Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2001 Introduction to Aerospace Engineering

Set A

Time : 3 hrs
Total Marks: 100

1. Calculate the values of pressure, density and temperature for the standard atmosphere at an altitude of 15000 m.

   The standard sea level values are pressure = 101325 N/ m^2, density = 1.2256 Kg/m^3 and temperature = 288.16 K. The temperature lapse rate a = -0.0065 K/m (20)

OR

2. (I) Define standard atmosphere. (4)

   (II) Derive an expression for pressure and density ratio

   (a)In the isothermal region of the standard atmosphere. (8)

   (b) In the gradient region of the standard atmosphere. (8)

3. (I) List the structural component of aircraft and explain with neat sketch the functions associated with them. (14)

   (II) With help of neat sketch explain wing construction. (6)

OR

4. (I) Distinguish between monocoque and semi monocoque structure . (10)

   (II) Explain with neat sketch the empennage of an aircraft. (10)

5. An airplane is flying at a velocity of 120 m/s at a standard altitude of 4 km. The pressure cofficient at appoint on the fuselage is 1.9. What is the pressure at this point.

   The standard sea level values are pressure = 101325 N/ m^2, density = 1.2256 Kg/m^3 and temperature = 288.16 K. The temperature lapse rate a = -0.0065 K/m (20)

OR

6. (I) Describe airfoil nomenclature .(6)

   (II) Define the term pressure coefficient and plot C_p Vs x/c - along the chord direction at the selected angle of attack for a standard airfoil. (8)

   (III) Define aspect ratio and explain the effect of aspect ratio on $C_L\alpha$ curve. (6)

7. (I) Define propulsive power, propulsive efficiency, thermal efficiency. (9)

   (II) A jet propulsion unit with turbojet engine having a forward speed of 95 km/hr produces a12 kN of thrust and uses 35 kg of air /sec. Find the relative exit velocity, thrust power, the propulsive power, and propulsive efficiency. (11)

OR

8. (I) Explain with sketch the principle of operation of jet engine. (8)

   (II) Explain the working principle of the ramjet engine with neat sketch and state its advantage and disadvantage. (12)

9. (I) Explain with sketch a solid propelled rocket. (8)

(II) Explain with sketch a liquid propelled rocket engine. What are the merits compared to solid propelled system. (12)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2003 Materials in Aerospace Application

Set A

Time : 3 hrs
Total Marks: 100

---

1. Define Atomic radius and derive atomic radius for simple cubic structure, B.C.C. structure and F.C.C. structure in terms of Lattice constant.

OR

2. (a). Write a short notes on crystalline solids.

   (b). Write a short notes on Amorphous solids.

3. Give a detailed description about titanium and its alloys.

OR

4. Write about copper and its alloys along with their applications.

5. Write short notes on wood and also mention the uses and their applications.

OR

6. (a). Write the properties and uses of plastics.

   (b). Write the properties and uses of glass.

7. Write the advantages, disadvantages and applications of adhesives.

OR

8. Write short notes on classification of composite materials along with their applications.

9. Write short notes on defects in metal crystals.

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2004 Elements of Avionics

Set A **Time : 3 hrs**
Total Marks: 100

---

1. Explain in detail about the hardware elements and protocol of MIL-STD-1553B data bus.(20)

OR

2. State the Avionics System with neat sketch and list out its features. (20)

3. Explain in detail about the HMD with neat sketch and state its applications. (20)

OR

4.

a. Write down the main function of HOTAS. (3)
b. Define controlled flight into accident. (3)
c. Explain in detail about the HUD with neat sketch. (14)

5. Explain in detail about the Classic GPWS with neat sketch. (20)

OR

6. Explain in detail about the evolution of avionics architecture. (20)

7. Explain in detail about the EGPWS with neat sketch. (20)

OR

8. Explain in detail about the second generation avionics architecture. (20)

9. Explain in detail about the avionics system design with neat sketch. (20)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2006 Aerodynamics

Set B

Time : 3 hrs
Total Marks: 100

1. a. What does continuity equation imply? Is it valid for all types of flows? 6
   b. Write the continuity equation in Cartesian coordinate system (x, y, z) for steady flow. 6
   c. For a 2D flow, the one velocity component is $u_r = \frac{A}{r}$. For incompressible flow find out the other component of velocity v_y. 8 8

OR

2. 1. Derive Continuity equation in Cylindrical coordinate system (r, θ, z). 20

3. 1. For a flow the velocity components are given by $u_r = U\cos\theta\left(1 - \frac{A}{r^2}\right)$ and $u_\theta = U\sin\theta\left(1 + \frac{A}{r^2}\right)$. Find the stream function Ψ and vorticity. 20

OR

4. 1. For a flow the velocity components are given by $u_x = -\frac{Ay}{x^2+y^2}$ and $u_y = \frac{Ax}{x^2+y^2}$. Find the pressure distribution to satisfy the momentum equation. 20

5. 1. Consider a pair of source and sink of equal strength in a Uniform stream with velocity U. The uniform stream velocity is aligned with line joining source and sink. The **Sink** is located at (c, 0) and **Source** is located at (-c, 0) while uniform flow is along x-axis towards $+\infty$. Find
      a. Velocity potential for the flow due to this combination 10
      b. Stream Function for the flow due to this combination 10

OR

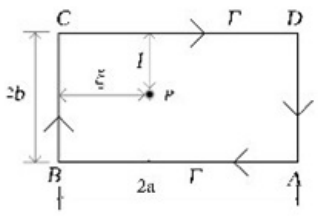
6. 1. A source of strength $80\,\pi\,\frac{m^2}{s}$ is located 3m upstream of sink of strength $40\,\pi\,\frac{m^2}{s}$ in a freestream with velocity of $20\,\frac{m}{s}$. Find
      a. Stagnation point 10
      b. Thickness of body at infinity downstream 10

7. 1. What is Kutta-Joukowski Theorem? Prove it for thin airfoil 20

OR

8. 1. Find the velocity induced due line vortex of strength Γ in a form of a rectangle with sides 2a and 2b as shown in the figure below, at its centre. 20

   2.



9. 1. For a thin aerofoil with camber $\frac{y}{c} = h\left[1 - \left(\frac{x}{c} - 0.5\right)^2\right]$, find out
      a. the lift distribution along its chord at angle of attack α. 10

b. Total lift at angle of attack α 10

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2010 Aircraft Instrumentation

Set A **Time : 3 hrs**
Total Marks: 100

1. a. How are secondary instruments classified and explain the essentials of an indicating instrument? (10)

   b. Explain the classification of measurement and the functional elements of a measuring system. (10)

OR

2. a. Explain with diagram the working of the pitot static instruments. (10)

   b. Explain gear and hairspring mechanism in detail. (5)

   c. Explain tangent and double tangent mechanism of a rod. (5)

3. a. Define a transducer. Explain any three types of transducer. (12)

   b. Explain the working principle of bi-metal strip and thermistors. (8)

OR

4. a. Give a detailed note temperature, resistive position and capacitive type of transducers.(10)

   b. Explain the working of strain gauge, LVDT and photoelectric cells. (10)

5. Explain the following.

   a. Direct Reading Pressure Gauges. (4)

   b. D.C Synchronous system. (8)

   c. D.C Ratio meter system. (8)

OR

6. a. Write a detailed note on Float type fuel quantity indicating system and the basic gauge system. (10)

   b. Explain the transmitters of independent and integrated fuel flowmeters. (10)

7. a. Explain the capacitance type fuel gauge system. (10)

   b. Explain guide vane thermocouple probe. (10)

OR

8. a. What is a thermocouple? How does it work? Draw neat sketches of different types of thermocouples and explain the working in detail. (10)

   b. With a neat sketch, explain the following.

   i. Temperature Sensing Element. (5)

   ii. Radiation Pyrometer System. (5)

9. Comment in detail on the power indicators for turbojet engines. (20)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2012 Aircraft Structures

Set A

Time : 3 hrs
Total Marks: 100

1. A truss of 6m span is subjected to a point load of 30kN as shown in the figure1. Find the forces in all members of truss and tabulate the results.

