 kg/m3. | CO3 | A | 8 |
|  | b. | An aircraft has a drag coefficient (CD​) of 0.02, a wing area of 40 m², and is flying at an altitude where the air density is 1.1 kg/m³. The available thrust is 50,000 N. Determine the maximum velocity the aircraft can achieve in level flight. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. |  | Obtain the expression for velocity as shown for the maximum rate of climb of a steady, unaccelerated climbing flight using the equation . | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Derive the expression for minimum turn radius from and . (Note that n is a function of ) | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | An aircraft is landing at an airport where the standard sea-level conditions apply. The aircraft's landing approach speed is 70 m/s under standard conditions (15°C, 1.225 kg/m³ air density).  On a hot summer day (35°C), the air density decreases to 1.1 kg/m³.  On a cold winter day (-10°C), the air density increases to 1.3 kg/m³.  Assume the braking deceleration remains the same in all conditions. Determine the landing speed and runway distance required for landing. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the mechanism of velocity instability and velocity stability for a steady, level flight with the help of a neat sketch. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Derive the aerodynamic relations for the condition corresponding to maximum values of ​, using the drag polar equation and explain their significance in aerodynamic performance. | CO5 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Describe the mechanisms of aircraft lift and drag production. |
| **CO2** | Distinguish why different powerplants are appropriate to different flight speed regimes. |
| **CO3** | Estimate the performance characteristics in level flight and calculate how aircraft drag and thrust vary with flight speed and altitude. |
| **CO4** | Calculate speed and angle of climb in steady climbing flight. |
| **CO5** | Estimate the turning performance characteristics of aircraft. |
| **CO6** | Realize the ground effects on performance. |