Code No: RR312106 **RR** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
AEROSPACE PROPULSION - I
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Describe with a neat sketch components and the thermodynamics of a turbo-jet engine. In what ways, this engine is superior to a turbo-prop engine. Are there any limitations in its applications? Comment. [16]

2. The following design data apply to a double-sided centrifugal compressor:

Outer diameter of the impeller	= 50cm
Rotational speed	= 270rev/s
Inlet temperature	= 288K
Inlet pressure	= 1.01bar
Isentropic efficiency of impeller only	= 0.90
Radial gap of vane-less space	= 4cm
Axial depth of vane-less space	= 5cm
Power input factor	= 1.04
Slip factor	= 0.9

   (a) Calculate the stagnation pressure and temperature at the outlet of the impeller assuming no pre-whirl.
   (b) Show that the radial outlet velocity at the impeller tip is 96m/s and, hence, find the Mach number and air leaving angle at the impeller tip (neglect the impeller tip thickness). [16]

3. The overall pressure loss factor of a combustion chamber may be assumed to vary with the temperature ratio according to the law
$\frac{\Delta p_0}{m^2/2\rho_1 A_m^2} = K_1 + K_2[(T_{02}/T_{01}) - 1]$
For a particular chamber having an inlet area of $0.0389m^2$ and a maximum cross-sectional area A_m of $0.0975m^2$, cold loss tests show that K_1 has the value of 19. When tested under design conditions, the following readings were obtained:
Air mass flow, m = 9.0kg/s
Inlet stagnation temperature, T_{01} = 475K
Outlet stagnation temperature, T_{02} = 1023K
Inlet static pressure, p_1 = 4.47 bar
Stagnation pressure loss = 0.27 barEstimate the pressure loss at a part load condition for which m is 7.0kg/s, $T_{01}$is 400K, T_{02} is 850K and p_1 is 3.4 bar.Also for these two operating conditions, compare the values of the pressure loss as a fraction of inlet stagnation (i.e. compressor delivery) pressure and comment on the result. [16]

4. Consider a front air intake for a subsonic turbojet airplane as that for He-178 or F-86 Saber jet. Show the internal layout for the air to be swallowed by the engine.

Explain its aerodynamics and thermodynamics in details when the airplane climbs at higher angles in its flight. [16]

5. (a) What factors must be considered for efficient designing of an axial flow compressor?
   (b) Derive the following relationship for an axial flow compressor stage:
   $\Lambda = (\mathrm{Ca}/2\mathrm{U})[\tan\beta_1 + \tan\beta_2)$. [16]

6. (a) Explain the importance of 'thrust spoiler' and 'noise suppressor' with respect to convergent propelling nozzle.
   (b) Distinguish between choked and un-choked flows. [16]

7. Consider an air standard Brayton cycle, where the air enters the compressor at 0.12 Mpa,25^o C .It leaves the compressor at 0.5 Mpa. TIT is 1000^o C. Determine pressure and temperature at each point in the cycle.Work out the efficiency of its compressor,turbine and the overall engine. [16]

8. Consider a conical spike type supersonic air inlet with fixed geometry for optimum performance at one Mach number. Describe its aerodynamics and thermodynamics at the design Mach number. What happens when the operating mach number falls short of the design Mach number? [16]

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Code No: RR312106 **RR** **Set No. 4**

III B.Tech I Semester Examinations,November 2010
AEROSPACE PROPULSION - I
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Describe with a neat sketch components and the thermodynamics of a turbo-jet engine. In what ways, this engine is superior to a turbo-prop engine. Are there any limitations in its applications? Comment. [16]

2. The overall pressure loss factor of a combustion chamber may be assumed to vary with the temperature ratio according to the law
$\frac{\Delta p_0}{m^2/2\rho_1 A_m^2} = K_1 + K_2[(T_{02}/T_{01}) - 1]$
For a particular chamber having an inlet area of $0.0389m^2$ and a maximum cross-sectional area A_m of $0.0975m^2$, cold loss tests show that K_1 has the value of 19. When tested under design conditions, the following readings were obtained:
Air mass flow, m = 9.0kg/s
Inlet stagnation temperature, T_{01} = 475K
Outlet stagnation temperature, T_{02} = 1023K
Inlet static pressure, p_1 = 4.47 bar
Stagnation pressure loss = 0.27 barEstimate the pressure loss at a part load condition for which m is 7.0kg/s, $T_{01}$is 400K, T_{02} is 850K and p_1 is 3.4 bar.Also for these two operating conditions, compare the values of the pressure loss as a fraction of inlet stagnation (i.e. compressor delivery) pressure and comment on the result. [16]

3. (a) What factors must be considered for efficient designing of an axial flow compressor?
   (b) Derive the following relationship for an axial flow compressor stage:
   Λ = (Ca/2U)[tanβ_1 + tanβ_2). [16]