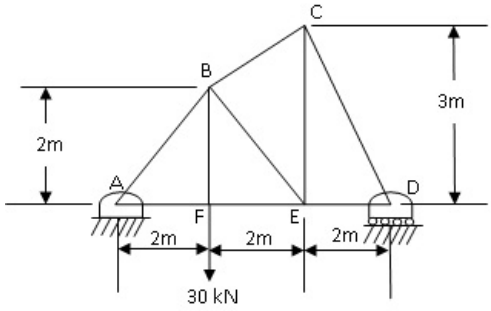


Fig. 1

OR

2. A simply supported beam ABC is continuous over two spans AB and BC of 6 m and 5 m respectively. The span AB is carrying a uniformly distributed load of 2 kN/m and the span BC is carrying a point load of 5 kN at a distance of 2 m from B. Find the moments along the beam and the reactions at the supports. Also draw the bending moment and shear force diagram by using three moment method.

3. Using the method of virtual work, find the vertical deflection component of point E of the truss shown in fig.2. Cross-sectional areas of members are: AE and FD = 250 mm^2 ; EF and EC = 1875 mm^2 ; AB, BC, CD, EB and FC =1250 mm^2 ; young's modulus E = 200 kN/mm^2 .

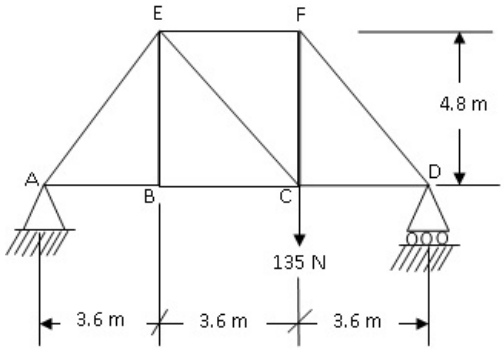


Fig. 2

OR

4. A continuous beam ABCD is fixed at A and simply supported at B, C and D. The Span AB is 5 m and carrying a point load of 40 kN at a distance 2 m from A. The span BC is 4 m and carries a uniformly distributed load of 10 kN/m. The span CD is 4 m and carrying a point load of 30 kN at a distance 1.5 m from C. Sketch the bending moment and shear force diagram by using method of moment distribution.

5. Compute the load on the lumped flanges due to bending of the section shown in fig.3. Assume the web do not take part in bending. Compute the loads using moment values with respect to x and y axis and principle axis.

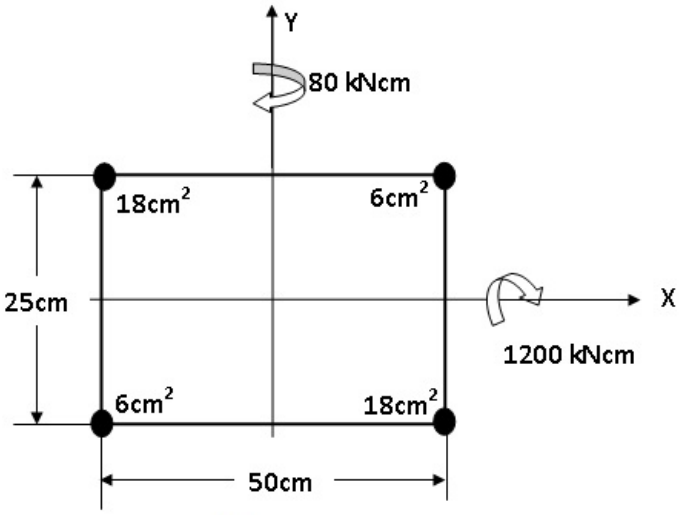


Fig.3

OR

6. The cross-section of a beam has the dimensions shown in Fig.4. If the beam is subjected to a negative bending moment of 100 kN m applied in a vertical plane (i.e. M_X = -100 kN), Calculate the maximum direct stress in the stating clearly the point at which it acts.

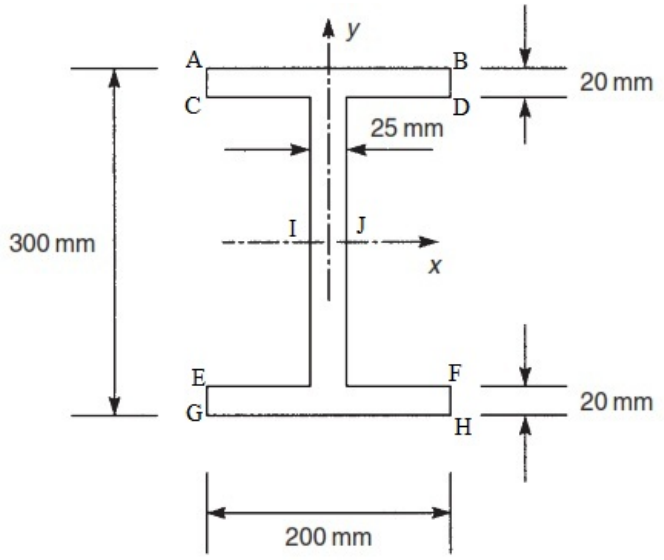


Fig.4

7. Calculate the shear flows in the web panels and direct load in the flanges and stiffeners of the beam shown in fig.5.if the web panels resist shear stresses only.

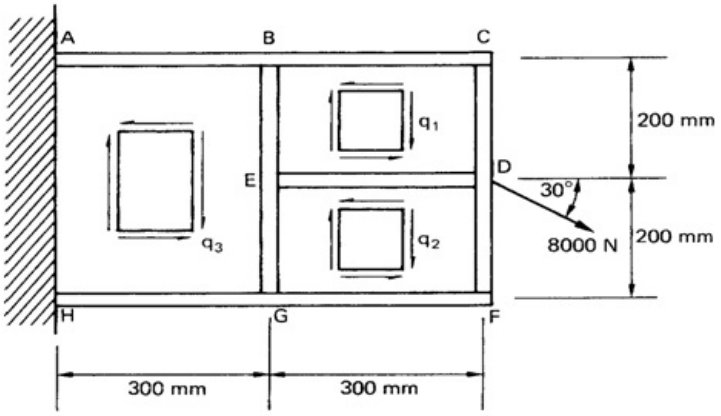


Fig.5

OR

8. A single cell rectangular beam shown in fig.6 carrying a load of 100N. Draw the shear flow diagram.

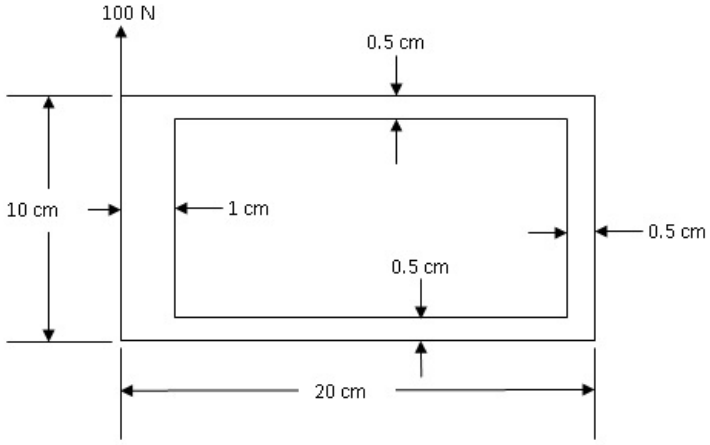


Fig.6

9. Calculate the shear flow distribution in the channel section shown in Fig.7 produced by a vertical shear load of 4.8 kN acting through its shear centre. Assume that the walls of the section are only effective in resisting shear stresses while the booms, each of area 300 mm^2, carry all the direct stresses.

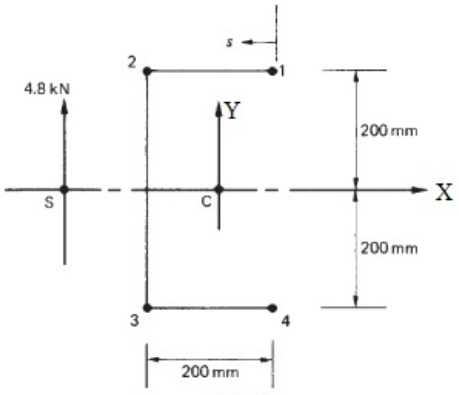


Fig.7

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2014 Aircraft Performance

Set A

Time : 3 hrs
Total Marks: 100

1. a. Briefly explain the type of Drag and Drag polar. (10)

   b. Shortly explain the NACA Aerofoil nomenclature. (5)

   c. Shortly explain the streamlined and bluff bodies. (5)

OR

2. a. Drive the equation of motion of an aircraft using force approach. (10)

   b. Draw and explain the thrust required verse velocity graph of an aircraft. (10)

3. a. Drive the Endurance equation for propeller driven aircraft and explains the conditions the maximum Endurance. (10)

   b. Drive the aerodynamic relation associated with Maximum $(C_L^{3/2}/C_D)$ and Velocity at $(C_L^{3/2}/C_D)_{max.}$ (10)

OR

4. a. Consider the jet propelled aircraft fly is speed of 250 m/s at 8000 m. Aircraft overall weight 40000 kg, empty weight 28000 kg, wing span 104 m^2, Zero lift drag is 0.019, K= 0.085, Thrust specific consumption 0.59 hr^{-1}. Determine range and endurance of the aircraft. (10)

   b. What is the total energy of 18000 kg aircraft is flying at 300 m/s speed; 12000 m above sea level. (7)

   c. Define Reynolds number and specific fuel consumption. (3)

5. a. Drive the range equation for jet propelled aircraft and explains the conditions the maximum Range. (10)

   b. A small jet transport airplane has the following characteristics.

   Takeoff weight = 22700 kg

   Empty Weight = 12700 kg

   $C_D = 0.019+0.055C_L^2$

   Cruising Altitude = 10600 m

   Thrust specific consumption = 0.65 hr^{-1}

   Wing Area = 47 m^2

   Mach Number = 0.75

   Assume that begin weight and end weight in the cruise phase is 22200 kg and 17700 kg. Determine the cruise range at constant Mach number . (10)

OR

6. a. Define rate of climb and drive the rate of climb equation for jet propelled airplane. (10)

   b. Draw and explain the hodograph diagram for climb performance. (6)

   c. Define absolute ceiling and service ceiling. (4)

7. a. Define takeoff ground roll and drive the suitable formula for the estimating same. (10)

b. Drive the expression of gliding angle and velocity of gliding flight for maximum range. (10)

OR

8. a. Define Landing ground roll and drive the suitable formula for the estimating same. (10)

b. Explain the methods of Thrust augmentation. (10)

9. a. Drive equation of turn radius and turn rate of pull-down maneuvers of an airplane.(6)

b. What is thrust reversers and explains the types of thrust reversers.(7)

c. Draw and explain the V_n Diagram using FAR 23. (7)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2016 Space Dynamics

Set **Time : 3 hrs**
A **Total Marks: 100**

1. 1. (a). Write Kepler laws of motion. Use third law of motion to calculate the orbital period of Saturn if its distance from Sun is 9.6 Astronomical Units (AU). (5)

(b) From the Kepler's equation $M = E - e \sin E$, where e is the eccentricity of an elliptic orbit and E and M are eccentric and mean anomaly, respectively, if M = 65 degrees and e = 0.1, calculate the eccentric anomaly E in degrees. (10)

(c) Compute eccentric anomaly E from true anomaly θ and eccentricity e using the following relations

$$\cos E = (e + \cos q) / (1 + e \cos q),$$

$$\sin E = (1-e^2)^{1/2} \sin q / (1 + e \cos q),$$

for e = 0.1 and q = 75 degrees. (5)

OR

2. 2. (a) Draw a neat diagram to show the orbital elements of a satellite moving in an elliptic orbit. (3)

(b) If the position and velocity of a satellite are (100, -4700, -4700) km and (7.7, 0.2, 0.0) km/s, respectively; find angular momentum and the orbital elements: eccentricity (e), inclination (i), argument of perigee (ω), right ascension of ascending node (Ω) and true anomaly of the satellite. (17)

3. 3. (a) Explain briefly Geocentric-inertial coordinate system. (3)

(b) Define Sun-synchronous orbits for Earth satellites. (2)

(c) Calculate the orbital inclination for an elliptic Sun-synchronous orbit, whose semi-major axis is 7000 km and eccentricity is 0.1. Earth's gravitational constant (μ) = 398600 km^3s^{-2},

J_2 = 0.00108263 and Earth's radius is 6378 km. (15)

OR

4. 4. Explain Cowell's and Encke's methods. Give their advantages and disadvantages. (20)

5. 5. (a) Find the additional velocity required for a Hohmann transfer from a circular Earth satellite orbit of radius 7400 km to a circular Earth satellite orbit of radius 8400 km. (10)

(b) Calculate the velocity change required to transfer a satellite from a circular orbit at an altitude of 450 km with an inclination of 50° to an orbit of the same size at an inclination of 10°. Earth's gravitational constant = 398600 km^3s^{-2}. (6)

(c) For an elliptic orbit, prove that $r = a (1 - e \cos E)$. (4)

OR

6. 6 (a) Draw a neat sketch of hyperbolic trajectory. Show in the sketch, true anomaly of the asymptote, turn angle, periapsis, apoapsis and semi-major and semi-minor axes. (5)

(b) At a given point of a spacecraft's geocentric trajectory, the radius is 16500 km, the speed is 8.7 km/s, and the flight path angle is 50 degrees. Show that the path is a

hyperbola. Calculate hyperbolic excess velocity, angular momentum, true anomaly and eccentricity. (15)

7. 7. (a) Calculate the sphere of influence of the Venus. The mass of the Venus and the Sun are 4.869×10^{24} kg and 1.989×10^{30} kg, respectively. The radius of Venus's orbit about Sun is 108.2×10^{6} km.