4. Consider a front air intake for a subsonic turbojet airplane as that for He-178 or F-86 Saber jet. Show the internal layout for the air to be swallowed by the engine. Explain its aerodynamics and thermodynamics in details when the airplane climbs at higher angles in its flight. [16]

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6. The following design data apply to a double-sided centrifugal compressor:
Outer diameter of the impeller = 50cm
Rotational speed = 270rev/s

Inlet temperature	= 288K
Inlet pressure	= 1.01bar
Isentropic efficiency of impeller only	= 0.90
Radial gap of vane-less space	= 4cm
Axial depth of vane-less space	= 5cm
Power input factor	= 1.04
Slip factor	= 0.9

(a) Calculate the stagnation pressure and temperature at the outlet of the impeller assuming no pre-whirl.

(b) Show that the radial outlet velocity at the impeller tip is 96m/s and, hence, find the Mach number and air leaving angle at the impeller tip (neglect the impeller tip thickness). [16]

7. (a) Explain the importance of 'thrust spoiler' and 'noise suppressor' with respect to convergent propelling nozzle.

   (b) Distinguish between choked and un-choked flows. [16]

8. Consider a conical spike type supersonic air inlet with fixed geometry for optimum performance at one Mach number. Describe its aerodynamics and thermodynamics at the design Mach number. What happens when the operating mach number falls short of the design Mach number? [16]

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Code No: RR312106 **RR** **Set No. 1**

III B.Tech I Semester Examinations,November 2010
AEROSPACE PROPULSION - I
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The following design data apply to a double-sided centrifugal compressor:

Outer diameter of the impeller	= 50cm
Rotational speed	= 270rev/s
Inlet temperature	= 288K
Inlet pressure	= 1.01bar
Isentropic efficiency of impeller only	= 0.90
Radial gap of vane-less space	= 4cm
Axial depth of vane-less space	= 5cm
Power input factor	= 1.04
Slip factor	= 0.9

   (a) Calculate the stagnation pressure and temperature at the outlet of the impeller assuming no pre-whirl.

   (b) Show that the radial outlet velocity at the impeller tip is 96m/s and, hence, find the Mach number and air leaving angle at the impeller tip (neglect the impeller tip thickness). [16]

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3. Consider a front air intake for a subsonic turbojet airplane as that for He-178 or F-86 Saber jet. Show the internal layout for the air to be swallowed by the engine. Explain its aerodynamics and thermodynamics in details when the airplane climbs at higher angles in its flight. [16]

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   (b) Derive the following relationship for an axial flow compressor stage:
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8. (a) Explain the importance of 'thrust spoiler' and 'noise suppressor' with respect to convergent propelling nozzle.
   (b) Distinguish between choked and un-choked flows. [16]

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Code No: RR312106 **RR** **Set No. 3**

III B.Tech I Semester Examinations,November 2010
AEROSPACE PROPULSION - I
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. The overall pressure loss factor of a combustion chamber may be assumed to vary with the temperature ratio according to the law
$\frac{\Delta p_0}{m^2/2\rho_1 A_m^2} = K_1 + K_2[(T_{02}/T_{01}) - 1]$
For a particular chamber having an inlet area of $0.0389m^2$ and a maximum cross-sectional area A_m of $0.0975m^2$, cold loss tests show that K_1 has the value of 19. When tested under design conditions, the following readings were obtained:
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Inlet stagnation temperature, T_{01} = 475K
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Inlet static pressure, p_1 = 4.47 bar
Stagnation pressure loss = 0.27 barEstimate the pressure loss at a part load condition for which m is 7.0kg/s, T_{01} is 400K, T_{02} is 850K and p_1 is 3.4 bar.Also for these two operating conditions, compare the values of the pressure loss as a fraction of inlet stagnation (i.e. compressor delivery) pressure and comment on the result. [16]

2. Consider a conical spike type supersonic air inlet with fixed geometry for optimum performance at one Mach number. Describe its aerodynamics and thermodynamics at the design Mach number. What happens when the operating mach number falls short of the design Mach number? [16]

3. The following design data apply to a double-sided centrifugal compressor:

Outer diameter of the impeller	= 50cm
Rotational speed	= 270rev/s
Inlet temperature	= 288K
Inlet pressure	= 1.01bar
Isentropic efficiency of impeller only	= 0.90
Radial gap of vane-less space	= 4cm
Axial depth of vane-less space	= 5cm
Power input factor	= 1.04
Slip factor	= 0.9

(a) Calculate the stagnation pressure and temperature at the outlet of the impeller assuming no pre-whirl.

(b) Show that the radial outlet velocity at the impeller tip is 96m/s and, hence, find the Mach number and air leaving angle at the impeller tip (neglect the impeller tip thickness). [16]

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