(5)

(b) Estimate the trip time T from the Earth to Mars along the Hohmann transfer orbit by assuming the orbits of Earth and Mars around the Sun to be circular with radii of 149.6×10^{6} and 227.9×10^{6} km, respectively. The value of the Sun's gravitational constant (μ) = 1.32715×10^{11} km^3s^{-2}. (5)

(c). Calculate the synodic period of Mars relative to the Earth. The orbital periods of Earth and Mars are 365.26 days and 687.99 days, respectively. (5)

(d) A geocentric trajectory has perigee velocity of 12 km and perigee altitude of 200 km. Find the angular momentum (h) and eccentricity (e) of the orbit. Earth's gravitational constant is 398600 km^3s^{-2}. (5)

OR

8. 8. (a) Explain briefly static and dynamic stability of rockets. (10)

(b) Describe briefly Earth's atmosphere. (10)

9. 9. (a) Derive the rocket equation

$$V_b = g_0 I_{sp} \ln(M_i/M_f),$$

where V_b is the burnout velocity, g_0 is acceleration of gravity at sea level, I_{sp} is specific impulse and M_i/M_f is the mass ratio. (8)

(b) If the Isp of a rocket using hydrogen and oxygen as fuel and oxidizer is 380 s, and V_b is 9800 metres/s, calculate its mass ratio. (g_0=9.8 m/s^2). (4)

(c) Consider a two-stage rocket with the following design characteristics:

First stage: propellant mass = 9000 kg, structural mass = 2000 kg

Second stage: propellant mass = 6000 kg, structural mass = 1000 kg

The payload mass is 100 kg. The I_{sp} of the first stage is 300 s and the second stage is 350 s. Calculate the final burnout velocity. (8)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2021 Gas Dynamics

Set A **Time : 3 hrs**
Total Marks: 100

1. a. Write short notes on Mach Wave and supersonic flow. (6)

   b. Define Speed of sound. Derive equations for speed of sound. (14)

OR

2. Derive Momentum equation based on control volume approach. (20)

3. a. Define shock strength. Derive the shock strength equation based on Rankine-Hugoniot approach with neat sketch. (14)

   b. Which of the following gas will result in the stronger shock? One is Helium and another is air at same Mach Number 5. (6)

OR

4. 4. An oblique shock of strength 1, in air, meets the free boundary assume Mach number M_1= 2 and p_1 =1atm.

   (i) Describe the reflection of the shock from the boundary, the flow process across the reflected wave, and sketch the reflection. (5)

   (ii) Find the Mach number and total pressure, downstream of the reflection zone. (5)

   (iii) Find the fan angle of the expansion . (5)

   (iv) Determine the deflection angle of the free boundary with reference to the freestream direction, upstream of the shock, and check whether the flow downstream of the expansion satisfies the streamline concept. (5)

5. a. Derive θ-β-M relation for an oblique shock with neat sketch. State its inference also. (14)

   b. Write short notes on Reflection and intersection of shocks. (6)

OR

6. Derive the Prandtl-Meyer function with neat sketch. Assume stationary expansion fan. (20)

7. Determine the flow field and Mach number, static pressure around a flat plate kept at 15° angle of attack to a supersonic stream of Mach 2.4 and stagnation temperature 300K by the shock-expansion theory. (20)

OR

8. Determine the flow field and Mach number around a symmetric double wedge of 20° included angle kept at 15° angle of attack to a supersonic stream of Mach 2.4 and stagnation temperature 300K, by the shock-expansion theory. Assume expansion takes place at leading edge top corner as well as trailing edge bottom corner and compression is opposite to expnsion corner. (20)

9. A Mach 2 C-D nozzle, run by a settling chamber with air maintained at 300 K, is discharging to an environment at atmospheric pressure. Determine the settling chamber pressure required to run the nozzle (i) at correctly expanded state, (4)

   (ii) with maximum possible overexpansion, (4)

   (iii) with normal shock at the exit. (4)

(iv) Determine the settling chamber pressure required to position a normal shock in the divergent part of the nozzle, at location where the area is 1.5 times the throat area.
What will be the flow speed behind the normal shock? (8)

Assume isentropic flow, $\gamma = 1.4$, $cp = 1.00$ kJ/kg.K.

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE2030 Basics of Aerospace Engineering

Set A **Time : 3 hrs**
Total Marks: 100

---

1. a. Describe the terms aircraft and airplane. (6)
   b. Classify aircrafts and explain in its detailed manner with neat sketch. (14)

OR

2. a. Write short notes on Wright brother's airplane. (6)

   b. Explain in detail about the flying instruments of an airplane. (14)

3. a. Write short notes on airfoil nomenclature. (6)

   b. Derive lift and drag equation with neat sketch. (14)

OR

4. Explain in detail about wing construction of airplane with neat sketch. (20)

5. Elaborate the fuselage construction of airplane with neat sketch. (20)

OR

6. Describe working principle of piston engine and elaborate its merits and demerits with neat sketch. (20)

7. a. Classify jet engines. (4)

   b. Explain the working principle of turbojet and turbofan engine with neat sketch. (16)

OR

8. a. Differentiate propeller from airfoil. (2)

   b. Write short notes on propeller nomenclature. (6)

   c. Elaborate propeller theory with neat sketch. (12)

9. Define aerospace materials .Explain in detail the materials used in aircraft industry and its applications with neat sketch. (20)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE3001 Advanced Solid Mechanics

Set A

Time : 3 hrs
Total Marks: 100

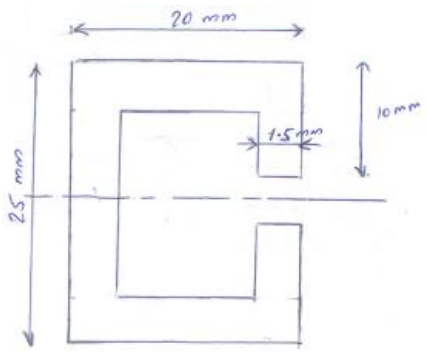
1. Explain the analytical method for determining stresses on oblique section for the following cases

   a. Member subjected to like direct stresses in two mutually perpendicular direction. (10)
   b. Member subjected to direct stresses in two mutually perpendicular direction accompanied by simple shear stress (10)

OR

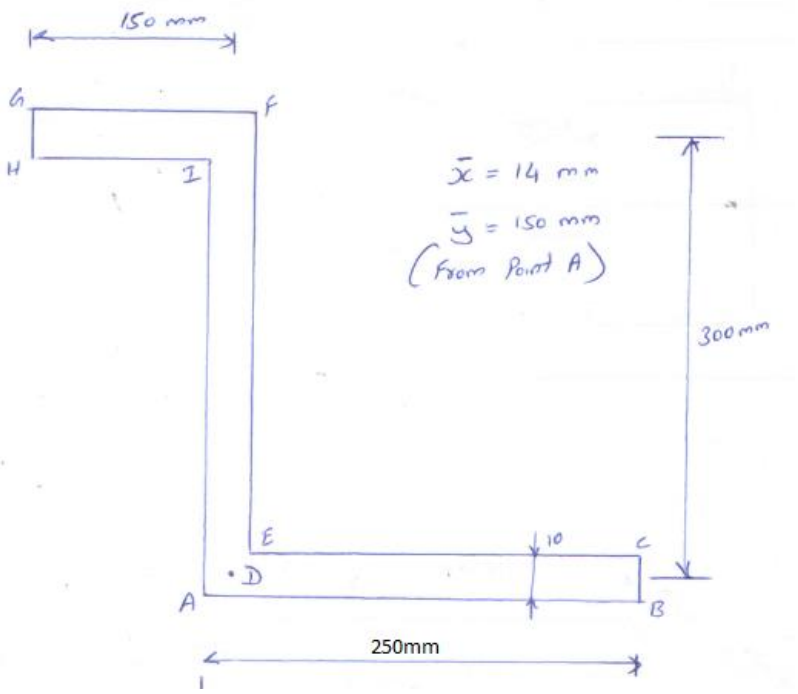
2. a) Derive an expression to find the location of shear centre for a channel section? (8)

   b) Find the location of shear centre for the given section? (12)



3. a) Explain the shear centre for unsymmetrical sections? And what are the procedures applicable for the determination of shear centre of an unsymmetrical section? (5)

   b) Find the location of shear centre for the given unsymmetrical section? (15)



OR

4. a) Define columns? How it is classified? What are the end conditions applicable for these columns? Explain equivalent length? (3)

   b) Derive Euler's formula for both ends of the column are fixed? (6)

   c) Derive Euler's formula for a column when one end fixed and other end free? (6)

   d) A bar of length 4m when used as a simply supported beam and subjected to a u.d.l of 30kN/m over the whole span, deflects 15mm at the centre (centre deflection of the beam is $5wl^4/384EI$). Determine the Crippling load when it is used as a column with all types of end conditions? (5)

5. a) Explain in detail the bending of rectangular plate to a cylindrical surface? (10)

   b) With an example explain the bending of long uniformly loaded rectangular plate with simply supported edges? (10)

OR

6. a) Explain in detail the bending of circular plate loaded symmetrically to the centre? (10)

   b) With an example explain the bending of long uniformly loaded circular plate with clamped edges? (10)

7. Explain in detail the Contact stresses – both point and line contact with all the possible conditions? (20)

OR

8. a) Explain Stress concentration in Tension and Compression Members? (5)

   b) Explain the stresses in a plate with a Circular hole? (15)

9. Explain the general theory of an infinite length beam subjected to a concentrated load supported on elastic foundations? (20)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE3002 Advanced Computational Fluid Dynamics

Set A **Time : 3 hrs** **Total Marks: 100**

1. a. Write notes on 5 user activities at the pre-processor stage [10]
   b. Write notes on various data visualization tools available in today's CFD packages [10]

OR

2. From the first principles derive the momentum equation [20]

3. a. Write notes on turbulence [8]
   b. Write notes on Pradtl's mixing length model [12]

OR

4. a. Explain the Conservative, differential and integral form of transport equation [10]
   b. Write notes on K – ε model [10]

5. a. Water flows through a pipe 1.2 m dia at 3 m/s, find the volume flow rate; and passes through a pipe of 1.5 m dia, find the velocity in this pipe; then it branches into two, one branch as 0.8 m dia and carries 1/3 rd of the flow, find the velocity ion this branch; velocity in other branch is 2.5 m/s, find the dia. [8]
   b. 250 lit of water is flowing in a pipe with a dia of 300 mm. If the pipe is bent by 135^0, find the magnitude and direction of resultant force in the bend. The pressure of water is 39.24 n/cm^2 [12]

OR

6. a. Ethane is burned with atmospheric air and the volumetric analysis of dry products yields the following: 10% CO_2; 1% CO; 3% O_2; 86% N_2. Determine the
      i. Combustion equation [4]
      ii. % of excess air [2]
      iii. Air fuel ratio [2]
      iv. Dew point of combustion products [2]
   b. Find the finite difference form of the first order and second order differential using Taylor's series [4]
   c. Derive the finite difference formulation of transient one dimensional conduction equation [6]

7. a. Explain the finite difference formulation [6]
   b. Formulate finite differential equation for steady two dimensional heat conduction problem [14]

OR

8. Draw neat schematic diagram of TDMA and explain the algorithm [20]

9. Derive the finite difference equation for a supersonic flow over a flat plate [20]

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE3003 Thermodynamics & Heat Transfer

Set B

Time : 3 hrs
Total Marks: 100

1. a) The air speed of a turbojet engine in flight is 270m/s. Ambient air temperature is –15 ^{o}C. Gas temperature of outlet of nozzle is 600^{o}C. Coresponding enthalpy values for air and gas are respectiely 260 and 912 kJ/kg. Fuel-air ratio is 0.0190. Chemical energy of the fuel is 44.5 MJ/kg. Owing to incomplete combustion 5% of the chemical energy is not released in the reaction. Heat loss from the engine is 21 kJ/kg of air. Calculate the velocity of the exhaust jet. (10)

   b) Explain the properties of entropy. (10)

OR

2. a) Explain the change of entropy in irreversible process (10)

   b) Energy is always conserved, but its quality is always degraded. Explain (10)

3. Prove that

$$C_p - C_v = -T\left(\frac{\partial V}{\partial T}\right)_p^2 \cdot \left(\frac{\partial p}{\partial V}\right)_T$$ (20)

OR

4. Write down the first and second Tds equations, and derive the expression for the difference in heat capacities, C_p and C_V. what does the expression signify? (20)

5. a) An aluminium sphere mass 5.5 kg and initially at a temperature of 290^{o}C is suddenly immersed in a fluid at 15^{o}C with heat transfer co-efficient 58 W/m^{2}K. Find the Biot number and verify the lumped heat capacity analysis is applicable. Also find the time required to cool the aluminium sphere to 95^{o}C and time constant. (12)

   b) What is critical radius of insulation? Explain.(8)

OR

6. A steam pipe 10 cm inner diameter 11 cm outer diameter is covered with an insulating material (K=1W/mK). The steam temperature and the ambient temperatures are 200^{o}C and 20^{o}C respectively. If the convection heat transfer co-efficient between the insulating surface and air is 8W/m^{2}K. Find the critical radius of insulation and the heat lost per meter of pipe for the value of r_c. And also find the outer surface temperature. (20)

7. Derive an energy equation for thermal boundary layer over a flat plate. (20)

OR

8. a) A furnace wall emits radiation at 2000 K. treating it as black body radiation calculate (a) Monochromatic radiant flux density at 1μm wave length (b) wave length at which emission is maximum and the corresponding emissive power (c) total emissive power. (10)

   b) A liquid oxygen is stored in double walled spherical vessel. Inner wall temperature is -160^{o} C and outer wall temperature is 30 ^{o}C. Inner diameter of sphere is 20 cm and outer diameter is 32 cm. Calculate the

following. (i) Heat transfer if emissivity of spherical surface is 0.05. (ii) Rate of evaporation of liquid oxygen if its rate of vaporization of latent heat is 200 kJ/kg. (10)

9. Calculate the heat lost by radiation per meter length of 8 cm diameter at 400^{o}C and emissivity of 0.7, when (a) It is located in a large room with a red brick walls maintained at a temperature of 35^{o}C. (b) It is enclosed in a 20 cm diameter of red brick pipe maintained of 50^{o}C and emissivity of 0.9. Also find the reduction in heat loss. (20)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE3004 Flight Performance and Dynamics

Set A **Time : 3 hrs** **Total Marks: 100**

1. a) Explain in detail the atmospheric structure and various atmospheric properties? (8)

   b) Explain International Standard Atmosphere? (4)

   c) Show the changes of atmospheric properties with attitude effect? (4)

   d) Differentiate Aerodynamic centre, Centre of Gravity and Centre of pressure? (4)

OR

2. a) In detail explain the Power available and Maximum velocity of both propeller-driven and Jet propelled aircraft? (6)

   b) Explain the altitude effect on P_R , P_A , and Maximum Velocity? (6)

   c) An aircraft weighs 250 KN, has wing area 80m^2. Drag polar is given by $C_D = 0.016 + 0.04\ C_L^2$. Calculate the minimum Thrust required for straight level flight? (4)

   d) Explain the term range and endurance of an Aircraft? (4)

3. a) Derive quantitative and Breguet formulas for Range and Endurance under the conditions of both propeller-driven and Jet propelled aircraft? (10)

   b) State the condition for maximum range and endurance? (4)

   c) A piston propeller aircraft weighing 38000N, wing planform area 28m^2, Aspect ratio 7.5, Span efficiency factor e = 0.85, C_{Do} = 0.025, Propeller efficiency η = 0.8, specific fuel consumption c = 0.2 kg / Hp-hr, W_f = 400 Kg, Find R_{max} and E_{max} ? (6)

OR

4. a) Explain the turn flight and find an expression of turn radius and turn rate for different maneuvers? (10)

   b) Explain the features of the V-n diagram (10)

5. a) Explain in detail the different degrees of freedom and relate it with the various types of aircraft movement and its stability? (6)

   b) Derive an equation for Moment at CG with the aircraft wing contribution? (6)

   c) Show an expression for total pitching moment about CG point? (4)

   d) Define Stick Free stability and Stick Fixed Stability? (4)

OR

6. Explain in detail the devices for Aerodynamic Balancing? (20)

7. Explain and derive an expression for finding the position of neutral point in both stick-free and stick-fixed condition? (20)

OR

8. a) Explain the development of equation of motion under control locked condition? (15)

   b) Explain Dynamic Stability and show the typical modes of dynamic motion? (5)

9. Derive the equations of longitudinal dynamic motion and also obtain the non-dimensional simultaneous equation? (20)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE3005 Orbital Space Dynamics

Set B

Time : 3 hrs
Total Marks: 100

1. (a). What are Kepler's laws of motion ? The observed average separation of Pluto from Sun is 39.44 astronomical units. From Kepler's 3rd Law, calculate the orbital period for Pluto. (8)

   (b). With the help of a diagram, explain the six orbital parameters of an earth satellite. If the semi-major axis (a), eccentricity (e) and eccentric anomaly (f) of an earth satellite are 11000 km, 0.2 and 50 degrees, respectively, calculate its radial distance r and the velocity of the satellite. The value of the Earth's gravitational constant (μ) = 398600 km^3s^{-2}. (12)

OR

2. (a) What is Kepler's equation for elliptic orbits ? If mean anomaly and eccentricity are 85 degrees and 0.2, respectively, calculate the eccentric anomaly. (10)

   (b) Define periodic and quasi-periodic orbits. Explain the method to generate

   Poincaré surface of sections for planar restricted three- body problem. (10)

3. If the position and velocity of a satellite are (0, -5888.9727, -3400) km and (8.3, 0, 0) km/s, respectively;

   Find the angular momentum and the orbital elements. Earth's gravitational constant = 398600 km^3s^{-2}. (20)

OR

4. What are the various forces acting on an earth satellite? Explain them briefly. Define Sun-synchronous orbit. Calculate the orbital inclination for a Sun-synchronous orbit, whose semi-major axis is 7150 km and eccentricity is 0.1. Earth's gravitational constant (μ) = 398600 km^3s^{-2}, J_2 = 0.00108263 and Earth's radius is 6378 km. (20)

5. (a). To study the motion near any Lagrangian point L_i, write the expression for the force function Ω expanded up to second-order terms. Use it to obtain equations of motion around any Lagrangian point L_i. (10)

   (b). Discuss the motion around the equilateral points. Discuss the stable solutions of the linearized equations around the equilateral points for mass ratio less than the critical value of the mass parameter (0.03852…). (10)

OR

6. (a) Explain advantages and disadvantages of special perturbations and general perturbations. (7)

   (b) Explain Cowell's method (8)

   (c) Explain Earth's triaxiality effects. (5)

7. (a) Write Hamilton's equations. Define canonical transformation. (5)

   (b) Prove that the following transformation is canonical.

   $Q = (q^2 + p^2)/2, \quad P = - \tan^{-1} (q/p);$ (4)

   (c) Write the Hamiltonian of a Harmonic Oscillator. With the help of a generating function, reduce the Hamiltonian as function of momenta. (11)

OR

8. (a). Derive Lambert's problem analytically. (15)

(b) For a hyperbolic orbit, if the eccentricity e=1.5, the eccentric anomaly F =1.3 radians.

Find the mean anomaly M_h. (5)

9. Write equations of motion for planar restricted three-body problem in synodic co-ordinate system. Derive the two equations to find out the locations of the Lagrangian points. Derive the fifth-degree algebraic equations to find out the locations of the Lagrangian point L_1, L_2, L_3. (20)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE3006 Advanced Aerodynamics

Set A

Time : 3 hrs
Total Marks: 100

1. Consider the velocity field given by $u = x^2 - 2xy\cos y^2$

   1. Find v-component of velocity so as to satisfy incompressible flow continuity equation. 5
   2. Find Stream function for the flowfield 5
   3. Find Vorticity for the flowfield 5
   4. Find the discharge rate between points (0,0) and (1, $\sqrt{\pi}$) 5

OR

2. For the 3D flow with velocity components given by $v_y = \frac{y}{(x^2+y^2+z^2)^{\frac{3}{2}}}$ and $v_y = \frac{y}{(x^2+y^2+z^2)^{\frac{3}{2}}}$.

   1. Find missing velocity component v_x 12
   2. Find whether flow is rotational or Irrotational. 8

3. A sink of strength $20\,\pi\,\frac{m^2}{s}$ is located 3m upstream of source of strength $40\,\pi\,\frac{m^2}{s}$. The combination is placed in uniform velocity field along the line joining the source and sink. It is noted that at a point 2.5m equidistant from both source and sink, the velocity is normal to the line joining source and sink.

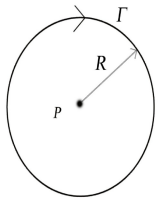
   1. Find the velocity of Uniform flow field. 10
   2. Find the velocity at the point mentioned above. 10

OR

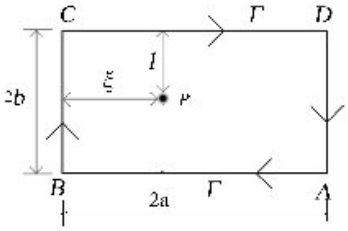
4. A two dimensional flow field is described by velocity components $u = a\,x$ and $v = -a\,y$ (a is positive constant).

   1. Find the streamlines of the flow field. 5
   2. What is the rotation ω of the flow field? 5
   3. A dust particle with no mass is placed at time $t=t_o$ on the point (x_o, y_o). At what time t_e the particle reaches point (x_e, y_e) of the streamline. 10

5. (a) Find the velocity induced by the line vortex in the form of a circle as shown below at its centre. 10

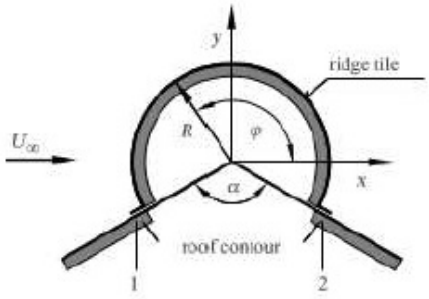


(b) Find the velocity induced by the line vortex in the form of a rectangle as shown below at its centre. 10



OR

6. A model to describe the inviscid flow past the ridge of a roof is obtained by superimposing a vortex of strength Γ over uniform flow with velocity U_∞ past a circular cylinder. The radius of the roof ridge is R; the ridge angle α is 120^o. The density ρ of the flow is ρ_∞



1. What circulation Γ of the potential must be chosen to correctly model the inviscid flow past the ridge? 8
2. What is the force acting on the ridge if the pressure of the flow below the ridge is p_∞ and the depth of the ridge is 1 m. 12

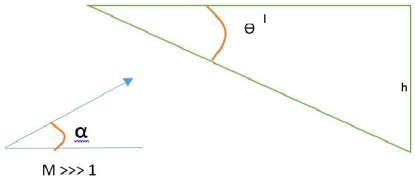
7. Consider a pair of source and sink of equal strength Λ in a Uniform stream with velocity V_∞. The uniform stream velocity is aligned with line joining source and sink. The **Sink** is located at (-c, 0) and **Source** is located at (c,0) while uniform flow is along x-axis towards $+\infty$. Find

1. Velocity potential for the flow due to this combination 4
2. Stream Function for the flow due to this combination 4
3. Velocities (u,v) at a point (x,y) 6
4. Stagnation points of the flow 6

OR

8. What are the flow features which distinguish hypersonic flow from supersonic flow? 20

9. A half cone as depicted in the figure below can be used as lifting body. Evaluate Normal Force Coefficient C_N and Axial Force Coefficient C_A as function of angle of attack α for hypersonic flow using Modified Newtonian relation. 20



Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE3007 Advanced Propulsion

Set B

Time : 3 hrs
Total Marks: 100

1. a. Explain the concept of Heat exchange and reheat in GTE [6]
   b. Draw schematic arrangement of a reheat cycle with heat exchanger and explain the flow path.[14]

OR

2. An axial flow compressor is to be designed to generate a total pressure ratio of 4 with an overall isentropic efficiency of 0.85. The inlet and outlet blade angles of rotor blades are 45 & 10 degrees respectively. The compressor stage has a degree of reaction of 50%. If the blade speed is 220 m/s. and the work done factor is 0.86 find the number of stages required. Is it likely that the compressor will suffer from shock losses? The ambient static temperature is 290 K and the air enters the compressor through the guide vanes. [20]

3. A single stage gas turbine operates at its design condition with an axial absolute flow at entry and exit. The absolute flow angle at nozzle exit is 70^0 At the stage entry the total pressure and temperature are 311 kPa and 850^0 C. The exhaust static pressure is 100 kPa. The total to static efficiency is 0.87 and mean blade speed is 500 m/s. Assuming constant velocity through the stage determine Specific work done; Mach number at the exit of the nozzle; axial velocity and Total to total efficiency. [20]

OR

4. Air [ambient condition of 0.56 bar pressure and 260 K temperature] enters the compressor [pressure ratio of 6 and an efficiency of 0.85] of a turbo prop aircraft flying at a speed of 360 km / hr. The propeller diameter is 3 m. Efficiency of propeller is 0.8. gear reduction efficiency is 0.95 The products of combustion enter the turbine [expansion ratio of 5 and efficiency 0.88] at 1100 k. Estimate the air fuel ratio and thrust created by the nozzle [efficiency 0.9] Specific heat of air/gases is 1.005 KJ / kg K & calorific value of fuel 40 MJ/kg. [20][5] Air [ambient condition of 0.56 bar pressure and 260 K temperature] enters the compressor [pressure ratio of 6 and an efficiency of 0.85] of a turbo prop aircraft flying at a speed of 360 km / hr. The propeller diameter is 3 m. Efficiency of propeller is 0.8. gear reduction efficiency is 0.95 The products of combustion enter the turbine [expansion ratio of 5 and efficiency 0.88] at 1100 k. Estimate the air fuel ratio and thrust created by the nozzle [efficiency 0.9] Specific heat of air/gases is 1.005 KJ / kg K & calorific value of fuel 40 MJ/kg. [20]

5. A supersonic diffuser diffuses air in an isentropic flow from a mach number of 1.5. The static conditions of air at inlet are 70 kPa and -7^0 C. If the mass flow rate of air is 125 kg/s Determine the stagnation conditions; throat area; exit are and the static conditions of air at exit.[20]

OR

6. a. Sketch a general schematic diagram of a propulsive device and derive an expression for Thrust developed [12]
   b. Explain under what conditions the pressure thrust can be ignored [2]
   c. The effective jet velocity from a jet engine is 2700 m/s. The forward flight velocity is 1350 m/s and the air flow rate is 78.6 kg/s Calculate Thrust, Thrust power & propulsive efficiency. [6]

7. A Ramjet engine operates at M = 1.5 at an altitude of 6500 m [T = 245.9 K; P = 0.44 Bar; Local Speed of sound = 314.5 m/s and density = 0.624 kg / Cum.] The diameter of inlet diffuser is 50 cms. and the stagnation temperature at the nozzle entry is1600 k. The calorific value is 40 MJ/kg. The properties of the combustion gas are same as that of air [ratio of sp heats = 1.4; Gas constant 287 J / KgK] The velocity of air at diffuser exit is negligible. Assume diffuser efficiency = 0.9; efficiency of combustion chamber = 0.98 Total pressure loss in CC is 0.02 of P_{02} ; Nozzle efficiency 0.96; $M_4 = 1.41$. Calculate efficiency of the ideal cycle; flight speed; air flow rate; diffuser pressure ratio; fuel air ratio; nozzle pressure ratio; nozzle jet mach number; propulsion efficiency and the thrust. [20]

OR

8. a. Describe the performance difference of the air breathing engine and rocket engine [5]

b. Draw a schematic diagram of a chemical rocket and its corresponding T – s diagram [5]
c. Derive an expression fro thrust produced by a chemical rocket [10]

9. a. Write short notes on simple gas turbine engine [4]
b. State the Clausius and Kelvin-plank statement of II law of thermodynamics and show that they are same.[10]
c. State the unsteady Euler's equation and under what conditions is valid [6]

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

14AE3008 Aerospace Structural Analysis

Set A

Time : 3 hrs
Total Marks: 100

1. Explain in detail the historical evolution of the Aircraft and spacecraft structures and the materials? (20)

OR

2. a) Explain the Design aspects of Aerospace structures, types of design and its requirement? (10)

   b) Explain various stages of aerospace structural design? (10)

3. A cantilever truss is loaded as shown in fig. Find the reactions and forces in the members of the truss? (20)

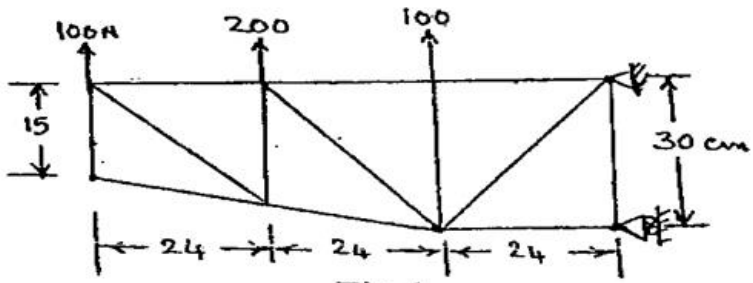


Fig.1

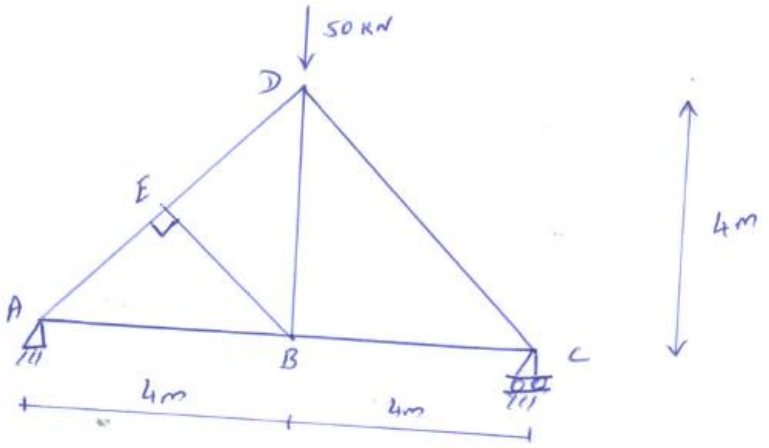
OR

4. Explain in detail with the examples, the virtual work done method of analyzing the structure? (20)

5. Explain and derive the work done by the internal force system in the following conditions a) Axial Force , b) Shear Force , c) Bending Moment (20)

OR

6. Calculate the vertical deflection of the joint B and the horizontal movement of joint C in the truss shown in the figure. The cross sectional area of each member is 1200 mm^2 and the E value of the material is 150,000 N/mm^2 ? (20)

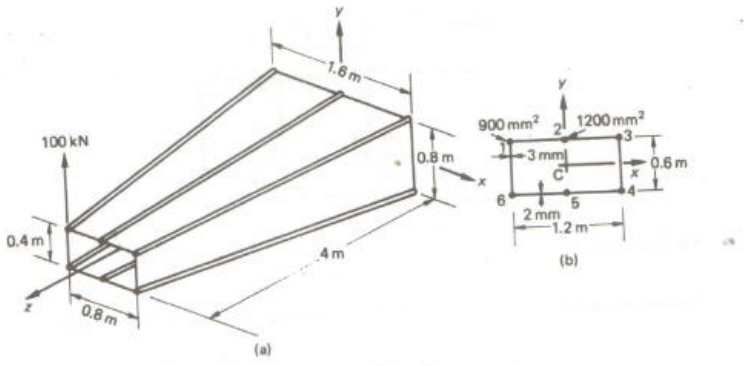


7. Explain in detail the pure bending of thin plates subjected to bending moments of intensities M_x and M_y per unit uniformly distributed along its edges? (20)

OR

8. The cantilever beam shown in fig is uniformly tapered along its length in both x and y directions and carries a load of 100KN at the free end. Calculate the forces in the booms and shear flow distribution on the walls at the section 2m from the built-in end if the boom resists all the direct stresses while the walls are effective only in shear. Each corner

boom has a cross-sectional area 900mm^2 while both the central booms are 1200mm^2. (20)



9. Explain the analysis of a wing rib as a multi cell section under the torsional force, shear force and bending? (20)

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

15AE3005 Flight Control System

Set B

Time : 3 hrs
Total Marks: 100

---

1. What are the Modern Control systems? Explain.

OR

2. What are the early-control systems used? Explain in detail mechanical control systems and its elements.

3. Explain Douglas Long Beach program.

OR

4. What are the needs for FBW systems and what are the elements of DFBW control?

5. Define SAS system in detail.

OR

6. Five a brief note on control augmentation systems.

7. Elaborately discuss the glideslope and flare control mechanism.

OR

8. How are autopilots used in controlling the missiles and longitudinal stability of aircrafts?

9. Give a detailed note on autopilots well-found with lateral beam guidance.

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

15AE3007 Advanced Aircraft Systems

Set B

Time : 3 hrs
Total Marks: 100

---

1. Write about the classification of different pressure systems used in Aircraft pneumatic systems with a neat sketch for each.

OR

2. (a). Write a short notes on the actuating cylinders used in aircrafts along with their types with neat sketch.

   (b). What are the procedures to be followed during the maintenance and servicing of Aircraft hydraulic systems?

3. (a). Write short notes on working of Independent brake system.

   (b). Explain the working of Goodyear master brake cylinder with a neat sketch.

   (c). Explain the working of Warner master brake cylinder with a neat sketch.

OR

4. Write short notes on hydraulic landing gear Retraction systems with a neat sketch.

5. (a). Write short notes on different types of valves used in fuel systems.

   (b). Write a short notes on fuel tanks and Fuel strainer.

OR

6. (a). Write short notes on reciprocating engine ignition system maintenance and inspection.

   (b). Write about the operation of magneto ignition system operating principle with a neat sketch.

7. Give a detailed description on instrument warning systems.

OR

8. Give a detailed description about collision avoidance and ground proximity warning systems.

9. Write short notes on the Temperature indicators used for aircraft.

Wishing you All the Best

Karunya University
(Karunya Institute of Technology and Sciences)
(Declared as Deemed to be University under Sec.3 of the UGC Act, 1965)

End Semester Examinations - Nov-Dec 2015 Exams

15AE3008 Unmanned Aircraft Systems

Set A

Time : 3 hrs
Total Marks: 100

---

1. a) Explain the different categories of Unmanned Aerial systems based on the capability or size of the air vehicle. (10 Marks)

   b) Explain the principle and working of a convertible rotor aircraft. (10 marks)

OR

2. a) Explain the classification of airspace and enumerate the personnel requirement and their qualifications in the operation of Unmanned Systems as per FAA regulations. (10 marks)

   b) Describe the various kinds of lift generated in a rotary wing unmanned Aircraft. (10 Marks)

3. Explain the various Vertical Take-off and Landing (VTOL) configurations used in Unmanned Aerial Systems. (20 Marks)

OR

4. Explain the characteristics of long range, long endurance UAVs and the 3 main concerns to be considered by an airframe designer. (20 Marks)

5. Explain the control mechanism adopted for achieving stability in a single rotor helicopter UAV. (20 Marks)

OR

6. Explain the launch and recovery mechanism used in HTOL UAVs for safe launching and landing of UAVs. (20 marks)

7. Detail the component, sub-assembly and whole structure testing procedure of HTOL UAV system. (20 Marks)

OR

8. Briefly explain the influence and interactions of Human Factors on Unmanned Aircraft Systems. (20 Marks)

9. Briefly describe the main elements of an Unmanned Aircraft system. (20 Marks)

Wishing you All the Best
